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A HIERARCHICAL DIAGNOSTIC SYSTEM FOR STUMPS-BASED BIST STRUCTURES

by

Yansong W. Xu



A thesis submitted to the Faculty of Graduate Studies and Research in partial fulfillment of the requirements for the degree of Master of Science.

Department of Electrical and Computer Engineering

Edmonton, Alberta Spring 2000



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Abstract

A two-stage hierarchical system for diagnosing gate-level faults in built-in self-testing CMOS circuits is presented. The first stage employs a new structural analysis algorithm, while the other stage diagnoses by building and looking up a dynamic fault dictionary. The system is a further develop to built-in self-diagnosis schemes which can locate the position of failing flip-flops.

The new structural analysis algorithm is given which diagnoses based on only the position of the failing flip-flops. The organization and management of the dynamic fault dictionary is also given. The new approach significantly reduces the size and look-up time of conventional dictionary while keeping higher diagnostic resolutions.

Extensive computer simulations are performed to illustrate the merits and feasibility of the new algorithms and the high efficiency of the new dictionary using ISCAS 85 and ISCAS 89 benchmark circuits.

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Contents

1	Intr	oduct	ion	1
2	Bac	kgrou	nd and Literature Review	8
	2.1		and Fault Testing	8
	2.2		Diagnosis	11
		2.2.1	Overview of the Existing Diagnostic Methods	13
		2.2.2	Diagnosis Using the Fault Dictionary Method	15
		2.2.3	Diagnosis Using a Hierarchical Method with a Dynamic Dictio-	
			nary	17
		2.2.4	Fault Diagnosis in a STUMPS Environment	19
		2.2.5	STUMPS-Based Built-in Self-diagnosis	22
3	A N	lew D	iagnostic Scheme	27
	3.1	Overv	iew of the Proposed Method	27
	3.2	Termi	nology and Notations	29
	3.3	Testin	ng and Diagnostic Environment and Process	31
		3.3.1	Diagnosis of the Failing Flip-flops	32
		3.3.2	Diagnosis of the Faulty Nodes	32
	3.4	Diagn	ostic Stage 1: Structural Analysis	33
		3.4.1	Flip-flops and PIs/POs	34
		3.4.2	Structural Analysis Algorithm	35
		3.4.3	Diagnostic Example Using the Structural Analysis Algorithm.	45
		3.4.4	Discussion on Structural Analysis	51
	3.5	Diagn	ostic Stage 2: Using a Dynamic Fault Dictionary	52
		3.5.1	Signature Collection Model	53
		3.5.2	Organization of the Fault Dictionary	54
		3.5.3	The Construction of the Fault Dictionary	55
		3.5.4	Dynamic Dictionary Based Diagnostic Algorithm	56
		3.5.5	General Diagnostic Procedure in Stage 2	62
		3.5.6	Diagnostic Example	63
		3.5.7	Evaluation of the Dynamic Dictionary Used in the Stage	65
4	Eva		n of Diagnostic Resolution	74
	4.1	•	rimental System Overview	
	4.2	Diagr	osability and Experimental Objectives	77

	4.3	Experi	imental Procedures and Results Analysis	79
		4.3.1	Number of Test Vectors and the Test Pattern Generator	79
		4.3.2	Data Collection for the Calculation of FE	80
		4.3.3	Estimation of RES	81
		4.3.4	Results for the Structural Analysis Stage	82
		4.3.5	Results for the Dynamic Dictionary Stage	83
		4.3.6	Resolution Comparison	97
5	Soft	ware S	System Implementation	100
	5.1	Gener	al Introduction to the Implementation	100
	5.2	Impor	tant Data Structures	101
		5.2.1	Data Structures in Main function	101
		5.2.2	Data Structures in Classes	101
	5.3	Diagn	ostic Implementation	106
6	Cor	clusio	n	108
Bi	bliog	graphy		111
$\mathbf{A}_{]}$	ppen	dices		116
A	Alg	orithn	Flowcharts	116
	_		ural Analysis Algorithm Flowcharts	117
			nic Dictionary Related Algorithm Flowcharts	
В	h-D	IAG U	Jser's Guide	125
C	The	Com	parison of Dictionary Looking-up Time	128
D	Exp	erime	nt on ISCAS 85 With Testing Length 64 K	150
\mathbf{E}	Exp	erime	nt on ISCAS 89 With Testing Length 64 K	161

List of Figures

2.1 2.2	Logic Fault - One Input of a NAND Gate Stuck-at-0
	Nortel's BISD Structure
2.3	UofA's BISD Structure
2.4	UoiA's BisD Structure
3.1	Overview of the Diagnostic System
3.2	Flip-flops on Scan Chains
3.3	PIs and POs in the Original Circuit
3.4	Original PIs and POs in STUMPS
3.5	Cone Intersection
3.6	Basic Structures for Forward (up) and Backward Tracing (below) 37
3.7	Flowchart of Structural Analysis Algorithm
3.8	A Given CUT
3.9	Case 1: PO1 and PO2 Failing
3.10	Case 2: PO1 Failing
	Case 3: PO2 Failing
	Case 4: PO3 Failing
	Case 5: PO2 and PO3 Failing
	Case 6: PO1, PO2 and PO3 Failing
	Signature Collection Model
	Dynamic Dictionary Form
	Flowchart of Diagnosis Using Dynamic Dictionary
0.1.	
4.1	Overview of the Simulation Environment
4.2	ISCAS'85 circuits resolution overview by estimation of RES2 99
	4 17 4 7 1 4 7 7 4
5.1	General Flow Chart of h-DIAG
5.2	Gate Object
5.3	Gate List
5.4	Node Object
5.5	Node List
5.6	Fault-List Object
Δ1	Flowchart of the Structural Analysis Algorithm
A.2	2 10 11 11 11 11 11 11 11 11 11 11 11 11
	Flowchart of the Backwards Tracing Algorithm

A.4	Flowch	art of Diagn	osis U	sing Dynamic	Dictionary							121
A.5	Flowch	art of Fault	Simul	ation Used for	the Dynam	ic	Di	ctic	ona	ry		122
A.6	Flowch	art of Signat	ure C	ompaction								123
A.7	Flowch	art of Dictio	nary (Construction a	and Look-up	,			•		 •	124
C.1	Time:	Comparison	With	Conventional	Dictionary						 •	129
C.2	Time:	Comparison	With	Conventional	Dictionary							130
C.3	Time:	Comparison	With	${\bf Conventional}$	Dictionary							131
C.4	Time:	Comparison	With	${\bf Conventional}$	Dictionary							132
C.5	Time:	Comparison	With	${\bf Conventional}$	Dictionary							133
C.6	Time:	Comparison	With	Conventional	Dictionary							134
C.7	Time:	Comparison	With	Conventional	Dictionary							135
C.8	Time:	Comparison	With	Conventional	Dictionary							136
C.9	Time:	Comparison	With	Conventional	Dictionary							137
C.10	Time:	Comparison	With	Conventional	Dictionary							138
C.11	Time:	Comparison	With	Conventional	Dictionary							139
C.12	Time:	Comparison	With	Conventional	Dictionary							140
C.13	Time:	Comparison	With	Conventional	Dictionary							141
C.14	Time:	Comparison	With	Conventional	Dictionary							142
C.15	Time:	Comparison	With	Conventional	Dictionary							143
C.16	Time:	Comparison	With	Conventional	Dictionary							145
C.17	Time:	Comparison	With	Conventional	Dictionary							146
C.18	Time:	Comparison	With	Conventional	Dictionary							148
C.19	Time:	Comparison	With	Conventional	Dictionary							149
		-			•							

List of Tables

3.1	Length of Dictionary: The First 12 Benchmark Circuits	70
3.2	Length of Dictionary: The Second 12 Benchmark Circuits	71
3.3	Length of Dictionary: The Third 12 Benchmark Circuits	72
3.4	Length of Dictionary: The Last 4 Benchmark Circuits	73
3.5	Comparison With DAPPER: Average Fault Number to be Simulated	73
4.1	Characteristics of ISCAS'89 Benchmark Circuits	75
4.2	Characteristics of ISCAS'85 Benchmark Circuits	75
4.3	Polynomials Used in PRPG for ISCAS Benchmark Simulations	84
4.4	Experiment Results: at Vector Size = 1 Block	85
4.5	Experiment Results: at Vector Size = 3 Blocks	86
4.6	Experiment Results: at Vector Size = 8 Blocks	87
4.7	Experiment Results: at Vector Size = 30 Blocks	88
4.8	Experiment Results: at Vector Size = 100 Blocks	89
4.9	Experiment Results: at Vector Size = 200 Blocks	90
	Experiment Results: at Vector Size = 256 Blocks	91
	Experiment Results: at Vector Size = 1 Block	92
	Experiment Results: at Vector Size = 3 Blocks	93
	Experiment Results: at Vector Size = 100 Blocks	94
	Experiment Results: at Vector Size = 200 Blocks	95
	Experiment Results: at Vector Size = 256 Blocks	96
	Resolution Comparision With DAPPER (At Testing Length = 8 Blocks)	
D 1	Results for Benchmark C17	151
D.2		152
	Results for Benchmark C2670	153
	Results for Benchmark C3540	154
	Results for Benchmark C432	155
	Results for Benchmark C499	156
	Results for Benchmark C5315	157
	Results for Benchmark C6288	158
	Results for Benchmark C7552	159
	Results for Benchmark C880	160
		166
E.1	Results for Benchmark S1196	162
E.2	Results for Benchmark S1238	163

13.0	D14-	£	Danahmanla	C1200	7																							104
E.3			Benchmark			٠	•	•	•	•	•	•	•	•	•	•	•		• •	•	•	•	•	•	•	•	•	164
E.4			Benchmark			•	•	•	•	•	•	•	•	•	•	-						•		•		•	•	165
E.5	Results	for	Benchmark	S1488	}	•	•	•		•	•	•	•	•	•										•	•	•	166
E.6	Results	for	${\bf Benchmark}$	S1494	Į									•	•										•			167
E.7	Results	for	${\bf Benchmark}$	S1585	0																							168
E.8	Results	for	Benchmark	S208																					•			169
E.9	Results	for	Benchmark	S27.																								170
E.10	Results	for	Benchmark	S298																								171
E.11	Results	for	Benchmark	S334																								172
E.12	Results	for	Benchmark	S349																								173
E.13	Results	for	Benchmark	S3593	32													•	•	•								174
E.14	Results	for	Benchmark	S382														•										175
E.15	Results	for	Benchmark	S3841	17																							176
E.16	Results	for	Benchmark	S3858	34																							177
E.17	Results	for	Benchmark	S386																								178
E.18	Results	for	Benchmark	S420																								179
E.19	Results	for	Benchmark	S444																								180
E.20	Results	for	Benchmark	S510																								181
E.21	Results	for	Benchmark	S526																								182
E.22	Results	for	Benchmark	S5378	8																							183
E.23	Results	for	Benchmark	S64.																								184
E.24	Results	for	Benchmark	S713																								185
E.25	Results	for	Benchmark	S820																								186
E.26	Results	for	Benchmark	S832																								187
E.27	Results	for	Benchmark	S838																								188
E.28	Results	for	Benchmark	S923	4																							189
			Benchmark	_																								190
		-		-																								_

Chapter 1

Introduction

Pass/fail testing is an integral part of integrated circuit (IC) manufacturing: each fabricated part is placed on a tester for several seconds to determine whether it is functioning correctly. When the test of a circuit under test (CUT) produces a "fail" result, post-testing diagnosis can be employed to identify the physical defect or defects responsible because in a very large scale integrated (VLSI) circuit there may be millions of transistors and a "fail" in a pass/fail test of such an ICs does not reveal which of the millions of transistors is defective. Therefore, no design corrections/improvements can be made to eliminate the failure causing problem without diagnosis.

Diagnosis of a CUT starts from the errors observed during testing and attempts to identify the faults which are responsible. Here, "error" means circuit responses inconsistent with reference circuit responses, while "fault" means models of physical defects within a circuit that may manifest themselves as errors under specific input stimuli. We can know there is a defect in the CUT through its errors, while we can find the location of the defect by knowing the faults. This knowledge can be used to correct design problems or to make design improvements to enhance fabrication yield.

As VLSI circuits and systems increase rapidly in complexity and decrease in size, fault diagnosis for IC chips is becoming much more essential for IC manufacturing. In the production phase, failure diagnosis is used to identify faults which explain the erroneous behavior of a circuit. This in turn helps to locate design and process weaknesses or errors, improve manufacturing yield, and reduce cost.

At this stage, both zero and low yield are the conditions for diagnosis. Fault diagnosis is also useful in quality improvements. When a VLSI device that passes the original production test fails in the field, diagnosing the failure can provide information on design and fabrication weaknesses. This information can assist in field maintenance and help to correct the design and/or fabrication to minimize a future appearance of the failure.

Fault diagnosis methodologies for a chip are tightly coupled to the methodologies with which the chip is tested. Testing techniques can be divided according to following standards:

Voltage testing and parametric testing

Voltage testing is concerned with the logic values of circuit outputs (voltage levels) generated by input stimuli as compared with the logic values generated by a reference circuit for the same stimuli. Parametric testing is concerned with the measured values of circuit parameters, such as current (like in IDDQ testing), propagation delay or power consumption, and whether those values fall within predetermined thresholds.

External and internal testing

External testing relies exclusively on an external tester to supply stimuli to the CUT, and to capture and evaluate the circuit responses. Its chief drawbacks are the expense of the complex, high-speed testing equipment (multi-million dollars), and the large volume of data managed by the tester, resulting in long testing times. Internal testing, such as built-in self-test (BIST), reduces the need for complex, expensive test equipment by including testing circuitry on-chip. As circuit packing density doubles every 18 months, an increasing amount of silicon area (normally < 10%) can be used for BIST. By staying on-chip, BIST can proceed at higher internal circuit speeds making effective testing of larger, higher density ICs more practical. Internal testing has become an indispensable technique for testing deep sub-micron ICs.

STUMPS¹ is a BIST architecture utilizing signature analysis first proposed by Bardell and McAnney [6] (STUMPS is introduced in detail in chapter 2). Although

¹Self-Test Using MISR/Parallel SRSG (shift-register sequence generator)

originally proposed for board-level testing, STUMPS has gained in popularity for IC-level testing. It consists of a pseudorandom pattern generator (PRPG) to provide test patterns and a parallel compactor to compact internal circuit responses. Test pattern generation and response compaction occur inside the STUMPS-equipped device. The tester initiates the test and at its completion obtains and evaluates the final signature from the CUT.

Off-line and on-line testing

A test is characterized as off-line when the CUT must be taken out of normal operation to be tested. On-line testing methods perform board-level or chip-level testing during normal system operation. On-line testing is necessarily internal as a tester cannot be utilized during normal system operation. Due to design complexity and high cost, on-line testing is mainly found in safety-critical systems.

The testing process in typical off-line testing environment consists of:

- (1) applying many stimuli to the CUT;
- (2) capturing the generated circuit responses; and
- (3) comparing the responses from the CUT to reference good circuit values to render a "pass/fail" judgement.

Two basic components are needed for testing, whether external or internal: a mechanism to provide input stimuli to the CUT, and a mechanism to evaluate the generated circuit responses. In external testing these mechanisms are wholly contained within the tester, while in BIST some mechanisms are implemented on-chip.

Exhaustive, random and pseudorandom testing

In an ideal testing environment, every CUT would be exposed to all possible input stimuli during testing, termed *exhaustive* testing. Due to time and storage constraints, exhaustive testing is only practical for small circuits. For example, to exhaustively test a 100-input circuit with a test system able to apply 1 billion test patterns per second would require approximately 4×10^{13} years, i.e. several orders of magnitude greater than the age of the universe. To keep testing costs low, the test of a single IC should be accomplished in mere seconds. A practical solution to this problem is the

random test [7]. A random test consists of a large, random selection of test patterns used to expose the CUT to a sample of its input space. A truly random selection of test patterns is undesirable for testing purposes since it is not repeatable (unless stored). Repeatability is necessary to simplify the comparison of circuit responses. Instead, a pseudorandom test is used to approximate a random test. It has the properties of a random test but is fully repeatable. A pseudorandom pattern generator (PRPG) is a mechanism for generating repeatable sequences of pseudorandom test patterns. PRPGs can be realized directly in hardware for BIST applications.

After applying an input stimulus, randomly generated or otherwise, it is necessary to compare the circuit response with a good reference. The obvious approach would be a direct bit-by-bit comparison of each response with its reference. This is impractical, however, due to the time required to compare numerous circuit responses in the test and the high storage demands of many reference responses. A more practical approach, suitable for BIST, is data compaction. Data compaction is destructive data compression with the primary objective of distinguishing different data streams. Data compaction is performed on the sequence of responses generated by the CUT. The final result is termed the signature of the CUT. This signature is compared to a precomputed good circuit signature to render a judgment on the CUT. Thus, only a single comparison is performed involving a small quantity of data (typically 16 - 32 bits) permitting short testing times, minimal storage needs, and high test quality. Several data compaction methods exist, including parity checking, transition counting and ones counting [7]. In practice, the mostly commonly used data compaction method is signature analysis [7].

BIST has been widely accepted by the industry because it is considered as a promising and efficient method for testing large and complex VLSI designs. In BIST architecture, test pattern generator is embedded into the chip of the circuit. The corresponding test responses are compacted into a shift register, which is also part of the chip.

Different from the non-BIST architectures, where the response for each test pattern can be obtained, only the compacted responses (*signatures*) are available in BIST architectures. This makes it impossible to directly analyze the relationship between each test pattern and its response. Unfortunately, this leads to difficulties in the diagnosis of the BIST. (Traditionally, it is an effective and a regularly used method to diagnose the faults of a circuit by analyzing its test-response pairs.)

Based on some assumptions, a series of schemes to solve the diagnostic problems of BIST architectures have been proposed. In [19], McAnney and Savir proposed a scheme which is based on the analysis to the signatures. They presented a technique for single input signature analyzer implemented by a linear feedback shift register (LFSR). This technique is valid for diagnosis of single error sequences. In [12], Chan and Abraham proposed another scheme which has similar results for Multiple Input Signature Registers (MISR). The common deficiency of the methods in [19] and [12] is their single/double error assumptions. These assumptions are not realistic in most of the situations because even a single defect in a CUT can usually cause hundreds or thousands of errors in a test response sequence.

Another class of fault diagnostic methodology introduced in [11, 2, 3] is diagnosis based on a fault dictionary. Fault dictionary methods had been widely used in fault diagnosis because of their high resolution. Signature-based fault dictionary methods use look-up tables to compare the signatures from faulty circuits to the signature of a fault-free circuit. The look-up table is created by simulating faults or fault classes in a circuit, and recording the faulty signature that is produced. Although the fault dictionary method can produce a high diagnostic resolution, it has some drawbacks. The most serious drawback is the time and memory required to construct and store a complete dictionary, even when small circuits are considered. It is shown in [20, 21, 22, 23, 24, 25] that for large circuits, the amount of memory required may make the construction of a conventional dictionary infeasible.

To overcome all the drawbacks existing in the previously mentioned diagnostic schemes, a novel STUMPS-based diagnostic technology called *built-in self-diagnosis* (BISD) has been developed recently in [29] and [34]. With minimal modification of existing BIST architectures, these novel BISD structures have following common advantages:

(1) They are capable of locating individual scan flip-flops that capture the erroneous circuit responses of the CUT, regardless of the number of errors in the output

stream. These flip-flops are called failing flip-flops.

- (2) They have a high diagnostic resolution, short diagnostic time, and support a wide range of trade-offs between diagnostic time and hardware.
 - (3) They can be compatible with the IEEE standard 1149.1 [2]
- (4) They support at-speed BIST operations and fit well in the multi-frequency BIST environment.

Both [29] and [34] successfully locate the failing flip-flops in the scan chains, but one problem is left. The problem is: based on the locations and signatures of the failing flip-flops on the scan chains, what method should be employed to locate the faulty gates (nodes) in the circuits which cause these flip-flops on the scan chain to fail.

The objective of the thesis is to solve the above problem as an extension to the novel BISD schemes introduced before. Specifically, a new scheme performing fault diagnosis in this diagnostic environment is investigated. A structural analysis based hierarchical diagnostic system, h-DIAG, developed and employed to finish the above functional extension, will be presented in this thesis. The hierarchical system is composed of two stages. The first stage proceeds structural analysis using the failing flip-flop information to locate the plausible faulty nodes in the CUT. In the second stage, based on the results of the previous stage, a dynamic fault dictionary is constructed and looked-up.

In the dynamic dictionary, each column represents a failing flip-flop, while each row represents a plausible fault. The element at the intersection of each row (corresponding to a fault) and each column (corresponding to a failing flip-flop) in the dictionary is a signature. The signature is the compacted responses on the flip-flop of the column when fault simulation is processing for the fault of the row. The diagnostic procedure in this stage is supported by an efficient fault dictionary scheme which is designed to make the fault dictionary easy to construct and look up.

The structural analysis algorithm in our h-DIAG system is a new practical structural analysis scheme at the gate-level that starts the diagnosis from the location of the failing flip-flops with reasonable resolution. The experiments on the dynamic fault dictionary show that the storage space and time used to construct and look up the fault dictionary have been significantly reduced compared with the conventional

dictionary schemes without sacrificing the resolution of the diagnosis. The shrink scale of our dictionary is much more efficient than that developed and employed in R.C. Aitken and V. K. Agarwal's DAPPER system [3]. The experimental results also show that final resolution of h-DIAG is very high.

The remainder of this thesis is organized as follows.

Chapter 2 contains a background introduction and a literature review about IC fault detection and diagnosis. STUMPS-based BIST structures, novel BISD schemes and diagnosis using the fault dictionary will be emphasized.

Chapter 3 presents our proposed structural analysis scheme and dynamic fault dictionary scheme. The algorithms used in the schemes will be explained with detailed examples. A complexity analysis of the algorithms will be given. Examples using the dynamic fault dictionary will be described. The achievement in the size and time over the conventional fault dictionary and the comparison to the shrink scale of the dictionary in the famous scheme DAPPER will be shown through a series of tables and figures from the experimental results of benchmark circuits.

Chapter 4 presents the resolution evaluation methods and the results of the hierarchical diagnostic system. We will introduce the experimental environments, procedures and circuits used before the analysis of the resolution and other diagnostic features.

Chapter 5 presents the implementation of the software system.

Chapter 6 gives the conclusion to sum up the thesis.

In Appendix A, the flow chart of the algorithms used in structural analysis and dynamic dictionaries are presented. In Appendix B, figures reflecting the lookup time of conventional fault dictionaries and dynamic fault dictionaries are presented for all the benchmark circuits.

In Appendix D and Appendix E, detailed experimental results on diagnostic resolution and diagnostic time at specific testing length are presented for ISCAS'85 and ISCAS'89 benchmark circuits, respectively.

Chapter 2

Background and Literature Review

This Chapter presents an overview of some of the topics relating to the digital testing and diagnostic techniques in digital circuits. STUMPS structure and some fault diagnostic methods for the STUMPS environment are described. The diagnostic methods using fault dictionaries are discussed and evaluated. An overview of diagnosis using hierarchical schemes with dynamic dictionaries is presented. *Built-in self-diagnosis* (BISD) structures and their principles are given. Specifically, the two new BISD schemes proposed in [34] and [29], which the research in this thesis is based on, are described.

2.1 Faults and Fault Testing

According to the definition in [33], a Fault is a physical failure or defect of one or more components in a digital circuit/system caused by the manufacturing process, extreme operating conditions, or wear-out (aging) of the physical components.

Some main reasons which can regularly cause physical failures in manufacturing processes are silicon defects, lithographic problems, processing problems, etc. Wearing out or aging can also cause physical defects from long-term operation of circuits under conditions of high current densities, ion migration, hot electronic trapping, etc. Another class of physical failure is caused by the automated manufacturing steps in mounting ICs on the *printed circuit board* (PCB). The automated IC insertion equipment can damage the input or output pins by either bending them or shorting them out.

When a fault changes the logic behaviors of an element, the fault is called a Logic

Fault. Stuck-at Fault is modeled by having a line segment stuck at logic 0 (stuck-at 0) or 1 (stuck-at 1).

For example, the output of a NAND gate normally is logic 0 when all of its inputs are logic 1, and logic 1 when one or more than one of its inputs is logic 0. When one of its input is constantly connected to logic 0, as in Figure 2.1 (VSS represents 0), its behavior is changed in such a way that its output is always a logic 1 no matter what input values are applied. We call this input node *stuck-at-0*.

One main task of testing is to find a set of inputs to cause the outputs to be different from the normal logic behaviors. If such a set of inputs is found, we then say that this set of inputs constitutes a test for the logic element under that particular faulty condition because the set of inputs is capable of distinguishing a logic element (gate) that is functioning normally from one that is being faulty.

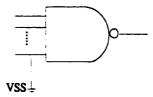


Figure 2.1: Logic Fault - One Input of a NAND Gate Stuck-at-0

Permanent faults (we discuss only) are faults in existence long enough to be observed at test time, as opposed to temporary faults (transient or intermittent), which appear and disappear in short intervals of time, or delay faults which affects the operating speed of the circuit.

Multiple faults exist when more than one fault exists at one time. The probability of multiple faults existing in a circuit is typically less than the probability of a single fault, but the probability increasing with increases in circuit density.

Multiple faults can exist in such a manner that they can be degraded to an equivalent single fault. In this case, the input vectors that test for the existence of the single fault also test for the existence of the multiple fault condition.

Masked faults are undetectable by definition since the observed circuit behavior is correct. The presence of some internal or primary input faults may not be observable at any circuit output. In this case the fault is considered to be masked.

Fault detection or testing is a process of evaluating a circuit/system to detect the presence of hardware failure due to faults. In general, fault detection frequently involves the application of a sequence of test stimuli called vectors or patterns to the inputs of a CUT and analysis of the corresponding responses to the applied test by first collecting data at the outputs of the CUT. The analysis step is characterized by comparing the test responses with expected responses when the same test stimuli are applied. The whole process can be generally automated since it may involve an automatic test pattern generation (ATPG) and automatic test equipment (ATE). The generation of test stimuli with expected responses is a very difficult process if done manually. ATPG can help in many cases if the design has inherent testability. The ATE used in most cases is either a components or board tester for manufacturing testing, or a logic analyzer used commonly for prototype debugging.

Closely related to design for testability (DFT), BIST is a design technique in which parts of the circuit are used to test the circuit itself. BIST is the capability of a circuit (chip, board, or system) to test itself. It represents a merger of the concept of built-in test (BIT) and self-test. BIST techniques can be classified into two categories, namely on-line BIST, which includes concurrent and non-concurrent techniques, and off-line BIST, which includes functional and structural approaches.

Among these categories, structural off-line BIST is most widely used. Structural off-line BIST deals with the execution of a test based on the structure of the CUT. A PRPG is a multi-output device normally implemented using an LFSR, while a *shift* register pattern generator (SRPG) is a single-output autonomous LFSR. For output response analyzers, a MISR and *single-input signature register* (SISR) are normally used.

An off-line BIST architecture incorporating scan testing and partitioning is the self-test using MISR/parallel SRSG¹ (STUMPS) testing architecture [6]. It was originally proposed to test multi-chip modules at the board-level. A special testing chip implements the SRSG and MISR components of STUMPS which, respectively, generate test patterns for the other chips on the board and compact in parallel their output responses.

Each chip to be tested must utilize scan-based flip-flops [6] configured into scan

¹This is the acronym of Shift-Register Sequence Generator.

chains (or data streams). A number of scan chains, per board, are formed by directly connecting the scan-in and scan-out ports of individual chips. The scan chains are supplied pseudorandom test patterns in parallel from the SRSG. By scanning in known test patterns into the scan chains, a sequential circuit is converted into a combinational circuit during testing. Combinational circuits are easier to test as their response depends only upon the current input vector, not on past inputs.

The scan chains provide the inputs to the combinational logic blocks and capture the generated responses. Normal circuit operation is governed by a system clock or clocks. Scan testing also introduces a separate test clock to govern the serial flow of data within scan chains. With multiple applications of the test clock, data from the SRSG is scanned into the scan chains, loading test patterns into the chips to be tested. The regular system clock is then asserted once to capture the responses from the chips back into the scan chains. The subsequent test patterns are then scanned in, while simultaneously, the circuit responses are being scanned out to the test chip where they are compacted by the MISR. After the application of many test patterns, the final signature is scanned out of the test chip and compared with a error-free signature to determine whether response errors were detected.

STUMPS has since become a standard IC-level BIST architecture. Memory elements are realized as scan registers connected to form scan chains. The functions of the test chip are implemented directly within the IC as dedicated BIST resources. Figure 2.2 shows the IC-level STUMPS architecture showing the configuration of scan chains, SRSG and MISR [31].

2.2 Fault Diagnosis

Diagnosing a faulty device intuitively means to find out, although with a certain degree of uncertainty, the cause of failure. Diagnosis is receiving increasing attention from both industry and academic: testing for pass/fail information is inadequate, especially for the purpose of tuning the manufacturing process of ICs.

A CUT fails when its observed behavior is different from its expected behavior. Diagnosis consists of locating the fault(s) in a structural model of the CUT. In other words, diagnosis maps the observed misbehavior of the CUT into fault(s) affecting

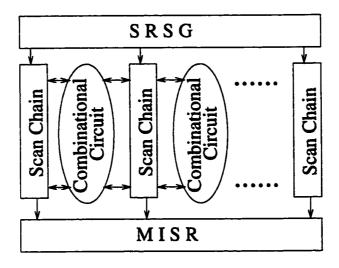


Figure 2.2: The STUMPS Architecture

its components or their interconnections.

The diagnostic process is often hierarchical such that the faulty unit identified at one level becomes the target of diagnosis at the next level. This is so-called top-down process, starts with a system operating in the field. During the fabrication of a system, however, its testing proceeds bottom-up (e.g., from ICs to boards, then to system), such that a higher level is assembled only from components already tested at a lower level. This is done to minimize the cost of diagnosis and repair, which increases substantially with the level at which the faults are detected. In our research, we will focus on diagnosis at the IC-level.

The degree of accuracy to which faults can be located is referred to as diagnostic resolution. No external testing experiment can distinguish among functionally equivalent faults. The partition of all the possible faults into distinct sets of functionally equivalent faults defines the maximal fault resolution, which is an intrinsic characteristic of the system. The fault resolution of a test sequence reflects its capability of distinguishing among faults, and it is bounded by the maximal fault resolution.

Conventionally, fault diagnosis can be approached in two different ways. The first approach does most of the work before the testing experiment (pre-testing work). It uses fault simulation to determine the possible responses to a given test in the presence of faults. The data base constructed in this step is called a *fault dictionary*. To locate faults, one tries to match the actual response obtained from the CUT with one of

the precomputed responses stored in the fault dictionary. If this look-up process is successful, the dictionary indicated the corresponding faults in the CUT. This kind of diagnosis can be characterized as a *cause-effect* analysis [30, 15] that starts with possible causes (faults) and determines their corresponding effects (response). A second type of approach, employed by several diagnostic methods, relies on an *effect-cause* analysis [1, 32, 5, 35], in which the effect (the actual response obtained from CUT) is processed to determine its possible causes (faults).

2.2.1 Overview of the Existing Diagnostic Methods

Diagnosis and Testing have different purposes and conflicting requirements. Testing should be fast, comprehensive and inexpensive since it is performed on every device manufactured. Techniques used to speed testing, such as signature analysis, severely hamper fault diagnosis by compacting, and losing, the circuit responses necessary for diagnosis. Diagnosis is only performed on devices that fail testing, thus the primary requirements are diagnostic accuracy and detail. The results of diagnosis must be accurate and specific enough to focus attention on the location of the defect so that it can be quickly corrected. To reduce cost, it is desirable to perform diagnosis with existing testing methods and with minimal tester support.

A circuit may have countless possible physical defects that can produce faulty behavior. Diagnosis employs fault models to systematically characterize the majority of the potential defects. A fault model is a set of rules and assumptions which describe the effects that defects have on digital circuits [2]. The results of fault diagnosis are one or more faults (or fault classes) in the adopted fault model. Although many fault models, besides stuck-at model, have been proposed to describe various defects, including: bridging faults, transition faults and delay faults, the most common is still the *stuck-at* fault model. Much of the early work in fault diagnosis has been based on the assumption of the stuck-at fault model. This section reviews the published literature as a history of fault diagnosis.

Simulation-based Methods

Early diagnostic approaches attempted to enumerate the behavior of faults in the assumed fault model [1]. A fault dictionary is compiled by simulating the CUT with

every fault and recording the corresponding circuit response. Diagnosis then consists of the simple task of locating the observed response of the CUT in the fault dictionary and noting the corresponding fault(s). Disadvantages of this technique are set by the limits of the adopted fault model and the inability to diagnose multiple faults.

Signature Analysis-based Methods

Signature analysis based methods attempt to solve the problem of response data loss inherent with data compaction. Considerable effort has been made in identifying and locating errors in the non-compacted circuit responses based on the observed signature [7, 13, 19, 32]. There are three types of signature analysis-based fault location techniques: fault dictionary, algebraic analysis and intermediate signatures.

A. Fault Dictionary

Fault dictionary technology as an outgrowth of logic simulation has been a useful tool for diagnosing faults in integrated circuit [30, 15]. The fault dictionary-based method can construct a look-up table containing the modeled faults and their corresponding faulty signatures [7]. Diagnosis then consists of locating the observed faulty signature in the dictionary. Fault dictionary technology has been widely accepted because of its high resolution and accuracy. Recent research indicated that stuck-at fault dictionary is very efficient in the diagnosis of CMOS bridging faults, which is a very popular research topic in VLSI diagnostic area [20]. Further discussion about fault dictionary methods will be presented in section 2.2.2.

B. Algebraic Analysis

Algebraic analysis methods attempt to compute the erroneous circuit response from the faulty signature obtained from testing.

The first such method was given by McAnney and Savir [19]. It uses an *linear* feedback shift register (LFSR) that is the reciprocal of the LFSR used for compaction. The reciprocal LFSR is initialized with the faulty signature obtained from the CUT then clocked to reverse the compaction and compute where the error was introduced. This method constrains the test length to be no greater than the state space of the LFSR. At most two errors in the test sequence can then be identified.

A similar method by Chan and Abraham [13] is applicable to both serial and parallel compactors. It uses state transition matrices to describe the compaction process. An analytical formulation is given to calculate the error location in the test sequence. The method is limited to identifying which compaction step introduced the errors or the channel(s) containing the errors.

C. Intermediate Signatures

Intermediate signature methods are based on signatures obtained at regular intervals during testing. For diagnostic purposes, circuit responses are partitioned into short blocks. An intermediate signature is obtained after the compaction of each block of responses. The intermediate signatures are compared with error-free counterparts to target failing blocks for diagnosis [32].

Error Control Code Method

The diagnostic method in [34], which we will discuss in subsection 2.2.3.1 in more detail, uses a special programmable MISR (PMISR) to perform compaction. A set of equations based on Reed-Solomon codes [17] is obtained from the faulty signatures and solved to identify the error-capturing frames. Each scan chain is then re-tested to locate the actual erroneous flip-flops.

2.2.2 Diagnosis Using the Fault Dictionary Method

Many fault dictionary methods have been proposed [2, 8, 14, 20, 21, 22, 23, 24, 25] for fault diagnosis. A fault dictionary is a database used for diagnosing faults on VLSI. The fault dictionary records the errors that each fault on a circuit's fault list would cause during testing. A fault list is created after equivalent faults have been collapsed. A fault simulation then determines for each input what the correct outputs are, and what errors each fault on the fault list would cause.

Term 1: A full response dictionary is the dictionary which stores the circuit outputs in the presence of each fault for each test. This dictionary has the advantage of providing all the information available for a given test set. Further, it can easily be stored in a bit-packed manner.

Term 2: A pass/fail dictionary is similar to the full dictionary but only stores one bit of information per fault-vector pair — a 1 if the circuit fails the test in the presence of the fault and a 0 if it passes. The diagnostic expectation of the pass/fail dictionary is worse than the diagnostic expectation for the full dictionary, but if the circuit has a large number of primary outputs, the pass/fail dictionary is significantly smaller.

To locate the faults in a detective circuit, the errors observed on the circuit are compared with the errors recorded in the fault dictionary. If the fault model were perfect, fault location would be a matter of "looking up" the observed errors in the dictionary. A matching algorithm is used to choose the fault from the fault list which is the same models as the fault to be located (as in *Exact-Match Dictionary Method* [11]). Some methods, as described in [23], choose the fault from the fault list which most closely models the fault to be located. These methods identify the fault from the fault list which would cause errors most closely matching the observed errors. The matching algorithm assigns a score to each fault on the fault list. The fault with the highest score is hopefully the fault which best models the defect in the circuit under test.

Although much more feasible than the guided probe method with higher resolution, the stumbling block to the serious application of conventional fault dictionaries and matching algorithms for relative large circuits is the size of the dictionary and processing time of constructing and looking-up the dictionary. The experiment in [24] shows that for some ISCAS circuits, the file to store the conventional dictionary would fill several large disks, take months to create, and take days to process for each diagnosis. Thus, the conventional fault dictionary is an appealing fault location tool and has already been proven effective in many aspects, but the enormity of a conventional dictionary prevents its application to fault location at the VLSI circuit level.

In order to reduce the complexity of the fault dictionary, many dictionary compaction measures have been taken.

In [21], Pomeranz and Reddy proposed a compaction dictionary which is named Compact. The dictionary uses a greedy algorithm to choose columns from the full response dictionary to augment a pass/fail dictionary. The result is a compacted dictionary with little or no erosion of diagnostic expectation (for the modeled faults).

Boppana and Fuchs [8, 2] introduced two methods for compacting fault dictionaries based on diagnostic trees. A diagnostic tree gives the equivalence classes that are distinguished after each test is applied. Both of the proposed methods use a tree-based analysis to remove information from the dictionary that does not contribute to increased diagnostic performance. After the diagnostic tree is compacted it is stored in a set of tables.

A problem in these schemes is: although the size of the dictionary had been reduced, the entry number in the dictionary is still the number of the faults in CUT. In another words, the length of the dictionary did not get reduced.

2.2.3 Diagnosis Using a Hierarchical Method with a Dynamic Dictionary

Different from a conventional dictionary, which has entries for all of the faults in the circuit, the dynamic dictionary contains only the entries for the suspicious faults based on the clues obtained in previous testing/diagnostic stages. In these kinds of hierarchical structures, as the clues obtained in previous stages become clearer, the size of the dictionary will become smaller and the time used to look up the dictionary will become shorter.

In [24] P. G. Ryan from Intel proposed a new scheme which can reduce the size of the dictionary by using a two-stage procedure to reduce problem size before constructing a small fault dictionary. The approach utilizes dynamic fault dictionaries, test set partitioning and reduced fault lists to reduce the size and complexity of the fault dictionary. It develops multiple tests for a CUT with each test covering a small portion of the circuit and corresponding to a small fault list that could cause the faulty circuit. During a diagnosis, the complete fault list is reduced by intersecting the coverage list of the tests the chip fails. One of the failing test sets is then fault simulated to build the dictionary. One of the limitations of the approach is the need for multiple, partitioned tests as described above. If these tests are not available as a consequence of the design process, manually partitioning an existing test program may be difficult.

In [25], a two-stage fault isolation for sequential random logic VLSI circuits was

presented. Two fault dictionaries, limited ² and dynamic ³ fault dictionaries were introduced. In the first stage of the dynamic process, a limited fault dictionary identifies candidate faults, which are further distinguished in the second stage by a dictionary generated dynamically for the candidate faults and a subset of the test vectors. High resolution was provided and the cost of full static dictionaries was avoided.

A common limitation to both [24] and [25] is that these methods focussed on the analysis to the individual test pattern< -> response pairs instead of signatures which are the compressed responses to a series of input. This makes these methods not suitable for the situations where only signatures are directly available.

In another aspect, although the use of date compaction techniques such as signature analysis [7] can reduce the size of the dictionary, a full circuit simulation is required to obtain each entry in the dictionary which can easily negate the cost savings which initially justified data compaction.

In [3], R.C. Aitken and V.K. Agarwal from the VLSI Design Laboratory of McGill University proposed a diagnostic method using pseudo-random vectors without intermediate signatures which can be used to locate faults in circuits tested with random or pseudo-random test vectors. Their proposed scheme, named DAPPER, is applicable to multi-output combinational circuits. DAPPER classifies faults initially by their detection probability, then based on the classification, it performs fault simulation. Due to the fact that the resolution of the classification is very coarse, the number of faults to be simulated in the next stage is still not very ideal.

As part of this thesis research, a dynamic dictionary with a hierarchical structure is proposed (see chapter 3). Based on structural analysis, the number of final faults to be simulated to construct the dynamic dictionary and the size of the dictionary can be greatly reduced compared with a conventional fault dictionary (see following chapters). The degree of the reduction in the number of faults to be simulated, on average, is much more apparent than that in DAPPER for single-stuck-at fault model⁴. The new dictionary scheme can be used in BIST with the STUMPS structure.

²a small, inexpensive fault dictionary created once to identify for each diagnosis a small number of candidate faults.

³a dictionary which has the detail of a full dictionary, but for just the candidate faults.

⁴Besides this fault model, DAPPER is also valid for some other fault models which our system

2.2.4 Fault Diagnosis in a STUMPS Environment

Fault diagnosis is an important process in the design of integrate circuit chips with BIST structure using sub-micron technologies. As well as helping to correct design errors, it can be used to improve yield and increase circuit reliability. Normally, fault diagnosis is the opposite of fault simulation: it starts with a stimulus and observed faulty circuit responses, and then determines the fault set that can produce the faulty response given the same stimulus. To reduce the fault set, many stimulus/faulty response pairs must be considered. Knowledge of the fault(s) potentially responsible for the observed behavior is then used by the designer to correct design problems or improve yield.

In 1987, McAnney and Savir proposed to use faulty signature information for fault diagnosis [19]. The technique they presented was to use a single input signature analyzer implemented by a LFSR. The technique is valid for the diagnosis of single error sequences. In 1990, Chan and Abraham obtained similar results by using *Multiple Input Signature Registers* (MISR) [12]. Some other techniques that use two LFSRs for diagnosing single and double error sequences were reported in [26].

The major deficiency of these techniques is their single/double error assumptions and these assumptions are generally unrealistic. In [16], r-error correcting BCH code is used to diagnose r bit errors in a sequence. Unfortunately, r can only be very small. For sequences with more than 4 bit errors, the diagnostic aliasing is very high.

In many situations, fault diagnosis requires that many stimulus/faulty response pairs be obtained from a CUT. However, this is at odds with current internal testing methods. The necessity of testing increasingly dense ICs has led to the innovation of BIST. One form of BIST is STUMPS which is both an aid and a hindrance to fault diagnosis. It is an aid since it permits the observation of many internal circuit nodes, aiding diagnostic resolution. However, it is a hindrance as these observation points are inaccessible from off-chip during testing. Additionally, post-testing time must be expended to scan out this internal circuit information where it can be used for fault diagnosis.

Once initialized, the testing of a STUMPS-equipped IC occurs mainly on-chip.

is not valid yet.

The result obtained is a final signature (typically 16 - 32 bits long) which is the compacted response of the CUT for the entire test set. This signature is then compared off-chip with the good signature (obtained through logic simulation of the good circuit) by the tester to produce a pass/fail judgment of the IC. By staying mainly on-chip, testing can proceed at much higher speeds.

The final signature is suitable for rendering a pass/fail judgment of a CUT, however on its own it is grossly inadequate for fault diagnosis. Consider a STUMPS implementation consisting of 16 data streams, each of 1024 bits and a test length of 100,000 patterns. Each circuit response consists of (16 × 1024) bits or 2 Kbytes of information, while the entire test consists of 200 Mbytes of information. The circuit response information lost during data compaction is unrecoverable from a final signature of several bytes. This makes IC-level fault diagnosis a difficult and costly task.

Data retrieval is one method for obtaining the lost circuit response information [32]. Recall that in STUMPS, access to all data streams is only available through two ports: a scan-in port for input and a scan-out port for output. Data retrieval in STUMPS is the process of scanning out in serial the contents of all data streams to obtain the response of the CUT.

To perform fault diagnosis, many stimulus/faulty response pairs must be scanned out from the CUT. However, scanning out the entire circuit response for every stimulus in the test set is time-consuming and unnecessary. Not every circuit response will be faulty as certain stimuli may not induce errors in circuit responses and produce the same responses as the good circuit. Fault-free circuit responses can be determined through circuit simulation, thus it is desirable to only scan out the faulty circuit responses.

For the purposes of data retrieval, the test set is divided into discrete intervals of one or more test patterns. Each interval has an *intermediate signature* computed by logic simulation of the good circuit. This is the intermediate result of compacting all responses up to and including the responses from the current testing interval. All such signatures are compiled into a dictionary of intermediate signatures. During data retrieval, the intermediate signatures obtained from the CUT are compared with their counterparts in the dictionary. A discrepancy indicates that the preceding test

interval must contain at least one faulty response, whereupon all responses in the present interval are scanned out to be used for fault diagnosis.

Consider a system with intervals consisting of 100 test patterns, the specific steps of the data retrieval process are [7]:

- Step 1: Initialize the BIST circuitry in the CUT to the beginning of the test sequence.
- Step 2: Apply the next 100 test patterns to the CUT.
- Step 3: Scan out the intermediate signature from the CUT.
- Step 4: Compare the signature with the counterpart in the dictionary. If the signatures are the same, the state of the BIST circuitry in the CUT is restored to the state before the signature was scanned out. However, if the signatures differ, the BIST circuitry in the CUT is restored to the state at the start of the current interval. The 100 test patterns are then re-applied, but instead of being compacted each response is scanned out and stored for further fault diagnosis. Once all responses in the interval have been scanned out, the BIST circuitry in the CUT is restored to that of the good circuit at the end of the current test interval.
- Step 5: If there are more intervals in the test set, go to Step 2.
- Step 6: The stored responses are transferred from the tester to a workstation where fault diagnosis can proceed off-line.

After data retrieval is complete, fault diagnosis [32] is performed to determine the fault class(es) responsible for the observed faulty responses. In addition to the faulty responses, the following data and systems are necessary to perform fault diagnosis: (1) a structural description of the CUT, (2) a fault simulator, and (3) a PRPG to generate the test patterns in the test. The first step of fault diagnosis involves the structural analysis of the circuit to create a minimal fault list. Subsequently, each fault in the list is simulated with the generated stimuli and the resulting responses are compared with the retrieved responses. If the simulated responses match all retrieved responses, the fault is accepted. Otherwise, the fault is rejected as it does

not reproduce all observed responses. The final result of fault diagnosis is a set of faults that can reproduce the observed faulty behavior and thus are potentially responsible for the defect(s) in the CUT.

As can be seen from the previous steps, data retrieval is a complex, lengthy process as compared with pass/fail testing. A pass/fail judgment of a CUT involves a single, uninterrupted application of the test set followed by the scan-out and comparison of the final signature. The only tester-CUT interaction is at the start to initiate the test, and at the end to scan-out the final signature. Data retrieval, on the other hand, demands many more interactions between the tester and the CUT. Each test interval is initiated and halted, the intermediate signatures are scanned out, the BIST circuitry is reset, and ultimately the circuit responses are scanned out. Data retrieval occupies an expensive testing system for an extended length of time that can otherwise be used to verify many more newly fabricated ICs. It transfers more data from the CUT than may be necessary to accomplish fault diagnosis.

In [31], an alternative solution to the data retrieval method used in Waicukauski's diagnostics scheme [32] was proposed. In this solution, they proposed to transfer partially compacted data from the CUT to the tester, and to use analytical methods off-line to recover the information lost during signature compaction. The recovery scheme can reduce the amount of data transferred from the CUT to the tester (typically by a factor of 8), and can eliminate the need for decision making by the tester on every intermediate signature. As a result, the tester time used for data retrieval for fault diagnosis can be decreased, while employing a less expensive tester to perform the task.

2.2.5 STUMPS-Based Built-in Self-diagnosis

In [19] a technique for single input signature analyzer was presented. The technique is implemented by a linear feedback shift register and it guarantees that correct diagnosis of single error sequences. The major deficiency of this technique is its single error assumption.

In [34], a novel BIST fault diagnostic scheme for scan-based VLSI devices was proposed. The scheme is an application of error control code theory [17] and it is

based on multiple scan structure STUMPS and its faulty signature information as shown in Figure 2.3.

This scheme can guarantee correct identification of the scan flops that capture errors during test, regardless of the number of the error the CUT may produce. Knowing failing scan flops location is very helpful in diagnosis since most of today's VLSI circuits are designed in RTL (Register Transfer Level). In addition to failing scan flops, the proposed scheme is also capable of identifying failing test vector(s) with a better diagnostic capacity than existing techniques. [34] supports at-speed BIST operations and fits well in the multi-frequency BIST environment.

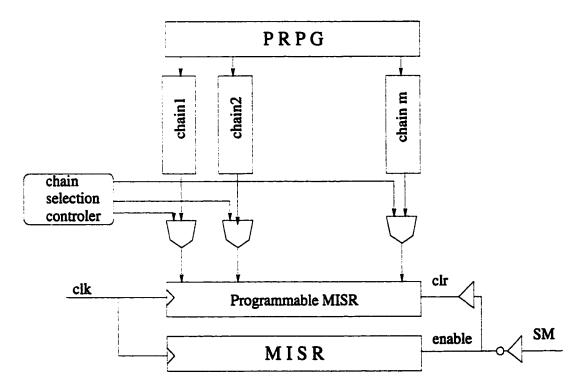


Figure 2.3: Nortel's BISD Structure

This scheme consists of two levels of data compaction. It firstly compresses the test response of a test vector into the PMISR (Programmable MISR); secondly it compresses the content of the PMISR into the MISR, then it clears the PMISR.

After all test vectors have been applied, the signature collected in the MISR is saved for off-line analysis. The PMISR is then set to another polynomial and the whole process is repeated until an adequate number of signatures have been collected.

Basically, the scheme requires applying the same test vector set 2t times if up to t scan flop frames may capture errors during the test. In order to improve the resolution (at the flip-flop level), the final approach used is to fault diagnose one chain at a time. So, assuming that at most t_j $(1 \le j \le m)$ scan flops on scan chain j may capture errors, the scheme requires repeating the same test set $2^*(t_1+t_2+...t_m)$ times in order to diagnose all of the scan chains.

In [34], diagnostic coverage is defined as the percentage of circuit nodes in a CUT that are diagnosable for a given test time if any of them fails during test. This coverage can be used as a measure of the effectiveness of its proposed scheme for an allowed test time for diagnosis.

Diagnostic coverage of faulty nodes is a different concept from the final resolution of the faulty nodes. Some nodes can be covered but can not be identified at last. The identification of the possible faulty nodes is the responsibility of logic level diagnosis. Experiments show that a reasonable high diagnostic coverage can be achieved in this scheme with a small test time cost.

For the logic-level diagnosis, two basic methods are recommended in [34]: the first method is through identification of the failing test vectors; the second method is through analysis of the structure of the CUT after knowing the exact locations of the failing scan flops. In order to further improve the resolution, the approach to combine both of them are also recommended.

In [29], another novel built-in self-diagnosis scheme, named BISD-Scan, for IC-level STUMPS-like architectures was presented as shown in Figure 2.4. BISD-Scan utilizes normal BIST resources, and processes in high diagnostic resolution, short diagnostic time and with low hardware overhead.

This scheme requires partitioning each scan chain into p segments so that each scan segment contains n/p scan flip-flops. It also introduces a signal named compaction control.

This scheme employs a divide-and-conquer technique to identify faulty segments in a CUT, then refines the diagnostic resolution to locate individual failing flip-flops, using output masking. The locations of failing flip-flops provide important information to further identify faulty gates and physical failures in CUTs.

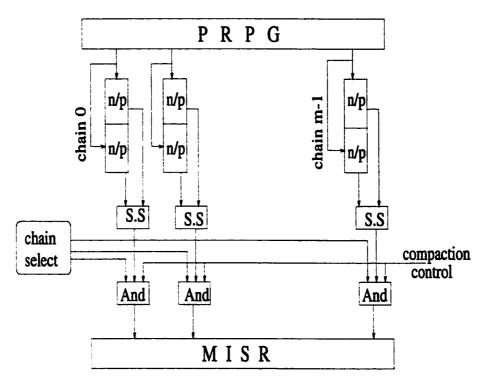


Figure 2.4: UofA's BISD Structure

The BISD procedure consists of four basic steps as follows:

Step1: Compute *mp* signatures, one for each scan segment, and locate all faulty segments.

Step2: Locate the faulty scan segments on the m scan chains.

Step3: Compute k (n/p) signature in k faulty segments.

Step4: Locate individual faulty scan flip-flops in k faulty scan segments.

This scheme possesses a high diagnostic resolution (to the scan flip-flop level) and an affordable diagnostic time. As for logic-level diagnosis, simulation-based techniques, structural analysis and electronic probing method are recommended.

Both [29] and [34] achieved a reasonable high diagnostic coverage or resolution at flip-flop level. The essential problem solved by them is locating the failing flip-flops. This means that once a fault is created in the circuit, the failing flip-flops caused by it can be located. This is very important but not enough. For the manufacturers, the exact location of the faulty gate (node) is what they finally need.

In this thesis, as the function extension to the novel BISD schemes designed in [29] and [34], a hierarchical diagnostic scheme is proposed to locate the faulty gate (node) in the circuit. The hierarchical system is composed of two stages. In the first stage, it analyses the circuit with structural analysis algorithms to get the plausible faulty sites of the circuit. Based on this information and fault simulation, a dynamic fault dictionary is built up. Through looking up the dynamic dictionary, the further diagnosis is processed.

Both the novel structural analysis algorithm which is specially designed for the requirement and the scheme of the new fault dictionary will be presented in the following chapters.

Chapter 3

A New Diagnostic Scheme

This chapter presents a new hierarchical scheme for gate-level fault diagnosis in STUMPS-based built-in self-diagnosis (BISD) structures. An overview of the scheme is given. The terminology used to describe the scheme is defined. The algorithms used in the scheme are described and examples to illustrate the operations of the scheme and algorithms are presented. The computational complexity of the algorithms is also analyzed.

3.1 Overview of the Proposed Method

With the techniques proposed in [29] and [34], any flip-flop that has captured the erroneous circuit responses of a CUT, called a failing flip-flop, can be correctly identified independent of error multiplicity. The signatures of all failing flip-flops can be collected during the test procedure. Based on the locations of failing flip-flops and their faulty signatures provided by the above two schemes, the hierarchical scheme proposed in this thesis will further diagnose the error-causing logic gates.

As shown in figure 3.1, the hierarchical system is composed of two stages. They are the *Structural Analysis* stage and the *Dynamic Dictionary* stage.

In the first stage of the hierarchical system, where the corresponding algorithms employ the conventional single fault assumption, the diagnosis uses the locations of the failing flip-flops to locate gate level fault, or find out the suspicious faulty sites through a new structural analysis method.

Structural analysis had been used in many ATPG algorithms, but the main problem solved is to analyze the relation between each test pattern and corresponding

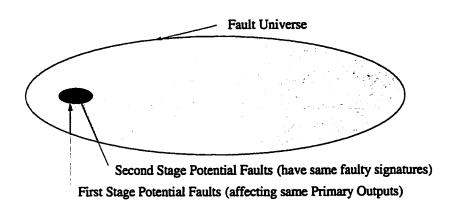


Figure 3.1: Overview of the Diagnostic System

response. So the logical structure of the circuit and the logical relationship between the nodes must be considered. This is not suitable to our situation because failing vector information was lost during the signature computation.

The new structural analysis method presented in this thesis only depends on the location of the failing flip-flops and the connection between nodes.

In the second stage, where the corresponding algorithms employ the single stuckat fault assumption, the diagnosis creates a dynamic dictionary for the plausible faults
diagnosed by the first stage. It is based on the analysis of signatures for each flip-flop.
The dictionary is constructed by fault simulation, response compaction and signature
collection. There is one entry in the dictionary for each plausible fault obtained in the
structural analysis. The simulation length is the same as the testing length. During
the diagnosis, once the corresponding signatures are collected from the testing site
with the schemes provided in [34] and [29], they are used to look up the dictionary
to find the entry which has same signatures. The corresponding fault(s) is (are) the
diagnostic result, the final plausible faulty set.

Introducing the dynamic dictionary greatly reduced the size of the conventional dictionary and the time of looking up the dictionary.

In the remainder of this chapter, the algorithms used in the two stages are presented. All the terms related to the algorithms are defined. The examples reflecting the algorithms are given. The complexity of the algorithms are analysed¹.

¹In this scheme, we assume that all faults exist on the line segments (nodes) in the CUT and that the gates themselves perform fault-free function.

3.2 Terminology and Notations

Definition 3.1 A circuit consists of a set of logic gates and a set of line segments. A gate in the circuit is a logic gate while a node in the circuit is one line segment. Each logic gate and node has an unique identification number.

A set of gates is a set of numbers each of which represents a logic gate in the circuit. A set of nodes is a set of numbers each of which represents a node. The number representing a gate is equal to the number representing the output node of the gate.

Definition 3.2 The forward tracing set of nodes N: f_affected_nodes is a set of nodes which are on all the paths from N to all the primary output nodes. The set is constructed in following way:

- 1. N belongs to the set f_affected_nodes.
- 2. The output of a gate G belongs to the set f_affected_nodes if N is the input of the gate G.
- 3. M belongs to the set f_affected_nodes if M is fanout of N.
- 4. The elements in f_affected_nodes of M belong to f_affected_nodes of N if M is in the set f_affected_nodes of N.

Definition 3.3 backward tracing set of node N: b_affected_nodes is a set which is composed of all nodes which are on the path from N to any PIs. The set is constructed in following way:

- 1. N belongs to the set b_affected_nodes.
- 2. All the inputs of the gate G belong to the set b_affected_nodes if N is the output of the gate.
- 3. M belongs to the set b_affected_nodes if N is a fanout of M.
- 4. The elements in b_affected_nodes of M belong to b_affected_nodes of N if M is in the b_affected_nodes of N.

Definition 3.4 A failing flip-flop pattern (FFFP) is a set of flip-flops which caught an error during a test.

For example, in figure 3.2, if the flip-flops are coded from 1 to 12 and the first, seventh and the twelfth caught the error, the failing flip-flop pattern is $\{1, 7, 12\}$. The FFFP is one of the important inputs to the diagnostic system.

Definition 3.5 Fault collapsing is to identify equivalent faults in a circuit and to generate the minimum fault set under a chosen fault model.

Definition 3.6 General fault collapsing is a procedure to collapse faults among the whole circuit based on the single stuck-at fault model².

Definition 3.7 A fault list is a fault set containing all the collapsed faults after general fault collapsing.

Definition 3.8 Local fault collapsing is to collapse faults among plausible faults of the circuit after structural analysis under single stuck-at fault model.

Definition 3.9 A group is a fault set satisfying following conditions:

- 1. each member of it is a collapsed-fault.
- 2. all of its members (if it has more than one member) affect the same primary outputs (POs).
- 3. is also the maximum set satisfying above (1) and (2).

Once the plausible faulty sites (nodes) are located after structural analysis, local fault collapsing is performed among these nodes. Then all the resulting faults form a group. It can be seen that the more groups the circuit has, the higher the resolution that can be obtained in the structural analysis stage.

Definition 3.10 The First Fault Elimination (FE1) is the ratio between the number of excluded faulty sites over the number of all collapsed faults. The higher the FE1 the higher the diagnostic resolution of structural analysis.

²General fault collapsing is performed to get the fault list which is used after structural analysis to decide which faults are to be simulated.

Definition 3.11 A common-sig-set(t) is a set satisfying the following conditions:

- 1. each member of it is a collapsed-fault.
- 2. all its members (if it has more than one member) belong to same group and have the same signatures at the given testing length t.
- 3. is the maximum set satisfying (1) and (2) above.

Definition 3.12 An act-fault-set(t) is the common-sig-set(t) in which the actual fault exists.

Definition 3.13 A dynamic fault dictionary is a fault dictionary which is created and looked up during the diagnosis.

In h-DIAG, the fault dictionary is constructed after structural analysis. There is an entry for each fault of the *group*, which affects only failing flip-flops in the given FFFP. There is a column for each affected primary output (failing flip-flop). The elements of the dictionary are the failing signatures collected from the failing flip-flops by fault simulation.

Definition 3.14 The Second Fault Elimination (FE2) is the ratio between the number of excluded faults over the number of all collapsed faults. The higher the FE2 the higher the diagnostic resolution of second stage.

Definition 3.15 A failing signature of a failing flip-flop F (FFFS) is the signature which is the result of compacting all the responses on F into MISR. FFFS is an important input to the diagnostic system.

3.3 Testing and Diagnostic Environment and Process

The diagnostic system is part of a complete fault testing and diagnosis process. It incorporates the results of testing and diagnosis of failing flip-flops along with the corresponding signatures of those flip-flops collected during the testing. The complete testing and diagnostic process proceeds as follows:

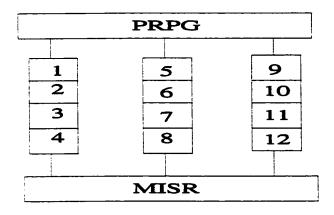


Figure 3.2: Flip-flops on Scan Chains

3.3.1 Diagnosis of the Failing Flip-flops

The general steps used in diagnosis of failing flip-flops can be summarized as follow:

- 1. Generate a series of pseudorandom test patterns using PRPG.
- 2. Assert the test patterns to the circuit under test/diagnosis.
- 3. Collect the signatures.
- 4. Analyse the signatures using the algorithms in [29, 34] to detect if there are faults in the circuit. If there is at least one flip-flop detected as failing, the circuit is faulty and the gate level diagnostic process should be performed.

3.3.2 Diagnosis of the Faulty Nodes

The basic steps in the diagnosis of a fault are listed as follow.

- 1. Read in the circuit. The netlist of the circuit is read in and an internal form of the circuit is created and data structures like gate list, node list etc. are constructed.
- 2. Enter stage 1 diagnosis by invoking a structural analysis algorithm. Using the location of failing flip-flops as input, the algorithm creates the set which contains the locations of the plausible faulty nodes.

We assume there is no signature aliasing during the diagnosis of failing flip-flops so that all of the failing flip-flops can be exactly located before we enter our stage 1 diagnosis. In this stage, we also assume that each circuit under test contains a single

fault.

- 3. Perform fault collapsing. Through general fault collapsing, create a fault list. We complete the local fault collapsing by picking up the faults in the fault list which are located on the sites belonging to sets created in previous step. Thus, a corresponding group is constructed.
- 4. Enter stage 2 diagnosis by constructing a dynamic fault dictionary. For the plausible faults diagnosed in the previous step, construct a fault dictionary whose size is decided by the number of faults in the group and the number of the failing flip-flops. Insert the relative signatures obtained through fault simulation into the dictionary.

In this stage, we assume that the fault simulation length is same as that used in the physical testing and we also assume that each circuit under test contains a single stuck-at fault.

- 5. Look up above fault dictionary by physically collecting signatures of failing flip-flops. A fault set is created. This set is composed of all the faults which have exactly the same signatures as those collected from the testing.
- 6. Make Conclusion. If the above set is empty, or the current system doesn't identify any fault which is responsible for the failing flip-flops and their corresponding signatures in the assumed fault model, another fault model should be considered.

3.4 Diagnostic Stage 1: Structural Analysis

After testing is completed in a STUMPS structure, the signatures of all flip-flops are compared with good machine values. When the CUT fails in the testing, i.e. the correct signatures are different from the signatures collected from testing on at least one flip-flop, and the pass/fail states of all the output points become known, the structural analysis starts. It proceeds to identify the component(s) that, if detectable, affect all the failing flip-flops and do not affect those correct flip-flops. The components identified are the potential causes of the test failure.

As with many testing and diagnostic schemes which assume that only one fault exists in the circuit during the test session, in our system, the structural analysis is based on the assumption that the fault model belong to the single faulty site model, e.g., single stuck-at fault, single stuck open or single gate delay fault model. This is known as single fault assumption. This assumption is justified when tests are performed frequently enough so that the probability of more than one fault developing between test sessions is sufficiently small.

The structural analysis algorithms consist of four main procedures. The first procedure, called Forward_Tracing, is used to find the f_affected_nodes of any node and to find the primary outputs that the node can reach. The second procedure, called Backward_Tracing, is used to trace backwards from any site to primary inputs to get b_affected_nodes of the site. The third procedure, called getcommon, examines the b_affected_nodes of any two primary outputs and find common elements in them. These elements have paths to both primary outputs. The last procedure, kick-common, analyses the b_affected_nodes of the correct primary outputs and removes them from the plausible faulty sites.

3.4.1 Flip-flops and PIs/POs

The flip-flops on scan chains in a STUMPS structure are composed of the flip-flops and primary inputs/outputs of original circuits. Consider the combinational circuit below in figure 3.3. Let the circuit have *Ii* primary inputs and *Io* primary outputs.

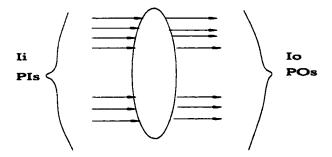


Figure 3.3: PIs and POs in the Original Circuit

In the corresponding STUMPS structure, each Primary Input/Primary Output is mapped to a flip-flop. The input of the flip-flop corresponds to a primary output and the output of the flip-flop corresponds to a primary input. When the number of primary inputs I_i is greater than the number of primary outputs I_0 , there will be (I_i)

- Io) flip-flops left which have no inputs. When the number of primary outputs Io is greater than primary inputs Ii, there will be (Io - Ii) flip-flops left which have no output.

Assuming the combinational circuit having 10 primary inputs and 5 primary outputs, and there are two scan chains, then the STUMPS may look like the one depicted in figure 3.4:

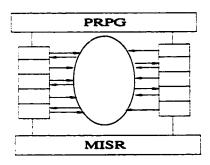


Figure 3.4: Original PIs and POs in STUMPS

Thus, for combinational circuits in STUMPS structure, the failing flip-flops can be regarded as the failing primary outputs of the CUT. And the tracing from failing primary outputs to primary inputs is equivalent to the tracing back from failing flip-flops, which represent the failing primary output nodes, to flip-flops which represent the primary input nodes.

3.4.2 Structural Analysis Algorithm

Once a fault is injected into a circuit under test (CUT), there exists a path from the site of the fault to each of the POs (Primary Outputs) where errors are detected. Hence, the plausible fault sites belong to the intersection of the cones of all the failing primary outputs as depicted in Figure 3.5. The cone of a primary output indicates all the sites which can cause that primary output to fail. For example, in Figure 3.5, there are two big ovals. The left one represents a set of nodes while the right one represents a set of primary outputs (flip-flops). Each small black square in the right big oval represents a primary output (flip-flop). For example, the cone of the primary output represented by the third black square from top, is composed of nodes f1, f2 and f3.

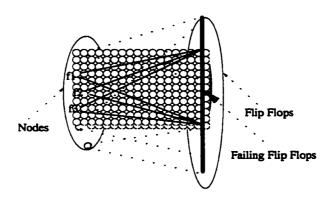


Figure 3.5: Cone Intersection

The basic technique used is tracing back through the CUT from its POs (flip-flops). For each failing flip-flop fff, we trace backwards from it to the PIs. During the tracing, we create a set of sites, which are the b_affected_nodes for the POi. We name this set TBi, which means the tracing back result of primary output i. As we finish tracing back for all of the failing flip-flops, we take the intersection of above sets: TB0, TB1, TB2, TB3, ..., TBn. All the elements in the intersection are sites which affect all of the failing flip-flops. We name this intersection set as f_{-s} , which means that each site of this set affects all failing POs.

At same time, Figure 3.5 also shows us other information: for any plausible fault site, there should not be any path from it to the correct POs³.

For the elements in the current f_{-s} , it is still possible that some of them can also affect the correct POs. Therefore, the next step of the algorithm is to remove those sites affecting the correct POs from the f_{-s} .

We use a similar method to get all the sites which can affect the correct POs. For each correct PO, we trace backwards from it to the PIs and we put b_affected_nodes of the correct PO into the set NFFi ("No Failing Flip-flop"). As we finish tracing back for all of the correct POs, we take the union of above sets: NFF0, NFF1,... NFFm, where m is the number of correct POs, to form another new set, n_-s , where each site has at least one path to the correct POs. Finally, we remove all the sites which are both in n_-s and f_-s from f_-s . The sites in current f_-s are the plausible faulty

³We assume that during the diagnosis of failing flip-flops, all possible input combinations for each gate had appeared, thus the locations of the failing flip-flops are exact.

sites of this stage.

In the algorithms, some basic structures of the circuits shown in figure 3.6 are given special consideration.

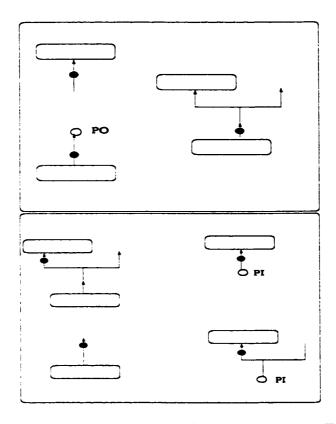


Figure 3.6: Basic Structures for Forward (up) and Backward Tracing (below)

- 1. Forward Tracing: There are three cases in the upper part of the figure 3.6 corresponding to three kinds of nodes from which forward tracing performs:
 - (1) Node which is an input node of a gate.
 - (2) Node which is an output of a gate which has fanout(s).
 - (3) Node which is a primary output node.
- 2. Backward Tracing: Four cases in below part of the figure 3.6 corresponding to four kinds of nodes from which backward tracing starts:
 - (1) Node which is a fanout of an output and an input of a gate.
 - (2) Node which is an primary input.
 - (3) Node which is an output of a gate.

(4) Node which is a fanout of a primary input.

The input to the algorithm are the positions of failing flip-flops. The algorithms proceed as follows:

Algorithm 3.1 Inside_Checker Algorithm:

Inputs:

Nlist: node list of the circuit;

N: node tracing backward from;

(Nlist and N all are non-null)

Output:

A success or failure indicator.

Comment:

The function of the algorithm is to check if a node has been inside a traced node set. We use n as the number of the nodes of the circuit and m as maximum fanout of gates.

Algorithm:

```
Procedure Inside_Checker(Node_list, Node)
```

```
1. L = Length(Node_list); /* decide the length
flag=0;
    for i=1, L
                             /* for all nodes in the list
3.
      if Node = Node_list(i) then
4.
                             /* matched
5.
        flag=1;
6.
        break:
7.
      end if;
8.
    end for
                             /* return the flag
9. return(flag);
end procedure;
```

Complexity Analysis:

Two basic operation of this algorithm is to analyze if a node is in a node set. In the worst case, the number of nodes in the set is n. Thus the W(n) = O(n).

Algorithm 3.2 Get_Common Algorithm:

Inputs:

Nlist: node set of the circuit;NL: node set of the circuit;

Output:

Ncomm: node set of the circuit which contains common nodes of two input node sets;

Algorithm:

Procedure Get_Common(Node_list, NL)

```
1. L1 = Length(Nlist);
                             /* decide the length of Nlist
2. L2 = Length(NL);
                              /* decide the length of NL
                             /* for all nodes in Nlist
     for i = 1, L1
                              /* for all nodes in NL
4.
       for j = 1, L2
          if Nlist(i) = NL(j) then
5.
                              /* matched
6.
          Ncomm <- Nlist(i);</pre>
7.
          end if;
8.
       end for
9.
     end for
10. return(Ncomm);
                             /* return the flag
end procedure;
```

Complexity Analysis:

The basic operation of this algorithm is to analyze if a node in NL is also a member of Nlist. In the worst case, the numbers of nodes in both Nlist and NL are same as the number of nodes in the circuit, n. Thus the $W(n) = n \times n = O(n^2)$.

Algorithm 3.3 Kick_Out_Common Algorithm:

Inputs:

Nlist: node set of the circuit;NL: node set of the circuit;

Output:

Nleft: node set which contains the nodes of Nlist except those which are members of NL;

Comment:

The algorithm is used to remove the nodes, which have path(s) to correct flip-flops, from a node set in which every node has at least one path to a failing flip-flop. We use n as the number of the nodes of the circuit.

Algorithm:

```
Procedure Kick_Out_Common(Nlist, NL)
```

```
1. L1 = Length(Nlist);
                             /* decide the length of Nlist
2. L2 = Length(N1);
                             /* decide the length of NL
                             /* for all nodes in Nlist
3. for i = 1, L1
     for j = 1, L2
                              /* for all nodes in NL
       if (Nlist(i) = NL(j)) /* matched
5.
6.
7.
            remove Nlist(i); /* removed the node
8.
            break:
9.
10.
     end for
11. end for
12. return(Nlist);
end procedure;
```

Complexity Analysis:

The basic operation of this algorithm is to analyze if a node in NL is also a member of Nlist. In the worst case, the numbers of nodes in both Nlist and NL are same as the number of nodes in the circuit, n. Thus the $W(n) = n \times n = O(n^2)$.

Algorithm 3.4 Backward_Tracing Algorithm:

Inputs:

```
Glist: gate list of the circuit;

Nlist: node list of the circuit;

N: node tracing backward from;

(Glist, Nlist and N all are non-null)

Output:
```

 $b_affected_nodes$: node set in which all elements can reach N by a path.

Comment:

The function of the algorithm is to locate all the nodes which have paths to a specific node. $b_affected_nodes$ is a set used to keep all the nodes which had been traced. We use n as the number of the nodes of the circuit, m as maximum fanout of gates and s_G as a source gate of a node. A flowchart of the algorithm can be found in figure A.3 of Appendix A.

Algorithm:

Procedure Backward_Tracing (Node)

```
1. if Inside_Cheker(b_affected_nodes, N) then
                                  /* if the node had been traced
2.
             return(0);
                                 /* no tracing any more
3.
     else
4.
          b_affected_nodes <- N; /* put the node into its
                                 /* back_tracing_set
5. end if
6. if s_G = SourceGate(N) != -1 then
                                  /* N is not a primary input
7.
          if output(s_G) = N then
                                  /* is an output of a gate
8.
             for i = 0 to No_input(s_G)
                                  /* for all its input nodes
9.
               Backward_Tracing(input(s_G,i));
                                  /* backward tracing its input
10.
             end for
11.
          else
12.
             if Inside_Checker(output_fanout(s_G), N) then
                                  /* is a famout of a gate
               Backward_Tracing(output(s_G));
13.
                                  /* backward tracing its fanin
14.
             end if
15.
          end if
16. else
                                  /* N is a PI related node
           node_in = N.fanin(); /* because it has no source gate
17.
           if node_in.fanout() > 1 then
18.
                                  /* N is one of the fanout
               Backward_Tracing(node_in);
19.
                                  /* backward tracing the PI
20.
           else
```

Complexity Analysis:

The basic operation of this algorithm is to analyze if nodes, met during the backward tracing procedure, had been traced (or, in the traced node list). In the worst case, there are n nodes can be met during the tracing procedure and the number of nodes in the traced node list is n. Thus the $W(n) = n \times n = O(n^2)$.

Algorithm 3.5 Forward_Tracing Algorithm:

Inputs:

```
Glist: gate list of the circuit;
Nlist: node list of the circuit;
N: node tracing forward from;
(Glist, Nlist and N all are non-null)
```

Output:

RPO: primary output node set in which all elements can be reached from N by a path.

Comment:

The function of this algorithm is to find all the output nodes which can be reached from a specific node in the circuit. The algorithm is mainly used in the simulation of the diagnostic system.

 $f_affected_nodes$ is a set used to keep all the nodes which had been traced. We use n as the number of the nodes of the circuit. A flowchart of the algorithm can be found in figure A.2 of Appendix A.

Algorithm:

Procedure Forward_Tracing(N)

1. if Inside_Checker(N, f_affected_nodes) then

```
/* if the node had been traced
                                /* no tracing any more
2.
          return(0);
3.
    else
          f_affected_nodes <- N;</pre>
4.
                                /* put the node into its
                                /* tracing_forward_set
5.
    end if
    if Node_HasFanoutGate(N) = 0 then
6.
                                /* if it has not any fanout
                                /* put the node into
7.
          RPO <- N;
8.
          RPO_num <- RPO_num + 1;
                                /* affected_PO_set
9.
    else
10.
        while (i <- Node.Fanout(N))</pre>
                                /* recursively invoke the procedure
                                /* to put elements of its fanout's
                                /* forward_tracing_set
                                /* into its forward_tracing_set
          f_Gate <- Node.FanoutGate(i);</pre>
11.
12.
          i <- i+1
                                 /* locate the famout gate
          Forward_Tracing(f_Gate.OutputNode());
12.
                                 /* invoke forward tracing proc
        end while
13.
14. end if
end procedure
```

Complexity Analysis:

The basic operation of this algorithm is to analyze if nodes, met during the forward tracing procedure, had been traced (or, in the traced node list). In the worst case, there are n nodes can be met during the tracing procedure and the number of nodes in the traced node list is n. Thus the $W(n) = n \times n = O(n^2)$.

Algorithm 3.6 Structural_Analysis Algorithm:

Input:

FFFP failing flip-flop pattern;

Output:

 p_-f_-n : plausible faulty nodes;

Comment:

This is a main procedure of the structural analysis. It traces the CUT (circuit under test) from all of the failing flip-flops to find all of the nodes which can reach the failing flip-flops. It also traces the CUT from all of the correct flip-flops (normal flip-flops) to find all the nodes which can reach the normal flip-flops. Based on the tracing results, it finds all the nodes which can reach the failing flip-flops and can not reach the normal flip-flops. These nodes are the plausible faulty nodes.

A primary output is denoted by PO[j] and a primary output in FFFP is denoted by FFFP[i], where j and i are the index variables. The algorithm refers to the number of primary output as m. A flowchart of the algorithm can be found in figure 3.7^4 .

Algorithm:

```
Procedure Structural_Analysis (FFFP)
                                  /* Now the failing POs are
                                  /* put in : FFFP
0. i \leftarrow 0;
1. while( i < size(FFFP) )</pre>
                                  /* for all failing POs
     Backward_Tracing(FFFP[i]);
2.
                                  /* back trace from this PO
                                  /* to get its tracing_back_set
3
     i <- i+1
4.
     if i = 1 then
                                   /* if this is the first one PO
5.
       p_f_n[] = p_f_n_for_one_PO[];
                                   /* put all it elements of
                                   /* tracing_back_set into
                                   /* p_f_n
6.
     else
7.
       p_f_n = Get_Common(p_f_n, p_f_n_for_one_P0)
                                   /* get those elements both in
                                   /* p_f_n and
                                   /* trace_back_set of current PO
8.
     end if
9. end while
10.for (j=0; j < m; j++)
```

⁴The flowchart also can be found in figure A.1 of Appendix A.

```
11.
      if !Inside_Cheker(FFFP, PO(j) ) then
                                  /* for each no-failing_flip_flop
        Backward_Tracing(PO(j));
12.
                                  /* backward tracing the PO
        p_f_n = Kick_Out_Common(p_f_n, p_f_n_for_one_PO)
13.
                                  /* remove those elements in
                                  /* the back_tracing_set of the PO
                                  /* from p_f_n
14.
      end if
15. end for
16. f_s <- p_f_n;
                                  /* return plausible faulty sites
17. return( f_s);
end procedure
```

Complexity Analysis:

Let the number of primary outputs be m and the number of nodes of the circuit be n. As what have been analyzed before: the complexity of Backward_Tracing is $O(n^2)$, the complexity of Get_Common is $O(n^2)$, the complexity of Inside_Cheker is $O(n^2)$ and the complexity of Kick_Out_Common is $O(n^2)$. So the complexity between line 2 and line 8 is $O(n^2)$ and the complexity between line 11 and line 14 is $O(n^2)$. Because m can not be greater than n, in the worst case, the complexity of the while loop is $O(n^3)$ and the complexity of the f or loop is also $O(n^3)$. Thus the complexity of whole procedure is $O(n^3)$.

Here, f_{-s} is a group and all its elements are the plausible faulty sites. In an extreme case, if there is only one element in f_{-s} , it means that only one site can affect all the failing flip-flops. In this case, we can decide the faulty site at once.

3.4.3 Diagnostic Example Using the Structural Analysis Algorithm

In this subsection, we present an example to show how the above algorithm works. We will use fff[i] to represent the tracing back result of failing flip-flop i and nff[i] to represent the tracing back result of correct flip-flop i.

Figure 3.2 shows a small combinational digital circuit. The circuit has eighteen different sites. There are 4 PIs and 3 POs. Therefore, there is a total of $C_1^3 + C_2^3$

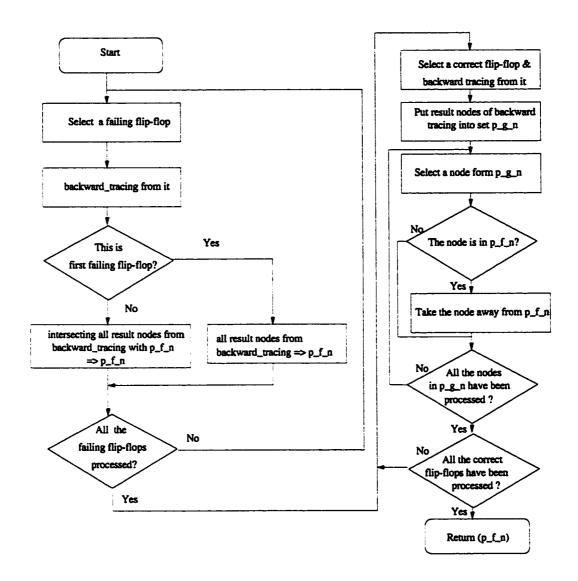


Figure 3.7: Flowchart of Structural Analysis Algorithm

 $+ C_3^3 = 3 + 3 + 1 = 7$ possible FFFPs: {PO1, PO2}, {PO1}, {PO2}, {PO3}, {PO3}, {PO3}, {PO1, PO2, PO3} and {PO1, PO3}.

The algorithm accepts any pattern in FFFP. For each pattern, the algorithm performs as follow:

Case 1: In the first case, both PO1 and PO2 are failing and PO3 is correct. We trace backwards from PO1 and find $fff[1] = \{18, 17, 12, 8, 16, 6, 5, 15, 2, 3\}$. We trace backwards from PO2 and find $fff[2] = \{14, 10, 11, 7, 8, 1, 4, 6, 5, 2, 3\}$. The intersection of fff[1] and fff[2] is $f_{-s} = \{2, 3, 5, 6, 8\}$. We trace

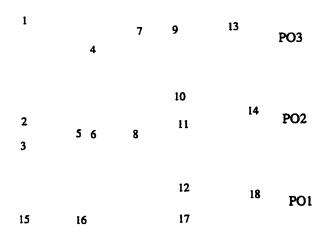


Figure 3.8: A Given CUT

backwards from PO3 and find $nff[3] = \{13, 9, 7, 1, 4, 5, 2, 3\}$. In this case, because there are no other correct POs, the $n_s = nff[3]$. The common sites of f_s and f_s is $\{2, 3, 5\}$. Taking them away from f_s , we get final $f_s = \{6, 8\}$. So, the plausible sites are node 6 and node 8 as shown in Figure 3.9.

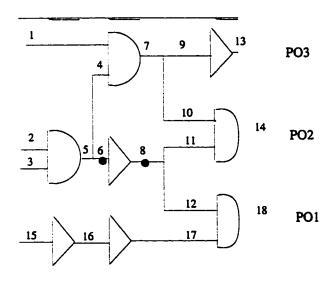


Figure 3.9: Case 1: PO1 and PO2 Failing

Case 2: In the second case, PO1 is failing and both PO2 and PO3 are correct. We trace backwards from PO1 and find $nf[1] = \{18, 17, 12, 8, 16, 6, 5, 15, 2, 3\}$.

We get $f_s = \{18, 17, 12, 8, 16, 6, 5, 15, 2, 3\}$. We trace backwards from PO2 and find $nff[2] = \{14, 10, 11, 7, 8, 1, 4, 6, 5, 2, 3\}$. We trace backwards from PO3 and find $nff[3] = \{13, 9, 7, 1, 4, 5, 2, 3\}$. The union of nff[3] and nff[2] is $n_s = \{14, 10, 8, 6, 9, 13, 11, 7, 1, 4, 5, 2, 3\}$. The common sites of f_s and n_s is $\{2, 3, 5, 6, 8\}$. Taking them away from f_s , we get final $f_s = \{18, 17, 12, 16, 15\}$. So, the plausible sites are node 18, 17, 12, 16 and node 15 as shown in Figure 3.10.

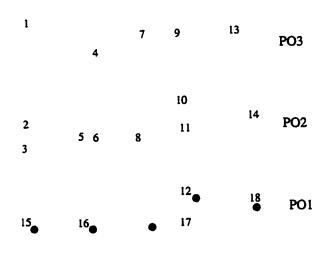


Figure 3.10: Case 2: PO1 Failing

Case 3: In the third case, only PO2 is failing. We trace backwards from PO2 and find $fff[2] = \{ 14, 10, 11, 7, 8, 1, 4, 6, 5, 2, 3 \}$. The $f.s = \{ 14, 10, 11, 7, 8, 1, 4, 6, 5, 2, 3 \}$. We trace backwards from PO3 and find $nff[3] = \{ 13, 9, 7, 1, 4, 5, 2, 3 \}$. We trace backwards from PO1 and find $nff[1] = \{ 18, 17, 12, 8, 16, 6, 5, 15, 2, 3 \}$. The union of nff[1] and nff[3] is $n.s = \{ 13, 9, 7, 1, 4, 5, 2, 3, 18, 17, 12, 8, 6, 16, 12 \}$. The common sites of f.s and n.s are $\{ 7, 8, 1, 4, 6, 5, 2, 3 \}$. Taking them away from f.s, we get final $f.s = \{ 14, 10, 11 \}$. Thus, the plausible sites are node 10, 14 and node 11 as shown in Figure 3.11.

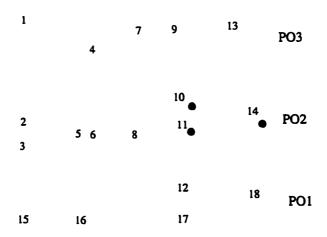


Figure 3.11: Case 3: PO2 Failing

11, 7, 8, 1, 4, 6, 5, 2, 3}, from PO1 and find $nff[1] = \{18, 17, 12, 8, 16, 6, 5, 15, 2, 3\}$. The union of nff[1] and nff[2] is $n_s = \{18, 17, 12, 8, 16, 6, 5, 15, 2, 3, 14, 10, 11, 7, 1, 4 \}$. The common sites of f_s and n_s are $\{7,1,4,2,3,5\}$. Taking them away from f_s , we get final $f_s = \{13,9\}$. So, the plausible sites are node 13 and node 9 as shown in Figure 3.12.

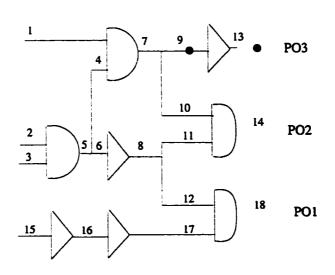


Figure 3.12: Case 4: PO3 Failing

Case 5: In the fifth case, PO2 and PO3 are failing, PO1 is normal. We trace back-

wards from PO2 and find $fff[2] = \{14, 10, 11, 7, 8, 1, 4, 6, 5, 2, 3\}$. We trace backwards from PO3 and find $fff[3] = \{13, 9, 7, 1, 4, 5, 2, 3\}$. The intersection of fff[2] and fff[3] is $f_{-s} = \{1,2, 3, 4,5, 7\}$. We trace backwards from PO1 and find $nff[1] = \{18, 17, 12, 8, 16,6, 5, 15, 2, 3\}$. In this case, because there are not other correct POs, the $n_{-s} = nff[1]$. The common sites of f_{-s} and n_{-s} are $\{2,3,5\}$. Taking them away from f_{-s} , we get final $f_{-s} = \{1,4,7\}$. So, the plausible sites are node 1,4 and node 7 as shown in Figure 3.13.

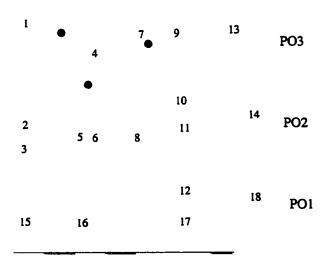


Figure 3.13: Case 5: PO2 and PO3 Failing

Case 6: In the sixth case, all PO1, PO2 and PO3 are failing. We trace backwards from PO1 and find $fff[1] = \{18, 17, 12, 8, 16, 6, 5, 15, 2, 3\}$. We trace backwards from PO2 and find $fff[2] = \{14, 10, 11, 7, 8, 1, 4, 6, 5, 2, 3\}$. We trace backwards from PO3 and find $fff[3] = \{13, 9, 7, 1, 4, 5, 2, 3\}$. The intersection of them is $f_{-}s = \{2,3,5\}$. Because $n_{-}s = \{\}$, we get final $f_{-}s = \{2,3,5\}$. So, the plausible sites are node 2,3 and node 5 as shown in Figure 3.14.

Case 7: In the last case, Both PO1 and PO3 are failing and PO2 is normal. We trace backwards from PO1 and find $fff[1] = \{18, 17, 12, 8, 16, 6, 5, 15, 2, 3\}$. We trace backwards from PO3 and find $fff[3] = \{13, 9, 7, 1, 4, 5, 2, 3\}$. The intersection of fff[1] and fff[3] is $f_{-s} = \{2,3,5\}$. We trace backwards from PO2

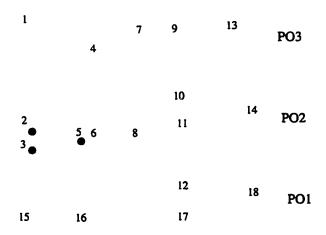


Figure 3.14: Case 6: PO1, PO2 and PO3 Failing

and find $nff[2] = \{14, 10, 11, 7, 8, 1, 4, 6, 5, 2, 3\}$. The $n_s = nff[2]$. The common sites of f_s and n_s are $\{2,3,5\}$. Taking them away from f_s , we get final $f_s = \{\}$. Therefore, no plausible faulty site! This is the case that some other fault models, rather than single-site fault models, should be considered.

3.4.4 Discussion on Structural Analysis

Main advantages

The diagnosis of this stage locates the plausible faulty sites without knowing the failing response vectors. This is a new investigation in the diagnostic area. The new features in this structural analysis can be summarized as follow:

- 1. Basically, it starts from the location of failing flip-flops. It also considers the flip-flops which are not failing so that the resolution can be raised.
- 2. It does not require any test pattern response pairs information.
- 3. It does not need to know any logical relationship between nodes in the CUT.
- 4. The analysis speed is very fast.

5. It can offer high enough resolution which will guide the further diagnosis in a very small range. (In our hierarchical scheme, it makes the number of faults to be simulated much smaller, even smaller than that of DAPPER [3]).

A fact affecting the resolution

The resolution of this stage depends on the number of *groups* in the CUT. Thus, the resolution of this stage will be low when the number of *groups* in the CUT is small. Normally, circuits with more primary outputs (flip_flops) have more groups.

3.5 Diagnostic Stage 2: Using a Dynamic Fault Dictionary

In IC manufacturing process, the following situation may occur: after many chips have been manufactured, the yield is found to be very low and all the faulty chips have the same faulty behavior. In this case, it is necessary to find out the fault in these chips and the diagnostic result will be helpful for the manufacturers to modify the design or adjust the fabrication process.

The plausible faulty sites can be located after the diagnosis in stage 1, but to get a higher resolution, further diagnosis is necessary. In stage 2, a new fault dictionary diagnostic method is proposed. Using this method, the fault dictionaries are constructed dynamically to finish the further diagnosis with high efficiency. In the following parts of the chapter, we will describe the idea of the dynamic dictionary, the construction of the dynamic dictionary, looking up of the dynamic dictionary and the advantage of the dynamic dictionary over conventional dictionaries.

The conventional fault dictionary method, using a complete fault list, provides a high diagnostic resolution. However, a great deal of memory space is required for such a dictionary, even when small circuits are considered. At same time, due to the huge size of the dictionary, the time used to construct and look up the specific record can also be huge. Therefore, the implementation of such a dictionary is very expensive in

hardware.

The reason that the conventional dictionary is huge is that the dictionary contains a corresponding record for each fault of the circuit under test and diagnosis. Although some records may never be used, they still have to be constructed into the dictionary because there is no hint at all to indicate which records will be possibly used and which are not when the dictionary is constructed. Therefore the dictionary has to be a complete one.

In our hierarchical diagnostic system, the plausible faulty sites had been located by the diagnosis in the first stage. This means that only the fault set constructed by the first stage needs to be considered for further diagnosis instead of all of the possible faults of the circuit. Therefore a corresponding dictionary which only contains the records of the plausible faults can take the place of the complete dictionary.

The dynamic fault dictionary scheme is proposed based on our structural analysis implementation. The dynamic characteristics of the dictionary are reflected in the following aspects:

- 1. The dictionary is created during the diagnosis. The dictionary is created after diagnostic stage 1 and at the beginning of diagnostic stage 2.
- 2. The size of the dictionary is determined by the number of failing flip-flops from testing (i.e. the number of columns), and the number of the plausible faulty sites from the diagnosis of stage 1 (i.e. the number of rows).

3.5.1 Signature Collection Model

To collect the signature of a specific failing flip-flop (PO) in STUMPS-based BISD, "Chain select" and "Compaction control" in [29] are employed. By setting "Chain select" properly, we can select the chain in which the failing flip-flops exists. By selecting "Compaction control" properly, we can select the frame in which the failing flip-flop exists. Thus, we can force only responses of the specific PO to be compacted into the MISR during testing. We present the compaction model in the Figure 3.15.

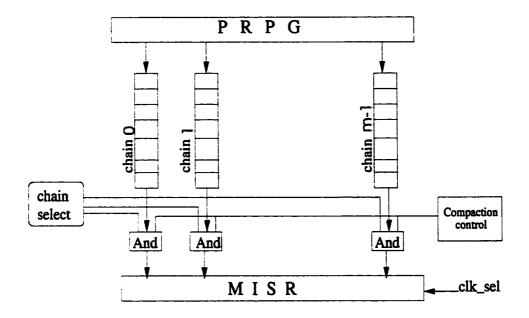


Figure 3.15: Signature Collection Model

In this model, clk_sel is a clock signal which is only "enabled" when the response of the specific PO has been shifted to the bottom of the chain. It is "disabled" in the other cases. For each chain, this makes the response value in the other flip-flops ignored by the MISR. During each fault simulation and testing, the chain containing the specific PO is connected to a MISR, and feeds the MISR as one of its input bits. The other input bits of the MISR are 0. The order of the MISR's input bit to be fed by the PO depends on the scan chain in which the PO is in. In one of the simplest cases, assuming there is only one 16-bit MISR and 16 scan chains, the order of the scan chain, where the PO is in, is the order of the MISR's input bit to be fed by the POs in the chain.

3.5.2 Organization of the Fault Dictionary

Based on a given FFFP, a plausible faulty site set can be obtained through diagnosis in the structural analysis stage. Then a corresponding *group* can be obtained by letting each site be stuck_at_0 and stuck_at_1 and then perform local fault collapsing inside the set.

For each fault in the group: F1, F2, F3, ... and Ff (f is the number of the faults in the group), there is a record in the dictionary corresponding to it. For each element in FFFP: fff1, fff2,... fffp (p is the number of the failing Flip-flops), there is one column corresponding to it. Thus, the dynamic dictionary is of the form shown in Figure 3.16.

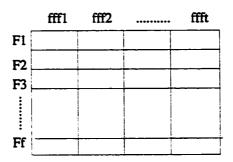


Figure 3.16: Dynamic Dictionary Form

The element on the cross point of each row (corresponds to a fault) and each column (corresponding to a failing flip-flop) in the dictionary is a signature. The signature is the compacted responses on the flip-flop of the column when fault simulation is processing for the fault of the row.

3.5.3 The Construction of the Fault Dictionary

The construction of the fault dictionary starts after the FFFP is available and corresponding group had been constructed by the diagnosis of structural analysis stage. The construction procedure is given below.

First, calculate the size of the dictionary to be constructed. The size of the dynamic dictionary is decided by multiplying the number of the flip-flops in the FFFP with the number of the plausible faults in the group. Second, eject a fault from the plausible fault set, then collect the signatures of the corresponding flip-flops. Once the fault is ejected, fault simulation is processed using an algorithm. Thirdly, collect the responses of failing primary outputs and compact them into MISR. For each failing primary output, its signature is collected using the signature collection model as described above. Finally, put the collected signatures into the corresponding position

of the dictionary.

For the dictionary constructed in this way, each plausible fault has a corresponding row entry in the dictionary. The look-up into the dynamic dictionary is a search procedure during which the signatures of each row, are compared entry by entry till the same entry as that collected from testing is located.

3.5.4 Dynamic Dictionary Based Diagnostic Algorithm

In this section, the algorithms used in the diagnosis by the dynamic dictionary are presented and analysed. The algorithms proceed as follows:

Algorithm 3.7 DD_Parall_Pattern_Sim Algorithm

Inputs:

Glist: gate list of the circuit;

Nlist: node list of the circuit;

Tp: 256 test patterns;

Fn and Fv: fault node and the stuck at value respectively;

(Glist, Nlist and Tp are all non-null; Fn and Fv can be null while it means fault free simulation:)

Output:

256 responses of the fault simulation or fault free simulation.

Comment:

The function of the algorithm is to perform parallel pattern simulation.

The index variable i is used to point to current gate being simulated; The g is the number of the gates in the Glist; n is the number of the nodes in the circuit; Pf is plausible fault set; PIs is the primary input set. A flowchart of the algorithm can be found in figure A.5 of Appendix A.

Algorithm:

Procedure DD_Parall_Pattern_Sim()

```
    if !(Fn in Pf) then /* if the fault is not the
    return /* plausible one, exit.
    end if
```

```
/* the fault is on a PI
3. if Fn in PIs then
        if Fv = 1 then
                               /* set bits of SA 1 node
5.
           setbit;
6.
        else
7.
           clearbit;
                               /* clear bits of SA 0 node
        end if;
9. end if
10. for i = 1 to g
                                /* for all the gates
          if fault_free(Glist(i)) then
                                /* the gate is no fault related
              ff_evaluate(Glist(i))
12.
                                /* evaluate its value
13.
         else
                                /* fault is in I/O of the gate
              for j = 1, input(Glist(i))
14.
15.
                  if fault_free(j) then
                                /* j is not faulty node
16.
                     continue; /* skip it
17.
                  else
18.
                     if Fv = 1 then
                                /* set j SA value
19.
                        setbit
20.
                     else
                        if Fv = 0 then
21.
22.
                           clearbit
23.
                        end if
24.
                     end if
25.
                        break;
26.
                  end if
                  j <- j+1;
27.
28.
              end for
29.
                  if j > input(Glist(i)) then
                                 /* no input is faulty
                     if Fv = 1 then
30.
                                 /* set output SA value
31.
                        setbit
32.
                     else
33.
                        if Fv = 0 then
34.
                           clearbit
35.
                        end if
36.
                     end if
37.
                   else
                     f_evaluate(Glist(i))
38.
                                 /* evaluate the gate
39.
                end if
40.
         end if
```

41. end for

end procedure

Complexity:

The basic operation in this algorithm is to perform evaluation for every gate in the circuit. All the gates are evaluated no matter if they are fault related or not. Thus, the complexity of the algorithm W(n) = O(n).

Algorithm 3.8 DD_Record_Compac Algorithm

Inputs:

256 responses of the fault simulation or fault free simulation;

Previous signatures of each failing flip-flop;

The failing flip-flop pattern (FFFP);

Output:

The new signatures of all failing flip-flops (FFFS);

Comment:

The function of the algorithm is to compact the outputs of the simulation into a MISR.

The index variable i is used to point to current primary output, m is the number of the primary output and n is the number of nodes in the circuit. A flowchart of the algorithm can be found in figure A.6 of Appendix A.

Algorithm:

Procedure DD_Record_Compac()

```
/* for all POs
1.
    for i = 0 to m
      if (i in FFFP) then
2.
3.
     signature[i].Load();
                              /* load its previous signature
     end if
4.
    end for;
5.
    for i = 1 to m
                               /* if i is not a failing PO
6.
      if !(i in FFFP) then
7.
         continue;
                               /* skip it
```

```
/* i is a failing PO
8.
     else
9.
        for (i = 0,255, i++)
                                /* for each response
10.
         if response[i,j] = 1
11.
           input_1_bit = 1
12.
         else
13.
           input_1_bit = 0
         MISR.NEXT(signature); /* get next state
14.
15.
         signature xor = input_1_bit
                                /* compact the response to the
                                /* signature
16.
        end for
17.
      end if
18. end for
19. return(FFFS)
 end procedure;
```

Complexity:

There are two basic operations here. The first one compares a primary output with each element in FFFP to judge if it belongs to the set(line 1 through 4), the complexity is $O(n^2)$. The second one gets the signatures for failing primary outputs, the complexity is also $O(n^2)$. Thus $W(n) = n \times n + n \times n = O(n^2)$.

Algorithm 3.9 DD_Build_In_And_Look_Up Algorithm

Inputs:

Psig: signatures from testing;

fPOs: number of failing primary outputs;

RECd: the compacted records, obtained from simulation, of failing flip-flops;

Outputs:

Match or no-match indicator (If the row entry is same as the signatures obtained from testing it returns 1) and the entry's location in DD.

Comment:

The function of the algorithm is to look up the dynamic dictionary to find the entry of the dictionary which has same signatures as that collected from the testing.

The index variable i is used to point to current primary output; n is the number of

the nodes in the circuit; L is current available entry of the dictionary and m is the number of the primary outputs in the circuit. The procedure is invoked when a fault simulation finishes and the signatures of all the failing flip-flops have been obtained from this simulation. A flowchart of the algorithm can be found in figure A.7 of Appendix A.

Algorithm:

Procedure DD_Build_In_And_Look_Up()

```
1. init Psig[0..fPOs];
                               /* obtain the signatures
                              /* for all failing signatures
2. for i = 1, fPOs
3. DD[L,i] <- RECd[i];
                               /* put the signature into
                               /* the dictionary
4. end for
5. for i = 1, fPOs
                               /* for all failing signatures
6. if !(Psig = RECd[i]) then /* compare the signature
7.
                               /* not matched
       break:
8. else
                              /* ready to compare the others
9.
     continue;
10. end if
11. i \leftarrow i + 1;
14. end for
15. if i = fPOs + 1 then
                               /* all matched
16. current-fault -> act-fault-set;
17. L = L + 1;
18. return (1);
18. else
19. L = L + 1;
20. return (0);
21. end if;
```

Complexity:

end procedure

The basic operation is to put the signatures collected from simulation for a fault into fault dictionary and compare the signatures with those from testing. Because m < n, in the worst case, the complexity W(n) = O(n).

Algorithm 3.10: DD_Based_Diagnosis Algorithm

Inputs:

```
F: the plausible faults diagnosed by structural analysis;
```

S: the signatures collected by testing;

L: the testing length;

(Both F and S are no empty and L is a positive integer;)

Output:

Final diagnostic result R (plausible faults diagnosed through DD).

Comment:

This is the main algorithm for the diagnosis of second stage. The function of the algorithm is to create the dynamic dictionary and look-up the dictionary. It basically is composed of a sequence of procedure calls, CreatTP(), DD_Parall_Pattern_Sim(), DD_Record_Compac() and DD_Build_In_And_Look_Up().

The element number of F is denoted as m and the number of nodes of the circuit is denoted as n. The index variable used are: i, the current fault in F being processed, and j, the current simulation block. This is the main algorithm for the diagnosis of second stage. It basically is composed of a sequence of procedure calls, CreatTP(), DD_Parall_Pattern_Sim(), DD_Record_Compac() and DD_Build_In_And_Look_Up(). A flowchart of the algorithm can be found in figure 3.17^5 .

Algorithm:

Procedure DD_Based_Diagnosis()

```
1.
   for i <- 0 to m
                                /* for all plausible faults
    for j <- 0 to L
2.
                                /* for all blocks
                                /* create the test patterns
3.
      CreatTP();
      DD_Parall_Pattern_Sim()
                                /* fault simulation
4.
                                /* compact the responses
      DD_Record_Compac()
5.
     end for
6.
     DD_Build_In_And_Look_Up(S); /* build into the dictionary
7.
                                /* and compare it with
                                /* the practical record
8. end for;
end procedure
```

⁵The flowchart also can be found in figure A.4 of Appendix A.

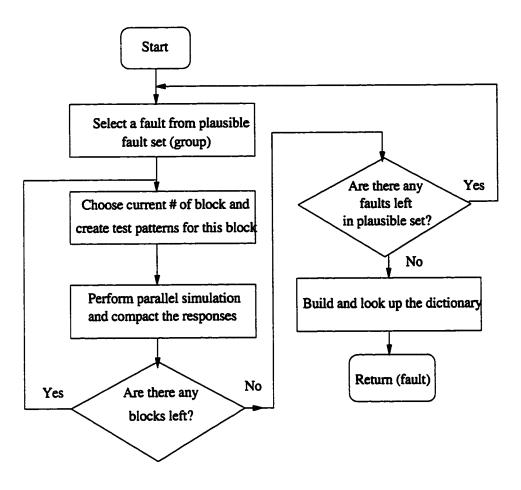


Figure 3.17: Flowchart of Diagnosis Using Dynamic Dictionary

Complexity:

As what had been analyzed before, the complexity of line 5 is $O(n^2)$. In the worst case, $m = 2 \times n$, so the complexity of the algorithm is $W(n) = O(n^3)$.

3.5.5 General Diagnostic Procedure in Stage 2

The diagnostic procedure in stage 2 can be summarized with the following steps:

Step 1: Create the plausible fault set pF: For each plausible site pSite diagnosed in stage 1, add "pSite S.A.1" and "pSite S.A.0" to pF, before local fault collapsing among pF.

Step 2: Signatures of each failing PO are collected after pseudo-random testing of a

certain length (e.g. t = 100 k).

- Step 3: At same time, signatures of each failing PO for all plausible faults in pF are calculated by fault simulation, with same testing length as in Step 2 (e.g. $t = 100 \ k$), forming a fault-signature dictionary for pF. The single-stuck-at fault model is assumed during the simulation.
- Step 4: Compare the actual fault signatures obtained in Step 2 with those in the fault-signature dictionary formed in step 3: If the testing signatures are same as the simulation signatures of fault f, f is the diagnosed fault. Due to the fact that there may be more than one fault which has the same simulation signatures as the testing signatures, the above f can be not unique. If only one plausible fault in pF has same faulty signatures as signatures obtained from testing ($|act_fault_set(t)| = 1$), the diagnosis finishes.

If there is a subset s of pF, all of the faults (more than one) in s have the same fault signatures as signatures obtained from testing ($|act_fault_set(t)| > 1$), the diagnosis should go further.

3.5.6 Diagnostic Example

To illustrate diagnosis using a dynamic dictionary, we emulate the diagnosis on benchmark circuit C7552 as an example.

In c7552, there are 3512 gates, 3719 nodes, 207 primary inputs and 108 primary outputs. Assume the input to the diagnostic system is as follow:

(1) Location of failing flip-flops node number of the failing primary outputs:

```
10101 10715 10716 10717 10718 10759 10837 10838 10839 10840 10641 10711 10712 10713 10714 10760 10761 10762 10763 10632 10905 10906 10104 10706 11334 11333 11340 10907 10574 10729
```

(2) Signatures of the failing flip-flops corresponding signatures for each failing flip-flop:

65378 5378 7648 18641 45223 65378 32318 52516 47687 58

45172 1553 44496 56629 65378 65378 38838 5616 21715 62548 53538 53538 53538 53538 23860 36799 26535 39957 35141 44803

According to this, the diagnostic result of stage 1 is:

Gate 3398's output node,

Gate 3007's output node,

Gate 221's output node,

Gate 3007's 2nd input node input node,

Gate 2381's output node,

Gate 2381's 1st input node input node and

Gate 2381's 2nd input node input node

(each of them can lead to two faults: SA1 and SA0.)

After local fault collapsing among above faults, there are 8 plausible faults left:

2381's output node stuck_at 0,

2381's output node stuck_at 1,

3398's output node stuck_at 0,

3398's output node stuck_at 0,

3398's 1st input node stuck_at 0,

3007's 1st input node stuck_at 1,

2381's 1st input node stuck_at 1 and

2381's 2nd input node stuck_at 1.

Then after fault simulation, the following dynamic dictionary was constructed: entry 0:

37929 37929 65378 5424 56300 37929 47945 51036 9305 42554 56127 27994 50843 46718 65378 37929 64765 32443 16280 12087 47721 47721 47721 47721 49551 6010 39109 34509 57870 21535

entry 1:

65378 65378 7648 18641 45223 65378 32318 52516 47687 58 45172 1553 44496 56629 65378 65378 38838 5616 21715 62548 53538 53538 53538 53538 23860 36799 26535 39957 35141 44803

entry 2:

```
37929 37929 65378 41326 56300 37929 3863 29442 36871 4708 56127 27994 50843 46718 65378 37929 64765 32443 16280 12087 47721 47721 47721 30161 41764 11419 12947 57870 57409
```

entry 3:

65378 65378 65378 51749 45223 65378 25692 6217 64332 31023 45172 1553 44496 56629 65378 65378 38838 5616 21715 17532 53538 53538 53538 53538 53538 53538 53538 53538 53538

entry 4:

37929 37929 65378 30307 56300 37929 55322 41999 18186 50537 56127 27994 50843 46718 65378 37929 64765 32443 16280 12087 47721 47721 47721 41692 29737 64406 58782 57870 14156

entry 5:

37929 37929 7648 9114 56300 37929 5493 42607 53516 27505 56127 27994 50843 46718 65378 37929 64765 32443 16280 40735 47721 47721 47721 13951 58612 3308 63326 57870 50248

entry 0 is corresponding to: 2381's output node stuck_at 0, 3398's output node stuck_at 0.

entry 1 is corresponding to: 2381's output node stuck_at 1.

entry 2 is corresponding to: 3398's 1st input node stuck_at 0,

2381's 2nd input node stuck_at 1.

entry 3 is corresponding to: 3007's 1st input node stuck_at 0.

entry 4 is corresponding to: 3007's 2nd input node stuck_at 1.

entry 5 is corresponding to: 2381's 1st input node stuck_at 1.

Because the given signatures are same as entry 1, the diagnostic result of the second stage is: 2381's output node stuck_at 1.

3.5.7 Evaluation of the Dynamic Dictionary Used in the Stage

The fault location capability of different dictionary diagnostic systems can be evaluated by the size of the fault dictionary, the complexity of creation, the look-up time and the resolution. In this section, some features of the new dynamic dictionary will

be compared with the conventional dictionary schemes. Also, we will conduct some experiments to compare the shrink scale while concerning the number of simulation to be performed between h-DIAG and DAPPER.

The Improvement of the Length over the Conventional Dictionary

In order to demonstrate the advantage of the dynamic dictionary in the dictionary length, the following experiments are performed on ISCAS benchmark circuits. For each circuit, 10 faults are randomly ejected. For each fault, Fi, we get the number of the faults in the corresponding group, N, whose value is same as the length of the dynamic dictionary of the group.

At same time, the number of all the collapsed faults in circuit is the length of the conventional dictionary.

All of the results are presented in tables 3.1 through 3.4 for the benchmark circuits. In these tables, TL stands for the length of complete dictionary; DD-length stands for the length of the dynamic dictionary for each group; while Save indicates the space saved by using the dynamic dictionary.

The Improvement of the Look-up Time of the Dynamic Dictionary

The look-up time in the fault dictionary method is actually the time used to compare the signatures obtained from testing with the signatures in the dictionary.

In order to demonstrate the advantage of the look-up time of the dynamic dictionary, the following experiments were performed. For each benchmark circuit, 10 faults from 10 groups are ejected randomly. Then, ten dynamic dictionaries were constructed for each group. At same time, a part of the conventional dictionary is constructed by putting the faults of the ten groups in the front of the dictionary. Using the time of comparing one entry as the time unit, the time to find the last fault in both the dynamic dictionaries and conventional dictionary can be calculated. The experimental results for all the benchmark circuits are shown in appendix C.

Comparison with DAPPER

DAPPER [3, 4] employed "fault detection probability estimation" method as its first diagnostic stage to provide coarse-grain resolution by eliminating potential faults before simulation. The average number of faults left after the elimination for ISCAS'85 benchmark circuits is given both numerically and as a percentage in the columns 3 and 4 in table 3.5⁶. For each circuit, the second column indicates the number of the faults in the circuit, the third column presents the average faults to be simulated and the fourth column tells the percentage of the faults to be simulated in the whole fault set. In the same table, we present the corresponding numbers by our structural analysis in the columns 6 and 7. We put the average number of faults in each group (which is the number of faults to be simulated) into the sixth column and put the percentage of the faults to be simulated in the whole fault set into the seventh column. We can find out that for all of the compared circuits, structural analysis can eliminate more faults than its counterpart in DAPPER. The percentage of the faults which it can eliminate more than DAPPER ranges from 0.92% to 17.77%.

Comparison with IBM simulation scheme

After the diagnosis of the first stage, one alternative method to perform the further diagnosis is the IBM simulation scheme [5]. In the IBM scheme, the testing and diagnostic patterns T1, T2, ..., Tn are generated firstly before they are applied to the physical circuit to get the responses: R1, R2, ..., Rn. Then, for all the faults in the plausible fault set, fault simulation is performed. During the fault simulation, each pattern Ti (i is from 1 to n) is applied to all the faults in above fault set. The faults will be discarded from the fault set if its response is different from that collected from testing/diagnosis, Ri. Thus, after all the patterns have been applied, the faults still in the fault set are the final plausible faults being looked for. These faults have the same responses as the physical fault for all the test patterns generated.

In our specific diagnostic environment, the dynamic dictionary scheme employed

⁶These two columns are from columns 4 and 5 of table 2 in [3].

⁷Their experiments are based on the single stuck-at fault model [4].

in h-DIAG is more suitable than IBM scheme because of the following reasons:

- The diagnostic result available for this stage is mainly the signatures of the failing flip-flops. In order to use the IBM scheme, we must take some special measures to recover all the required test response pairs from above signatures.
 Under our diagnostic condition, this is almost impossible.
- 2. Using the IBM simulation scheme, basic steps are performing fault simulation and comparing the simulation results. Using the h-DIAG dictionary scheme, the extra work necessary is to save the fault simulation results into a space to build up the dictionaries. The construction of fault dictionaries provides a possibility to reduce the fault simulation by reusing the fault dictionary. For example, if two faults existing in two chips affect the same POs, after the first chip is diagnosed using the dictionary, it is not necessary to invoke fault simulation for the fault in the second chip. Instead, the dictionary used for the first chip can be loaded and then looked up directly.

Compared with IBM's scheme, the apparent disadvantage of h-DIAG is the space to store the dictionary, although the size of the dictionary has been greatly reduced through dynamic technique.

Conclusions Reached

- 1. The diagnosis in this stage closely depends on the result of the previous stage.
- 2. In our scheme, the length of the dynamic fault dictionary is significantly reduced when compared with the conventional dictionary by around 98% for most of the benchmark circuits. Correspondingly, the construction and look-up time to the dictionaries are also significantly reduced compared with that needed in conventional dictionaries. This makes the dictionary method much more practical and appealing.
- 3. Due to the aliasing, it is possible that two complete records in two different groups are equal. In the conventional dictionary, these two faults can not be

identified. With the dynamic dictionary, the final plausible fault is restricted to a specific group and the faults of the other groups will not be considered at all. Thus aliasing becomes less and resolution is improved by using the dynamic dictionary method.

4. It will be an interesting investigation and development to generally reduce the simulation through re-use of the simulation results by looking up the dynamic dictionaries while diagnosing more than one chip.

Group	c6288, TI	-7744	c7552, T1	L=7556	c880, Tl	.=98 2	\$1196, TL	=1250
No.	DD-Length	Save %	DD-Length	Save %	DD-Length	Save %	DD-Length	Save %
1	2	99.9742	347	95.4076	1	99.8982	1	99.92
2	123	98.4117	468	93.8063	1	99.8982	3	99.76
3	282	96.3585	187	97.5251	23	97.6578	34	97.28
4	308	96.0227	2	99.9735	16	98.3707	57	95.44
5	2	99.9742	1	99.9868	44	95.5193	4	99.68
6	2	99.9742	16	99.7882	23	97.6578	37	97.04
7	175	97.7402	468	93.8063	1	99.8982	4	99.68
8	227	97.0687	468	93.8063	1	99.8982	59	95.28
9	331	95.7257	456	93.9651	38	96.1303	57	95.44
10	331	95.7257	146	98.0678	16	98.3707	2	99.84
Average	178.3	97.6976	255.9	96.6133	16.4	98.3299	25.8	97.936
Group	c1355, Tl	L=1574	c17, Tl	L=22	c1908, T	L=1893	c 2670 , Tl	L=2611
No.	DD-Length	Save %	DD-Length	Save %	DD-Length	Save %	DD-Length	Save %
1	777	50.6353	5	77.2727	161	91.495	13	99.5021
2	777	50.6353	5	77.2727	853	54.9392	39	98.5063
3	777	50.6353	7	68.1818	10	99.4717	2	99.9234
4	777	50.6353	5	77.2727	17	99.102	17	99.3489
5	14	99.1105	7	68.1818	853	54.9392	417	84.0291
6	777	50.6353	5	77.2727	853	54.9392	2	99.9234
7	777	50.6353	5	77.2727	853	54.9392	107	95.902
8	777	50.6353	7	68.1818	75	96.038	5	99.8085
9	14	99.1105	7	68.1818	853	54.9392	2	99.9234
10	777	50.6353	5	77.2727	17	99.102	59	97.7403
Average	624.4	60.3304	5.8	73.6364	454.5	75.9905	66.3	97.4607
Group	c3540, T	L=3446	c432 , T	L=504	c499, T	L=726	c15315, T	L=536 2
No.	DD-Length	Save %	DD-Length	Save %	DD-Length	Save %	DD-Length	Save %
1	7	99.7969	64	87.3016	209	71.2121	10	99.8135
2	285	91.7295	64	87.3016	209	71.2121	25	99.5338
3	136	96.0534	102	79.7619	8	98.8981	11	99.7949
4	35	98.9843	50	90.0794	8	98.8981	82	98.4707
5	109	96.8369	64	87.3016	209	71.2121	13	99.7576
6	201	94.1672	64	87.3016	209	71.2121	28	99.4778
7	136	96.0534	64	87.3016	8	98.8981	4	99.9254
8	107	96.895	32	93.6508	33	95.4545	2	99.9627
9	136	96.0534	5	99.0079	209	71.2121	112	97.9112
10	188	94.5444	64	87.3016	209	71.2121	2	99.9627
Average	134	96.1114	57.3	88.631	131.1	81.9421	28.9	99.461

Table 3.1: Length of Dictionary: The First 12 Benchmark Circuits

Group	\$1238, Tl	G=1355	s13207 , Ti	L=14027	€1423, TI	J=15 2 7	#1488, TL	=1546
No.	DD-Length	Save %	DD-Length	Save %	DD-Length	Save %	DD-Length	Save %
1	2	99.8524	6	99.9572	12	99.2141	2	99.8706
2	1	99.9262	2	99.9857	1	99.9345	19	98.771
3	9	99.3358	489	96.5139	11	99.2796	8	99.4825
4	1	99.9262	20	99.8574	5	99.6726	60	96.119
5	30	97.786	19	99.8645	11	99.2796	132	91.4618
6	3	99.7786	14	99.9002	6	99.6071	8	99.4825
7	10	99.262	12	99.9145	12	99.2141	3	99.806
8	1	99.9262	3	99.9786	14	99.0832	25	98.3829
9	44	96.7528	9	99.9358	11	99.2796	2	99.8706
10	1	99.9262	16	99.8859	12	99.2141	2	99.8706
Апетаде	10.2	99.2472	59	99.5794	9.5	99.3779	26.1	98.3118
Group	s1494, Ti	L=1588	\$15850, T	L=16077	\$208, T	L=219	#27, Tl	.=32
No.	DD-Length	Save %	DD-Length	Save %	DD-Length	Save %	DD-Length	Save %
1	2	99.8716	6	99.9627	101	53.8813	14	56.25
2	1	99.9358	13	99.9191	101	53.8813	4	87.5
3	5	99.6791	13	99.9191	1	99.5434	14	56.25
4	1	99.9358	13	99.9191	1	99.5434	14	56.25
5	66	95.7638	63	99.6081	101	53.8813	2	93.75
6	8	99.4865	15	99.9067	13	94.0639	3	90.625
7	108	93.068	6	99.9627	13	94.0639	14	56.25
8	8	99.4865	6	99.9627	101	53.8813	14	56.25
9	49	96.8549	115	99.2847	10	95.4338	14	56.25
10	6	99.6149	8	99.9502	10	95.4338	3	90.625
Ачетаде	25.4	98.3697	25.8	99.8395	45.2	79.3607	9.6	70
Group	\$298, T	L=320	8344, T	L=372	\$349, T	L=380	#35932, T	L=41398
No.	DD-Length	Save %	DD-Length	Save %	DD-Length	Save %	DD-Length	Save %
1	24	92.5	16	95.6989	1	99.7368	63	99.8478
2	13	95.9375	2	99.4624	21	94.4737	15	99.9638
3	14	95.625	2	99.4624	2	99.4737	27	99.9348
4	4	98.75	21	94.3548	23	93.9474	1	99.9976
5	24	92.5	4	98.9247	15	96.0526	27	99.9348
6	1	99.6875	19	94.8925	1	99.7368	63	99.8478
7	28	91.25	12	96.7742	21	94.4737	63	99.8478
8	1	99.6875	16	95.6989	5	98.6842	27	99.9348
9	1	99.6875	16	95.6989	16	95.7895	1	99.9976
10	20	93.75	23	93.8172	5	98.6842	3	99.9928
Average	13	95.9375	13.1	96.4785	11	97.1053	29	99.9299

Table 3.2: Length of Dictionary: The Second 12 Benchmark Circuits

Group	#382 , Ti	L=425	s38417, TL	=39028	#38584, TL	=38793	#386,TL	=410
No.	DD-Length	Save %	DD-Length	Save %	DD-Length	Save %	DD-Length	Save %
1	2	99.5294	9	99.9769	34	99.9124	37	90.9756
2	14	96.7059	1	99.9974	4	99.9897	2	99.5122
3	10	97.6471	2	99.9949	51	99.8685	46	88.7805
4	4	99.0588	70	99.8206	44	99.8866	2	99.5122
5	14	96.7059	18	99.9539	3	99.9923	13	96.8293
6	4	99.0588	70	99.8206	251	99.353	37	90.9756
7	14	96.7059	18	99.9539	44	99.8866	2	99.5122
8	15	96.4706	7	99.9821	16	99.9588	30	92.6829
9	2	99.5294	17	99.9564	27	99.9304	2	99.5122
10	3	99.2941	2	99.9949	251	99.353	13	96.8293
Average	8.2	98.0706	21.4	99.9452	72.5	99.8131	18.4	95.5122
Group	s420, Tl	L=457	s444, Tl	L=508	•510, Tl	L=564	\$526, Tl	=567
No.	DD-Length	Save %	DD-Length	Save %	DD-Length	Save %	DD-Length	Save %
1	1	99.7812	16	96.8504	2	99.6454	19	96.649
2	215	52.954	13	97.4409	54	90.4255	19	96.649
3	215	52.954	8	98.4252	102	81.9149	19	96.649
4	215	52.954	20	96.063	17	96.9858	14	97.5309
5	1	99.7812	17	96.6535	2	99.6454	14	97.5309
6	10	97.8118	24	95.2756	6	98.9362	7	98.7654
7	215	52.954	3	99.4094	17	96.9858	7	98.7654
8	215	52.954	14	97.2441	102	81.9149	6	98.9418
9	10	97.8118	1	99.8031	2	99.6454	6	98.9418
10	1	99.7812	10	98.0315	6	98.9362	2	99.6473
Average	109.8	75.9737	12.6	97.5197	31	94.5035	11.3	98.0071
Group	s5378, T	L=5325	s641, T	L=675	8713, T	L=737	\$820, T	L=850
No.	DD-Length	Save %	DD-Length	Save %	DD-Length	Save %	DD-Length	Save %
1	152	97.1455	3	99.5556	7	99.0502	134	84.2353
2	14	99.7371	25	96.2963	21	97.1506	134	84.2353
3	115	97.8404	6	99.1111	18	97.5577	103	87.8824
4	133	97.5023	19	97.1852	11	98.5075	83	90.2353
5	147	97.2394	7	98.963	12	98.3718	103	87.8824
6	17	99.6807	7	98.963	17	97.6934	9	98.9412
7	89	98.3286	17	97.4815	10	98.6432	2	99.7647
8	3	99.9437	9	98.6667	17	97.6934	137	83.8824
9	2	99.9624	7	98.963	7	99.0502	4	99.5294
10	3	99.9437	21	96.8889	7	99.0502	4	99.5294
Average	67.5	98.7324	12.1	98.2074	12.7	98.2768	71.3	91.6118

Table 3.3: Length of Dictionary: The Third 12 Benchmark Circuits

Group	s832, TI	=870	\$838, TL	=933	:9234, TL	=8805	s953, TL	=1107
No.	DD-Length	Save %						
1	2	99.7701	443	52.5188	204	97.6831	2	99.8193
2	143	83.5632	1	99.8928	202	97.7058	19	98.2836
3	4	99.5402	443	52.5188	524	94.0488	19	98.2836
4	2	99.7701	1	99.8928	1	99.9886	12	98.916
5	12	98.6207	443	52.5188	538	93.8898	33	97.019
6	4	99.5402	1	99.8928	63	99.2845	19	98.2836
7	2	99.7701	443	52.5188	114	98.7053	3	99.729
8	104	88.046	1	99.8928	18	99.7956	15	98.645
9	1	99.8851	13	98.6066	81	99.0801	ı	99.9097
10	2	99.7701	1	99.8928	576	93.4583	8	99.2773
Average	27.6	96.8276	179	80.8146	232.1	97.364	13.1	98.8166

Table 3.4: Length of Dictionary: The Last 4 Benchmark Circuits

Circuit	Num. of	avg. sim faults	Percentage	Num. of Group	avg. sim faults	Percentage
Name	Faults	in DAPPER	in DAPPER	in h-DIAG	in h-DIAG	in h-DIAG
c432	524	39.9	7.6%	15	34.93	6.68%
c499	758	152.0	20.1%	43	17.63	2.33%
c880	942	44.8	4.8%	68	13.85	1.47%
c1355	1574	244.0	15.5%	43	36.60	2.33%
c1908	1879	114.3	6.1%	57	32.96	1.75%
c2670	2595	91.3	3.5%	139	18.67	0.72%
c3540	3428	232.9	6.8%	127	26.99	0.79%
c5315	5350	444.4	8.3%	364	14.70	0.28%
c6288	7744	678.4	8.8%	63	122.92	0.16%
c7552	7548	407.8	5.4%	318	23.74	0.31%

Table 3.5: Comparison With DAPPER: Average Fault Number to be Simulated

Chapter 4

Evaluation of Diagnostic

Resolution

In this chapter, we describe a series of experiments to evaluate the effectiveness of the new diagnostic algorithms proposed in Chapter 3. Computer simulations were performed on some standard benchmark circuits. The simulations help to illustrate the performance of the algorithms and also show that it is feasible to apply the algorithms on large VLSI circuits.

An overview of the simulation environment is given, including discussions about the circuits used for the simulations and the computer resources used for the experiments. The simulation goals are defined and the simulation results are presented. Based on the simulation results, the performance of the algorithms is analyzed.

4.1 Experimental System Overview

The environment used to carry out the simulation experiments consists of software package h-DIAG and the set of ISCAS'85 and ISCAS'89 benchmark circuits. The software was developed using the GNU C++ compiler, g++, under SunOS and Solaris. All simulations were executed on identical SUN Ultra 1 workstations each equipped with 128 Mbytes of RAM.

The ISCAS'85 and ISCAS'89 benchmark circuits were introduced by Brglez and

etc. [9, 10] in 1985 and 1989 respectively. These circuits have become the standard for analyzing the performance of testing and diagnostic methods for both combinational circuits and sequential circuits. A description of the circuits are given in table 4.1 and 4.2 respectively.

Circuit	Circuit	Input	Output	D Flip	Basic
Name	Function	Lines	Lines	Plops	Gates
527	normal circuit	4	1	3	10
S208	functional multipliers	11	2	8	96
S298	traffic light controler	3	6	14	119
5344	re-synthesized s349	9	11	15	160
S349	four-bit multiplier	-	11	15	161
S382	re-synthesised s400	3	6	21	158
S386	controllers from HLD	7	7	6	159
S400	traffic light controler	3	6	21	162
S420	functional multipliers	19	2	16	196
5444	traffic light controler	3	8	21	181
S810	controllers from HLD	19	7	6	211
S526	traffic light controler	3	8	21	194
5641	PLD device based	35	24	19	379
5713	PLD device based	35	23	19	393
S820	re-synthesized s832	18	19	5	289
5832	PLD device based	18	19	- 5	287
5838	functional multipliers	35	2	32	390
5983	controllers from HLD	16	23	29	395
\$1196	re-synthesized \$1238	14	14	18	529
S1238	comb. with random FFs	14	14	18	508
S1423	normal circuit	17	5	74	657
\$1488	re-synthesized \$1494	- 8	19	6	653
S1494	controllers from HLD	- 8	19	6	647
S5378	normal circuit	35	49	179	2779
S9234	spesific real-chip	19	22	228	5597
S13207	spesific real-chip	31	121	669	6951
S15850	spesific real-chip	14	87	597	9772
535932	normal circuit	35	320	1728	16068
538417	spesific real-chip	28	106	1636	22179
538584	spesific real-chip	12	278	1452	19253

Table 4.1: Characteristics of ISCAS'89 Benchmark Circuits

Circuit	Circuit	Total	Input	Output
Name	Punction	Gates	Lines	Lines
C432	Priority Decoder	160 (18 EXOR)	36	7
C499	ECAT	202 (104 EXOR)	41	32
C880	ALU and Control	383	60	26
C1355	ECAT	546	41	32
C1908	ECAT	880	33	25
C2670	ALU and Control	1193	233	140
C3540	ALU and Control	1669	50	22
C5315	ALU and Selector	2307	178	123
C6288	16-bit Multiplier	2406	32	32
C7852	ALU and Control	3512	20%	108

Table 4.2: Characteristics of ISCAS'85 Benchmark Circuits

The "C" in the name of ISCAS'85 circuits stands for *combinational* circuits, while the "S" in the name of ISCAS'89 circuits stands for *sequential* circuits. The number in the name of each ISCAS circuit refers to the number of interconnect lines among the circuit primitives. The double of this number also represents the upper bound on the size of the single stuck-at fault list.

The ISCAS'89 benchmarks, compared to the ISCAS'85 benchmarks, are much bigger in size and more complex in circuit functions. Using both sets of benchmarks for our experiments provides both thorough and realistic evaluations of our diagnostic system.

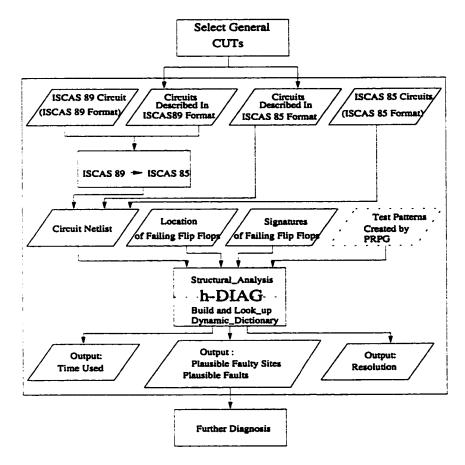


Figure 4.1: Overview of the Simulation Environment

The overview of our simulation environment is presented in Figure 4.1. The h-DIAG program is the center of the environment. h-DIAG implemented all the algorithms proposed in the previous chapter. h-DIAG requires four sources of input, they are: a circuit netlist in the format of the ISCAS'85¹, the location of failing flip-flops (the node number of corresponding primary outputs), a set of signatures of these failing flip-flops and pseudorandom test patterns created by PRPG. The main outputs produced by h-DIAG are the plausible faulty sites by structural analysis in its

¹For this reason, all the circuits described in the format of ISCAS'89 have to be transformed.

first stage and the final plausible faults by constructing and looking-up the dynamic dictionary in its second stage. The outputs also include some statistical data like diagnostic time and the diagnostic resolution.

The implementation issues and user's manual of h-DIAG will be presented in chapter 5 and appendix B respectively.

4.2 Diagnosability and Experimental Objectives

The diagnostic ability of a system reflects how powerful the system is in identifying and locating the fault(s). It is represented by the diagnostic resolution. The higher the diagnostic resolution is, the more valuable the diagnostic information becomes for finding actual defects in the CUT.

Two basic methods are used to measure the resolution of our diagnostic system. In the first method, a value named fault elimination rate (FE) is calculated. This value indicates the percentage of the faults, which are not causing the error, in the total faults of the circuit for each specific diagnosis. The larger the percentage is, the smaller the number of plausible faults is. The formula calculating FE can be expressed as:

$$Number_of_Total_Faults - Number_of_Plausible_Faults$$

$$FE = \underbrace{\hspace{1cm}} Number_of_Total_Faults$$

$$Number_of_Total_Faults$$

where Number_of_Total_Faults is the number of all the faults of the circuit after fault collapsing; Number_of_Plausible_Faults is the number of the faults not eliminated (including the un_distinguishable faults after diagnosis).

The second method originated from the theory discussed in [18], where a value and its corresponding calculation formula satisfying the following requirements were proposed:

- 1. The value should be minimum when the diagnostic method has completely failed, i.e. the diagnostic system can not distinguish any fault;
- 2. The value should be maximum when the diagnostic method is perfect, i.e. it can distinguish any fault;
- 3. The value should increase as number of groups and/or the equalization among fault number in groups increases.

Thus, the formula can be expressed as:

$$g1 \times log(g1/N) + g2 \times log(g2/N) +gn \times log(gn/N)$$

$$RES = - \times 100\%,$$

$$N \times logN$$

where N is the total number of faults of the circuit; n is the number of the groups divided by the diagnostic system; $g1, g2, \ldots gi, \ldots gn$ are the number of faults in each group;

This formula has following properties:

- 1. $0 \le RES \le 1$;
- 2. RES = 1 when N = n;
- 3. RES = 0 when n = 1;
- 4. any change toward equalization of g1,g2,...gi increases RES (when n has no change);
- 5. any increase to n (by breaking a gi) increases RES (when other groups have no change).

Assume two diagnostic algorithms, D1 and D2, and any CUT. If D1 can generally divide the faults of CUT into more groups and/or the numbers of the faults in different

groups have better equalization than D2, then the RES of D1 will be greater than RES of D2.

This method can reflect the general diagnostic ability of a specific diagnostic scheme on any circuit. But for each circuit, to get its exact RES value, all of the faults have to be diagnosed in advance to obtain the data for each group. This is not feasible for large circuits.

Our basic experimental objective is to evaluate the resolution of structural analysis and dictionary method through calculating some FE and estimating the RES through an approximate method. Also, we will compare the resolution of h-DIAG with that of DAPPER based on some calculation results of FE on ISCAS'85 benchmark circuits.

4.3 Experimental Procedures and Results Analysis

This section presents the procedure and the results of the experiment for both structural analysis stage and the dynamic dictionary stage. Statistic value of FE and RES were obtained for most of the benchmark circuits. FE value at testing length of 2048 are collected and compared with that of DAPPER. Some representative tables containing the complete results at testing length = 64k can be found in appendix D and appendix E.

4.3.1 Number of Test Vectors and the Test Pattern Generator

Our structural analysis stage is independent of the test vectors, so FE1 and RES1² will not be affected by test patterns.

The second stage of our system is based on the fault simulation. The total time required to execute a diagnosis run depends upon the number of test vectors used during the test session. To minimize the testing time, the total number of vectors

²FE1 and RES1 are FE and RES of stage 1 while FE2 and RES2 are those of stage 2, respectively.

should be as small as possible. However, the test set should be long enough to provide an acceptable diagnostic resolution. In another words, the final plausible fault set should be very small and most of the faults in the initial fault list should be eliminated.

For the experiments of our second stage, both FE and RES are the functions of the test length. So the test length used for diagnosis of each benchmark circuit must be chosen in advance. (The relationship between the RES2 and the testing length will be illustrated in Figure 4.2.)

Each set of vectors is generated using minimum cost LFSR defined by primitive polynomials [7]. The length of the LFSR used for each benchmark circuit is equal to the number of primary inputs in the circuit when the number of PIs are less than 256. For those circuits whose PIs is greater than 256, one or more LFSR with length=256 should be used and for the left PIs, another LFSR with the length same to the number of left PIs should be used.

Besides the polynomials corresponding to LFSR with length of 256, table 4.3 shows the polynomials which describe the LFSR used to generate the input vectors for each benchmark circuit. These polynomials are taken from the list of primitive polynomials given in [7].

4.3.2 Data Collection for the Calculation of FE

For most of the ISCAS benchmark circuits, we randomly ejected 10 groups from each circuit, then we randomly selected 10 faults from each group. In this way, we got 100 random faults for each circuit. For each fault in one group, we traced forward to get the flip-flops it affected. Using these locations of flip-flops as the locations of the failing flip-flops, we started our structural analysis scheme to locate all of the corresponding plausible faulty sites. Applying relative formula, we got the FE for the corresponding diagnosis.

For each specific fault in a group, we performed the fault simulation and collected all the faulty signatures for the corresponding failing flip-flops by compacting the generated responses through MISR. These signatures were supplied to the diagnosis algorithm in stage 2. They were inserted into the dynamic fault dictionary in proper position. Because some of the entries of the dictionary are the same, the length of the dictionary is definitely equal to or less than the number of the faults in the group. We focused on the number of the faults which have exactly the same faulty signatures as the specific faults, because these faults are just the plausible faults which we can not distinguish in the stage 2. And those N = number of total faults - number of the faults with same signatures as the specific fault faults are definitely distinguishable from the specific fault. This means that: while diagnosing with the characteristic of this specific fault, we can eliminate these N faults from the plausible fault set in this stage. Thus, we obtained the FE for the fault of the second diagnostic stage by dividing N with number of the total faults of the circuit and thus we get FE2.

The average values of FE1 and FE2 for each circuit are recorded in the column 4 and 8 of tables 4.4 through 4.15.

4.3.3 Estimation of RES

As described in the previous section, we randomly ejected 100 faults from 10 randomly selected groups. We used the number of the faults in each group as g(i), which is the result of structural analysis, the number of the selected group as n, and the addition of each g(i) are the N. The RES calculated in this way is called Res1 of the group.

After simulation, we can distinguish different $common_sig_set$, where all faults have same signatures. We added the number of the faults in each $common_sig_set$ together as N, the number of the $common_sig_set$ in the group as n, the number of the faults in each $common_sig_set$ as g(i), then we got the RES of stage 2 for this group, which is called Res2.

After we got the Res1 and Res2 of each group, we calculated their average values respectively. Thus we got the approximate RES1 and RES2 of the corresponding circuits.

In tables 4.4 through 4.15, the average values of RES1 and RES2 for each circuit are recorded in the columns 5 and 9.

In the following subsections, the results of the simulations for both structural

analysis and dynamic dictionary will be analysed and discussed.

4.3.4 Results for the Structural Analysis Stage

The first part of the tables 4.4 through 4.15 (columns 3 to 6), details the simulation results of the structural analysis.

Four quantities are presented for each circuit: The average number of faults in each group, which affect the same flip-flops; the average number of FE; the average number of RES; and the CPU time required for diagnosis by structural analysis. Each result is the average of the 100 trials performed. For example, considering C3540 in table 4.4, there are 192.6 faults on average in each group, FE on average is 0.944097, RES on average is 0.501029 and the average CPU time is 2.583084 seconds.

The following observations can be made from the tables:

- 1. The result of structural analysis is independent of the testing length (the number of the testing vectors).
- 2. The CPU time used in structural analysis, for all the benchmark circuits, ranged from 0.003486 seconds to 27.954675 seconds on a 140 MHZ Ultra 1 Sparcstation.
- 3. For some circuits, the FE is very high. The highest FE reached is 0.998749 for \$35932.
- 4. It can be found that, normally, for the circuits with more flip-flops in their scan chains, their FE is higher.
- 5. The number of faults in each group ranged from 5.9 of C17 to 451.2 of S13207.
- For any two circuits with similar number of faults, the smaller the average of faults in each group, the larger the number of its FE. One example is S38417 and S38584.

4.3.5 Results for the Dynamic Dictionary Stage

The second part of the tables 4.4 through 4.15 (columns 7 to 10), details the simulation results for the dynamic dictionary.

Because all of the benchmark circuits have an unequal number of inputs and outputs, for simplicity, test patterns are supplied by an LFSR of length equal to the number of inputs, connected directly to the circuit inputs. For example, for benchmark circuit C5315, a 178-bit LFSR is used to generate test patterns, with the least significant bit of the LFSR connected to the first input of the circuit.

The remaining parts in tables 4.4 through 4.15 summarize the results of the experiments in stage 2 of our diagnostic system. The testing length in tables 4.4 through 4.10 are 1 block (256 vectors), 3 blocks, 8 blocks, 10 blocks, 30 blocks, 100 blocks, 200 blocks and 256 blocks for ISCAS'85 benchmark circuits respectively. In tables 4.11 through 4.15 are 1 block, 3 blocks, 100 blocks, 200 blocks and 256 blocks for ISCAS'89 benchmark circuits respectively. In each table, from the seventh column to the tenth column, each column lists the following information: the average number of faults which have same signatures, the average FE of the stage, the average RES of the stage and the average simulation time required per fault.

The following significant observations can be made from the data:

- The diagnostic time closely depends on the testing length. For example, for C3540, the diagnostic time (CPU) used in this stage is 9.846411 seconds at testing length 1 block, while the diagnostic time (CPU) used is 34.112416 seconds when the test length is 3 blocks.
- 2. Normally, the longer the testing length, the higher the resolution³.
- 3. For most of the circuits, the fault elimination (FE) can reach more than 99% when the testing length reaches 100 blocks. In most situations, the plausible fault number is very close to one, the final target.
- 4. The resolution changes little after the testing length is longer than 100 blocks.

³The larger FE and RES will also be obtained.

Benchmark circuits (remained part) c1335	
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s1238 $x^{32} + x^{28} + x^{27} + x^{1}$ s13207 $x^{188} + x^{186} + x^{2} + x^{1}$ s1432 $x^{91} + x^{84} + x^{85} + x^{1}$	
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s1488	
s1494	+ 1
$z^{99} + z^{47} + z^{45} + z^2$	+1_
$x^{18} + x^7 + 1$	
$x^7 + x^1 + 1$	
s298	
2344	
s349	
$x^{227} + x^{21} + x^2 + x^1$	+1
$x^{24} + x^4 + x^3 + x^1 + x^4 + x^4 + x^5 + x$	
$x^{128} + x^{29} + x^{27} + x^2$	
	+1
s386 x13 + x4 + x3 + x1 +	1_
s420	+1
s444	1
$z^{25} + z^3 + 1$	
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s5378 $x^{214} + x^{87} + x^2 + x^1$	+1
$= x^{54} + x^{37} + x^{36} + x^{1}$	
$x^{54} + x^{37} + x^{36} + x^{1}$	+1
$z^{23} + z^5 + 1$	
$z^{23} + z^5 + 1$	
s838 $x^{66} + x^{10} + x^9 + x^1$	- 1
$x^{247} + x^{82} + 1$	
$x^{45} + x^4 + x^3 + x^1 + x^4 + x^3 + x^4 + x^4 + x^5 + x$	

Table 4.3: Polynomials Used in PRPG for ISCAS Benchmark Simulations

circuit		No.PO	FE1	Res1	Tim-1	N.sg	FE2	Res2	Tim2
C17	Mean val	5.9	0.731405	0.533700	0.003875	1.00	0.954545	1.000000	10.832122
	Std devi	1.0	0.046332	0.007733	0.000420	0.00	0.000000	0.000000	12.098172
C1908	Mean val	161.0	0.914950	0.498443	1.402980	22.56	0.988082	0.540494	3.135840
	Std devi	0.0	0.000000	0.000000	0.000000	23.89	0.012623	0.000000	0.000000
C2670	Mean val	307.9	0.882087	0.501401	0.808191	201.43	0.922853	0.518262	25.838037
	Std devi	261.9	0.100319	0.004141	0.352002	187.29	0.071730	0.031354	21.568973
C3540	Mean val	192.6	0.944097	0.501029	2.538938	18.32	0.994684	0.568683	9.846441
	Std devi	49.6	0.014384	0.007406	0.333998	32.84	0.009531	0.123478	4.575392
C432	Mean val	75.7	0.849802	0.512127	0.054102	7.63	0.984861	0.580407	2.262642
	Std devi	15.3	0.030322	0.002969	0.000513	8.63	0.017130	0.024493	0.338429
C499	Mean val	195.4	0.730812	0.522151	0.172306	1.53	0.997893	0.945665	30.207202
	Std devi	13.6	0.018786	0.003237	0.003020	0.76	0.001050	0.000653	2.250980
C5315	Mean val	55.2	0.989711	0.500968	1.333310	16.77	0.996872	0.579707	4.212523
	Std devi	33.4	0.006226	0.033914	0.102149	19.47	0.003630	0.064317	2.601977
C6288	Mean val	262.4	0.966114	0.510911	29.686549	1.26	0.999837	0.952493	22.407754
	Std devi	85.5	0.011035	0.031374	2.772940	0.41	0.000052	0.009605	8.610687
C7552	Mean val	360.9	0.952231	0.498974	3.319447	241.73	0.968008	0.513940	28.353079
	Std devi	14.0	0.001854	0.000228	0.356409	147.62	0.019537	0.008068	0.584208
C880	Mean val	30.0	0.969419	0.529421	0.060040	15.93	0.983778	0.536006	0.832946
	Std devi	13.5	0.013700	0.097049	0.005828	11.58	0.011795	0.095336	0.193653

Table 4.4: Experiment Results: at Vector Size = 1 Block

circuit	_	No.PO	FE1	Resl	Tim-1	N.sg	FE2	Res2	Tim2
C17	Mean val	5.9	0.731405	0.533700	0.003807	1.00	0.954545	1.000000	10.875810
	Std devi	1.0	0.046332	0.007733	0.000501	0.00	0.000000	0.000000	12.057351
C1908	Mean val	161.0	0.914950	0.498443	1.404200	2.05	0.998917	0.825423	93.939499
	Std devi	0.0	0.000000	0.000000	0.000000	1.94	0.001025	0.000000	0.000000
C2670	Mean val	307.9	0.882087	0.501401	0.806073	201.43	0.922853	0.518262	78.385253
	Std devi	261.9	0.100319	0.004141	0.349788	187.29	0.071730	0.031354	65.244135
C3540	Mean val	192.6	0.944097	0.501029	2.538192	2.13	0.999382	0.839885	34.112416
	Std devi	49.6	0.014384	0.007406	0.335803	8.54	0.002477	0.194847	16.808274
C432	Mean val	75.7	0.849802	0.512127	0.054251	1.42	0.997183	0.877723	6.957865
	Std devi	15.3	0.030322	0.002969	0.000501	1.76	0.003495	0.112979	1.039517
C499	Mean val	195.4	0.730812	0.522151	0.172500	1.02	0.998595	0.995592	95.551985
	Std devi	13.6	0.018786	0.003237	0.003014	0.02	0.000028	0.004430	7.120709
C5315	Mean val	55.2	0.989711	0.500968	1.333160	16.53	0.996917	0.607134	12.830254
	Std devi	33.4	0.006226	0.033914	0.102326	19.65	0.003665	0.074656	7.988380
C6288	Mean val	262.4	0.966114	0.510911	29.832922	1.26	0.999837	0.952493	69.607121
	Std devi	85.5	0.011035	0.031374	2.792268	0.41	0.000052	0.009605	26.800453
C7552	Mean val	360.9	0.952231	0.498974	3.319252	205.47	0.972807	0.517811	85.875088
	Std devi	14.0	0.001854	0.000228	0.362374	127.75	0.016907	0.012783	1.240207
C880	Mean val	30.0	0.969419	0.529421	0.060239	8.46	0.991385	0.563380	2.567477
	Std devi	13.5	0.013700	0.097049	0.005924	7.45	0.007587	0.090330	0.578692

Table 4.5: Experiment Results: at Vector Size = 3 Blocks

circuit		No.PO	FE1	Res1	Tim-1	N.sg	FE2	Res2	Tim2
C17	Mean val	5.9	0.731405	0.533700	0.003865	1.00	0.954545	1.000000	10.981832
	Std devi	1.0	0.046332	0.007733	0.000429	0.00	0.000000	0.000000	11.958290
C1908	Mean val	161.0	0.914950	0.498443	1.404200	2.05	0.998917	0.825423	93.939499
	Std devi	0.0	0.000000	0.000000	0.000000	1.94	0.001025	0.000000	0.000000
C2670	Mean val	307.9	0.882087	0.501401	0.804797	200.70	0.923133	0.519265	208.194814
	Std devi	261.9	0.100319	0.004141	0.349327	188.97	0.072374	0.031257	173.732569
C3540	Mean val	192.6	0.944097	0.501029	2.550121	1.29	0.999626	0.906536	87.810585
	Std devi	49.6	0.014384	0.007406	0.328201	2.01	0.000582	0.069980	42.717358
C432	Mean val	75.7	0.849802	0.512127	0.054373	1.13	0.997758	0.960251	18.180214
	Std devi	15.3	0.030322	0.002969	0.000839	0.28	0.000550	0.031209	2.731683
C499	Mean val	195.4	0.730812	0.522151	0.172036	1.02	0.998595	0.995592	246.778055
	Std devi	13.6	0.018786	0.003237	0.003030	0.02	0.000028	0.004430	18.388121
C5315	Mean val	55.2	0.989711	0.500968	1.332282	9.22	0.998280	0.625403	34.114103
	Std devi	33.4	0.006226	0.033914	0.102279	13.68	0.002550	0.094097	21.176466
C6288	Mean val	262.4	0.966114	0.510911	29.635309	1.26	0.999837	0.952493	180.517055
	Std devi	85.5	0.011035	0.031374	2.756831	0.41	0.000052	0.009605	69.859151
C7552	Mean val	360.9	0.952231	0.498974	3.315426	125.63	0.983374	0.527718	230.943356
	Std devi	14.0	0.001854	0.000228	0.356019	106.10	0.014042	0.022725	2.317982
C880	Mean val	30.0	0.969419	0.529421	0.059757	2.60	0.997352	0.723105	7.323440
	Std devi	13.5	0.013700	0.097049	0.005899	2.45	0.002494	0.070995	1.585640

Table 4.6: Experiment Results: at Vector Size = 8 Blocks

circuit		No.PO	FE1	Resl	Tim-1	N.sg	FE2	Res2	Tim2
C17	Mean val	5.9	0.731405	0.533700	0.003849	1.00	0.954545	1.000000	11.453884
	Std devi	1.0	0.046332	0.007733	0.000444	0.00	0.000000	0.000000	11.517226
C1908	Mean val	161.0	0.914950	0.498443	1.404200	2.05	0.998917	0.825423	93.939499
	Std devi	0.0	0.000000	0.000000	0.000000	1.94	0.001025	0.000000	0.000000
C2670	Mean val	307.9	0.882087	0.501401	0.808071	152.00	0.941785	0.525241	793.094032
	Std devi	261.9	0.100319	0.004141	0.351517	142.88	0.054722	0.032841	660.887024
C3540	Mean val	192.6	0.944097	0.501029	2.547390	1.26	0.999635	0.918804	325.840234
	Std devi	49.6	0.014384	0.007406	0.328210	0.92	0.000267	0.022812	158.537719
C432	Mean val	75.7	0.849802	0.512127	0.054046	1.13	0.997758	0.960251	67.804757
	Std devi	15.3	0.030322	0.002969	0.000461	0.28	0.000550	0.031209	10.150365
C499	Mean val	195.4	0.730812	0.522151	0.172331	1.02	0.998595	0.995592	929.836725
	Std devi	13.6	0.018786	0.003237	0.003018	0.02	0.000028	0.004430	69.280567
C5315	Mean val	55.2	0.989711	0.500968	1.334041	1.89	0.999647	0.825199	130.378806
	Std devi	33.4	0.006226	0.033914	0.102069	2.09	0.000389	0.100284	81.116046
C6288	Mean val	262.4	0.966114	0.510911	30.041573	1.26	0.999837	0.952493	677.165160
	Std devi	85.5	0.011035	0.031374	2.815485	0.41	0.000052	0.009605	260.706735
C7552	Mean val	360.9	0.952231	0.498974	3.321127	34.44	0.995442	0.598123	865.035728
	Std devi	14.0	0.001854	0.000228	0.354320	108.84	0.014404	0.092406	10.767680
C880	Mean val	30.0	0.969419	0.529421	0.059578	1.12	0.998860	0.961882	28.558824
	Std devi	13.5	0.013700	0.097049	0.005905	0.33	0.000333	0.027334	6.005498

Table 4.7: Experiment Results: at Vector Size = 30 Blocks

circuit		No.PO	FE1	Res1	Tim-1	N.sg	FE2	Res2	Tim2
C17	Mean val	5.9	0.731405	0.533700	0.003447	1.00	0.954545	1.000000	13.050176
_	Std devi	1.0	0.046332	0.007733	0.000089	0.00	0.000000	0.000000	10.025736
C1908	Mean val	161.0	0.914950	0.498443	1.404200	2.05	0.998917	0.825423	93.939499
	Std devi	0.0	0.000000	0.000000	0.000000	1.94	0.001025	0.000000	0.000000
C2670	Mean val	307.9	0.882087	0.501401	0.807179	23.05	0.991172	0.620865	2625.847524
	Std devi	261.9	0.100319	0.004141	0.351877	20.60	0.007889	0.301868	2190.156527
C3540	Mean val	192.6	0.944097	0.501029	2.539086	1.26	0.999635	0.918804	1088.035311
	Std devi	49.6	0.014384	0.007406	0.333889	0.92	0.000267	0.022812	527.265156
C432	Mean val	75.7	0.849802	0.512127	0.053934	1.13	0.997758	0.960251	226.601350
	Std devi	15.3	0.030322	0.002969	0.000471	0.28	0.000550	0.031209	33.905295
C499	Mean val	195.4	0.730812	0.522151	0.171822	1.02	0.998595	0.995592	3108.436746
	Std devi	13.6	0.018786	0.003237	0.002995	0.02	0.000028	0.004430	231.614127
C5315	Mean val	55.2	0.989711	0.500968	1.334772	1.25	0.999767	0.940847	436.006780
	Std devi	33.4	0.006226	0.033914	0.103687	0.42	0.000078	0.032890	271.176601
C6288	Mean val	262.4	0.966114	0.510911	29.837088	1.26	0.999837	0.952493	2325.593572
	Std devi	85.5	0.011035	0.031374	2.789874	0.41	0.000052	0.009605	968.234382
C7552	Mean val	360.9	0.952231	0.498974	3.316932	6.76	0.999105	0.835561	2891.513983
	Std devi	14.0	0.001854	0.000228	0.356957	32.20	0.004262	0.304235	40.346103
C880	Mean vai	30.0	0.969419	0.529421	0.059837	1.12	0.998860	0.961882	93.213357
	Std devi	13.5	0.013700	0.097049	0.005893	0.33	0.000333	0.027334	19.927223

Table 4.8: Experiment Results: at Vector Size = 100 Blocks

circuit		No.PO	FE1	Resl	Tim-1	N.sg	FE2	Res2	Tim2
C17	Mean val	5.9	0.731405	0.533700	0.003486	1.00	0.954545	1.000000	14.134148
	Std devi	1.0	0.046332	0.007733	0.000039	0.00	0.000000	0.000000	5.683369
C1908	Mean val	161.0	0.914950	0.498443	1.404200	2.05	0.998917	0.825423	93.939499
	Std devi	0.0	0.000000	0.000000	0.000000	1.94	0.001025	0.000000	0.000000
C2670	Mean val	307.9	0.882087	0.501401	0.807735	7.90	0.996974	0.660003	5458.815100
	Std devi	261.9	0.100319	0.004141	0.349808	6.06	0.002320	0.273329	4542.025294
C3540	Mean val	192.6	0.944097	0.501029	2.583084	1.26	0.999635	0.918804	2364.809385
	Std devi	49.6	0.014384	0.007406	0.300177	0.92	0.000267	0.022812	1183.518810
C432	Mean val	75.7	0.849802	0.512127	0.055431	1.13	0.997758	0.960251	514.060115
	Std devi	15.3	0.030322	0.002969	0.000255	0.28	0.000550	0.031209	76.710864
C499	Mean val	195.4	0.730812	0.522151	0.178925	1.02	0.998595	0.995592	6831.190783
	Std devi	13.6	0.018786	0.003237	0.003507	0.02	0.000028	0.004430	509.161224
C5315	Mean val	55.2	0.989711	0.500968	1.336986	1.25	0.999767	0.944982	909.599185
	Std devi	33.4	0.006226	0.033914	0.103930	0.41	0.000075	0.039950	567.707326
C6288	Mean val	257.5	0.966743	0.510958	27.954675	1.16	0.999850	0.951586	359.155948
	Std devi	88.7	0.011457	0.031367	3.151904	0.40	0.000052	0.009921	325.485275
C7552	Mean val	360.9	0.952231	0.498974	3.399714	5.16	0.999317	0.848371	6005.496838
	Std devi	14.0	0.001854	0.000228	0.382986	18.73	0.002478	0.296890	63.555649
C880	Mean val	30.0	0.969419	0.529421	0.060217	1.12	0.998860	0.961882	187.084758
	Std devi	13.5	0.013700	0.097049	0.005896	0.33	0.000333	0.027334	39.932952

Table 4.9: Experiment Results: at Vector Size = 200 Blocks

circuit		No.PO	FE1	Resi	Tim-1	N.sg	FE2	Res2	Tim2
C17	Mean val	5.9	0.731405	0.533700	0.004311	1.00	0.954545	1.000000	15.819340
	Std devi	1.0	0.046332	0.007733	0.000087	0.00	0.000000	0.000000	6.232031
C1908	Mean val	46.0	0.975717	0.497522	1.170343	1.29	0.999316	0.919218	261.100891
	Std devi	21.9	0.011584	0.001946	0.101115	0.46	0.000242	0.003097	125.383467
C2670	Mean val	289.7	0.889035	0.497437	0.764616	249.13	0.904585	0.588660	6034.480739
·	Std devi	126.3	0.048390	0.003373	0.131576	123.96	0.047476	0.193064	2578.342936
C3540	Mean val	154.8	0.955073	0.497475	2.779782	1.19	0.999655	0.934192	1796.801760
	Std devi	33.3	0.009677	0.004103	0.112361	0.94	0.000274	0.023102	146.174483
C432	Mean val	84.6	0.832064	0.509906	0.056907	1.19	0.997639	0.968242	683.457326
	Std devi	31.3	0.062030	0.005218	0.000290	0.30	0.000604	0.024077	289.761357
C499	Mean val	196.1	0.729862	0.523331	0.179654	1.03	0.998582	0.988980	8147.404217
	Std devi	12.9	0.017830	0.002051	0.002299	0.03	0.000042	0.011076	598.354840
C5315	Mean val	18.9	0.996468	0.505503	1.316716	1.04	0.999806	0.986245	480.217113
	Std devi	8.2	0.001530	0.003651	0.047601	0.20	0.000037	0.020152	234.944257
C6288	Mean vai	344.0	0.955579	0.508798	33.011082	1.24	0.999840	0.953541	7850.700117
	Std devi	65.3	0.008435	0.000331	5.913423	0.43	0.000055	0.001681	689.124612
C7552	Mean val	379.8	0.949730	0.498331	3.596253	4.79	0.999366	0.832931	8231.839510
	Std devi	33.0	0.004368	0.000418	0.118743	16.38	0.002167	0.274776	386.788076
C880	Mean val	33.3	0.966130	0.512168	0.060524	1.13	0.998850	0.958757	275.255875
	Std devi	12.2	0.012430	0.070052	0.003754	0.33	0.000333	0.029741	53.853788

Table 4.10: Experiment Results: at Vector Size = 256 Blocks

circuit	-	No.PO	FEI	Resl	Tim-1	N.sg	FE2	Res2	Tim2
S1196	Mean val	40.4	0.967664	0.509125	0.117076	10.52	0.991584	0.638678	0.739408
31130	Std devi	18.5	0.014768	0.073784	0.025230	12.25	0.009802	0.176470	0.226101
S1238	Mean val	26.5	0.980450	0.544943	0.138041	9.30	0.993137	0.638173	0.625464
31200	Std devi	16.0	0.011843	0.135472	0.035833	9.26	0.006837	0.204847	0.316259
S13207	Mean val	451.2	0.967833	0.503347	4.485122	415.50	0.970378	0.510609	179.388912
51020.	Std devi	209.8	0.014954	0.006082	1.396625	206.16	0.014697	0.084105	84.092115
S1423	Mean val	10.8	0.992935	0.504880	0.287925	1.27	0.999166	0.911600	0.475551
0	Std devi	3.2	0.002085	0.090158	0.042167	0.54	0.000355	0.088398	0.116078
s1488	Mean val	87.8	0.943195	0.504151	0.049056	2.80	0.998189	0.771755	1.493503
1	Std devi	51.3	0.033208	0.021097	0.014588	3.45	0.002232	0.179371	0.755777
51494	Mean val	77.8	0.950070	0.514955	0.046938	3.31	0.997875	0.782814	1.311980
	Std devi	42.3	0.027138	0.099820	0.010862	2.22	0.001426	0.175880	0.553523
S15850	Mean val	57.9	0.996402	0.501545	13.121100	50.14	0.996881	0.580030	18.414854
	Std devi	34.8	0.002162	0.017063	2.463643	38.77	0.002411	0.124950	11.198270
S208	Mean val	91.7	0.581187	0.502271	0.007545	2.04	0.990685	0.763321	0.853328
L	Std devi	28.0	0.127870	0.071652	0.000676	2.70	0.012330	0.037766	0.258813
527	Mean val	9.4	0.707589	0.507237	0.003756	1.14	0.964286	0.947114	0.126156
	Std devi	5.5	0.171209	0.038479	0.000032	0.36	0.011136	0.046641	0.080785
s298	Mean val	20.4	0.936094	0.509820	0.008182	1.20	0.996250	0.928554	0.252414
<u></u>	Std devi	7.3	0.022715	0.086924	0.000683	0.47	0.001473	0.041943	0.092438
s344	Mean val	17.6	0.952581	0.502774	0.010436	1.19	0.996801	0.933129	0.316783
	Std devi	5.7	0.015329	0.008490	0.001616	0.39	0.001060	0.046701	0.102387
s349	Mean val	16.5	0.956465	0.522945	0.010592	1.22	0.996796	0.926553	0.272924
	Std devi	6.7	0.017704		0.001481	0.41		0.061387	0.097884
s35932	Mean val	51.8 20.5	0.998748 0.000496	0.507962	1.574615 0.207984	35.71 21.76	0.999137 0.000526	0.531090	46.076119 19.671549
-280					0.201504	1.29	0.996975	0.908203	0.292267
s382	Mean val	11.2	0.973721	0.517136 0.031231	0.009324	0.53	0.001258	0.109931	0.292267
s38417	Mean val	51.7	0.998676	0.505275	12.369864	34.50	0.999116	0.566159	34.894143
500-111	Std devi	27.1	0.000695	0.071114	3.327115	24.78	0.000635	0.120659	17.936185
s38584	Mean val	183.8	0.995261	0.500325	5.654998	85.63	0.997793	0.514111	187.190423
300001	Std devi	100.0	0.002577	0.005781	1.474001	84.95	0.002190	0.009674	111.726843
s386	Mean val	35.2	0.914171	0.507157	0.009380	3.84	0.990634	0.794328	0.496652
3333	Std devi	13.1	0.031927	0.015882	0.001067	5.99	0.014621	0.200478	0.131595
5420	Mean val	208.6	0.543588	0.510314	0.025203	42.12	0.907834	0.522581	4.089510
	Std devi	42.2	0.092344	0.099554	0.002901	46.31	0.101345	0.097060	0.815929
s444	Mean val	16.7	0.967087	0.500779	0.010342	1.55	0.996948	0.877694	0.307685
	Std devi	4.9	0.009554	0.011098	0.000975	0.93	0.001821	0.108708	0.111791
s510	Mean val	67.4	0.880567	0.500911	0.019455	11.33	0.979911	0.580700	0.895692
	Std devi	30.7	0.054502	0.010747	0.003469	13.72	0.024334	0.140474	0.379244
s526	Mean val	14.2	0.974868	0.511028	0.011816	1.76	0.996887	0.850129	0.261785
L	Std devi	6.0	0.010557	0.042808	0.001508	1.82	0.003212	0.148433	0.061879
s5378	Mean val	126.0	0.976334	0.495438	0.739800	15.25	0.997136	0.569736	12.201607
	Std devi	26.1	0.004904	0.001866	0.071859	23.55	0.004422	0.026390	2.410274
8641	Mean val	17.8	0.973571	0.503703	0.067374	3.66	0.994578	0.668897	0.898368
<u></u>	Std devi	6.9	0.010294	0.018010	0.011154	3.23	0.004784	0.080649	0.528108
s713	Mean val	14.7	0.980122	0.496191	0.072047	2.95	0.995997	0.724039	0.434547
-000	Std devi	4.9	0.006712	0.011450	0.009795	1.83	0.002480	0.106096	0.190034
s820	Mean val	109.8	0.870788	0.502254	0.025279	34.42 28.62	0.959506 0.033670	0.510530 0.003710	1.651958 0.321705
C C C C C C C C C C C C C C C C C C C	Std devi	24.3	0.028579	0.005034	0.002867			0.582702	•
s832	Mean val	115.1 35.7	0.867713 0.040996	0.505600	0.025748 0.004323	34.00 37.48	0.960920	0.582702	1.797883 0.527931
s838	Mean val	443.0	0.525188	0.495984	0.135621	148.50	0.840836	0.502573	9.882970
8000	Std devi	0.0	0.000000	0.000000	0.000000	124.25	0.133175	0.000000	0.000000
s9234	Mean val	432.6	0.950870	0.491025	4.167816	301.56	0.965751	0.501422	40.581289
00207	Std devi	229.7	0.026092	0.491023	2.073148	229.52	0.026067	0.004537	20.845178
s953	Mean val	20.0	0.981951	0.508385	0.041788	4.60	0.995845	0.673504	0.661062
1	Std devi	10.0	0.009017	0.023915	0.006380	4.86	0.004392	0.163108	0.334610

Table 4.11: Experiment Results: at Vector Size = 1 Block

circuit		No.PO	FEI I	Resl	Tim-l	N.sg	FE2 2	Res2 2	Tim2 2
S1196	Mean val	40.4	0.967664	0.509125	0.117192	8.02	0.993584	0.711850	2.221863
51155	Std devi	18.5	0.014768	0.073784	0.025260	10.77	0.008620	0.184411	0.661930
S1238	Mean val	26.5	0.980450	0.544943	0.138173	6.29	0.995358	0.717567	1.902233
1 51200	Std devi	16.0	0.011843	0.135472	0.035822	8.00	0.005905	0.194906	0.966260
S13207	Mean val	451.2	0.967833	0.503347	4.475142	228.04	0.983743	0.511686	582.470852
313201	Std devi	209.8	0.014954	0.006082	1.391030	206.80	0.014743	0.086087	273.304172
S1432	Mean val	10.8	0.992935	0.504880	0.287494	1.18	0.999226	0.931911	1.520700
31402	Std devi	3.2	0.002085	0.090156	0.042621	0.39	0.000255	0.068339	0.465548
S1488	Mean val	87.8	0.943195	0.504151	0.050336	1.41	0.999088	0.898617	4.681600
31400	Std devi	51.3	0.033208	0.021097	0.015254	0.43	0.000278	0.077878	2.379818
S1494	Mean val	77.8	0.950070	0.514955	0.047442	1.36	0.999127	0.912235	4.029601
21434	Std devi	42.3	0.027138	0.099820	0.010954	0.40	0.000256	0.065754	1.700413
S15850	Mean val	57.9	0.996402	0.501545	13.227878	47.58	0.997041	0.591980	57.921164
213630	Std devi	34.8	0.002162	0.017063	2.487707	37.89	0.002357	0.142191	35.480927
S208	Mean val	91.7	0.581187	0.502271	0.007698	1.10	0.994977	0.968038	2.613114
3206	Std devi	28.0	0.127870	0.071652	0.000707	0.30	0.001377	0.045719	0.795429
S27	Mean val	9.4	0.707589	0.507237	0.003815	1.14	0.964286	0.947114	0.381541
521	Std devi	5.5	0.171209	0.038479	0.000052	0.38	0.011136	0.046641	0.247447
CHINA		20.4	0.936094	0.509820	0.008234	1.18	0.996312	0.932337	0.749791
S298	Mean val	7.3	0.022715	0.086924	0.000254	0.46	0.001431	0.038589	0.274888
				0.502774	0.010566	1.19	0.996801	0.933129	0.965103
S344	Mean val	17.6	0.952581	0.008490	0.001645	0.39	0.001060	0.933129	0.313632
	Std devi			0.522945	0.001040	1.22	0.996796	0.926553	0.826646
S349	Mean val	16.5	0.956465	0.522945	0.010727	0.41	0.001091	0.920003	0.320043
				0.507962	1.609906	25.49	0.999384	0.555580	139.086583
S35932	Mean val	51.8 20.5	0.998748 0.000496	0.507902	0.223111	14.63	0.000354	0.063884	59.407516
7888		11.2		0.517136	0.009580	1.21	0.997158	0.926828	0.875288
S382	Mean val	4.7	0.973721	0.031231	0.000853	0.41	0.000961	0.100068	0.517888
			0.998676	0.505275	12.370536	31.79	0.999185	0.566942	105.763023
538417	Mean val	51.7 27.1	0.000695	0.000275	3.327381	24.12	0.000618	0.120275	54.467150
COMPERA	Std devi		0.995261	0.500325	5.652058	83.32	0.997852	0.517357	642,720268
S38584	Mean val	183.8	0.995261	0.005781	1.471293	86.85	0.002239	0.042042	390.521607
1000				0.507157	0.009451	1.16	0.997171	0.950773	1.500052
S386	Mean val	35.2 13.1	0.914171	0.015882	0.009431	0.44	0.001081	0.034597	0.405652
0400			0.543588	0.510314	0.025227	27.45	0.939934	0.528923	9.020571
S420	Mean val	208.6 42.2	0.092344	0.099554	0.002938	35.04	0.076683	0.095771	1.795554
				0.500779	0.010377	1.53	0.996988	0.885691	0.923389
S444	Mean val	16.7	0.967087 0.009554	0.00119	0.000954	0.93	0.001823	0.115910	0.337797
CELO	Mean val	67.4	0.880567	0.500911	0.019526	1.32	0.997660	0.906006	2.709164
S510	Std devi	30.7	0.054502	0.010747	0.003437	1.20	0.002122	0.090762	1.148261
S526	Mean val	14.2	0.974868	0.511028	0.011795	1.15	0.997977	0.944215	0.787587
3020	Std devi	6.0	0.010557	0.042808	0.001499	0.36	0.000629	0.047126	0.188086
55378	Mean val	126.0	0.976334	0.495438	0.739858	2.93	0.999450	0.812201	36.261426
33310	Std devi	26.1	0.004904	0.001866	0.072841	1.28	0.000240	0.028479	7.109208
S641	Mean val	17.8	0.973571	0.503703	0.067118	2.06	0.996948	0.746788	2.937976
2041	Std devi	6.9	0.010294	0.018010	0.011031	1.32	0.001962	0.045145	1.781359
5713	Mean val	14.7	0.980122	0.496191	0.072086	2.75	0.996269	0.735115	1.371060
3113	Std devi	4.9	0.006712	0.011450	0.010009	1.71	0.002317	0.101986	0.648632
2900		109.8	0.870788	0.502254	0.025341	7.14	0.991600	0.578597	5.013247
S820	Std devi	24.3	0.028579	0.005034	0.002768	12.32	0.014498	0.013586	0.967151
5832	Mean val	115.1	0.867713	0.505600	0.025738	12.24	0.985931	0.611156	5.452150
3032	Std devi	35.7	0.040996	0.005970	0.004274	20.02	0.023010	0.108842	1.599854
S838	Mean val	443.0	0.525188	0.495984	0.136042	37.79	0.959496	0.508301	30.458401
3636	Std devi	0.0	0.0000000	0.000000	0.000000	73.52	0.078802	0.000000	0.000000
59234	Mean val	432.6	0.950870	0.491025	4.163123	298.38	0.966112	0.501539	122.398378
39234	Std devi	229.7	0.026092	0.491025	2.070511	233.89	0.026563	0.005162	63.369019
S953	Mean val	20.0	0.981951	T 0.508385	0.042309	2.36	0.997868	0.831792	2.507427
2902	Std devi	10.0	0.009017	0.023915	0.006440	3.13	0.002829	0.152252	1.258815
L	1 Day GEAT	10.0	0.000011	1 0.020010	, 0.000110	, 4.24	,	,,	,

Table 4.12: Experiment Results: at Vector Size = 3 Blocks

circuit		No.PO	FE1	Resl	Tim-I	N.sg	FE2	Res2	Tim2
S1196	Mean val	40.4	0.967664	0.509125	0.117559	1.10	0.999120	0.975917	73.413633
	Std devi	18.5	0.014768	0.073784	0.026136	0.30	0.000241	0.013457	22.173283
S1238	Mean val	26.5	0.980450	0.544943	0.140341	1.54	0.998863	0.885438	62.498819
L	Std devi	16.0	0.011843	0.135472	0.036224	1.31	0.000964	0.124728	31.817196
S13207	Mean val	450.8	0.967861	0.477111	4.460785	0.24	0.079983	NaN	26.626220
	Std devi	209.6	0.014945	0.007711	1.388280	1.69	0.467436	NaN	163.793013
S1423	Mean val	10.8	0.992935	0.504880	0.286779	1.18	0.999226	0.931911	50.083058
	Std devi	3.2	0.002085	0.090156	0.042639	0.39	0.000255	0.068339	14.297090
s1488	Mean val	87.8	0.943195	0.504151	0.048763	1.07	0.999308	0.976014	146.814391
	Std devi	51.3	0.033208	0.021097	0.014411	0.27	0.000177	0.025463	73.289751
51494	Mean val	77.8	0.950070	0.514955	0.046623	1.07	0.999313	0.974197	132.158791
	Std devi	42.3	0.027138	0.099820	0.010782	0.24	0.000153	0.014740	55.920015
S15850	Mean val	57.9	0.996402	0.501545	13.130156	34.07	0.997881	0.688131	1860.358042
	Std devi	34.8	0.002162	0.017063	2.462524	32.33	0.002011	0.143152	1133.028675
S208	Mean val	91.7 28.0	0.581187	0.502271 0.071652	0.007631 0.000692	1.04 0.20	0.995251 0.000899	0.985123 0.050704	85.175747 25.954366
S27	Mean val	9.4	0.707589	0.507237	0.003781	1.14	0.964286	0.947114	12.312904
321	Std devi	5.5	0.171209	0.038479	0.000042	0.36	0.904286	0.046641	8.011791
s298	Mean val	20.4	0.936094	0.509820	0.008156	1.14	0.996437	0.945815	24.462762
3230	Std devi	7.3	0.022715	0.086924	0.000653	0.35	0.001090	0.033634	9.050022
8344	Mean val	17.6	0.952581	0.502774	0.010441	1.19	0.996801	0.933129	31.323758
3011	Std devi	5.7	0.015329	0.008490	0.001625	0.39	0.001060	0.046701	10.176032
s349	Mean val	16.5	0.956465	0.522945	0.010600	1.22	0.996798	0.926553	26,995426
30.0	Std devi	6.7	0.017704	0.102848	0.001524	0.41	0.001091	0.061387	9.726708
s35932	Mean val	51.8	0.998748	0.507962	1.574314	4.73	0.999886	0.731297	4754.160868
1 300002	Std devi	20.5	0.000496	0.018067	0.208378	3.95	0.000095	0.093807	2054.791673
s382	Mean val	11.2	0.973721	0.517136	0.009568	1.21	0.997158	0.926828	28.956906
1	Std devi	4.7	0.010999	0.031231	0.000821	0.41	0.000961	0.100068	17.215196
s38417	Mean val	51.7	0.998676	0.505275	12.657835	2.32	0.999940	0.765388	3540.240704
	Std devi	27.1	0.000695	0.071114	3.515851	1.99	0.000051	0.075551	1822.848279
s38584	Mean val	183.8	0.995261	0.500325	5.665607	1.92	0.999950	0.864760	19610.315857
L	Std devi	100.0	0.002577	0.005781	1.480544	0.70	0.000018	0.032426	11768.585251
s386	Mean val	35.2	0.914171	0.507157	0.009343	1.06	0.997415	0.974603	49.773456
	Std devi	13.1	0.031927	0.015882	0.001028	0.24	0.000582	0.013941	14.403352
S420	Mean val	208.6	0.543588	0.510314	0.025209	5.20	0.988622	0.604806	296.128236
<u></u>	Std devi	42.2	0.092344	0.099554	0.002931	11.22	0.024544	0.080344	58.932283
8444	Mean val	16.7	0.967087	0.500779	0.010330	1.53	0.996988	0.885691	30.457289
<u></u>	Std devi	4.9	0.009554	0.011098	0.000990	0.93	0.001823	0.115910	11.152072
s510	Mean val	67.4	0.880567	0.500911	0.019450	1.00	0.998227	1.000000	90.428837
	Std devi	30.7	0.054502	0.010747	0.003457	0.00	0.000000	0.000000	38.214107
s526	Mean val	14.2	0.974868	0.511028 0.042808	0.011707 0.001522	1.12 0.32	0.998029 0.000572	0.953551 0.044479	25.958577 6.187776
s5378		1 126.0	0.976334	0.495438	0.741109	1.91	0.999641	0.863546	1235,068971
80378	Mean val	26.1	0.970334	0.001866	0.741109	0.80	0.000150	0.001353	242.267404
8641	Mean val	17.8	0.973571	0.503703	0.067043	1.84	0.997274	0.782394	95.725906
2041	Std devi	6.9	0.010294	0.018010	0.011259	1.16	0.001720	0.074199	57.655523
8713	Mean val	14.7	0.980122	0.496191	0.071854	2.51	0.996594	0.772397	44.946472
31.20	Std devi	4.9	0.006712	0.011450	0.010190	1.67	0.002269	0.120549	20.844555
s820	Mean val		0.870788	0.502254	0.025314	1.08	0.998730	0.966354	168.993858
	Std devi	24.3	0.028579	0.005034	0.002811	0.26	0.000302	0.016984	32.916131
s832	Mean val	115.1	0.867713	0.505600	0.025782	1.66	0.998092	0.863585	186.045482
L	Std devi	35.7	0.040996	0.005970	0.004297	2.60	0.002986	0.055803	54.662843
s838	Mean val	443.0	0.525188	0.495984	0.136353	18.09	0.980611	0.520291	1030.640015
	Std devi	0.0	0.000000	0.000000	0.000000	48.87	0.052382	0.000000	0.000000
s9234	Mean val	432.6	0.950870	0.491025	4.164550	176.06	0.980004	0.528993	4081.845998
	Std devi	229.7	0.026092	0.000616	2.060508	174.24	0.019789	0.175637	2110.354335
s953	Mean val	20.0	0.981951	0.508385	0.041605	1.00	0.999097	1.000000	66.039637
	Std devi	10.0	0.009017	0.023915	0.006370	0.00	0.0000000	0.0000000	29.384773
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Table 4.13: Experiment Results: at Vector Size = 100 Blocks

circuit		No.PO	FEI	ResI	Tim-1	N.sg	FE2	Res2	Tim2
S1196	Mean val	40.4	0.967664	0.509125	0.117146	1.06	0.999152	0.988957	147.249087
	Std devi	18.5	0.014768	0.073784	0.025213	0.24	0.000191	0.016443	44.298354
51238	Mean val	26.5	0.980450	0.544943	0.140306	1.52	0.998878	0.892887	125.030973
	Std devi	16.0	0.011843	0.135472	0.034881	1.31	0.000964	0.130554	63.622295
S13207	Mean val	451.2	0.967833	0.503347	4.481532	8.31	0.999408	0.624335	36939.020254 17314.794863
	Std devi	209.8	0.014954	0.006082	1.389790 0.289061	16.31	0.999228	0.0031911	100.383009
S1423	Mean val	10.8	0.992935	0.090156	0.265001	0.39	0.000255	0.068339	29.084290
s1488	Mean val	87.8	0.943195	0.504151	0.049502	1.07	0.999308	0.976014	297.574417
31400	Std devi	51.3	0.033208	0.021097	0.014716	0.27	0.000177	0.025463	148.375281
S1494	Mean val	77.8	0.950070	0.514955	0.047070	1.06	0.999319	0.976318	263.818519
	Std devi	42.3	0.027138	0.099820	0.010806	0.24	0.000153	0.013757	111.759692
S15850	Mean val	57.9	0.996402	0.501545	13.165654	33.46	0.997919	0.688100	3747.449760
L	Std devi	34.8	0.002162	0.017063	2.463513	31.72	0.001973	0.143176	2279.203481
S208	Mean val	91.7	0.581187	0.502271	0.007640	1.04	0.995251	0.985123	170.554580 51.854869
<u></u>	Std devi	28.0	0.127870	0.071652	0.000677	0.20	0.000899	0.050704	25.006189
S27	Mean val	9.4	0.707589	0.507237 0.038479	0.003923	1.14 0.36	0.011136	0.045641	16.251715
s298	Mean val	20.4	0.171209	0.509820	0.008293	1.14	0.996437	0.945815	49.252527
8230	Std devi	7.3	0.022715	0.086924	0.00053	0.35	0.001090	0.033634	18.229114
8344	Mean val	17.6	0.952581	0.502774	0.010603	1.19	0.996801	0.933129	62.774068
	Std devi	5.7	0.015329	0.008490	0.001752	0.39	0.001060	0.046701	20.398624
s349	Mean val	16.5	0.956465	0.522945	0.010657	1.22	0.996796	0.926553	54.076983
	Std devi	6.7	0.017704	0.102848	0.001446	0.41	0.001091	0.061387	19.471593
s35932	Mean val	51.8	0.998748	0.507962	1.643054	4.73	0.999886	0.731297	9791.756035
<u> </u>	Std devi	20.5	0.000496	0.018067	0.261218	3.95	0.000095	0.093807	4150.026015
s382	Mean val	11.2	0.973721	0.517136	0.009580	1.21 0.41	0.997158	0.926828	58.479288 34.373302
20437	Std devi	51.7	0.010999	0.505275	12.383353	2.32	0.999940	0.765388	7127.581564
s38417	Std devi	27.1	0.000695	0.000275	3.329150	1.99	0.000051	0.075551	3668.555390
s38584	Mean val	181.8	0.995312	0.500179	5.656237	1.53	0.999960	0.906149	39638.458155
300001	Std devi	140.5	0.003623	0.009532	1.925229	0.71	0.000018	0.081930	34595.017868
s386	Mean val	35.2	0.914171	0.507157	0.009259	1.06	0.997415	0.974603	99.485589
	Std devi	13.1	0.031927	0.015882	0.001032	0.24	0.000582	0.013941	28.997403
S420	Mean val	208.6	0.543588	0.510314	0.025858	4.14	0.990941	0.634390	594.336767
	Std devi	42.2	0.092344	0.099554	0.003078	8.62	0.018854	0.074329	118.281332
s444	Mean val	16.7	0.967087 0.009554	0.500779	0.010409	1.53	0.996988	0.885691 0.115910	61.481766 22.454129
	Mean val	67.4	0.880567	0.500911	0.001070	1.00	0.998227	1.000000	179.111218
s510	Std devi	30.7	0.054502	0.010747	0.003501	0.00	0.000000	0.000000	75.650023
s526	Mean val	14.2	0.974868	0.511028	0.011894	1.12	0.998029	0.953551	52.911416
1 3020	Std devi	6.0	0.010557	0.042808	0.001431	0.32	0.000572	0.044479	12.730298
s5378	Mean val	126.0	0.976334	0.495438	0.741353	1.91	0.999641	0.863546	2489.293048
	Std devi	26.1	0.004904	0.001868	0.070920	0.80	0.000150	0.001353	481.189011
s641	Mean val	17.8	0.973571	0.503703	0.067211	1.84	0.997274	0.782394	191.619170
	Std devi	6.9	0.010294	0.018010	0.011091	1.16	0.001720	0.074199	115.055459
s713	Mean val	14.7	0.980122 0.006712	0.496191 0.011450	0.073382 0.010419	2.51 1.67	0.996594	0.772397	90.493311 41.941011
-800	Std devi	4.9		0.502254	0.025235	1.07		0.967621	387.741011
s820	Mean val	109.8 24.3	0.870788 0.028579	0.005034	0.002835	0.24	0.996742	0.019689	66.538532
	Std devi	24.3	0.028579	0.005034	0.002835	0.24	0.000281	0.019689	66.538532
s832	Mean val	115.1	0.867713	0.505600	0.025782	1.64	0.998115	0.863771	368.130631
3002	Std devi	35.7	0.040996	0.005970	0.004289	2.60	0.002989	0.055720	108.023411
s838	Mean val	443.0	0.525188	0.495984	0.136384	17.71	0.981018	0.521175	2066.250000
	Std devi	0.0	0.000000	0.000000	0.000000	47.84	0.051272	0.000000	0.000000
s9234	Mean val	432.6	0.950870	0.491025	4.397266	178.14	0.979768	0.571571	5980.803442 1977.304895
s953	Std devi Mean val	229.7 20.0	0.026092	0.000616	2.102947 0.042074	177.74	0.020186	1.000000	134.227867
5500	Std devi	10.0	0.009017	0.023915	0.006309	0.00	0.000000	0.000000	61.838340
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Table 4.14: Experiment Results: at Vector Size = 200 Blocks

circuit		No.PO	FEI	Res1	Tim-1	N.sg	FE2	Res2	Tim2
S1196	Mean val	34.0	0.972816	0.504563	0.111697	1.00	0.999200	1.000000	427.135373
52256	Std devi	22.2	0.017775	0.016686	0.014001	0.00	0.000000	0.000000	324.338272
S1238	Mean val	28.5	0.978974	0.521747	0.116647	1.02	0.999247	0.956386	295.917012
52200	Std devi	21.6	0.015932	0.072049	0.018135	0.14	0.000104	0.063454	310.430953
S13207	Mean val	13.1	0.999067	0.496428	1.627785	3.00	0.999786	0.705524	1128.528546
32020	Std devi	4.9	0.000352	0.007203	0.073869	1.59	0.000113	0.114427	428.767579
S1423	Mean val	41.4	0.972888	0.510764	0.317670	1.20	0.999214	0.907801	1430.745272
J	Std devi	49.1	0.032184	0.073381	0.068815	0.40	0.000263	0.061490	2017.040580
S1488	Mean val	108.9	0.929547	0.500000	0.058486	1.08	0.999301	0.978084	471.361205
1	Std devi	37.6	0.024297	0.000000	0.009787	0.27	0.000176	0.004360	162.612369
51494	Mean val	63.1	0.959467	0.503863	0.045514	1.09	0.999300	0.975295	322.243564
	Std devi	21.9	0.014053	0.003985	0.005733	0.30	0.000194	0.025112	110.209484
S15850	Mean val	11.8	0.999265	0.549594	11.703672	3.82	0.999762	0.667054	995.284957
1 220000	Std devi	5.1	0.000320	0.153461	1.604618	1.51	0.000094	0.121014	431.396767
S208	Mean val	77.6	0.645480	0.505438	0.008298	1.10	0.994977	0.968782	230.938924
	Std devi	39.6	0.181003	0.071188	0.000884	0.30	0.001377	0.062059	114.972910
S27	Mean val	11.1	0.653409	0.508972	0.004388	1.18	0.963068	0.932690	48.950959
	Std devi	4.9	0.152761	0.005624	0.000062	0.39	0.012337	0.042189	24.518070
S298	Mean val	13.2	0.958814	0.516561	0.008639	1.26	0.996074	0.902941	56.377723
1	Std devi	4.6	0.014437	0.113529	0.000599	0.44	0.001373	0.069291	34.235028
\$344	Mean val	15.3	0.958800	0.500740	0.011225	1.17	0.996859	0.937665	82.963970
L	Std devi	6.3	0.016994	0.010360	0.001462	0.38	0.001011	0.054083	37.545672
S349	Mean val	16.6	0.956263	0.501188	0.012163	1.20	0.996842	0.931670	84.904563
	Std devi	5.5	0.014427	0.006620	0.001386	0.40	0.001058	0.058412	25.827714
S35932	Mean val	58.3	0.998593	0.522570	1.532068	5.71	0.999862	0.670373	14858.666705
	Std devi	12.4	0.000300	0.097044	0.097437	4.52	0.000109	0.066441	3066.686633
S382	Mean val	12.1	0.971492	0.498383	0.010706	1.35	0.996829	0.884832	78.302076
L	Std devi	4.3	0.010028	0.025865	0.000673	0.48	0.001129	0.101885	51.689174
538417	Mean val	173.7	0.995550	0.501289	12.496505	55.64	0.998574	0.699147	36967.451376
<u></u>	Std devi	76.2	0.001952	0.000503	2.136030	65.69	0.001683	0.191128	16386.478158
S38584	Mean val	84.2	0.997829	0.520643	4.543598	1.21	0.999969	0.960246	17215.117676
	Std devi	66.3	0.001709	0.119371	1.274687	0.68	0.000018	0.080336	13551.076979
S386	Mean val	32.1	0.921732	0.507089	0.010488	1.08	0.997366	0.972604	122.942513 47.766188
	Std devi	15.5	0.037849	0.015915	0.001073	0.27	0.000685		616.126910
S420	Mean val	150.0	0.671772 0.257715	0.493786	0.022605	2.22 5.17	0.995142	0.745102 0.111564	482.782380
- WAAA				* 		1.91	0.996240	0.818900	90.960955
S444	Mean val	19.6 4.5	0.961338	0.510817	0.013081 0.001099	1.01	0.001980	0.075880	21.793170
S510	Mean val	62.0	0.889982	0.505065	0.020454	1.00	0.998227	1.000000	223,601850
2010	Std devi	41.4	0.073320	0.017402	0.004490	0.00	0.000000	0.000000	132.528619
S526	Mean val	19.9	0.964903	0.504299	0.014388	1.11	0.998042	0.952965	107.910275
3020	Std devi	8.8	0.015462	0.010730	0.001307	0.31	0.000554	0.037658	32.753495
S5378	Mean val	138.2	0.974049	0.499790	0.793536	1.72	0.999677	0.869040	4536.303532
500.0	Std devi	58.8	0.011048	0.007430	0.154073	0.84	0.000157	0.070498	1950.768704
S641	Mean val	11.4	0.983069	0.498628	0.060733	2.29	0.996614	0.718197	162.806506
50	Std devi	3.7	0.005439	0.011356	0.007163	1.14	0.001683	0.058542	154.536390
S713	Mean val	1 12.0	0.983675	0.493070	0.070883	2.43	0.996709	0.749714	117.519485
1	Std devi	4.6	0.006179	0.020019	0.007117	1.33	0.001807	0.106649	57.899816
S820	Mean val	134.0	0.842353	0.497246	0.030136	1.06	0.998753	0.987212	535.833008
	Std devi	0.0	0.000000	0.000000	0.000000	0.24	0.000281	0.000000	0.000000
S832	Mean val	60.3	0.930713	0.517179	0.021379	1.24	0.998575	0.929402	260.858953
L	Std devi	31.7	0.036431	0.038147	0.003380	0.65	0.000751	0.032819	109.522932
S838	Mean val	443.0	0.525188	0.495984	0.139998	16.62	0.982186	0.521681	3068.679932
L	Std devi	0.0	0.000000	0.000000	0.000000	47.66	0.051084	0.000000	0.000000
S9234	Mean val	333.5	0.962127	0.495587	3.295575	22.84	0.997406	0.628578	9322.703651
<u></u>	Std devi	267.6	0.030394	0.009328	1.873781	20.61	0.002341	0.187094	7029.276570
5953	Mean val	20.1	0.981879	0.513811	0.045731	1.14	0.998970	0.954675	191.561287
	Std devi	8.8	0.007941	0.025558	0.006463	0.43	0.000388	0.046801	65.692972

Table 4.15: Experiment Results: at Vector Size = 256 Blocks

Figure 4.2 is a graphical representation of the RES2 for ISCAS'85 circuits. The X and Y axes are the test length and value of RES2 respectively. Each curve represents the RES2 average value of 100 faults at different testing lengths. It can be generally seen that the number of RES2 increases as the number of the test vectors increases. But after the length is greater than 100 Blks, the RES does not increase much.

4.3.6 Resolution Comparison

In [3], some experiments were performed to investigate the final resolution of DAP-PER. The circuits they checked were the ISCAS'85 benchmarks. Input vectors were generated by LFSRs as indicated in [10] and initialized to random values. A test length of 2048 was used. Based on the results of [3] and the redundancy number of each ISCAS'85 circuits presented in [27], we can calculate the average FE for each of their experimental circuit as shown in the sixth column in table 4.16. We also put our FE (average of FE2) of corresponding circuits at same testing length (t = 8 Blocks, equivalent to 2048 test vectors) in the seventh column in the same table.

Circuit	No. of	Missed	Redundant	un-distin	FE %	FE %	FE %
Name	Faults	Faults	Faults	faults	DAPPER	h-DIAG	difference
C432	520	0	4	4	99.2308	99.7758	0.5450
C499	750	0	8	8	98.9333	99.8595	0.9262
C880	942	9	0	9	99.0446	99.7352	0.6906
C1908	1870	20	9	29	98.4492	99.8917	1.4400
C2670	2478	314	117	431	82.6069	92.3133	9.7100
C3540	3291	19	137	156	95.2598	99.9626	4.7028
C5315	5291	1	59	60	98.8659	99.8280	0.9621
C6288	7719	0	34	34	99.5590	99.9837	0.4247
C7552	7417	366	131	497	93.2992	98.3374	5.0382

Table 4.16: Resolution Comparision With DAPPER (At Testing Length = 8 Blocks)

It can be seen that our fault elimination rate is higher than that of DAPPER by comparing the values in the FE columns in table 4.16. The last column in the table is used to illustrate the advantages of the resolution provided by our system. The numbers show how many percent of faults on average can be excluded more in our system than in DAPPER. For example, for C2670, we can eliminate 9.71% faults

more than DAPPER can do, so that, for each specific diagnosis, we can on average eliminate 9.71%*2478 = 240.6 faults more from the plausible fault, or undistinguished fault set. Therefore, the number of undistinguished faults will be 431-240 =191. This means that h-DIAG can restrict final fault to a even smaller range than DAPPER can do.

The fact that our final resolution is better than DAPPER is attributed to the following reasons:

- Our structural analysis has restricted the plausible faults in a smaller range than DAPPER's first stage's diagnosis. The diagnosis in the second stage inherits this previous advantage.
- 2. All signatures we analyzed in the second stage are complete signatures of a failing flip-flops while in DAPPER, information about the failing flip-flops is just part of the signatures.

Thus, if subsequent diagnostic methods are used for further diagnosis of a circuit, h-DIAG requires less time and computer resources than DAPPER because of the higher resolution h-DIAG has already obtained.

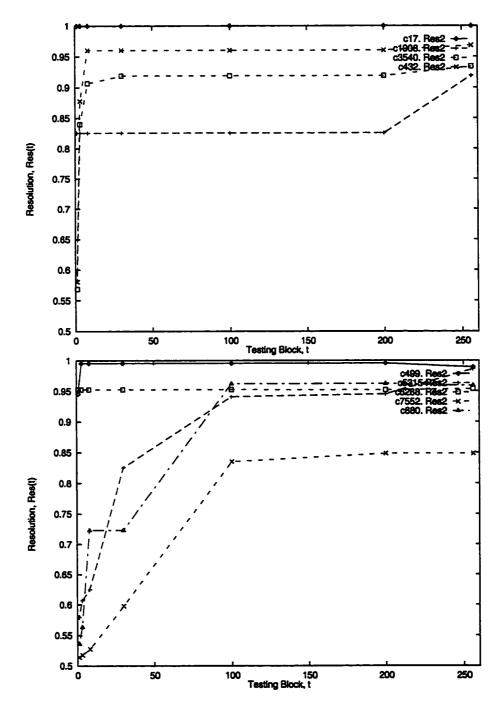


Figure 4.2: ISCAS'85 circuits resolution overview by estimation of RES2

Chapter 5

Software System Implementation

In this chapter, the implementation issues of h-DIAG will be discussed. We will present the general introduction to the implementation, the implementation tool, general flow chart of the system, main data structures and functions.

5.1 General Introduction to the Implementation

h-DIAG is a gate-level diagnostic system. It is a two-valued logic system, i.e., only two logic values, logic 1 and logic 0, are used. h-DIAG is a collection of software modules that perform simulation, creation of pseudorandomly generated responses, output response compaction, diagnosis by circuit structural analysis, dynamic dictionary construction and diagnosis by looking up the dictionary.

The h-DIAG software system was developed in a modular structure using C++. The various modules of the system were implemented as C++ objects, or classes. A C++ class is a collection of data and functions that operate on the data. The classes used in h-DIAG can be divided into three categories: circuit-related classes, diagnosis-related classes, and miscellaneous classes. Circuit-related classes define the structures of the logic gates available for simulations, construct a representation of the CUT, and control the way that logic information is passed between the gates during simulations. Diagnosis-related classes deal with structural analysis, test pattern generation, creating and injecting faults into the CUT, implementing the diagnostic algorithms, producing the simulation, constructing the dynamic dictionary and diagnostic outputs. The miscellaneous classes do not perform specific simulation or

diagnostic operations, but are used by other classes in h-DIAG.

A flowchart illustrating the functions performed by h-DIAG is given in figure 5.1.

5.2 Important Data Structures

The data structure in h-DIAG includes those used in main function, those used as members of classes and those used inside the member functions of each class. In this section, we will introduce the data structures in the main function and in each class.

5.2.1 Data Structures in Main function

The following data structures are used in main function:

- 1. previous_signature: An array of type Integer to keep the previous signatures for each failing flip-flop.
- affected_pri_out_nodes: An array that stores all the POs which are affected by a fault.
- 3. **vector and response:** Both are Integer arrays storing the test vectors and responses from simulator.
- 4. Arr: a long integer array used as a dynamic dictionary.
- 5. fault_no_in_the_set: An array that stores all the plausible faults after diagnosis in the first stage.

5.2.2 Data Structures in Classes

Some basic data structures in h-DIAG' classes are presented in this section.

Data Structures in Gate Class

The Gate class represents a single logic gate in a circuit. It is an abstract class serving as a base class from which subclasses representing the individual logic gates are derived.

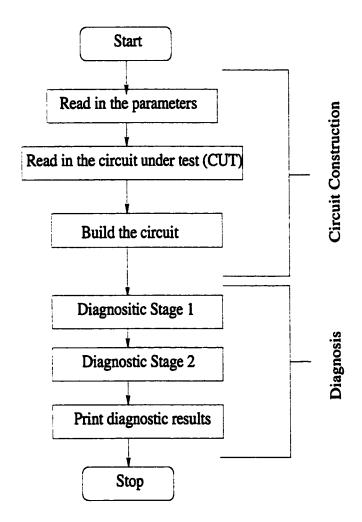


Figure 5.1: General Flow Chart of h-DIAG

The member variables of the Gate class include the number of inputs, the output Node, and an array of input Nodes. Each subclass derived from the base has a specific *Evaluate()* member function that implements the behavior of the respective logic gate. All Gate objects in the circuit are stored in a global linked-list.

Figure 5.2 illustrates the basic structure of a Gate object.

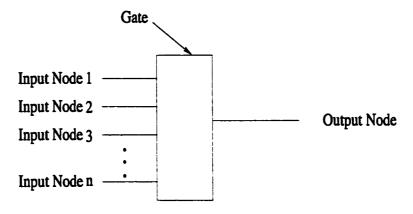


Figure 5.2: Gate Object

The following information is stored in every Gate object:

- 1. next: A pointer pointing to the next gate.
- 2. **ninputs:** The number of inputs to the gate.
- 3. in: The array of input Nodes.
- 4. out: The array of output Nodes.

The form of the gate list is shown in Figure 5.3

Data Structures in Node Class

The Node class abstracts the interconnections between logic gates in a digital circuit. All Nodes, except for the primary input and primary output Nodes, must have a source Gate and at least one fanout Gate. The primary input Nodes have no source Gate, while the primary output Nodes have no fanout Gate. The member variables of a Node object are: a unique numerical address, the Node name, the source Gate, the number of fanout Gates, an array of Gates in the fanout, and an Int256 object (see

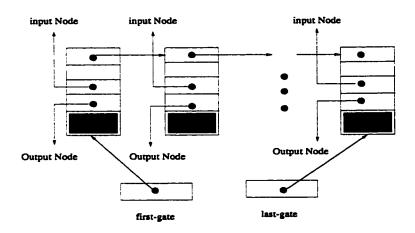


Figure 5.3: Gate List

below) which represents the 256 logic values of the Node when simulated in parallel. Figure 5.4 illustrates the basic structure of Node objects.

To allow quick access to any specific Node, all Nodes within the circuit are stored in a DynamicArray structure (see below), indexed by the Node address. This structure grows in size as the circuit is being created and new Nodes are added while permitting direct access to individual Nodes like a standard array.

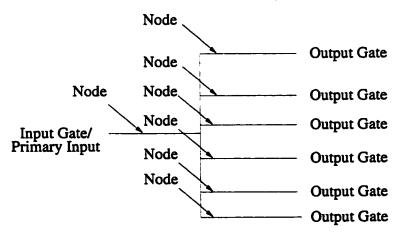


Figure 5.4: Node Object

The following information is stored in every Node object:

- 1. next: A pointer pointing to the next gate.
- 2. ninputs: The number of inputs to the gate.
- 3. in: The array of input Nodes.

4. out: The array of output Nodes.

A dynamic array is used to specify which numbers (addresses) correspond to existing Nodes in the circuit. The dynamic array contains pointers to all of the Nodes. The pointers are indexed by the address of the Nodes. Since the addresses are not necessarily consecutive, the dynamic array may contain gaps. If an address does not actually have an associated Node, the corresponding index in NodeArray is set to NULL. For example, if circuit Node number 3 in the ISCAS85 netlist represents a fanout node and is not directly associated with a logic gate, the dynamic array will contain a NULL value.

The basic connection of the node and the NodeArray is shown in Figure 5.5

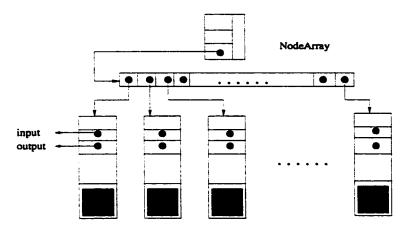


Figure 5.5: Node List

Data Structures in Fault Class and FaultList Class

The Fault class encapsulates an individual stuck-at fault. The member variables include: the type of stuck-at fault (input or output); the fault location in terms of a Gate and Node object; and the stuck-at value (either logic 1 or logic 0). Faults can be contained in FaultList objects, implemented as singly linked-lists.

The organization of the fault list can be shown in Figure 5.6.

Data Structures in Register Class

The Register class implements the MISR and LFSR objects used in the simulation. Register is the base class, and the MISR and LFSR classes are derived from the

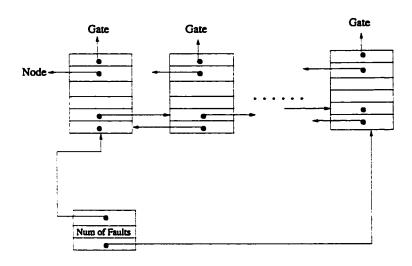


Figure 5.6: Fault-List Object

base class. To support large registers (more than 32 bits), the actual shift register is implemented with g++ built-in Integer objects. The Integer class provides multiple precision integer arithmetic, including logic operations. Thus, effectively any length of shift register can be realized.

Data Structures in Sim Class

The Sim class is mainly composed of an pointer array of Register class.

5.3 Diagnostic Implementation

The first step in the diagnostic procedure is to read the circuit into the h-DIAG. Thus, first of all we parse the circuit's net-list file and create the appropriate Gate and Node objects to represent the circuit. The net-list file is parsed one line at a time; the logic gate is extracted and the respective Gate and Node objects are created. Extensive use of regular expressions in the g++ built-in String class are used to parse each circuit line. Error-checking is performed on each line read to ensure a valid circuit in form of ISCAS85 circuit is created.

After the circuit has been read and the corresponding Node list and Gate list are set up, the location of the failing flip-flops are read in. This leads to the start of the diagnosis in structural analysis.

During this stage, each failing flip-flop fi is traced backward to the nodes corresponding to the primary inputs and all of the nodes passed by are put into Nfi. NF is initialized as Nf1. While all of the Nfi are obtained for the corresponding failing flip-flops, an "AND" operation is performed between Nfi and NF, and the result is put into NF. The nodes in the NF are those having paths to all of the failing flip-flops. After this is done, each correct flip-flop is traced back and every node passed by is checked to see if it belongs to NF. If it is, the node is eliminated from the NF. After this procedure, all the nodes in the NF are the nodes which affect the failing flip-flops but do not affect the correct flip-flops. Thus we get all of the plausible faulty nodes of stage 1.

For all the faulty nodes, we created the stuck-at-1 and stuck-at-0 faults. All these faults are put into a fault array. Then fault collapsing among these faults is completed to get the final fault array where all of the faults inside have been collapsed.

The above steps are implemented using forward_tracing, backward_tracing, in-side_checker, kick_out and some member functions of the Node class and Gate class.

Before the second stage starts, the signatures of all of the failing flip-flops are read. Then the faults in the previous fault array are ejected one by one. For each fault ejected, the 256-bit value of the node is set to the stuck-at value if the node is a output of a gate, or a specific bit corresponding to the node is set to the specific value. Test vectors are then created by calling the member function of LFSR, Next(). After 256 vectors are created, all of them are inserted to the 256-bit value of corresponding PI nodes. The 256 bits are simulated in parallel from the PIs to the POs, gate by gate. The final responses of the failing flip-flops are caught and compacted into the corresponding signatures. This procedure is repeated untill all of the required test vectors had been simulated. The final signatures are put into the fault dictionary and at same time compared with those of the actual testing result.

After the above analysis is done, the faults having the same signatures as those obtained from testing are the final plausible faults.

Chapter 6

Conclusion

As built-in self-testing (BIST) technique becomes widely applied in designing and testing digital systems, the diagnosis in a BIST environment should attract more attention from both academia and industry [2, 3, 5, 7, 12, 29, 32, 34].

One of the well known BIST architectures used for integrated circuit (IC) testing is self-test using MISR/parallel SRSG¹ (STUMPS) [6]. STUMPS presents many internal circuit observation points from which data is compacted into a final signature. The application of test patterns and circuit response compaction occurs completely on-chip. Only the final signature is extracted from the CUT where it can be compared by the tester with an error-free reference signature. The original circuit responses are thus normally unavailable for fault diagnosis.

Besides the location of the faulty scan-path(s) and/or flip-flops, there are two other important problems to be solved in the diagnosis of a STUMPS structure [29]. The first problem is to identify the scan flip-flops which capture erroneous circuit responses of the combinational logic associated with the flip-flops. The second problem, or the further problem, is to locate the gate-level faults and failures which cause the erroneous circuit responses. In [29] and [34], new built-in self-diagnosis (BISD) schemes were proposed and proved very efficient in diagnosing the failing flip-flops for STUMPS structures. With the BISD schemes, both the locations and corresponding signatures of the failing flip-flops can be obtained.

This thesis, based on the new BISD schemes, presents a new hierarchical scheme

¹This is the acronym of Shift-Register Sequence Generator.

to diagnose the faulty gate (node) of the CUT. The main contributions of this thesis are:

- (1) Extended the diagnostic ability of the BISD systems proposed in [29, 34], which can locate failing flip-flops, to the stage where faulty gate level nodes can be located.
- (2) Proposed and implemented a new and feasible gate-level structural diagnostic method which only requires the location of the failing/correct flip-flops and which is suitable to all the single faulty sites models.
- (3) Proposed and implemented a structural analysis based hierarchical diagnostic scheme.
- (4) Proposed and implemented a new dynamic dictionary scheme suitable for built-in self-test (BIST) / built-in self-diagnosis (BISD) environments, which greatly reduces the length, the build-up time and the look-up time needed in the conventional fault dictionaries.
- (5) Based on the two resolution evaluation methods introduced, extensive experiments were made for the new diagnostic system h-DIAG.
 - (6) A user friendly interface was designed and on-line user manual was constructed.

 The following conclusions are reached from this thesis research:
 - 1. As the first stage of the hierarchical system, the structural analysis algorithm provides an effective initial diagnosis of a faulty circuit. The experiments on ISCAS'85 benchmark circuits indicated that, for all of the circuits, h-DIAG can remove more faults from the plausible fault set than corresponding diagnostic stage of DAPPER [3] can do. In some cases, h-DIAG can even remove approximately 17% faults more than this stage of DAPPER. The smaller fault set size leads to savings in the amount of CPU resources, time and space required in implementing subsequent diagnostic stages, such as circuit-level fault simulation.
 - 2. Closely related to the results of our structural analysis, the length of our dynamic dictionary is significantly reduced compared to conventional dictionaries.

In most cases, the length of the dynamic dictionary was just 1 - 3% of the conventional length. In one specific case during our experiment, the length of the dynamic dictionary was just 0.0024% of the conventional length (S38414 of ISCAS'89, group 2). This makes the space for the dictionary, the time to construct and look-up the dictionary significantly reduced.

3. Generally speaking, the final resolution of h-DIAG depends on the test length. The experiments also indicated that at the testing length of 100 block (25600 vectors), our resolution was very good such that the number of plausible faults was very close to 1 in most of the cases (this means almost only one plausible fault is left). When we prolong the test length, little change in resolution can be obtained. The comparison to the final resolution of DAPPER at same testing length 2048 vectors on ISCAS'85 circuits showed that our h-DIAG is more powerful.

The result of this research suggests that our new diagnostic algorithms can be a valuable part of a complete fault testing and diagnostic system. The following problems have been identified for further investigation:

- 1. Due to the fact that state-of-the-art VLSI designs are closely held company secrets and, as such, are unavailable for experimentation, all of the experiment results that we obtained are based on the ISCAS benchmark circuits. We think it would be quite helpful to exercise our diagnostic scheme on circuits with industrial sizes and with practical faulty responses.
- 2. Investigate the application of the structural analysis to the other diagnostic schemes to reduce the diagnostic cost. For example, stuck-at fault dictionaries are used to diagnose CMOS bridging faults in [20]. The diagnostic method uses information from a stuck-at fault dictionary, and the relationships between stuck-at faults and low-resistance bridging faults, to perform a diagnosis. It is claimed in [20] that for tests performed on benchmark circuits, over 92% of bridging faults in the circuit can be diagnosed correctly.

Although this method produced a high diagnostic resolution, it has some draw-backs. The most serious drawback is the time and memory required to construct and store a complete stuck-at fault dictionary. For large circuits, the amount of memory required may make the construction of a dictionary infeasible.

We think it will be interesting research to see how much the size of the dictionary can be reduced by introducing our structural analysis scheme and the corresponding dynamic dictionary scheme to [20].

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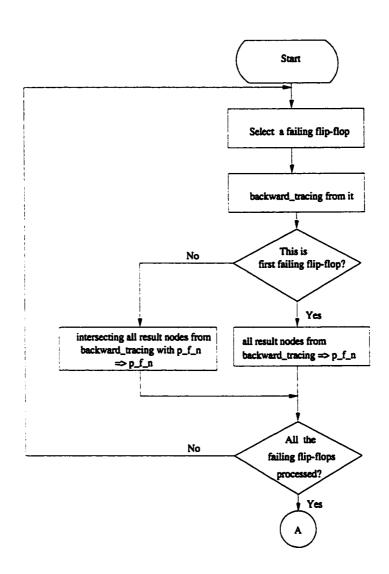
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Appendix A Algorithm Flowcharts

A.1 Structural Analysis Algorithm Flowcharts



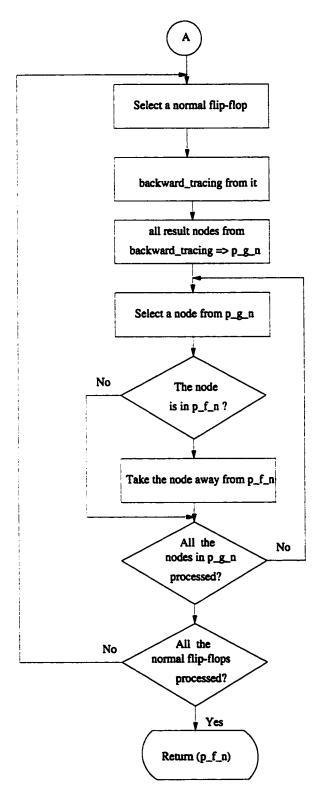


Figure A.1: Flowchart of the Structural Analysis Algorithm

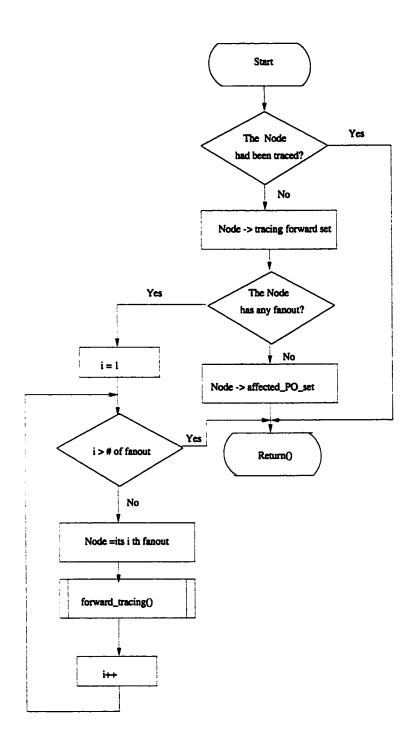


Figure A.2: Flowchart of the Forwards Tracing Algorithm

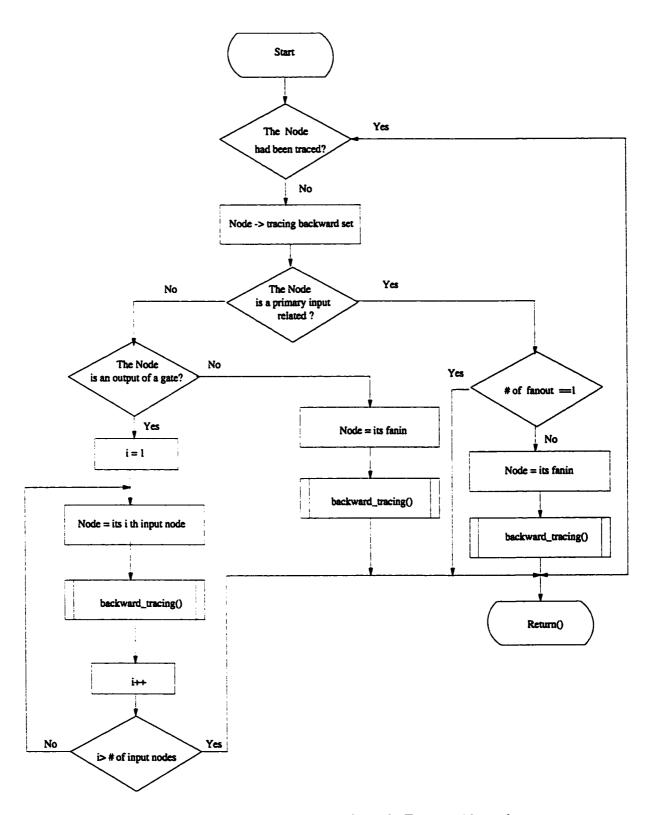


Figure A.3: Flowchart of the Backwards Tracing Algorithm

A.2 Dynamic Dictionary Related Algorithm Flowcharts

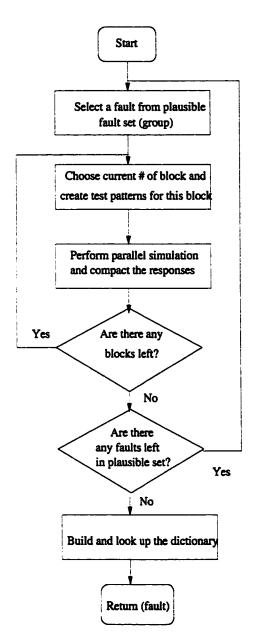


Figure A.4: Flowchart of Diagnosis Using Dynamic Dictionary

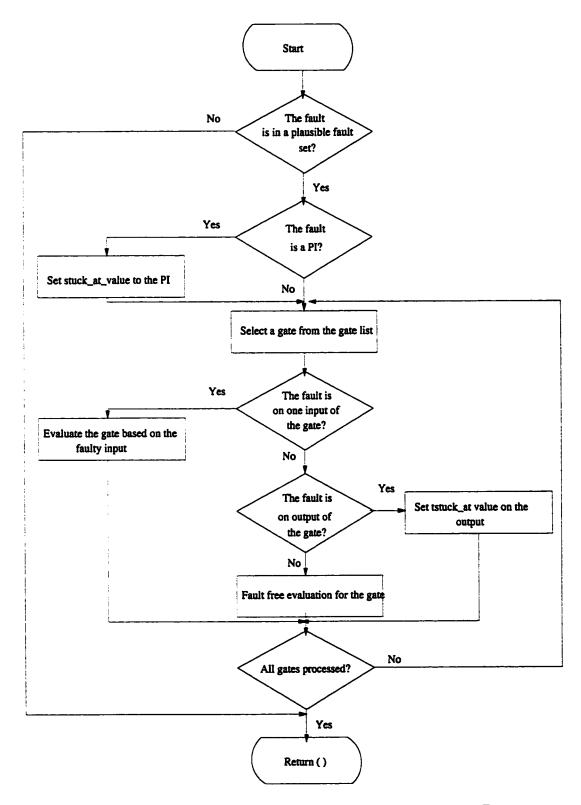


Figure A.5: Flowchart of Fault Simulation Used for the Dynamic Dictionary

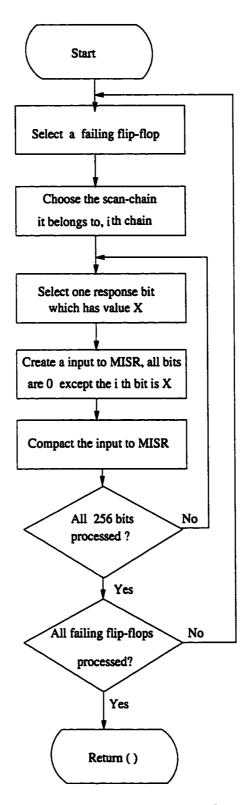


Figure A.6: Flowchart of Signature Compaction

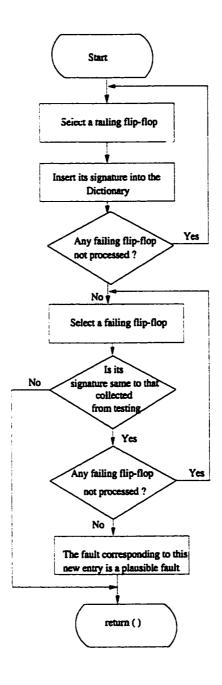


Figure A.7: Flowchart of Dictionary Construction and Look-up

Appendix B

h-DIAG User's Guide

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NAME

h-DIAG - a hierarchical diagnostic system

SYNOPSIS

h-DIAG [options] [#of_BLOCK] circuit_file

DESCRIPTION

h-DIAG can analyse all the combinational circuits described in the format of ISCAS85 [9]. It implements the diagnostic scheme presented in the author's M.Sc. thesis. It is able to perform two-stage diagnosis. The first is diagnosis by structural analysis while the second is diagnosis by constructing and looking up a dynamic fault dictionary.

Essentially, the first stage diagnosis requires the name of the circuit and the location (node number) of the failing flip-flops. For the second stage diagnosis, the signatures of the failing flip-flops are required.

The following information can be produced by h-DIAG during a diagnostic session.

- The number of faulty sites in each group.

- The number of faults in each common-sig-set(t)
- Time used for diagnosis
- The fault elimination rate (FE) of the diagnosis
- Total number of circuit Gates, Nodes, PIs and POs
- Total number of collapsed faults
- Help information
- Miscellaneous information

OPTIONS

help (inde) 1 -h both structural analysis and simulation; otherwise only structural -a analysis (test length is needed in the unit of block (256 patterns in each block)) instead of general resolution analysis, only diagnosis for a -8 specific case, indicated by the user what the failing POs are and/or what are their signatures produce signatures of failing POs for all plausible (a ejected) -p faults (requ² -a -s) -d diagnosis for specific failing POs and their signatures exclusive with -p (requ -s) eject a fault and get the POs affected by it (inde) -e show the total faults in the CUT after being collapsed -tf -fm shows the format of the input file (circuit) (inde) print out the netlist of the circuit being diagnosed -ct list the number of faults in each set 3 (requ -a) -ls list the number of the sites in each group -lg -dd shows core of current dynamic dictionary print the last polynomial being used as prpg (last LFSR) -pn show the polynomial being used as MISR -pm print all the test patterns created by last LFSR -Pg

-t1	print the time used for the structural analysis (requ -d -s)
-t2	print the time used for the second stage diagnosis (requ -d -s -a)
-e1	print the diagnostic resolution reflected by fault elimination rate
	of the stage 1
-e2	print the diagnostic resolution reflected by fault elimination rate
	of the stage 2
-nL	number of LFSRs used (256 bits < -> one LFSR, except last one)
-cG	print the number of circuit Gates
-cN	print the number of circuit Nodes
-cI	print the number of circuit primary Inputs
-cO	print the number of circuit primary Outputs

Note:

- 1 This is an independent parameter.
- 2 Other parameters are required.
- 3 Inside this set, all faults have same signatures.

Appendix C

The Comparison of Dictionary Looking-up Time

In this appendix, we present the time used in looking up the conventional dictionary and dynamic dictionary. The experiments are performed on all the ISCAS benchmark circuits. In each figure, the X represents 10 groups we randomly selected while the Y represents the time needed to find the last fault of the group. With a conventional dictionary, we assume that all the faults of group i+1 is just put after the faults of group i. The time unit is the time used to compare one entry of the dictionaries.

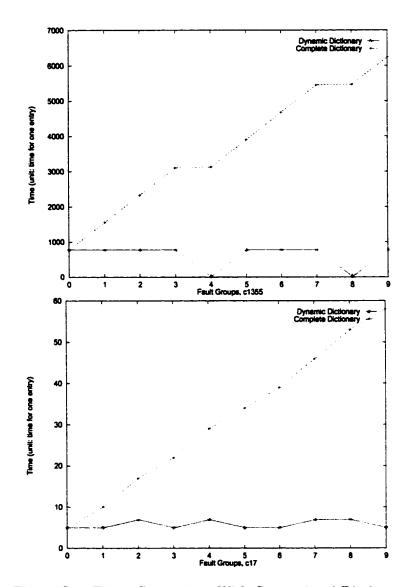


Figure C.1: Time: Comparison With Conventional Dictionary

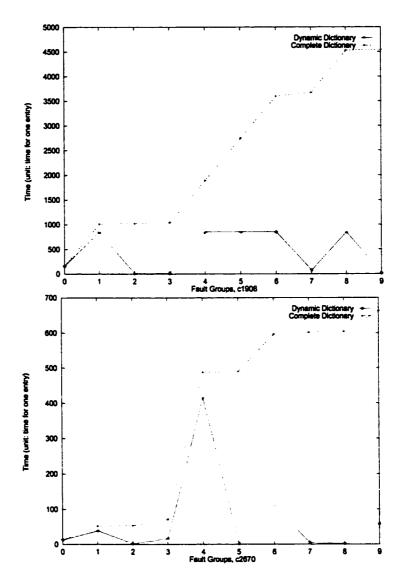


Figure C.2: Time: Comparison With Conventional Dictionary

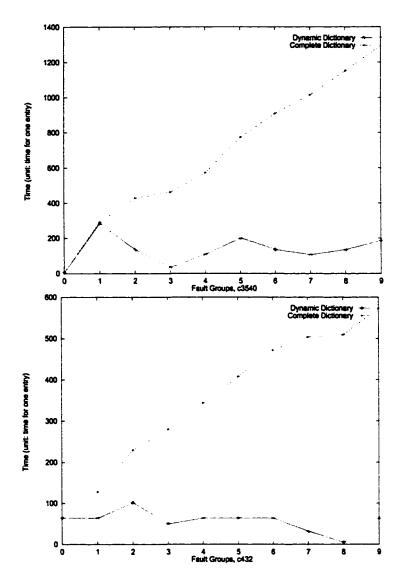


Figure C.3: Time: Comparison With Conventional Dictionary

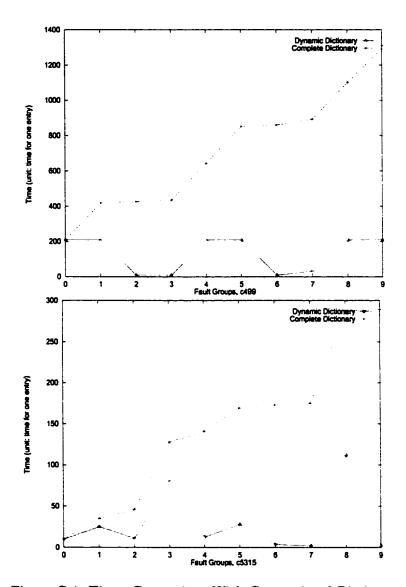


Figure C.4: Time: Comparison With Conventional Dictionary

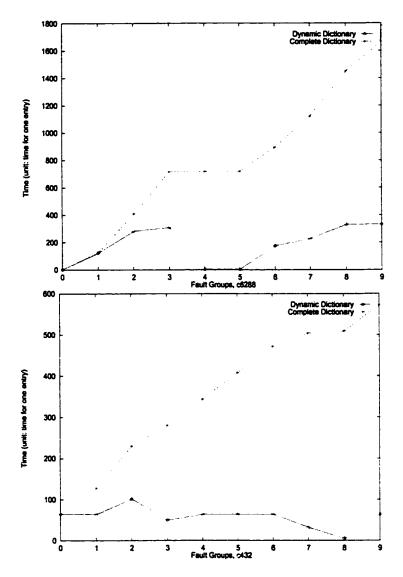


Figure C.5: Time: Comparison With Conventional Dictionary

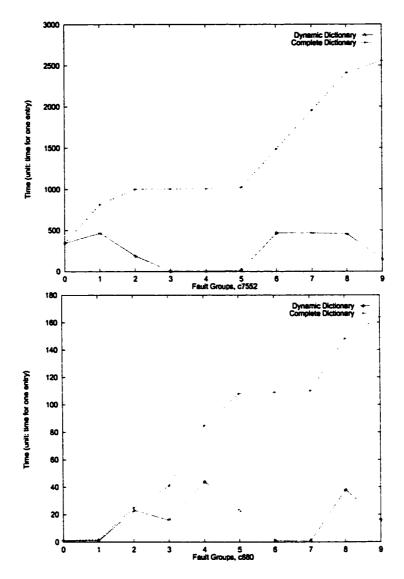


Figure C.6: Time: Comparison With Conventional Dictionary

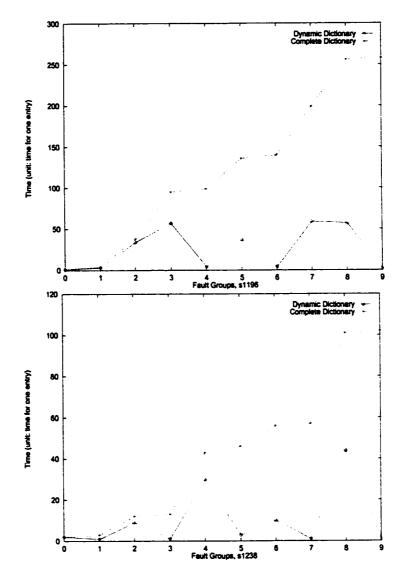


Figure C.7: Time: Comparison With Conventional Dictionary

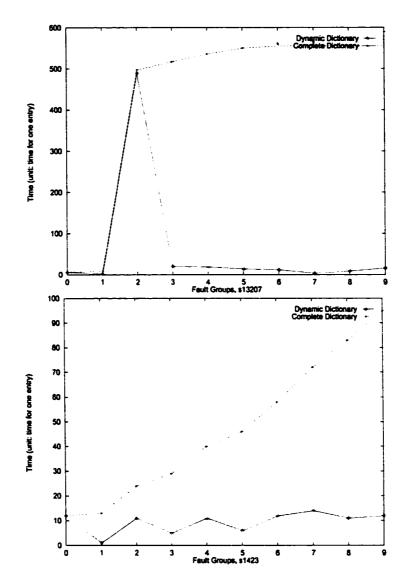


Figure C.8: Time: Comparison With Conventional Dictionary

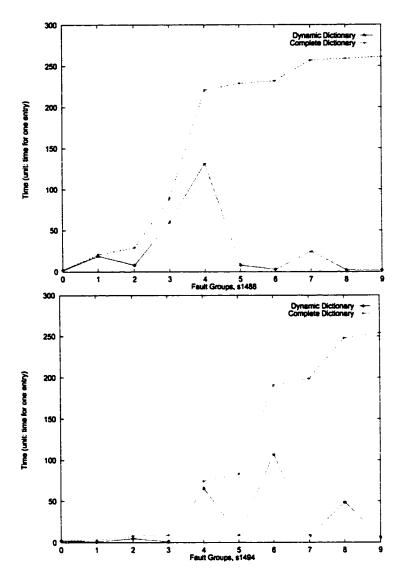


Figure C.9: Time: Comparison With Conventional Dictionary

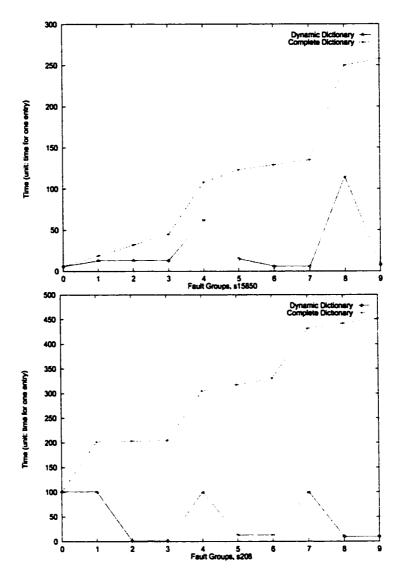


Figure C.10: Time: Comparison With Conventional Dictionary

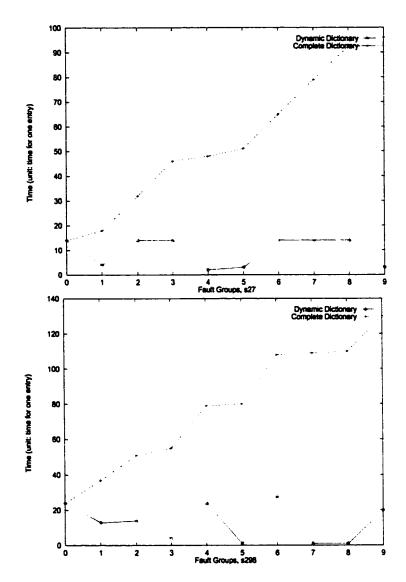


Figure C.11: Time: Comparison With Conventional Dictionary

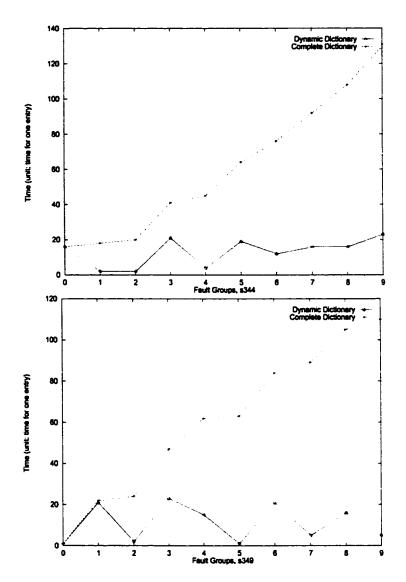


Figure C.12: Time: Comparison With Conventional Dictionary

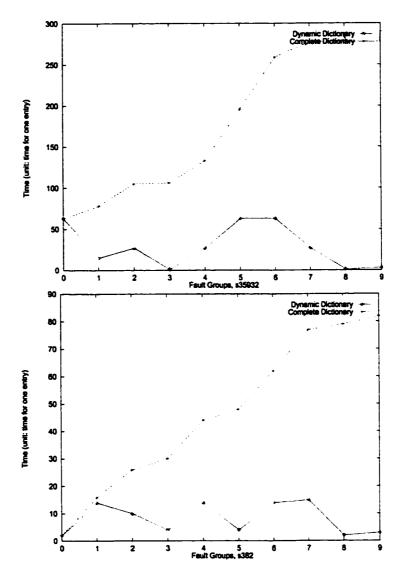


Figure C.13: Time: Comparison With Conventional Dictionary

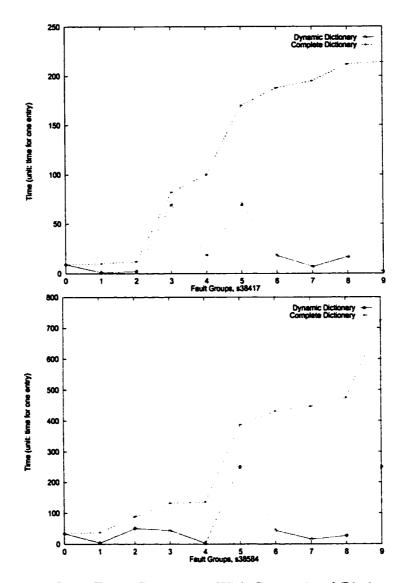


Figure C.14: Time: Comparison With Conventional Dictionary

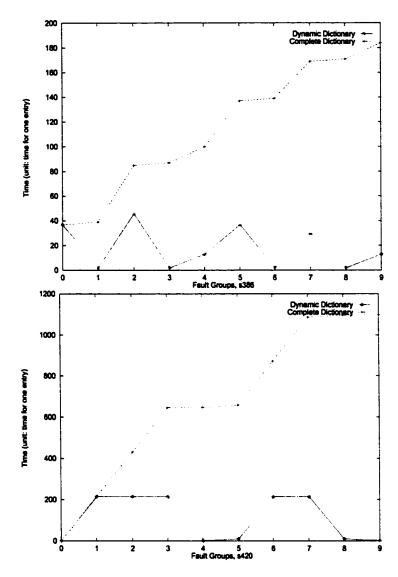
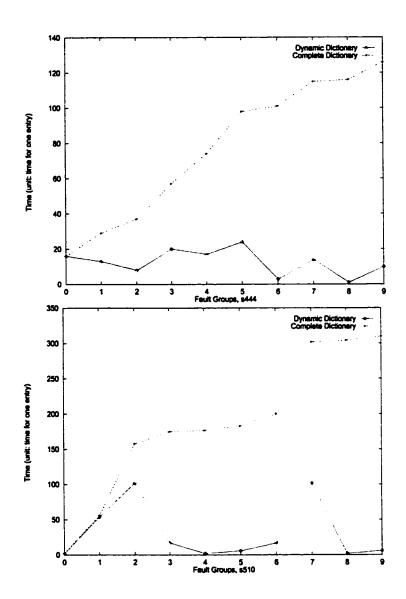


Figure C.15: Time: Comparison With Conventional Dictionary



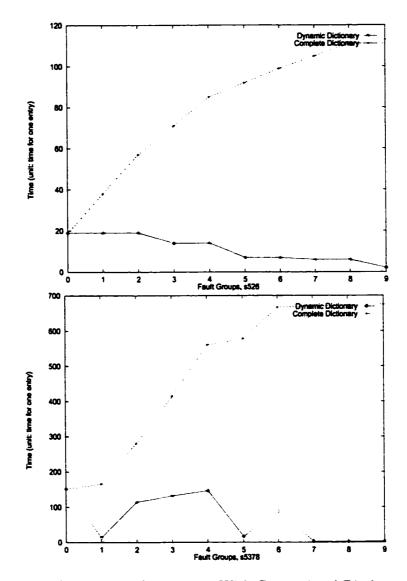


Figure C.16: Time: Comparison With Conventional Dictionary

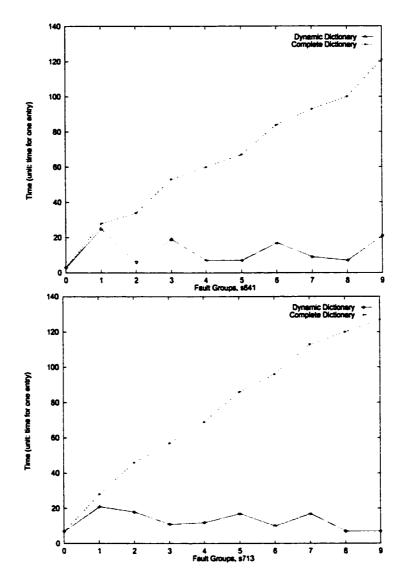
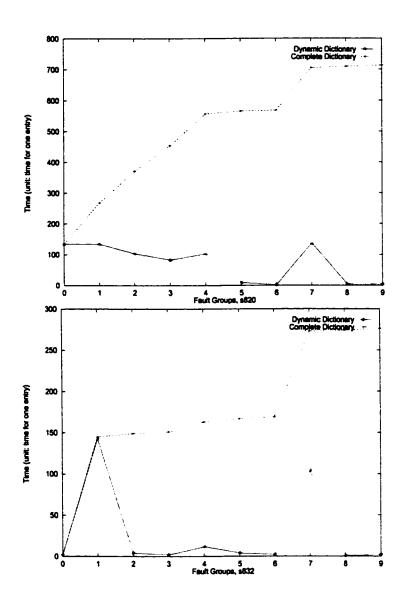


Figure C.17: Time: Comparison With Conventional Dictionary



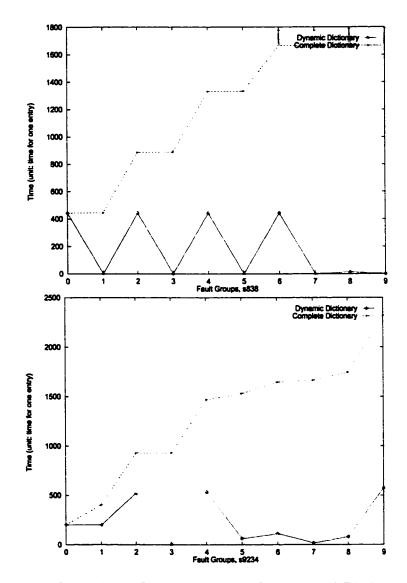


Figure C.18: Time: Comparison With Conventional Dictionary

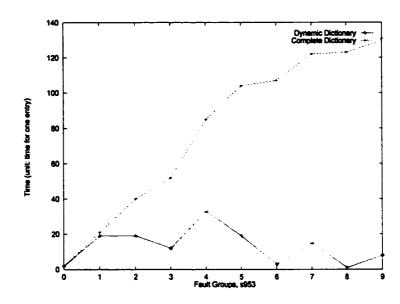


Figure C.19: Time: Comparison With Conventional Dictionary

Appendix D

Experiment on ISCAS 85 With Testing Length 64 K

In this appendix, we present the detailed diagnostic results for ISCAS'85 benchmark circuits at the testing length = 64 K (256 blocks). 100 randomly ejected single stuckate at faults are used to collect corresponding information.

Ele: element number

Inp: input order of the node to the element¹

SA: stuck-at value

N.PO: number of nodes affecting the same POs as the diagnosed fault

FE1: fault elimination rate for stage 1

Resl_1: estimation for RES1

Time.Stru: time used for structural analysis

N.Sq. number of the faults having same signatures as the diagnosed fault

ResL2: estimation for RES2

Time, Furt: time used for building and looking up the fault dictionary

FE2: fault elimination rate for stage 2

¹⁻¹ means that the node is just the output of the element itself.

C17,	testing	length = 641	K		·					
Ele	Inp	SA	N.PO	PEI	Rest	Tim.Str.	N.5g	PE2	Resi_2_	Tim,Furt
10	-1	0	. 5	0.772727	0.526503	0.004301	1	0.954545	1.000000	9.978010
10		1	5	0.772727	0.526803	0.004301	1	0.984845	1.000000	9.978010
22	-I	0	5	0.772727	0.526503	0.004301		0.954545	1.000000	9.978010
72		1	8_	0.772727	0.526803	0.004301		0.954545	1.000000	9.978010
10			- 5	0.772727	0.526803	0.004301	1		1.000000	9.978010
10			5	0.772727	0.526803	0.004301		0.954545	1.000000	9.978010
11	-1		7	0.581818	0.541977	0.004238		0.954545	1.000000	22.485201
п	1	1	7	0.551818	0.541977	0.004238		0.954545	1.000000	22.485201
11			7	0.681818	0.541977	0.004238		0.954545	1.000000	22.485201
_11			7	0.581818	0.541977	0.004238		0.954545	1.000000	22.485201
16				0.581818	0.541977	0.004238	L	0.984848	1.000000	22.485201
16	I			0.551518	0.541977	0.004238	Ľ	0.954545	1.000000	22.485201
16	0	T	7	0.581818	0.541977	0.004238	-	0.954545	1.000000	22.485201
16	1	1	7	0.881818	0.541977	0.004238	1	0.954545	1.000000	22.485201
3] -I	1		0.681818	0.541977	0.004238		0.954545	1.000000	22.485201
3	_ ·I_	0	7	0.681818	0.541977	0.004238		0.954545	1.000000	22.485201
19	[-: T	0	5	0.772727	0.526803	0.004443		0.954545	1.000000	10.550900
	-1		5	0.772727	0.526803	0.004443		0.954545	1.000000	10.580900
73	1	U	5	0.772727	0.526803	0.004443		0.954545	1.000000	10.550900
23	0		5	0.772727	0.526803	0.004443		0.954545	1.000000	10.580900
10	0		5.	0.772727	0.526803	0.004443		0.984845	1.000000	10.550900
19		1	5	0.772727	0.526803	0.004443		0.984845	1.000000	10.580900
	t T	Mean val	5.9	0.731405	0.533700	0.004311	1.00	0.954545	1.000000	15.819340
		Std devi	1.0	0.046332	0.007733	0.000087	0.00	0.000000	0.000000	6.232031

Table D.1: Results for Benchmark C17

		lengt	= 64	K							
552	Inp -1	57		N.PO	0.968720	Rest_1 0.498010	Tim.Str. 1.239330	N.Sg	7E2 0.999472	Resl_2 0.919579	Tim,Furt 358.510010
552	-1			63	0.966720	0.496010	1.239330	<u> </u>	0.999472	0.919679_	358.510010
2809 2800	-1	1	-	63	0.966720 0.966720	0.496010 0.496010	1.239330		0.999472	0.919679	358.510010 358.510010
2595	ŏ	 †		83	0.986720	0.498010	1.239330		0.999472	0.919679	358.510010
2895	U	Ţ		63	0.965720	0.498010	1.239330	7	0.998943	0.919679	358.510010 358.510010
2895 2898		1		63	0.968720	0.496010	1.239330		0.999472	0.919679	358.510010
2597	Ď	Ī		53	0.968720	0.498010	1.239330	7	0.998943	0.919579	358.510010
2897 552	-			63	0.966720	0.496010 0.496010	1.239330	7	0.998943	0.919679	358.510010 358.510010
352	ĭ 	-i		- 83	0.966720	0.496010	1.239330	ī	0.999472	0.919679	358.510010
628	-1	0	\Box	63	0.968720	0.498010	1.239330		0.999472 0.999472	0.919679	358.510010 358.510010
628 981	-1		_	63 63	0.965720	0.496010	1.239330	i	0.999472	0.919579	358.510010
951	-1	1		63	0.968720	0.496010	1.339330		0.999472	0.919579	358.510010 358.510010
984	-1	9		63	0.966720	0.496010	1.239330	-	0.999472	0.919879	358.510010
1231	-1	Ö		63	0.966720	0.496010	1.239330	Ī	0.999472 0.999472	0.919679	358.510010
1383	<u>:</u>	- 0	\neg	92	0.965720 0.966720	0.495010	1.239330		0.999472	0.919679	358.510010 358.510010
1322	ŏ	i		- 53	0.966720	0.496010	1.239330	2	0.998943	0.919679	358.510010
1322	Ţ	1	$\overline{}$	53	0.966720 0.966720	0.496010	1.239330	2	0.998943	0.919679	358.510010 358.510010
1231	-1	t		63	0.966720	0.496010	1.239330	- i -	0.999472	0.919679	358.510010
1640	<u> </u>	Ī		63	0.966720	0.496010	1.239330		0.999472	0.919679	358.510010
1661	4	- 7		63	0.966720 0.966720	0.496010	1.239330	 	0.999472	0.919679	358.510010 358.510010
1697	-1	Ö		63	0.966720	0.496010	1.239330		0.999472	0.919679	358.510010
1697	-1	Ö	\Box	63 63	0.966720 0.966720	0.496010	1.239330		0.999472	0.919679	358.510010
1727	-1	 ĭ		63	0.966720	0.496010	1.239330	2	0.998943	0.919679	358.510010
1762	1	P		63	0.966720	0.496010	1.239330		U.999472 U.999472	0.919679	358.510010 358.510010
1812	۴.	0		63	0.968720	0.496010	1.239330	 	0.999472	0.919679	358.510010
1791	0			53	0.988720	0.496010	1.239330	1	0.998943	0.919879	358.510010
1791	-	-		63	0.966720 0.966720	0.496010 0.496010	1.239330	2 2	0.998943	0.919679	358.510010
1728	-1 -	i		83	0.966720	0.496010	1.239330	- i	0.999472	0.919679	358.510010
1728	-	-		63	0.966720	0.496010	1.239330	1	0.998943	0.919679	358.510010 358.510010
1933	-1	- 8		63	0.966720	0.498010	1.239330	├ i -	0.999472	0.919679	358.510010
1933	1			63	0.965720	0.498010	1.239330		0.999472	0.919879	358.510010
1897	7	1		63	0.968720	0.496010	1.239330	2 2	0.998943	0.919679	358.510010
1865	ò			63	0.966720	0.496010	1.239330	2	0.998943	0.919679	358.510010
1985	-1	9		63	0.966720	0.496010	1.239330	7	0.999472	0.919679	358.510010 358.510010
2863	-1	l i		63	0.965720	0.496010	1.239330	i i	0.999472	0.919679	388.510010
2883	-1	Ĩ		63	0.966720	0.496010	1.239330		0.999472	0.919679	358.510010 358.510010
2883 2875	0	 		63	0.968720 0.968720	0.496010	1.239330	1 2	0.999472 0.998943	0.919679	358.510010
2875	1			63	0.966720	0.496010	1.239330	7	0.998943	0.919679	358.510010
2863 2829		1		63	0.988720	0.496010	1.239330	1-7-	0.9999472	0.919679	388.510010
2829	-1			53	0.988720	0.496010	1.239330	Ť	0.999472	0.919679	388.510010
2829 2829	7			63	0.966720 0.966720	0.496010	1.239330	1	0.999472	0.919679	358.510010
2829	- ż-	i		63	0.965720	0.496010	1.239330		0.393472	0.919679_	358.510010
554 554	=			19	0.989963	0.500000	1.131240		0.999472 0.999472	0.923108	104.849998
2889	-1			19	0.989963	0.500000	1.131240	 i 	0.999472	0.923108	104.849998
2589	Ū			19	0.989963	0.500000	1.131240		0.999472	0.923108	104.849998
2879 2869	-8-			19	0.989963	0.500000	1.131240	1 1	0.999472	0.923108	104.849998
2869	Ť	 	<u> </u>	19	0.989963	0.500000	1.131240	1	0.998943	0.923108	104.849998
2879	- 1			19	0.989963	0.500000	1.131240	1	0.998943	0.923108	104.849998
2853 2853	Ť			19	0.989963	0.500000	1.131240	1 2	0.998943	0.923108	104.849998
554 554	0			19	0.989983	0.500000	1.131240		0.999472	0.923108	104.849998
354 1818	+		,	19	0.989983	0.500000	1.131240	1	0.999472	0.923108	104.849998
1818	-1			19	0.989963	0.500000	1.131240	i	1 11 0000277	0.923108	TITA NAGOZIA
2821 2821	-}-			19	0.989963	0.500000	1.131240		0.999472 0.999472	0.923108	104.849998
2821	U		_	19	0.989963	0.500000	1.131240	<u> </u>	0.999472	0.923108	104.849998
2821	1			19	0.989963	0.500000	1.131240		0.999472	0.923108	104.849998
343		 		19	0.989963	0.500000	0.974620	1	0.999472	0.913269	97.557297
343	-1			17	0.991020	0.500000	0.974520		0.999472	0.913269	97.557297
534		 		17	0.991020	0.500000	0.974620	1 1	0.999472	0.913269	97.567297
2669	-1		-	17	0.991020	0.500000	0.974620	l i	0.990472 0.990472	0.913269	97.557297
2753 2753	-1	\vdash	7	17	0.991020	0.500000	0.974620	 -	0.999472	0.913269	97.567297
2720	- 6 -			17	0.991020	0.500000	0.974620	1 2	0.998943	0.913269	97.557297
2720	-1-	ļ		17	0.991020	0.500000	0.974520	2	0.998943	0.913269	97.667297 97.667297
2669 2558	7	1 1	3	17	0.991020	0.500000	0.974620	1 2	0.999472	0.913269	97.567297
2558	-1		I	17	0.991020	0.500000	0.974620	<u>i</u>	0.999472	0.913269	97.667297
2558 2558	-			17	0.991020	0.500000	0.974620	\Box	0.999472	0.913269	97.667297
	<u> </u>	<u> </u>	<u> </u>	17	0.991020	0.500000	0.974620	<u> </u>	0.999472	0.913269	97.667297
2558	- 3			17	0.991020	0.500000	0.974620		0.999472	0.913269	97.567297
2558						i u.auzzuu	1 11.364 4020		1 0.3939164	U.FLJ409	T 21.00448/
2558 2558	<u> </u>			17				7 7 70			
2558			n val	46.0	0.975717	0.497522	1.170343 0.101115	1.29	0.999318	0.919218	261.10089 125.38346

Table D.2: Results for Benchmark C5315

177	C2670, testing	length = 64	K							
124 U				PEI	Rest_1	Tim.Str.	N.Sg	IT DOORTY	Rest_2	Tim,Furt
1855 U	1541 0	· · ·	17	0.993489	0.504993	0.495518	- i - 	0.999617	1.000000	440.080994
Total	1542 0						\dashv	U.999617	1.000000	440.050994
Trans.		i	17	0.993489	0.504993	0.495518		0.999817	1.000000	440.080994
1			344		0.496339	0.838450				
Tell			322	0.888250	0.496339	0.835450	315	0.879357	0.500005	7109.520117
2316 0	2552 0		344	0.858250	0.496339			0.879357		
1411	2315 0	- i				0.835450		0.879357	0.500005	7109.620117
Trial	2414 1		344	0.888250	0.498339	0.835450	315	0.879387		7109.620117
1			344	U.86828U	0.496339	0.835450		0.879357	0.500005	
1.	2549 1		344	0.858250	0.496339	0.838450		0.879357		
1		1			0.496339	D.838480	312	0.879357		
1	2547 0	ì	344	0.858250	0.495339	0.835450	315	0.879387	0.500005	7109.520117
1	2410 0	1								
Triple	2409 1	ī	344	0.868250	0.498339	0.835450	315	0.879357	0.500005	7109.620117
1984		-	344			0.835450		0.879357	0.500005	7109.620117
1971 1	2544 I	i	344	0.868250	0.496339	THE RESIDENT	315	0.879387	0.500006	
17710		1				0.835450				
Trial	2750 1	i .	344	0.868250	0.498339	0.835450	315	0.879357	0.500005	7109.520117
1285 1	2558 1		344		0.496339		315			
2323 0	2567 I	i	344	0.858250	0.496339	0.835450	315	0.879357	0.500008	7109.620117
12525	2565 0		344			0.835450		0.879357	U.500005	
1	2333 0	- i- -	344	0.858250	0.496339	0.835450	315	0.879357	U.500005	7109.520117
1751 4	2430 1			0.858250			212	0.879357		
1089 U	2751 4	- 	- 333 -	0.868250	0.496339	0.835450	315	IEX70357	0.500005	7109.620117
887 -1	2563 1	<u> </u>	344	0.868250	0.496339	0.835450	315	0.879357		
6825 -1		 	344	0.888250	0.498339	0.835450	315	0.879357	0.500005	7109.520117
1700 1	693 -1		344	0.868250	0.496339	0.835450	315	0.879357	0.500005	7109.520117
1715			344	0.868250	0.496339	0.835450		0.879357	0.500005	
1237 -1	1219 -1				0.496339			0.879357		
1725			344		0.496339	0.835450		11.3793337	0.500005	
1251 -1	1237 -1	Ü	344	0.868250	0.496339	0.835450	315	0.879387	0.500005	7109.520117
1787 -1								0.879357	0.500005	7109.620117
1544 -1	1257 -1	0	344	0.858250	0.496339	13.835450	315	0.879357	0.500005	
1910	1263 -1		344	0.868250	0.496339	0.835450		0.879357	0.500005	
1911	1910 0	1	344	0.868250	0.496339	0.835450	315	0.879357	0.500005	7109.520117
1546 -1	1545 -1			0.868250	0.498339	0.835450			0.500005	
1547 -1	1545 -1		344	0.888250	0.496339	0.835450	315	0.879357	0.500005	7109.620117
1913	1912 0					0.835450				
T914			344	0.868250	0.496339	T 0.835450	315	0.879357	0.500005	7109.520117
1918 -1	1548 -1		344	0.868250	0.496339	0.835450		0.879387	0.500005	
1860 -1		 6	344		0.496339	0.835450	315	0.879357	0.500008	7109.620117
1851 -1	1915 0	1	344		0.496339	0.835450				
1851 -1		 'i 	344		0.496339	0.835450		0.879357	0.500005	7109.520117
1862 -1	1551 -1_	0	344	0.868250	0.496339	0.835450	315	0.879357	0.500008	7109.620117
Table		 			0.496339			0.879357	0.500008	7109.620117
1925	1918 0		344	0.868250	0.496339	0.835460	315	0.879357	0.500005	7109.620117
1978 0	1564 -1			0.868250	0.496339	0.835450		0.879357	0.500008	7109.620117
1886 -1	1565 -1	Ō	344	0.868250	0.496339	0.835450	315	0.879357	0.500005	7109.620117
1.830	1929 0					0.835450			0.500005	7109.620117
1831 U	1930 0	<u> </u>	344	0.868250	0.496339	0.835450	315	0.879357	0.500005	7109.620117
1808 -1			344					0.879387		7109.620117
1.522 0	1568 -1		344	0.868250	0.496339	0.835450	315	0.879357	0.500005	7109.620117
1833 0 1 344 0.888250 0.498339 0.838450 315 0.879857 0.500008 7109.620117 1874 0 1 344 0.888250 0.498339 0.838450 315 0.879857 0.500008 7109.620117 1934 0 1 344 0.888250 0.498339 0.838450 315 0.879857 0.500008 7109.620117 29 -1 1 344 0.888250 0.498339 0.838450 315 0.879857 0.500008 7109.620117 29 -1 1 344 0.888250 0.498339 0.838450 315 0.879857 0.500008 7109.620117 29 -1 1 344 0.898250 0.498339 0.838450 315 0.879857 0.500008 7109.620117 20 -1 0 107 0.989220 0.500497 0.498833 1 0.998617 0.897849 2474.22988 20 -1 1 107 0.989220 0.500497 0.498833 2 0.999234 0.897849 2474.22988 20 -1 1 107 0.989020 0.500497 0.498833 2 0.999234 0.897849 2474.22988 20 -1 0 107 0.989020 0.500497 0.498833 2 0.999234 0.897849 2474.22988 20 -1 0 107 0.989020 0.500497 0.498833 2 0.999234 0.897849 2474.22988 20 -1 0 107 0.989020 0.500497 0.498833 2 0.999234 0.897849 2474.22998 20 -1 0 107 0.989020 0.500497 0.498833 2 0.999234 0.897849 2474.22998 20 -1 0 107 0.989020 0.500497 0.498833 2 0.999234 0.897849 2474.22998 20 -1 0 107 0.989020 0.500497 0.498833 2 0.999234 0.897849 2474.22998 31 1 107 0.989020 0.500497 0.498933 1 0.999617 0.897849 2474.22998 32 1 1 107 0.989020 0.500497 0.498933 1 0.999617 0.897849 2474.22998 32 1 1 107 0.989020 0.500497 0.498933 1 0.999617 0.897849 2474.22998 31 1 107 0.989020 0.500497 0.498933 1 0.999617 0.897849 2474.22998 31 1 107 0.989020 0.500497 0.498933 1 0.999617 0.897849 2474.22998 31 1 107 0.989020 0.500497 0.498933 1 0.999617 0.897849 2474.22998 31 1 107 0.989020 0.500497 0.498933 1 0.999617 0.897849	1932 0				0.498339	0.835450		0.879357		
1870 -1		1 1	344	0.858250	0.496339	0.835450	315	0.879357	0.500005	7109.520117
TI -1	1570 -1		344	0.858250	0.496339	0.835450	315		0.500008	
79 -1 1 344 0.888280 0.498339 0.830450 315 0.878357 0.500008 7109.62011 7 0.107 0.9590270 0.500497 0.498033 1 0.999617 0.897849 2474.229988 901 1 1 107 0.959020 0.500497 0.498933 2 0.999234 0.897849 2474.229988 903 1 1 1 107 0.959020 0.500497 0.498933 2 0.999234 0.897849 2474.229988 903 1 1 1 107 0.959020 0.500497 0.498933 2 0.999234 0.897849 2474.229988 903 1 1 1 107 0.959020 0.500497 0.498933 1 0.999617 0.897849 2474.229988 903 1 1 107 0.959020 0.500497 0.498933 1 0.999617 0.897849 2474.229988 903 1 1 107 0.959020 0.500497 0.498933 1 0.999617 0.897849 2474.229988 903 1 1 107 0.959020 0.500497 0.498933 2 0.999234 0.897849 2474.229988 903 1 1 107 0.959020 0.500497 0.498933 1 0.999617 0.897849 2474.229988 909 1 1 107 0.959020 0.500497 0.498933 1 0.999617 0.897849 2474.229988 138 -1 0 107 0.959020 0.500497 0.498933 1 0.999617 0.897849 2474.229988 1422 -1 0 107 0.959020 0.500497 0.498933 1 0.999617 0.897849 2474.229988 1422 -1 0 107 0.959020 0.500497 0.498933 1 0.999617 0.897849 2474.229988 1423 1 1 107 0.959020 0.500497 0.498933 1 0.999617 0.897849 2474.229988 1423 1 1 107 0.959020 0.500497 0.498933 1 0.999617 0.897849 2474.229988 1516 -1 0 107 0.959020 0.500497 0.498933 2 0.999234 0.897849 2474.229988 1516 -1 0 107 0.959020 0.500497 0.498933 2 0.999234 0.897849 2474.229988 1516 -1 0 107 0.959020 0.500497 0.498933 2 0.999234 0.897849 2474.229988 1516 -1 0 107 0.959020 0.500497 0.498933 2 0.999234 0.897849 2474.229988 1516 -1 0 107 0.959020 0.500497 0.498933 2 0.999234 0.897849 2474.229988 1506 -1 0 107 0.959020 0.500497 0.498933 2 0.999234 0.897849 2474.229988 1506 -1 0 107 0.959020 0.500497 0.498933 2 0.999234 0.897849 2474.229988 1506 -1 0 107 0.959020 0.500497 0.498933 2 0.999234 0.897849 2474.229988 1506 -1 0 107 0.959020 0.500497 0.498933 2 0.999234 0.897849 2474.229988 1506 -1 0 107 0.959020 0.500497 0.498933 2 0.999234 0.897849 2474.229988 1506 -1 0 107 0.959020 0.500497 0.498933 2 0.999234 0.897849 2474.229988 1506 -1 1 107 0.959020 0.500497 0.498933 2 0.999234 0.897849 2474.229988 1506 -1 1 107 0.959020	11 -1	 	344	0.868250	0.496339	0.835450	315	0.879357	0.500005	7109.520117
901 1 1 107 0.959020 0.500497 0.498933 2 0.999234 0.897849 2474.22998 903 1 1 1 107 0.959020 0.500497 0.498933 1 0.999617 0.897849 2474.22998 903 1 1 1 107 0.959020 0.500497 0.498933 2 0.999234 0.897849 2474.22998 903 1 1 107 0.959020 0.500497 0.498933 1 0.999617 0.897849 2474.22998 903 1 1 107 0.959020 0.500497 0.498933 2 0.999234 0.897849 2474.22998 903 1 1 107 0.959020 0.500497 0.498933 2 0.999234 0.897849 2474.22998 903 1 1 107 0.959020 0.500497 0.498933 2 0.999234 0.897849 2474.22998 909 1 1 107 0.959020 0.500497 0.498933 1 0.999617 0.897849 2474.22998 1422 -1 0 107 0.959020 0.500497 0.498933 1 0.999234 0.897849 2474.22998 1422 -1 0 107 0.959020 0.500497 0.498933 1 0.999617 0.897849 2474.22998 1422 1 1 107 0.959020 0.500497 0.498933 1 0.999617 0.897849 2474.22998 1423 1 1 107 0.959020 0.500497 0.498933 1 0.999617 0.897849 2474.22998 1429 1 1 107 0.959020 0.500497 0.498933 1 0.999617 0.897849 2474.22998 1516 -1 0 107 0.959020 0.500497 0.498933 2 0.999234 0.897849 2474.22998 1516 -1 0 107 0.959020 0.500497 0.498933 2 0.999234 0.897849 2474.22998 1516 -1 0 107 0.959020 0.500497 0.498933 2 0.999234 0.897849 2474.22998 1516 -1 0 107 0.959020 0.500497 0.498933 2 0.999234 0.897849 2474.22998 1506 -1 0 107 0.959020 0.500497 0.498933 2 0.999234 0.897849 2474.22998 1506 -1 0 107 0.959020 0.500497 0.498933 2 0.999234 0.897849 2474.22998 1506 -1 0 107 0.959020 0.500497 0.498933 2 0.999234 0.897849 2474.22998 1506 -1 1 107 0.959020 0.500497 0.498933 2 0.999234 0.897849 2474.22998 1506 -1 1 107 0.959020 0.500497 0.498933 2 0.999234 0.897849 2474.22998 1509 -1 1 107 0.959020 0.500497 0.498933 2 0.999234 0.897849 2474.22998 1509 -1 1 107 0.959020 0.500497 0.498933 2 0.999234 0.897849 2474.22998 1509 -1 1 107 0.959020 0.500497 0.498933 2 0.999234 0.897849 2474.22998 1509 -1 1 107 0.959020 0.500497 0.498933 2 0.999234 0.897849 2474.22998 1509 -1 1 107 0.959020 0.500497 0.498933 2 0.999234 0.897849 2474.22998 1509 -1 1 107 0.959020 0.500497 0.498933 2 0.999234 0.897849 2474.22998 1509 -1 1 107 0.959020 0.500497 0.498933 2 0.	29 -1		344	0.868250	0.496339	0.835450		0.879357	0.500005	7109.620117
007 -1 0 107 0.859020 0.500497 0.458933 1 0.599817 0.897849 2474.225988 903 1 1 107 0.859020 0.500497 0.458833 1 0.599817 0.897849 2474.225988 904 -1 0 107 0.859020 0.500497 0.458833 1 0.599817 0.897849 2474.225988 908 -1 1 107 0.859020 0.500497 0.458833 1 0.599817 0.897849 2474.225988 908 -1 0 107 0.859020 0.500497 0.458833 1 0.599817 0.897849 2474.225988 908 -1 0 107 0.859020 0.500497 0.458833 1 0.599817 0.897849 2474.225988 10 0.500497 0.458833 1 0.599817 0.897849 2474.225988 10 0.500497 0.458833 1 0.590817 0.897849 2474.225988 10 0.500497 0.458833 1 0.599817 0.897849 2474.225988 10 0.500497 0.458833 1 0.599817 0.897849 2474.225988 10 0.500497 0.458833 1 0.599817 0.897849 2474.225988 10 0.500497 0.458833 1 0.590817 0.897849 2474.225988 10 0.500497 0.458833 1 0.599817 0.897849 2474.225988 10 0.500497 0.458833 1 0.590817 0.897849 2474.225988 10 0.500497 0.458833 1 0.							1 2	0.999234	0.897849	T 2474.229980
904 -1 U 107 0.959020 0.500497 0.488833 1 0.999817 0.897849 2474.22998 905 1 1 107 0.959020 0.500497 0.488833 1 0.99924 0.897849 2474.22998 908 -1 U 107 0.959020 0.500497 0.488833 1 0.999817 0.897849 2474.22998 709 1 1 107 0.959020 0.500497 0.488833 1 0.999817 0.897849 2474.22998 718 -1 U 107 0.959020 0.500497 0.498833 1 0.999817 0.897849 2474.22998 718 -1 U 107 0.959020 0.500497 0.498833 1 0.999817 0.897849 2474.22998 718 -1 U 107 0.959020 0.500497 0.498833 1 0.999817 0.897849 2474.22998 718 -1 U 107 0.959020 0.500497 0.498833 1 0.999817 0.897849 2474.22998 718 -1 U 107 0.959020 0.500497 0.498833 2 0.99924 0.897849 2474.22998 718 -1 U 107 0.959020 0.500497 0.498833 2 0.99924 0.897849 2474.22998 718 -1 U 107 0.959020 0.500497 0.498833 1 0.999817 0.897849 2474.22998 718 -1 U 107 0.959020 0.500497 0.498833 1 0.999817 0.897849 2474.22998 718 -1 U 107 0.959020 0.500497 0.498833 1 0.999817 0.897849 2474.22998 718 -1 U 107 0.959020 0.500497 0.498833 1 0.999817 0.897849 2474.22998 718 -1 U 107 0.959020 0.500497 0.498833 1 0.999817 0.897849 2474.22998 718 -1 U 107 0.959020 0.500497 0.498833 1 0.999817 0.897849 2474.22998 718 -1 U 107 0.959020 0.500497 0.498833 1 0.999817 0.897849 2474.22998 718 -1 U 107 0.959020 0.500497 0.498833 1 0.999817 0.897849 2474.22998 718 -1 U 107 0.959020 0.500497 0.498833 1 0.999817 0.897849 2474.22998 718 -1 U 107 0.959020 0.500497 0.498833 1 0.999817 0.897849 2474.22998 718 -1 U 107 0.959020 0.500497 0.498833 1 0.999817 0.897849 2474.22998 718 -1 U 107 0.959020 0.500497 0.498833 1 0.999817 0.897849 2474.22998 718 -1 U 107 0.959020 0.500497 0.498033 1 0.999817 0.897849 2474.22998 718 -1 U 107 0.959020 0.500497 0.498033 1 0.999817 0.897849 0.49843 0.897849 0	902 -1	ŏ	107	0.959020	0.500497	0.498933		0.999617	0.597849	2474.229980
908 1 1 107 0.989020 0.500497 0.498933 2 0.999234 0.897849 2474.22998 908 -1 0 107 0.989020 0.500497 0.498933 2 0.999234 0.897849 2474.22998 909 1 1 107 0.989020 0.500497 0.498833 2 0.999234 0.897849 2474.22998 1422 -1 0 107 0.989020 0.500497 0.498833 1 0.999617 0.897849 2474.22998 1422 -1 0 107 0.989020 0.500497 0.498833 1 0.999617 0.897849 2474.22998 1423 1 1 107 0.989020 0.500497 0.498833 2 0.999234 0.897849 2474.22998 1423 1 0 107 0.989020 0.500497 0.498833 1 0.999617 0.897849 2474.22998 1439 -1 0 107 0.989020 0.500497 0.498833 1 0.999617 0.897849 2474.22998 1516 -1 0 107 0.989020 0.500497 0.498833 1 0.999617 0.897849 2474.22998 1519 -1 0 107 0.989020 0.500497 0.498833 1 0.999617 0.897849 2474.22998 1509 -1 0 107 0.989020 0.500497 0.498833 1 0.999617 0.897849 2474.22998 1509 -1 0 107 0.989020 0.500497 0.498833 1 0.999617 0.897849 2474.22998 1509 -1 0 107 0.989020 0.500497 0.498833 1 0.999617 0.897849 2474.22998 1509 -1 0 107 0.989020 0.500497 0.498833 1 0.999617 0.897849 2474.22998				0.959020		0.498933	1 1		0.897849	2474,229380
1	905		107	0.959020	0.500497	0.498933	Ž	0.999234	1 0.897849	2474.229980
T38		1 1			0.500497	0.498933	1 - 1	0.999232	0.897849	2474.229980
1422 -1 0 107 0.9590730 0.500497 0.498933 1 0.999817 0.897849 2474.22998 1429 1 107 0.989020 0.500497 0.498933 2 0.999234 0.897849 2474.22998 1499 -1 0 107 0.989020 0.500497 0.498933 2 0.999234 0.897849 2474.22998 1515 -1 0 107 0.989020 0.500497 0.498833 1 0.999817 0.897849 2474.22998 1809 -1 0 107 0.989020 0.500497 0.498833 1 0.999817 0.897849 2474.22998 1908 -1 1 107 0.989020 0.500497 0.498833 2 0.999817 0.897849 2474.22998 1908 -1 1 107 0.989020 0.500497 0.498833 2 0.999817 0.897849 2474.22998 1908 -1 1 107 0.989020	738 -1		107	0.959020	0.500497	0.498933	<u> </u>	0.999617	0.897849	2474.229980
1499 -1 0 107 0.989020 0.500497 0.498933 2 0.990234 0.897849 2474.22998 1515 -1 0 107 0.989020 0.800497 0.498933 1 0.999817 0.897849 2474.22998 1809 -1 0 107 0.989020 0.800497 0.498933 1 0.999817 0.897849 2474.22998 1939 1 1 107 0.989020 0.800497 0.498933 2 0.999234 0.897849 2474.22998 1939 1 1 107 0.989020 0.800497 0.498933 2 0.999234 0.897849 2474.22998 1939 -1 1 107 0.989020 0.800497 0.498933 2 0.999234 0.897849 2474.22998 1939 -1 1 107 0.989020 0.800497 0.488933 1 0.999817 0.897849 2474.22998 1939 -1 1 107 0.989020 0.800497 0.488933 1 0.999817 0.897849 2474.22998 1939 -1 1 107 0.989020 0.800497 0.488933 1 0.999818 0.897849 2474.22998 1939 -1 1 107 0.989020 0.800497 0.488933 1 0.999818 0.897849 0.488738 1939 -1 1 107 0.989020 0.800497 0.488933 1 0.999818 0.897849 0.488738 1939 -1 1 107 0.989020 0.800497 0.488933 1 0.999818 0.897849 0.488738 1939 -1 1 107 0.989020 0.800497 0.488933 1 0.999818 0.897849 0.488738 1939 -1 1 1 107 0.989020 0.800497 0.488933 1 0.999818 0.897849 0.488738 1939 -1 1 1 107 0.989020 0.800497 0.488933 1 0.999818 0.897849 0.488738 1939 -1 1 1 107 0.989020 0.800497 0.488933 1 0.999818 0.897849 0.488738 1939 -1 1 1 107 0.989020 0.800497 0.488933 1 0.999818 0.897849 0.488738 1939 -1 1 1 107 0.989020 0.800497 0.488933 1 0.999818 0.897849 0.488738 1939 -1 1 1 107 0.989020 0.800497 0.488933 1 0.999818 0.897849 0.488738 1939 -1 1 1 107 0.989020 0.800497 0.488933 1 0.999818 0.897849 0.488738 1939 -1 1 1 1 107 0.988738 0.897849 0.488738 1939 -1 1 1 1 107 0.988738 0.897849 0.488738 1939 -1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	1422 -1	0		0.959020	0.500497	0.498933	1	0.999617	0.897849	2474.229980
1516 -1				0.959020	0.500497	0.498933	1_2_	0.999234	0.897849	2474.229980
1939 I I 107 0.989020 0.500407 0.498833 2 0.999234 0.897849 2474.72998 1908 -1 I 107 0.989020 0.800407 0.498833 1 0.999817 0.897849 2474.72998 Mean val 289.7 0.889035 0.497437 0.764616 249.13 0.904885 0.88860 6034.48073	1516 -1	1 0	107	0.959020	0.500497	0.498933				2474.229980
1908 -1 1 107 0.959020 0.500497 0.498933 1 0.999517 0.897849 2474.22998 Mean val 289.7 0.889035 0.497437 0.764616 249.13 0.904585 0.588660 6034.48073		 		0.959020		0.498933	+ 1/2	0.999234	0.897849	2474.229980
		<u> </u>	107	0.959020	0.500497	0.498933	I I	0.999817	0.897849	2474.229980
3rd devi 120.3 0.048390 0.003373 0.131876 123.96 0.047476 0.193084 2578.34293										
		1 24d devi	1 126.3	1 0.048390	1 0.003373	_ U.1315/6	1 143.80	1 0.04/4/0	1 0.183004	1 4010.394930

Table D.3: Results for Benchmark C2670

C30540.	testin	g length = 5	4K							
Ble	Inp	SA	N.PO	PEI	Rest.	Tim.Str.	N.Sg	PE2	Rest_2 0.911206	Tim,Furt
1815	-1		188	0.945444 0.945444	0.493393 0.493393	2.891580 2.891580	├─╁	0.999710	0.911208	1651.359965
4985	<u> i </u>	i	188	0.945444	0.493393	2.891580	3	0.999129	0.911206	1651.359985
3634 2730	-1		188	0.945444 0.945444	0.493393	2.891880 2.891880	┡┼╌┦	0.999710 0.999710	0.911206	1651.359985 1651.359985
4075	ö	 	188	0.945444	0.493393	2.891580	4	0.998839	0.911206	1551.359985
4189	1		188	0.945444 0.945444	0.493393	2.891580 2.891580		0.999710	0.911206 0.911206	1651.359985 1651.359985
3271	0	 	188	0.348444	0.493393	2.891580	 	0.999710	0.911206	1651.359985
3398	7	Ö	188	0.945444	0.493393	2.891580		0.999710	0.911205	1651.359985 1651.359985
3274 3276	<u> 1</u>		188	0.945444 0.945444	0.493393	2.891580 2.891580	┝╌╬╶┤	0.999710 0.999710	0.911206	1651.359985
3398	7	<u> </u>	188	0.945444	0.493393	2.891580		0.999710	0.911206	1651.359985
3398	8	1 0	188	U.945444 U.945444	0.493393	2.891580 2.891580	 	0.999710	0.911206	1551.359985 1551.359985
3208	 -	 	188	0.945444	0.493393	2.891580	i	0.999710	0.911206	1661.359985
3210		į	188	0.945444	0.493393	2.891580 2.891580		0.999710	0.911205	1651.359985 1651.359985
3390		9	188	0.945444 0.945444	0.493393	2.891580	 	0.999710	0.911206	1651.359985
2729	-1	1	188	0.945444	0.493393	2.891580		0.999710	0.911205	1551.359985
4949 4899	0	-	188	0.945444	0.493393	2.891580	 - <u>-</u> - 	0.999710	0.911206	1651.359985
4982	i	· · · · · ·	188	0.945444	0.493393	2.891580	- i	0.999710	0.911208	1651.359985
3172	1		188	0.945444 0.945444	0.493393 0.493393	2.891580 2.891580		0.999710	0.911206	1651.359985
4098	-6 -	1	188	0.945444	0.493393	7.891580	1 2	0.999420	0.911208	1851.389985
3980	-1	0	188	0.945444 0.945444	0.493393 0.493393	2.891580 2.891580		0.999710	0.911205	1551.359985
4705	÷	+ +	188	0.945444	0.493393	2.891580	2	0.999420	0.911206	1651.359985
4549	工	Ī	188	0.948444	0.493393	2.591550		0.999710	0.911206	1651.359985
4659	-1	8 -	188	0.945444 0.945444	0.493393	2.891580 2.891580	1	0.999710	0.911206	1851.359985
4844	-1	0	188	0.945444	0.493393	2.591550		0.999710	0.911206	1651.359985
769	-		135	0.960534	0.505245	2.753490	1	0.999710	0.975631	2588.310059 2588.310059
820	-1	 	135	0.980534	0.506246	2.753490		0.909710	0.975631	2588.310059
829 832	-1	Ų	136	0.980534	0.505245	2.753490 2.753490		0.999710	0.975631 0.975631	2588.310059 2588.310059
896	-1	 6	135	0.960534	0.506246	2.753490	i	0.999710	0.975631	2588.310059
913	-1		136	0.980834	U.506246 U.506246	2.753490 2.753490		0.999710	0.975631	2588.310059 2588.310059
1219	÷	 	136	0.960834	0.508248	2.753490	_ i _	0.999710	0.975631	2588.310059
1315	Ţ	1	135	0.960534	0.506245	2.753490 2.753490	1	0.999710	0.975631	2588.310059 2588.310059
1991	-1	0	136	0.960534	0.505248	7.753200	 i -	0.999710	0.975831	2588.310059
1599	ı		136	U.960534 U.960534	0.505246	2.783490		0.999710	0.975631	2588.310059 2588.310059
1408 2723	-11	 	136	0.980834	0.506246	2.753490	l i	0.999710	0.975631	2588.310059
2449	0_	1	135	0.980534	0.505246	2.753490		0.999710	0.975631	2588.310059 2588.310059
1864	- 6		138	0.960834	0.505245	2.753490 2.753490	 	0.999710	0.975631	2588.310059
1409	Ŭ.	<u> </u>	136	0.960534	0.506246	2.753490		0.999710	0.975631	2588.310059
1667 2103	- 0	1	136	0.960534	0.506246	2.753490	 	0.999710	0.975631	2588.310059 2588.310059
1905	-i -	 	136	0.900534	0.506246	2.753490	3	0.999129	0.975631	2588.310059
2043 2715	7	8	135	0.960534	0.506246 0.506246	2.753490 2.753490		0.999710 0.999710	0.975631	2588.310059 2588.310059
3168		 	136	0.950534	0.506246	2.753490	 i	0.999710	0.975631	2588.310059
3483 3468	7		138	0.960534	0.506246	2.753490 2.753490	1-1-	0.999710	0.975631	2588.310059 2588.310059
45	-1	 	136	0.960534	0.506246	2.753490	l i	0.999710	0.975631	2588.310059
179	-1	0	136	0.960534	0.505245	2.753490 2.753490		0.999710	0.975631	2588.310059 2588.310059
274	-1	1 0	136	0.960534	0.506246	2,753490	 	0.999710	0.975631	2588.310059
917	-1	0	36	0.989553	0.493855	2.456950		0.999710	1.000000	478.166992 478.166992
3471 4056		0	35	0.989553	0.493855 0.493855	2.456950	┼╌╁╌	0.999710	1.000000	475.166992
3383	1	i	36	0.989553	0.493855	2.456950		0.999710	1.000000	478.166992 478.166992
3194 1917	7	1	36	0.989553	0.493855	2.456950	+ +	0.999710	1.000000	478.166992
4091		1 1	36	0.989553	0.493855	2.456950	<u> i</u>	0.999710	1.000000	478.166992
1484	-1	1	35	0.989843	0.493618	1.830710	1	0.999710	0.900090	333.415985 333.415985
2331	1	<u> </u>	35	0.989843	0.493518	1.830710	<u> </u>	0.999710	0.900090	333.415985
1945 2139	-1	1	35	0.989843	0.493618	1.830710	1 2	0.999420	0.900090	333.415985 333.415985
2977	-1	1 6	35	0.989843	0.493618	1.830710	<u>ti</u>	0.999710	0.900090	333,415985
1845 4255	-1	0	200	0.941962 0.941962	0.493619	3.000650	+ +	0.999710	0.900189	1721.739990
4255	-1	 	200	0.941962	0.493619	3.000650	1	0.998839	0.900189	1721.739990
4109 3408			200	0.941982	0.493619	3.000650	3	0.999129	0.900189	1721.739990 1721.739990
3206	2	+ 6	200	N 021087	0.493519	3.000550	 i 	0.999710	0.900189	1721.739990
3406	Ī		200	0.941962	0.493519	3.000650		0.999710	0.900189	1721.739990 1721.739990
3546 3304	-8-	+	200	0.941962	0.493619	3.000650	+ +	0.999710	0.900189	1721.739990
3402	3	Ō.	200	0.941962 0.941962 0.941962	0.493519	3.000550	11	0.999710	0.900189	1721.739990
3307	-		200	0.941962	0.493819	3.000550	++-	0.999710	0.900189	1721.739990
3545	Ĭ	i	200	0.941962	0.493619	3,000650		0.999710	0.900189	1721.739990
3394 3241	Ŧ	7 - 9 -	200	0.941962 0.941962	0.493619	3.000680	 	0.999710	0.900189	1721.739990
3243	- 6	i	200	0.941962	0.493619	3.000650	i	0.999710	0.900189	1721.739990
3394	-	0	200	0.941962	0.493619	3.000650 3.000650		0.999710	0.900189	1721.739990
3246 2737	+	- 6	200	0.941962	0.493619	3.000650	+	0.999710	0.900189	1721.739990
4900	0	ŏ	200_	0.941962	0.493619	3.000650	11	0.999710	0.900189	1721.739990
4755	9	+ +-	200	0.941962 0.941962	0.493619	3.000680	1 1	0.999420	0.900198	1721.739990 1721.739990
3181	Ġ	i	200	0.941962	0.493619	3.000650	ı i	0.999710	0.900189	1721.739990
		Mean va		0.955073	0.497475	2.779782	1.19	0.999655	0.934192	
		Std devi	33.3	0.009877	0.004103	0.112361	0.94	0.000274	0.023102	146.174483

Table D.4: Results for Benchmark C3540

Sile Inp	SA	N.PO 80 80 80 80 80 80 80 80 80 80 80 80 80	FEI U.900794 U.7079782 U.779782	Real_1 0.504870 0.504870 0.504870 0.504870 0.504870 0.504870 0.504870 0.504870 0.504870 0.504870 0.504870 0.504870 0.504870 0.504870 0.504870 0.504837 0.504837 0.504837 0.504837 0.504837 0.504837 0.504837 0.504837 0.504837 0.504837 0.504837 0.504837 0.504837 0.504837 0.504837	Tim.Str. 0.086871 0.0868871 0.0868881 0.0868888 0.0868888 0.0868888 0.0868888 0.0868888 0.0868888 0.0868888	N.SR.	FE2 0.988016 0.988016 0.988016 0.988016 0.988016 0.988016 0.988018 0.988016	Real_2 1.000000 1.000000 1.000000 1.000000 1.000000 1.000000 1.000000 1.000000 1.000000 1.000000 1.000000 1.000000 1.000000 1.000000 1.000000 1.000000 0.980288 0.980288 0.980285 0.980285 0.980285	Tim, Furt 318.351013
381 -1 381 2 246 0 386 -1 386 2 250 0 388 2 250 0 398 -1 399 2 254 0 399 2 255 0 360 -1 131 -1 147 -1 157 -1 157 -1 157 -1 157 -1 189 -		50 50 50 50 50 50 50 50 50 50 50 50 50 111 111	0.900794 0.900794 0.900794 0.900794 0.900794 0.900794 0.900794 0.900794 0.900794 0.900794 0.900794 0.900794 0.900794 0.700796 0.779782 0.779782 0.779782 0.779782 0.779782 0.779782 0.779782 0.779782 0.779782 0.779782 0.779782 0.779782 0.779782 0.779782 0.779782 0.779782 0.779782 0.779782	0.504870 0.504870 0.504870 0.504870 0.504870 0.504870 0.504870 0.504870 0.504870 0.504870 0.504870 0.504870 0.504870 0.504857	0.086871 0.086871 0.086871 0.086871 0.086871 0.086871 0.086871 0.086871 0.086871 0.086871 0.086871 0.086871 0.086871 0.086881 0.086888 0.086888 0.086888 0.086888 0.086888 0.086888 0.086888 0.086888 0.086888 0.086888 0.086888 0.086888		0.988018 0.988018 0.988018 0.988018 0.988018 0.998018 0.998018 0.998018 0.988018 0.988018 0.988018 0.988018 0.988018 0.988018 0.988018 0.988018 0.988018 0.988018	1.00000 1.0000 1.00000 1.00000 1.00000 1.00000 1.00000 1.00000 1.00000 1.0000 1.00000	318.351013 318.351013
246 U 386 -1 386 Y 250 U 398 -1 399 -1 399 Y 254 U 399 Y 255 U 399 Y 255 U 399 Y 255 U 360 -1 123 -1 131 -1 157 U 167 -1 157 U 264 -1 185 U 270 -1 189 -1 189 -1 189 -1 189 -1 193 U 2770 -1 189 U 2770 -1 189 U 2770 -1 189 U 2770 -1 193 U 2770 -1 193 U 2771 -1 193 U 2772 -1 197 -1		50 50 50 50 50 50 50 50 50 50 50 50 111 111	0.900794 0.900794 0.900794 0.900794 0.900794 0.900794 0.900794 0.900794 0.900794 0.900794 0.700794 0.719782 0.719782 0.719782 0.719782 0.719782 0.719782 0.719782 0.719782 0.719782 0.719782 0.719782 0.719782 0.719782	0.804870 0.804870 0.804870 0.804870 0.804870 0.804870 0.804870 0.804870 0.904870 0.904870 0.904837 0.904837 0.904837 0.904837 0.904837 0.904837 0.904837 0.904837 0.904837 0.904837 0.904837 0.904837 0.904837 0.904837	0.086871 0.086871 0.086871 0.086871 0.086871 0.086871 0.086871 0.086871 0.086871 0.086871 0.086871 0.086871 0.086881 0.086881 0.086881 0.086888 0.086888 0.086888 0.086888 0.086888 0.086888		0.988016 0.998018 0.998018 0.998018 0.998018 0.998018 0.998018 0.998018 0.998018 0.998018 0.998018 0.998018 0.998018 0.998018 0.998018 0.998018 0.998018	1.00000 1.000000 1.000000 1.000000 1.000000 1.000000 1.000000 1.000000 1.000000 1.000000 1.000000 0.980285 0.980285 0.980285 0.980285 0.980285 0.980285	318.351013 318.351013 318.351013 318.351013 318.351013 318.351013 318.351013 318.351013 318.351013 318.351013 318.351013 318.351013 318.351017 839.067017 839.067017 839.067017 839.067017 839.067017 839.067017 839.067017 839.067017 839.067017
386 -1 386 -1 386 -7 250 0 385 -7 250 0 393 -1 393 -1 399 2 254 0 350 -1 399 2 255 0 360 -1 123 -1 131 -1 131 -1 131 -1 131 -1 131 -1 137 -1 157 0 270 -1 185 -1 185 -1 185 -1 185 -1 185 -1 185 -1 185 -1 185 -1 185 -1 185 -1 185 -1 185 -1 185 -1 185 -1 185 -1 185 -1 187 0 270 -1 185 -1 187 0 270 -1 185 -1 187 0 270 -1 185 -1 187 0 270 -1 189 0 276 -1 193 -1		50 50 50 50 50 50 50 50 50 50 50 50 50 5	C.900794 U.900794	0.804870 0.804870 0.804870 0.804870 0.804870 0.804870 0.804870 0.804870 0.904870 0.904870 0.904837 0.904837 0.904837 0.904837 0.904837 0.904837 0.904837 0.904837 0.904837 0.904837 0.904837 0.904837 0.904837 0.904837	U.086871 U.086871 U.086871 U.086871 U.086871 U.086871 U.086871 U.086871 U.086871 U.086871 U.086871 U.086871 U.086886		0.98018 0.998018 0.998018 0.998018 0.998018 0.998018 0.998018 0.998018 0.998018 0.998018 0.998018 0.998018 0.998018 0.998018 0.998018 0.998018 0.998018	1.000000 1.000000 1.000000 1.000000 1.000000 1.000000 1.000000 1.000000 1.000000 1.000000 1.000000 1.000000 1.000000 1.000000 0.980285 0.980285 0.980285 0.980285 0.980285	318.351013 318.351013
256		50 50 50 50 50 50 50 50 50 50 111 111 11	0.900794 0.900794 0.900794 0.900794 0.900794 0.900794 0.900794 0.900794 0.900794 0.900794 0.900794 0.700796 0.779782 0.779782 0.779782 0.779782 0.779782 0.779782 0.779782 0.779782 0.779782 0.779782 0.779782 0.779782 0.779782 0.779782 0.779782 0.779782 0.779782	0.504870 0.504870 0.504870 0.504870 0.504870 0.504870 0.504870 0.504870 0.504837 0.504837 0.504837 0.504837 0.504837 0.504837 0.504837 0.504837 0.504837 0.504837 0.504837 0.504837 0.504837 0.504837 0.504837 0.504837 0.504837	U.088871 U.088871 U.088871 U.088871 U.088871 U.088871 U.088871 U.088871 U.088881 U.088888 U.088888 U.088888 U.088888 U.088888 U.088888 U.088888 U.088888 U.088888 U.088888 U.088888 U.088888 U.088888 U.088888 U.088888 U.088888		0.988018 0.998018 0.998018 0.998018 0.998018 0.998018 0.998018 0.998018 0.998018 0.998018 0.998018 0.998018 0.998018 0.998018 0.998018 0.998018 0.998018	1.000000 1.000000 1.000000 1.000000 1.000000 1.000000 1.000000 1.000000 0.980288 0.980288 0.980288 0.980288 0.980288 0.980288	318.351013 318.351013 318.351013 318.351013 318.351013 318.351013 318.351013 318.351013 318.351017 839.087017 839.087017 839.087017 839.087017 839.087017 839.087017 839.087017 839.087017 839.087017 839.087017
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398 2 254 U 399 -1 399 -1 399 -1 399 2 255 U 360 -1 123 -1 131 -1 137 -1 157 -1 157 U 270 -1 185 -1	1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	50 50 50 50 50 50 50 111 111 111 111 111	0.900794 0.900794 0.900794 0.900794 0.900794 0.7079782 0.779782 0.779782 0.779782 0.779782 0.779782 0.779782 0.779782 0.779782 0.779782 0.779782 0.779782 0.779782 0.779782	0.504870 0.504870 0.504870 0.504870 0.504870 0.504870 0.504837 0.504837 0.504837 0.504837 0.504837 0.504837 0.504837 0.504837 0.504837 0.504837 0.504837 0.504837 0.504837	0.088671 0.088671 0.088871 0.088871 0.088871 0.088871 0.088880 0.088888 0.088888 0.088888 0.088888 0.088888 0.088888 0.088888 0.088888 0.088888 0.088888		U.998016 U.998016 U.998016 U.998016 U.998016 U.998016 U.998016 U.998016 U.998016 U.998016 U.998016 U.998016 U.998016	1.000000 1.000000 1.000000 1.000000 1.000000 0.980288 0.980288 0.980288 0.980288 0.980288 0.980288	318.351013 318.351013 318.351013 318.351013 318.351013 318.351013 318.351013 318.351017 839.067017 839.067017 839.067017 839.067017 839.067017 839.067017 839.067017 839.067017
399 -1. 399 2 255 0 255 0 360 -1 123 -1 131 -1 139 -1 147 -1 157 0 254 -1 185 0 270 -1 185 -1 185 0 270 -1 189 0 276 -1 189 0 276 -1 189 0 276 -1 193 -1 194 -1 195	1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	50 50 50 50 111 111 111 111 111 111 111	0.900794 0.900794 0.900794 0.700794 0.779782 0.779782 0.779782 0.779782 0.779782 0.779782 0.779782 0.779782 0.779782 0.779782 0.779782 0.779782 0.779782 0.779782 0.779782	0.504870 0.504870 0.504870 0.504870 0.504837 0.504837 0.504837 0.504837 0.504837 0.504837 0.504837 0.504837 0.504837 0.504837 0.504837 0.504837 0.504837	0.086671 0.086871 0.086871 0.086871 0.086888 0.086888 0.086888 0.086888 0.086888 0.086888 0.086888 0.086888 0.086888 0.086888		0.998018 0.998018 0.998018 0.998018 0.998018 0.998018 0.998018 0.998018 0.998018 0.998018 0.998018	1.000000 1.000000 1.000000 1.000000 0.980285 0.980285 0.980285 0.980285 0.980285 0.980285	318.351013 318.351013 318.351013 318.351013 318.351013 339.087017 839.087017 839.087017 839.087017 839.087017 839.087017 839.087017 839.087017 839.087017
399 2 255 0 360 -1 123 -1 131 -1 131 -1 131 -1 137 -1 157 -1 157 -1 185 -1 185 -1 185 -1 185 -1 185 -1 185 -1 185 -1 185 -1 185 -1 187 -1 189 -1 189 -1 193 -1 193 -1 193 -1 193 -1 193 -1 193 -1 193 -1 193 -1 193 -1 193 -1 193 -1 193 -1 193 -1 193 -1 193 -1 194 -1 195 -1 197	1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	50 50 111 111 111 111 111 111 111 111 11	U.900794 U.900794 U.700794 U.779762 U.779762 U.779762 U.779762 U.779762 U.779762 U.779762 U.779762 U.779762 U.779762 U.779762 U.779762 U.779762 U.779762 U.779762 U.779762	0.804870 0.804870 0.804870 0.804837 0.804837 0.804837 0.804837 0.804837 0.804837 0.804837 0.804837 0.804837 0.804837	0.086871 0.086871 0.0868871 0.086888 0.086888 0.086888 0.086888 0.086888 0.086888 0.086888 0.086888 0.086888 0.086888 0.086888		0.998018 0.998018 0.998018 0.998018 0.998018 0.998018 0.998018 0.998018 0.998018 0.998018	1.000000 1.000000 1.000000 0.980285 0.980285 0.960285 0.960285 0.960285 0.960285 0.960285	318.331013 318.331013 318.331013 839.087017 839.087017 839.087017 839.087017 839.087017 839.087017 839.087017 839.087017 839.087017 839.087017
285	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	50 111 111 111 111 111 111 111 111 111 1	0.900794 0.779762 0.779762 0.779762 0.779762 0.779762 0.779762 0.779762 0.779762 0.779762 0.779762 0.779762 0.779762 0.779762 0.779762 0.779762 0.779762 0.779762	0.504870 0.504837 0.504837 0.504837 0.504837 0.504837 0.504837 0.504837 0.504837 0.504837 0.504837 0.504837	0.088871 0.088368 0.088368 0.088368 0.088368 0.088368 0.088368 0.086368 0.086368 0.086368 0.086368 0.086368		0.998018 0.998018 0.998018 0.998018 0.998018 0.998018 0.998018 0.998018	1.000000 0.980285 0.980285 0.980285 0.980285 0.980285 0.980285 0.980285	318.351013 839.087017 839.087017 839.087017 839.087017 839.087017 839.087017 839.087017 839.087017
128 -1 131 -1 139 -1 147 -1 157 -1 157 -1 157 -1 157 -1 155 -1 185 -1 185 -1 185 -1 185 -1 185 -1 189 0 270 -1 189 0 278 -1 189 0 278 -1 193 -1 194 -1 195 -1 197 -1 198 -1 199 -	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		0.779762 0.779762 0.779782 0.779782 0.779762 0.779762 0.779762 0.779762 0.779762 0.779762 0.779762 0.779762 0.779762 0.779762	0.804837 0.804837 0.804837 0.804837 0.804837 0.804837 0.804837 0.804837 0.804837 0.804837 0.804837	0.088568 0.058568 0.088566 0.086566 0.086566 0.086566 0.086566 0.086566 0.086568		0.998015 0.998016 0.998016 0.998016 0.998016 0.998016 0.998016	0.980288 0.980288 0.980288 0.980288 0.980288 0.980288 0.980288	839.067017 839.067017 839.067017 839.067017 839.067017 839.067017 839.067017 839.067017
131 -1 139 -1 147 -1 157 -1 157 -1 157 -1 158 -1 188 -1 188 -1 188 -1 189 -1 189 -1 189 -1 189 -1 193 -1 193 -1 193 -1 193 -1 197 -1 197 -1 197 -1 197 -1 197 -1	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		0.779762 0.779762 0.779762 0.779762 0.779762 0.779762 0.779762 0.779762 0.779762 0.779762 0.779762 0.779762	0.804837 0.804837 0.804837 0.504837 0.804837 0.804837 0.804837 0.804837 0.804837 0.804837	0.056566 0.056566 0.056566 0.056566 0.056566 0.056566 0.066566 0.056568 0.056566 0.056566		0.998016 0.998016 0.998016 0.998016 0.998016	0.980268 0.980268 0.960268 0.960268 0.980268 0.980268 0.980268	839.067017 839.067017 839.067017 839.067017 839.067017 839.067017 839.067017
147 -1 157 -1 158 -1 185 -1 185 -1 185 0 270 -1 189 0 278 -1 193 -1 193 -1 193 -1 197 -1 197 -1 274 -1 230 -1 230 -1 230 -1 230 -1	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		0.719762 0.779762 0.719762 0.719762 0.719762 0.719762 0.719762 0.719762 0.719762 0.719762 0.719762	0.504537 0.504537 0.504537 0.504537 0.504537 0.504537 0.504537 0.504537 0.504537	0.058566 0.056566 0.058566 0.058566 0.058566 0.058566 0.058566 0.058566 0.058566		0.998016 0.998016 0.998016 0.998018 0.998016	0.960268 0.960268 0.960268 0.960268 0.960268	839.067017 839.067017 839.067017 839.067017 839.067017
157 -1. 157 0 264 -1 185 -1 185 0 270 -1 189 0 278 -1 189 0 278 -1 193 -1 193 -1 195 0 282 -1 197 0 224 -1 230 -1 236 -1 235 -1	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		0.719762 0.719762 0.719762 0.719762 0.719762 0.719762 0.719762 0.719762 0.719762 0.719762	0.504537 0.504537 0.504537 0.504537 0.504537 0.504537 0.504537 0.504537	0.056566 0.056566 0.056566 0.056566 0.056566 0.056566 0.056566 0.056566		0.998016 0.998016 0.998016 0.998016	0.960265 0.960265 0.960265 0.960265	839.067017 839.067017 839.067017 839.067017
187 U 284 -1 185 -1 185 0 270 -1 189 -1 189 U 278 -1 193 -1 193 -1 193 U 282 -1 197 -1 197 -1 274 -1 230 -1 230 -1 235 -1 235 -1	0 0 0 0 0 0 0 0 0 0 0 0 0		0.779762 0.719762 0.719762 0.719762 0.719762 0.719762 0.719762 0.719762 0.719762	0.504837 0.504837 0.504837 0.504837 0.504837 0.504837	0.056566 0.056568 0.056568 0.056566 0.056566		0.998018 0.998016	0.960268 0.960268 0.960268	839.067017 839.067017 839.067017
185 -1 185 0 270 -1 189 -1 189 0 276 -1 193 0 282 -1 197 0 224 -1 230 -1 236 -1 243 -1	0 0 0 0 0 0 0 0 0 0 0 0 0		0.779762 0.779762 0.779762 0.779762 0.779762 0.779762 0.779762 0.779762	0.504537 0.504537 0.504537 0.504537 0.504537	0.056566 0.056566 0.056566 0.056566 0.056566		0.998016 0.998016	0.960265 0.960265	839.067017 839.067017
185 0 270 -1 189 -1 189 0 276 -1 193 -1 193 0 282 -1 197 -1 197 0 224 -1 230 -1 243 -1	0 0 0 0 0 0 0 0 0		0.779762 0.779762 0.779762 0.779762 0.779762 0.779762 0.779762	0.504537 0.504537 0.504537 0.504537 0.504537	0.088888 0.088886 0.088888 0.088888		0.998016	0.960265	
189 -1 189 U 276 -1 193 -1 193 U 282 -1 197 -1 197 U 224 -1 230 -1 243 -1	0 0 0 0 0 0 0 0 0	111 111 111 111 111	0.779762 0.779762 0.779762 0.779762 0.779762	0.504537 0.504537 0.504537	0.055566 0.058566		0.998016	0.960265	A39,0471117
189 U 276 -1 193 -1 193 U 282 -1 197 -1 197 U 224 -1 230 -1 233 -1 243 -1	0 0 0 0 0 0 0	111 111 111 111 111	0.779762 0.779762 0.779762 0.779762	0.504537	0.056566		0.998018	0.960265	839.067017
276 -1 193 -1 193 0 282 -1 197 -1 197 0 224 -1 230 -1 238 -1 243 -1	0 0 0 0 0	111	0.779762 0.779762 0.779782	0.504537		 i 	0.998016	0.960265	839.067017
193 U 282 -1 197 -1 197 U 224 -1 230 -1 236 -1 243 -1	0 0 0 0 0	111	0.779752		0.055566	\Box	0.998016 0.998016	0.960263 0.960268	839.067017
282 -1 197 -1 197 0 224 -1 230 -1 236 -1 243 -1	0 0 0 0	111		0.504537	0.055566 0.055566	 	0.998016	0.960265	839.067017 839.067017
197 0 224 -1 230 -1 236 -1 243 -1	0 0 0		0.779752	0.504537	0.058566	<u> </u>	0.998016	0.950265	839.067017
234 -1 230 -1 236 -1 243 -1	0		0.779762	0.504537 0.504537	0.056566 0.056566	-	0.996032	0.960265 0.960265	839.057017 839.057017
230 -1 236 -1 243 -1	Ŏ	111	0.779762	0.504537	0.088888	1 2	0.996032	0.960265	839.067017
243 -1		111	0.779762	0.504537	0.056566	2	0.996032	0.960265	839.067017 839.067017
		111	0.779762	0.504537 0.504537	0.056566	1 2 1	0.996032	0.960265 0.960265	839.067017
251 -1	ŏ	111	0.779762	0.504537	0.055555	<u> </u>	0.998032	0.960266	839.057017
296 0 296 4		111	0.779762	0.504537 0.504537	0.056368 0.056366		0.998016	0.960265	839.057017 839.057017
296 8	i	 iii 	0.779762	0.504537	0.056566	 i -	0.998016	0.960265	839.067017
21 -1	U	111	0.779762	0.504537 0.504537	0.058568		0.998016 0.998016	0.960265	839.067017 839.067017
73 -1	 	111	0.779762	0.504537	0.056566 0.056566	 - 	0.998016	0.960265	839.057017
- 1 - 1	Ö	111	0.779762	0.504537	0.056566		0.998016	0.960265	839.087017
256 -1 344 1		72	0.986349 0.986349	0.506940 0.506940	0.055782		0.998016	1.000000	124.518997
404 3	 i	22	0.956349	. 0.506940	0.055782	i	0.998016	1.000000	124.518997
257 -1		22 22	0.956349	0.505940	0.055782	\Box	0.998018	1.000000	124.518997
345 1 407 3	 i	22	0.956349	0.506940	0.055782	 - i -	0.998015	1.000000	124.518997
118 -1	ĭ	54	0.873016	0.515153	0.055497	1	0.998016	0.992658	523.554001
122 -1	1	64 64	0.873016	0.515153 0.515153	0.056497	1	0.998016	0.992658	623.564001
130 1	1	54	0.873016	0.515153	0.058497	i_	0.998016	0.992658	523.584001 523.684001
134 -1	11	54	0.873016	0.515153	0.056497	\Box	0.998016	0.992558	523.584001 523.684001
138 -1	1	64	0.873016	0.515153	0.055497	+ + -	0.998016	0.992658	523.564001
146 -1	i i	64	0.873016	0.515153	0.056497		0.998018	0.992658	623.664001
150 -1	1	54 54	0.873016	0.515153 0.515153	0.058497	+ +	0.998016	0.992658	523.554001 523.554001
199 3	1	64	0.873016	0.515153	0.056497		0.998016	0.992658	623.664001
199 7		54 54	0.873016 0.873016	0.515153	0.056497		0.998016	0.997658 0.997658	523.554001 523.564001
17 -1	 i	54	0.873016	0.515153	0.056497	 i 	0.998016	0.992658	623.664001
30 -1	1	64	0.873016	0.515153	0.058497		0.998016	0.992658	523.6640U1
36 -1		54	0.873016	0.515153	0.056497	+ +	0.998016	0.997658	623.664001 623.664001
59 -1	<u> </u>	54	0.873016	0.515153	0.056497	<u>ti</u>	0.998016	0.992658	623.584001
82 -1 95 -1		54 54	0.873016	0.515153	0.056497	1	0.998016	0.992658	623.664001 623.664001
108 -1	1 1	64	0.873016	0.515153	0.055497	 i 	0.998016	0.992658	523.554001
263 -I	Ö	102	0.797519	0.514706	0.057903	2	0.998032	0.936912	857.681030
184 -1 184 0	0	102	0.797619	0.514706	0.057903	+ 2	0.998032	0.935912	857.681030 857.681030
289 -I	- ō	102	0.797619	0.514706	0.057903	1 2	0.996032	0.936912	857.681030
188 -1 188 0	0	102	0.797619	0.514706	0.057903	7	0.996032	0.936912	857.581030 857.581030
291 -1	0	102	0.797619	0.514706	0.057903	+	0.996032	0.936912	857.681030
192 -1	0	102	0.797619	0.514706	0.057903	2	0.995032	0.936912	857.581030 857.581030
192 0 293 -1	8	102	0.797619	0.514708	0.057903	+ 1/2	0.998016	0.936912	857.681030
196 -1	Ö	102	0.797619	0.514708	0.057903	1 2	0.996032	0.936912	857.681030
196 0 295 -1	0	102	0.797519	0.514708	0.057903	1 1	0.998018	0.936912	857.581030 857.581030
309 -1	1 0	102	0.797619	0.514708	0.057903		0.998016	0.936912	857.581030
348 -1	0	102	0.797619	0.514708	0.057903		0.998016	0.936912	857.581030 857.581030
331 0 349 1	1	102	0.797619	0.514706 0.514706	0.057903	+	0.996032	0.936912	857.681030
332 0	i	102	0.797619	0.514708	0.057903		0.998018	0.936912	857.681030
357 3	1 - 6	102	0.797619	0.514706	0.057903	7	0.998016	0.936912	857.581030 857.581030
352 0	1	102	0.797519	0.514708	0.057903	±i−	0.998016	0.935912	857.581030
335	1 1	102	0.797619	0.514706	0.057903		0.998016	0.936912	857.581030 857.681030
337 0	1	102	0.797619	0.514705	0.057903	+	0.998032	0.936912	857.681030
339 0	1	102	0.797619	0.514706	0.057903	1	0.998016	0.935912	857.681030
357 7 341 1		102	0.797519	0.514706 0.514706	0.057903	2	0.996032	0.936912	857.581030
356 U	 '	102	0.797619	0.514706	0.057903	+ +	0.998018	0.936912	857.581030
3/3 1		102	0.797619	0.514708	0.057903		0.998018	0.936912	857.681030
	Mean val	84.6	0.832064	0.509906	0.056907	1.19	0.997639	0.988242	683.457326
	Std devi	31.3	0.062030	0.005218	0.000290	0.30	0.000604	0.024077	289.761357

Table D.5: Results for Benchmark C432

C499, testini	r length = 6	AK .				· · · · ·			
Ele Inp			PEI	Resl_I	Tim.Str.	N.S _K	FE2 0.998623	Resl_2 1.000000	Tim,Furt 8742.759768
250 -1 290 1	0	209	0.712121	0.525372 0.525372	0.181942 0.181942	- i -	0.998523	1.000000	8742.759766
251 1	- 0 -	209	0.712121	0.525372	0.181942	Ť	0.998623_	1.000000	8742.759766
293 -1	U	209	0.712121	0.525372	0.181942 0.181942		0.998523	1.0000000	8742.759766 8742.759766
753 0 754 -1	- 0	209	0.712121	0.525372 0.525372	0.181942	 	0.998523	1.000000	8742.759766
296 L	0	209	0.712121	0.525372	0.181942		0.998623	1.000000	8742.759766
255 1	- 0	209	0.712121	0.525372	0.181942 0.181942	-	0.998523 0.998523	1.0000000	8742.759766 8742.759766
299 -1 257 U	- 8	209	0.712121	0.525372	0.181942	- i -	0.998523	1.000000	8742.759766
258 -1	0	209	0.712121	0.525372	0.181942		0.998623	1.000000	8742.759766
302 1	0	209	0.712121	0.525372	0.181942		0.998523 0.998523	1.0000000	8742.759766 8742.759768
259 I 305 -1	-	209	0.712121	0.525372	0.181942	-i-	0.998623	1.000000	8742.759768
261 0		209	0.712121	0.525372	0.181942		0.998523	1.000000	8742.759755
762 -1 308 1	- 0	209	0.712121	0.525372	0.181942 0.181942		0.998623	1.0000000	8742.759766 8742.759766
263 I	- 8	209	0.712121	0.525372	0.181942	- i -	0.998523	1.0000000	8742.759766
311 -1	-	209	0.712121	0.525372	0.181942		0.998523 0.998523	1.0000000 T.0000000	8742.759766
765 U	-8-	209	0.712121 0.712121	0.525372 0.525372	0.181942 0.181942	 	0.996023	1.000000	8742.759756 8742.759756
384 -1	- 6 -	209	0.712121	0.525372	0.181942	<u> </u>	0.998623	1.000000	8742.759766
314 0	0	209	0.712121	0.525372	0.181942	\Box	0.998623	1.000000	8742.759766 8742.759766
274 1	- 8	209	0.712121	0.525372 0.525372	0.181942 0.181942	 	0.998623	1.000000	8742.759766
348 1	- 6	209	0.712121	0.525372	0.181942		0.998523	1.000000	8742.759766
342	- 0 -	209	0.712121	0.525372	0.181942		0.998623	1.000000	8742.759766 8742.759766
267 -1 367 -1	0	209	0.712121	0.525372	0.181942 0.181942	 	0.998623	1.000000	8742.759766
318 0	Ö	209	0.712121	0.525372	0.181942	i_	0.998623	1.0000000	8742.759768
276 1	0	209	0.712121	0.525372	0.181943 0.181942	1	0.998623	1.000000	8742.759766 8742.759766
277 U	0	209	0.712121	0.525372	0.181942	 	0.998623	1.000000	8742.759756
343	0	209	0.712121	0.525372	0.181942		0.998623	1.000000	8742.759766
268 -1 380 -1	8 -	209	0.712121	0.525372	0.181942 0.181942	1-1-	0.998623	1.000000	8742.759766 8742.759766
380 -1 316 0	8	209	0.712121	0.525372	0.181942	 i 	0.998623	1.000000	8742.759766
278	. 0	209	0.712121	0.525372	0.181942	Į Į	0.998623	1.000000	8742.759766 8742.759766
279 0 348 1	- 8	209	0.712121	0.525372	0.181942		0.998523	1.000000	8742.759766
344 1	8 -	209_	0.712121	0.525372	0.181942 0.181942		0.998823	1.000000	8742.759768
269 -1	0	209	0.712121	0.525372	0.181942	1	0.998523	1.000000	8742.759766 8742.759766
393 -1 317 0	0	209 209	0.712121	0.525372 0.525372	0.181942 0.181942	 	0.998623	1.000000	8742.759766
280 1	- 8	209	0.712121	0.525372	0.3303922	Ī	0.998623	1.000000	8742.759766
281 0	0	209	0.712121	0.525372	0.181942 0.181942		0.998523	1.000000	8742.759766 8742.759766
349 1	0	209	0.712121	0.525372	0.181942	 	0.998623	1.000000	8742.759766
270 -1	0	209	0.712121	0.525372	0.181942	<u> </u>	0.998623	1.000000	8742.759766
406 -1	0	209	0.712121	0.525372 0.525372	0.181942 0.181942	 	0.998623	1.000000	8742.759766 8742.759766
318 0 282 1	8	209	0.712121	0.525372	0.181942	 i 	0.998523	1.000000	8742.759765
283 0	0	209	0.712121	0.525372	0.181942		0.998623	1.000000	8742.759786 8742.759786
350 1	0	209	0.712121	0.525372 0.525372	0.181942 0.181942	 	0.998623	1.000000	8742.759766
271 -1	 ŏ	209	0.712121	0.525372	0.181942	1	0.998623	1.000000	8742.759768
419 -1	0_	209	0.712121	0.525372	0.181942	1	0.998623	1.000000	8742.759766 8742.759766
319 0 284 1	0	209	0.712121	0.525372	0.181942	 	0.998623	1.000000	8742.759768
285 0	0	209	0.712121	0.525372	0.181942		0.998623	1.000000	8742.759755
351 I	8	209	0.712121	0.525372	0.181942 0.181942		0.998623	1.000000	8742.759766 8742.759766
272 -1	 0 -	209	0.712121	0.525372	0.181942	1 i	0.998623	1.000000	8742.759766
432 -1	0 _	209	0.712121	0.525372 0.525372	0.181942 0.181942	1	0.998623	1.000000	8742.759766 8742.759766
320 0 286 1	- 0	209	0.712121	0.525372	0.181942	 	0.998623	1.000000	8742.759768
287 0	T O	209	0.712121	0.525372	0.181942		0.998623	1.000000	8742.759766
352 1	0	209	0.712121	0.525372	0.181942 0.181942	1-1-	0.998623	1.000000	8742.759766 8742.759766
340 1 273 -1	0	209	0.712121	0.525372	0.151942	 i 	0.998623	1.000000	8742.759766
445 -1	1 0	209	0.712121	0.525372	0.181942		0.998523	1.000000	8742.759766
321 U	0	209	0.712121	0.525372 0.525372	0.181942	\Box	0.998623	1.000000	8742.759766
289 0	├──	209	0.712121	0.525372	0.181942	 i	0.998523	1.000000	8742.759755
353	0	209	0.712121	0.525372	0.181942		0.998823	1.0000000	8742.759766
341 1		209	0.712121	0.525372	0.181942	+-+-	0.998623	1.000000	8742.759766 8742.759766
9 -1	1 1 -	209	0.712121	0.525372	0.181942	<u></u>	0.998823	1.0000000	8742.759758
17 -1		209_	0.712121	0.525372	0.181942		0.998623	1.000000	8742.759766 8742.759766
75 -1 33 -1	1	209	0.712121	0.525372	0.181942 0.181942	+-+	0.998523	1.0000000	8742.759766
41 -1	 i _	209	0.712121	0.525372	0.181942 0.181942	<u> </u>	0.998623	1.000000	8742.759766
49 -1		209	0.712121	0.525372	0.181942	II	0.998523	1.0000000	8742,759766 8742,759766
57 -1		209	0.712121	0.525372	0.181942	1 1	0.998623	T.0000000	8742.759755
73 -1		209	0.712121	0.525372	0.181942		0.998623	1.000000	8742.759766
81 -1		209	0.712121	0.525372	0.181942	1 1	0.998623	1.000000	8742.759766 8742.759768
97 -1	 	209	0.712121	0.525372	0.181942	L i	0.998823	1.0000000	8742.759766
105 -1	i	209	0.712121	0.525372	0.181942	I	0.998523	1.000000	8742.759766 8742.759766
113 -1	1	209	0.712121	0.525372	0.181942 0.181942	++	0.998623 0.998623	1.000000	8742.759766
121 -1	† †	209	0.712121	0.525372	0.181942	 i	0.998623	1.0000000	8742.759766
394 -1	1 1	33	0.954545	0.469225	0.164637	1	0.998623	0.779600	314.864014 314.864014
595 1 596 0		33	0.954545	0.469225	0.164637 0.164637	1 2	U.997245 U.997245	0.779600	314.864014
596 0	 	33	0.954545	0.469225	0.164637	+ 1	0.998623	0.779600	314.864014
597 3	1 1	33	0.954545	0.469225	0.154637	1 2	0.997245	0.779600	314.864014
692 -1 724 0	- 0	5 -	0.993113	0.563705	0.110820	+ +	0.998623	1.000000	44.721699
	Mean va		0.729862	0.523331	0.179654	1.03	0.998582	0.988980	8147.404217
 	Std devi		0.017830	0.002081	0.002299	0.03	0.000042	0.011076	598.354840

Table D.6: Results for Benchmark C499

C5315,	testing	length = 64	K							
Ble 816	Inp	SA_	N.PO	FE1 0.999627	Rest_1 0.500000	Tim.Str. 1.171050	N.Sg	0.999813	Resl_2 1.000000	Tim,Furt 39.951900
816	-1	i	2	0.999627	0.500000	1.171080	i	0.999813	1.000000	39.951900
3808	-1	9	13	0.997576 0.997576	0.507120	1.345750		0.999813	1.000000	324.298004 324.298004
7567	-1 +	- i -	13	0.997576	0.507120	1.345750	i	0.999813	1.000000	324.298004
7567 4547	9	0	13	0.997576 0.997576	0.507120	1.345750		0.999813	1.000000	324,298004 324,298004
4547	7	- i	13	0.997576	0.507120	1.345750	i	0.999813	1.000000	324.298004
4547 7557	7		13	0.997576 0.997576	0.507120	1.345750		0.999813	1.000000	324.298004 324.298004
7487	- 6 - 1	Ť	13	0.997576	0.507120	1.345750	i	0.999813	1.0000000	374.793004
7487	1 2		13	0.997576 0.997576	0.507120	1.345750	-	0.999813	1.000000	324.298004 324.298004
3808	- ô-	i	13	0.997576	0.507120	1.345750	<u> </u>	0.999813	1.000000	324.298004
3808	1 7		13	0.997575	0.507120	1.345750	 	0.999813	1.000000	324.298004 324.298004
1042	-1	- 6	28	0.994778	0.509821	1.347720	2	0.999827	0.957016	638.861023
1042	-	1	28 28	0.994778	0.509821 0.509821	1.347720	1 2	0.999827	0.987018 0.987018	638.861023 638.861023
1042	1	i	28	0.994778 0.994778	0.509821	1.347720		0.999813	0.957016	538.861023 538.861023
1755			28 28	0.994778 0.994778	0.509821	1.347720	 	0.999813	0.957016	638.861023
1758	-1	ō	28	0.994778	0.509821	1.347720		0.999813	0.957016	638.861023 638.861023
1758 2524	+	0	28 28	0.994778 0.994778	0.509821	1.347720	 	0.999813	0.957016	638.861023
2524	-1		28	0.994778	0.509821	1.347720		0.999813	0.957016	638.861023
7525	-1	0	28 28	0.994778 0.994778	0.509821	1.347720	<u> </u>	0.999813	0.957016 0.957016	638.861023 638.861023
7626	-0	i	28 28	0.994778	0.509821	1.347720	7	0.999627	0.957016 0.957018	638.861023 638.861023
7525 4741	8	1 -	28	0.994778	0.509821 0.509821	1.347720	1	0.999813	0.987016	638.861023
4741			28	T 0004778	0.509821 0.509821	1.347720		0.999813	0.957015	538.861023 538.861023
7525	$\frac{2}{1}$	0 _	28 28	0.994778	0.509821	1.347720_	<u> </u>	0.999813	0.957016	638.861023
7114	9		28 28	0.994778 0.994778	0.509821	1.347720	1-1-	0.999813	0.957016	638.861023 638.861023
7114	2		28	0.9844778	0.509821	1.347720	<u> </u>	0.999813	0.957016	638.861023
7525	3	9	28	0.994778	0.509821 0.509821	1.347720	\vdash	0.999813	0.957016	638.861023
7484	Ī	<u> </u>	28	0.994778	0.509821	1.347720	l i	0.999813	0.957016	538.861023
7484	-2		28 28	0.994778	0.509821	1.347720		0.999813	0.957016	638.861023
2624		i	28	0.994778 0.994778	0.509821	1.347720	i	0.999813	0.957016	638.861023
2624 599	-1		28 28	U.994778 U.994778	0.509821	1.347720	+	0.999813	0.987018	638.861023
599	-1	Ö	78	0.994778	0.509821	1.347720	i	0.999813	0.957016	538.861023
603 603	-1	1	28 28	0.994778 0.994778 0.994778	0.509821	1.347720	 	0.999813	0.987018	638.861023 638.861023
1663	-1	ŭ	4	0.999254	0.500000	1.203730	1	0.999813	1.000000	128.923004
1685	<u>.</u>	0	1	0.999254	0.500000	1.203730	1	0.999813	1.000000	128.923004
1685	-1	1	1	0.999254	0.300000	1.203730		0.999813	1.000000	128.923004
1821	<u>:</u>	9		0.999627	0.500000	1.173150	+ + -	0.999813	1.000000	42.104599
2584		Ō	3	0.999627	0.500000	1.173970		0.999813	1.000000	39.950599
1223	+	6	10	0.998135	0.500000	1.173970	 i	0.999813	1.0000000	222.279999
1223	-1		10	0.998135 0.998135	0.500000	1.297230		0.999813	1.0000000	222.279090
1235	+	Ť	10	0.998135	0.500000	1.297230	1	0.999813	1.0000000	222.279999
2722	- -	Q	10	0.998135	0.500000	1.297230		0.999813	1.000000	722.279999 222.279999
2728	-i		10	0.998135	0.300000	1.297230	<u> </u>	0.999813	1.000000	222.279999
2728	+	1	10	0.998135	0.500000	1.297230		0.999813	1.000000	222.279999 222.279999
2739			10	0.998135	0.500000	1.297230	i	0.999813	1.000000	222.279999
2602 2602		9	19	0.996457	0.504317	1.313410	 	0.999813	1.000000	408.824005
7513	-i	•	19	0.996457	0.504317	1.313410		0.999813	1.000000	408.824005
7606			19	0.998457	0.504317	1.313410	++	0.999813	1.000000	408.824005
7513	ġ	i i	19	0.996457	0.504317	1.313410		0.999813	1.000000	408.824005
7445	7	- 	19	0.996457 0.996457	0.504317 0.504317	1.313410		0.999813	1.000000	408.824005
7445	2	ī	19	0.996457	0.504317	1.313410	T.	0.999813	1.000000	408.824005 408.824005
7513 7446	- 0	0	19	0.996457	0.504317 0.504317	1.313410	_ i 	0.999813	1.000000	408.824005
7448			19	0.998457	0.504317	1.313410		0.999813	1.000000	408.824005
7446	2	0	18	0.998457	0.504317	1.313410	<u> </u>	0.999813	1.000000	408.824005
3534	Ü	ļ	10	0.998457	0.504317	1.313410		0.999813	1.000000	408.824005
3634 3634	- 1	1	19	0.996457	0.504317 0.504317	1.313410	1 i	0.999813	1.000000	408.824005
2602	-		19	0.996457	0.504317	1.313410	++	0.999813	1.000000	408.824005
2602		<u> </u>	19	0.998457	0.504317	1.313410	1	0.999813	1.000000	408.824005
4392 4392		9	72	0.995897	0.503570	1.329450	$\overline{\Box}$	0.999813	1.000000	848.500000
5427	-1	ė –	72	0.995897	0.503570	1.329450	† i	0.999813	1.000000	848.500000
6152	-	0	722	0.995897	0.503570	1.329450	+-+-	0.999813	1.000000	848.500000 848.500000
6152	Ĭ	i	72	0.995897	0.503570	1.329450	T i	0.999813	1.000000	848.500000
6427 6153	7	9	22	0.995897	0.503570	1.329450		0.999813	1.000000	848.500000 848.500000
5153	Ť	<u> </u>	22	0.995897	0.503570	1.329450	T I	0.999813	1.000000	848.500000
6153 6427	3	- 1	22	0.995897 0.995897	0.503570	1.329450	1 1	0.999813	1.000000	848.500000
8154	5	ĭ	22	0.995897	0.503570	1.329450	<u> </u>	0.999813	1.000000	848.500000
6154 6154			22	0.995897	0.503570	1.329450	$\mp \mp$	0.999813	1.000000	848.500000
	Ť	Mean val	18.9	0.996468	0.505503		1 1.04	0.999806	0.986245	480.217113
								0.000037	0.020152	234.944257
		Std devi	8.2	0.001530	0.003651	0.047601	0.20	0.000037	1 0.020132	234.544201

Table D.7: Results for Benchmark C5315

CORTER	i del inc	Inneth - RI	к							
Ele	Inp	r length = 64	<u>г оч.и</u>	FE1	Restal	Tim.Str.	N.Sg	kE3	Resl_2	Tim,Furt
376	-1	0	279	0.963972	0.509128	27.127300		0.999871	0.951869 0.951869	7165.029785 7165.029785
846	+	8	279	0.963972	0.509128	27.127300	 i 	0.999871	0.951869	7165.029785
881	-1	ŏ	279	0.963972	0.509128	27.127300		0.999871	0.951869	7165.029785
1381	3	0	279	0.963972 0.963972	0.509128	27.127300	 2 	0.999742	0.951869 0.951869	7155.029785 7155.029785
1553	7	0	279	0.963972	0.509128	27.127300	 	0.999871	0.951869	7165.029785
1799	-1	0	279	0.963972	0.509128	27.127300		0.999871	0.951869	7165.029785
1870	8	8	279	0.963972	0.509128 0.509128	27.127300	 	0.999742	0.951889	7168.029788
2021		8	279	0.963972	0.509128	27.127300	 	0.999871	0.951889	7165.029785
2340	-1	0	279	0.963972	0.509128	27.127300		0.909871	0.951869	7155.029785
2508	-	0	279	0.963972	0.509128 0.509128	27.127300 27.127300	├─ ┼─┤	0.999871 0.999871	0.951869 0.951869	7165.029785 7165.029785
2619	+	0	279	0.963972	0.509128	27.127300	l i l	0.999871	0.951859	7165.029785
2837	.0.	0	279	0.963972	0.509128	27.127300	-3-	0.999742	0.951869	7165.029785 7165.029785
2998	-	0	279 279	0.963972 0.963972	0.509128	27.127300 27.127300	 7 	0.999742	0.951869	7165.029785
3165			279	0.963972	0.509128	27.127300		0.999871	0.951869	7185.029785
3498	-1	0	279	0.963972	0.509128	27.127300		0.999871	0.951889	7165.029785 7165.029785
3616	-11	0	279 279	0.963972 0.963972	0.509128 0.509128	27.127300 27.127300	├─ ┼─┤	0.999871	0.951869	7165.029785
3841	- 10	- 8	279	0.963972	0.509128	27.127300	1 2 1	0.909742	0.951869	7165.029785
4010	0	0	279	0.963973	0.509128	27.127300	2	0.999742	0.951869	7185.029785
4183	<u>:</u>		279	0.963972	0.509128 0.509128	27.127300	╀┈┼┈┤	0.999871 0.999871	0.951869	7165.029785 7165.029785
4355	-1	- 8	279 279	0.963972	0.509128	27.127300	 i 	0.999871	0.951889	7165.029785
4648	1	0	279	0.963972	0.509128	27.127300		0.999871	0.951869	7165.029785
4817	4		279 380	0.963972 0.983512	0.509128 0.508752	27.127300 38.162701	├─┼─ ┤	0.999871 0.999871	0.951869	7165.029785 7774.739980
864		8	350	0.953512	0.508752	38.182701	i	0.999871	0.987040 0.987040	7774.729980
999	-1	0	360	0.953512	0.505752	35.152701		0.999871	0.957040	7774.729980
1134		0	380 380	0.953512 0.953512	0.508752	36.182701 36.182701	├─┼	U.999871 U.999871	0.957040	7774.729980
1945		0	360	0.953512	0.508752	38.182701	<u>i</u>	0.999871	0.957040	7774.729980
2080	-1	-	380	0.953512	0.508752	35.152701		0.999871	0.957040	7774.729980 7774.729980
2217	-:	0	360	0.953512 0.953512	0.508752 0.508752	36.162701 36.162701	╀╌┼	0.999871 0.999871	0.957040	7774,729980
2353	- ;-	8	350	0.953512	0.508752	38.162701		0.999871	0.957040	7774.729980
2587	0.	U	380	0.963512	0.508752	36.162701	1 4 1	0.999742	0.957040	7774.729980 7774.729980
2732	<u> </u>	8	380	0.953512	0.508752 0.508752	38.162701 38.162701	├┈┋ ┤	0.999871	0.957040	7774.729980
3052		 8	360	0.953512	0.808752	36.162701		0.999871	0.957040	7774.729980
3193	-1	0	380	0.963512	0.508752	35.152701		U.999871 U.999871	0.957040	7774.729980 7774.729980
3344 3455	-1	8	360 360	0.953512	U.508752 U.508752	38.162701 38.162701	┤╴ ╬╌┤	0.999871	0.957040	7774.729980
3582		 	360	0.983812	0.508752	35.152701	1 2	0.999742	0.957040	7774.729980
3738	Ů	0	360	0.953512	0.508752	38.162701	1 2	0.999742	0.957040 0.957040	7774.729980 7774.729980
3921 4077		0	360 360	0.953512	0.508752	36.162701 36.162701	╁╌╁╌┤	0.999871 0.999871	0.987040	7774.729980
4211	∹	 6	360	0.953512	0.508752	36.162701	<u> </u>	0.999871	0.957040	7774.729980
4368	-1	Ö	360	0.983512	0.508752	35.162701		0.999871	0.957040	7774.729980 7774.729980
4488	-1	0	360 360	0.953512	0.508752 0.508752	35.162701 35.162701	1 2	0.999871	0.957040	7774.729980
4780	ő	l ŏ	350	0.953512	0.508752	36.162701	1 2	0.999742	0.957040	7774.729980
4963	-1	0	360	0.983512	0.508752 0.508752	36.162701 36.162701		0.999871	0.957040	7774.729980
5134	-1	0	360	0.953512	0.508752	38.162701	 i 	0.999871	0.957040	7774.729980
5434	-1	0	380	0.953512	0.508752	35.152701		0.999871	0.987040	7774.729980 7774.729980
3554	-1	0	380 380	0.983512 0.983512	0.508752	36.162701	1	0.999871	0.957040	7774.729980
5684 5845	0	8	360	0.953512	0.508752	36.162701	1-2	0.999742	0.957040	7774.729980
3979	-1	- <u>0</u>	360	0.953512	0.508752	36.162701		0.999871	0.957040	7774.729980
5058	-1	-8-	360	0.953512	0.508752	36.162701 36.162701	++-	0.999871	0.957040	7774.729980 7774.729980
6114	-:1-	 8	360	0.953512	0.508752	36.162701	 i 	0.999871	0.957040	7774,729980
681	-1	0	382	0.950571	0.508568	34.599899		0.999871	0.951160	8518.209961 8518.209961
816		0	382	0.950671	0.508568	34.599899	++-	0.999871	0.951160	8518.209961
951 1088		8-	382	0.950671	0.508568	34.599899	<u> 1_i_</u>	0.999871	0.951160	8518.209961
1221	-1	0	382	0.980671	0.508568	34.599899		0.999871	0.951160	8518.209961
1624			382 382	0.950671	0.508568	34.599899 34.599899	1 7	0.999742	0.951160	8518.209961
1891	-1	 6	382	0.950571	0.508568	34.599899	1	0.999871	0.951160	8518.709961
2000		0	382	0.950671	0.508568	34.599899	2 2	0.999742	0.951160	8518.209961 8518.209961
2138	-1	0	382 382	0.950671 0.950671	0.508568 0.508568	34.599899	+ i -	0.999871	0.951160	8518.209961
2452	_ -1	Ū	382	0.950571	0.508568	34.599899		0.999871	0.951160	8518.209961
2582	-1	- 0	382	0.950671	0.508568 0.508568	34.599899	$+$ $\overline{+}$	0.999871	0.951160	8518.209961 8518.209961
2727	-	8	382	0.950671	0.508568	34.599899	 i	0.999871	0.951160	8518.209961
2967	o o	<u> </u>	382	0.950571	0.508568	34.599899	1 2	0.999742	0.951160	1 8518.209961
3120		0	382	0.980671	0.508568 0.508568	34.599899	T 7	0.999742	0.981160	8518.209961 8518.209961
3300 3453	-:	0	382	0.950671	0.508568	34.599899	 	0.999871	0.951160	8518.209961
3577	ŀ	0	382	0.950571	0.508568	34.599899		0.999871	0.951160	8518.209961
3730	-1	8	382	0.950671	U.508568 U.508568	34.599899	T 1	0.999871	0.951160	8518.209961 8518.209961
3862	-	 8	382	0.950571	0.508568	34.599899	2	0.999742	0.951160	8518.209961
4139	6	0	382	0.980871	0.508568	34.599899	7-7	0.999742	0.951160	8518.209961 8518.209961
4318		- 0	382 382	0.980671	0.508568	34.599899	 	0.999871	0.951160	8518.209961
4607		8	382	0.950671	0.508568	34.599899		0.999871	0.951160	8518.209961
4775	-1	ō	382	0.950671	0.508568	34.599899		0.999871	0.951160	8518.209961 8518.209961
4901 5022	71	- 8	382	0.950671	0.508568	34.599899 34.599899		0.999871	0.951160	8518,209961
5193	8	 	382	0.950671	0.508568	34.599899	1 2	0.999742	0.951160	8518.209961
5378	-1	0	382	0.950571	U.508568	34.599899	1.3	0.999871	0.951160	8518.209961 8518.209961
5552 5679	-1	0	382	0.980671	0.508568	34.599899		0.999871	0.951160	8518.209961
		Mean val	344.0	0.955579	0.508798	33.011082		0.999840	0.953541	7850.700117
	 	Std devi	65.3	0.008435	0.000331	5.913423	0.43	0.000055	0.001681	689.124612
	-									

Table D.8: Results for Benchmark C6288

C7552, testing	angth - AIK								
Ele Inp	SA	N.PO	PEI	Real_I	Tim.Str.	N.Sg	FE2	Rest_2	Tim,Furt
636 -1 1649 -1	- 8	347	0.954076	0.498747	3.714400 3.714400	1	0.999868	0.559532 0.559532	7846.990234 7846.990234
2172 -1	- 6 - 1	347	0.954076	0.498747	3.714400	4	0.999471	0.559532	7846.990234
7826 1	- 1	347	0.954076	0.498747 0.498747	3.714400 3.714400	58	0.992324	0.559532 0.559532	7846.990234 7846.990234
7066 2	Ť	347	0.954076	0.498747	3.714400		0.999868	0.559532	7845.990234
7080 I I		347 347	0.954076 0.954076	U.498747 U.498747	3.714400		0.999868	0.559532	7845.990234 7845.990234
7104 1	- i 	347	0.954075	0.498747	3.714400	i	0.999868	0.559532	7845.990234
7106 7 2	1	347 347	0.954076 0.954076	0.498747 0.498747	3.714400		0.999858	0.559532	7845.990234 7845.990234
3675 -1 3697 -1	- 	347	0.954075	0.498747	3.714400	- i -	0.999888	0.589532	7846.990234
3718 -1		347	0.984078 0.984078	U.498747 U.498747	3.714400 3.714400		0.999868	0.559532 0.559532	7845.990234 7845.990234
3754 -1 5283 0	- i -	347	0.954076	0.498747	3.714400	3	0.999603	0.559532	7848.990234
5288 0		347	0.954076	0.498747	3.714400 3.714400	58	0.992324	0.559532	7846.990234 7846.990234
8009 -1 4623 -1	0	347 347	0.954076 0.954076	0.498747	3.714400	58	0.992324	0.559532	7845,990234
7057 3	1	347	0.954076	0.498747	3.714400		0.999868	0.559532 0.559532	7848.990234 7846.990234
7063 3 4645 -1	- 1	347	0.954075 0.954075	0.498747	3.714400	1	0.999735	0.559532	7846.990234
5319 1	ī	347	0.954076	0.498747	3.714400	58	0.992324	0.559532	7848.990234
7100 -1 9408 -1		347	0.954076 0.954075	0.498747 0.498747	3.714400	58	0.999868	0.559532	7848.990234 7846.990234
9618	<u>i</u>	347	0.954076	0.498747	3.714400	58	0.992324	0.559532	7846.990234 706.980012
4817 -1 8324 0		33	0.995633	0.497790	1.928230		0.999868	0.900090	705.950012
1960 1	i -	7	0.999074	0.516586	2.267780	i	0.999868	0.879588	232.074997
2282		458 458	0.939651	0.497399	3.413990		Q.999868 Q.999868	0.912011	9704.200195 9704.200195
2766 -1 2342 -1	1 1	456	0.939651	0.497399	3.413990		0.999888	0.912011	9704.200195
3167 -1		456	0.939651	0.497399	3.413990	2	0.999735 0.999868	0.912011	9704.200198 9704.200198
3545 -1 3574 -1		456 456	0.939651 0.939651	0.497399	3.413990	 i 	0.999868	0.912011	9704.200195
3595 -1	i	456	0.939851	0.497399	3.413990	1	0.999888	0.912011	9704.200195 9704.200195
5181 U 5762 -1	1	456	0.939651 0.939651	0.497399	3.413990 3.413990	1	0.999868	0.912011	9704.200195
4899 -1	<u> </u>	455	0.939651	0.497399	3.413990	2	0.999735	0.912011	9704.200195
5477 U	- 1	456 456	0.939651	0.497399	3.413990	2	0.999735 0.999735	0.912011	9704.200195 9704.200195
4958 -1	i	456	0.939851	0.497399	3.413990		0.999868	0.912011	9704.200195
4979 -1 10113 -1	- 1	456 456	0.939651	0.497399	3.413990		0.999868	0.912011	9704.200198 9704.200198
10157 0	<u> </u>	456	0.939651	0.497399	3.413990	1	0.999735	0.912011	9704.200198
6092 -1 6842 0	1	456 456	0.939651	0.497399	3.413990	2 2	0.999735	0.912011	9704.200195 9704.200195
6848 0	- i -	455	0.939851	0.497399	3.413990		0.999735	0.912011	9704.200195 9704.200195
7560 -1	0	456	0.939651	0.497399	3.413990	7	0.999868 0.999735	0.912011	9704.200195
6229 -1 6812 -1	1	455 455	0.939651	0.497399	3.413990	1	U.VVVV888	0.912011	9704.200195
8145 0	Ţ	456	0.939651	0.497399	3.413990	2	0.999735	0.912011	9704.200195
9856 U	1	455	0.939651	0.497399	3.413990	3 2	0.999735	0.912011	9704.200195
8865	i	456	0.939651	0.497399	3.413990	3	0.999603	0.912011	9704.200195
8477 -1 9488 -1	- 6	456 456	0.939651	0.497399	3.413990	1	0.999868	0.912011	9704.200195
9603 2	- ĭ	456	0.939651	0.497399	3.413990	3	0.999603	0.912011	9704.200195
9802 -1 9371 2		456 456	0.939651	0.497399	3.413990	1 3	0.999868	0.912011	9704.200198 9704.200198
1293 -1	- i -	165	0.978163	0.501170	4.352830	ī	0.999888	0.962705_	3931.479980
1821 -1 4463 0		165	0.978163	0.501170	4.362830	7	0.999735	0.962705 0.962705	3931.479980 3931.479980
5170 0	i	165	0.978163	0.501170	4.352830	1 2	0.999735	0.962708	3931.479980
5683 -1 4467 0		165 165	0.978163	0.501170	4.352830	1 1	0.999868	0.962705	3931.479980 3931.479980
6768 2	- i -	165	0.978163	0.501170	4.362830	 i	0.999868	0.962705	3931.479980
3101 -1	0	168	0.978163	0.501170	4.362830		0.999868	0.962705	3931.479980 3931.479980
7649 -1 6838 1	- 0	165	0.978163	0.501170	4.362830	 	0.999868	0.962705	3931.479980
3499 -1	1	165_	0.978163	0.501170	4.362830		0.999888	0.962705	3931.479980 3931.479980
8298 -1 3215 -1	0	165	0.978163	0.501170	4.352830 2.911120	 	0.999868	0.962705 0.907449_	464.101990
672 -1	Ū	468	0.938062	0.497103	3.555080		0.999868	0.924742	9888.969727
2365 1 3888 1	0	468 468	0.938062	0.497103	3.555080	1	0.999888	0.924742	9888.969727 9888.969727
3885 -1	0	468	0.938062	0.497103	3.555080		0.999868	0.924742	9888.969727 9888.969727
3486 -1 3775 -1	0	468 468	0.938062	0.497103	3.555080	1 1	0.999868	0.924742	9888.969727
3851 -1		468	0.938052	0.497103	3.555080	1 1	0.999868	0.924742	9888.969727
3882 -1 6087 1	7	468	0.938062	0.497103	3.555080	 	0.999868	0.924742	9888.969727 9888.969727
5454 -1	Ü	468	0.938062	0.497103	3.555080	<u> </u>	0.999868	0.924742	9888.969727
4783 -1 5603 1	9	468	0.938062	0.497103 0.497103	3.555080	1 2	0.999868 0.999735	0.924742	9888.969727 9888.969727
5120 -1	Ğ	468	0.938052	0.497103	3.555080		0.999888	0.924742	GRUR, 959727
5141 -1 5152 -1	0	468 468	0.938062	0.497103	3.555080	+	0.999868	0.924742	9888.969727 9888.969727
10402 2	<u> </u>	468_	0.938062	0.497103	3.555080	<u> </u>	0.999868	0.924742	9888.969727
10155 0 6704 -1	1	468	0.938062	0.497103	3.555080		0.999868	U.924742 U.924742	9888.969727 9888.969727
6189 -1	8	488	0.938062	0.497103	3.555080	i i	0.999868	0.924742	9888.969727
6752 I		468	0.938062	0.497103	3.555080	7	0.999735	0.924742	9888.969727
7591 1	1 6	468	0.938062	0.497103	3.555080	+ +	0.999735	0.924742	GRADE GRO727
7408 -1	0	468	0.938062	0.497103	3.555080		0.999868	0.924742	9888.969727 9888.969727
9702 -1 8991 0		468	0.938062	0.497103	3.555080 3.555080	1 3	0.999603	0.924742	9888.969727
9418 0	ò	468	0.938062	0.497103	3.555080	ī	0.999868	0.924742	9888.969727
8566 -1 9235 I	1	468	0.938062	0.497103		1 2	0.999868	0.924742 0.924742	9888.969727 9888.969727
	Mean val	-	0.949730			4.79	0.999386	0.832931	8231.839510
	Std devi	33.0	0.004368	0.000418		16.38	0.002167	0.274776	

Table D.9: Results for Benchmark C7552

C880, testing	leneth — Ki	R .							
Ele Inp	SA J	N.PO	ARI .	Real_I	Tim.Str.	N.Sg	FE2	Real_2	Tim,Furt
489 -1	0	20	0.979833	U.514766 U.514766	0.081130		0.998982 0.998982	1.000000	239.641006 239.641006
573 -1 541 0	- 0	20 20	0.979833	0.514766	0.061130	 i 	0.998982	1.0000000	239.641006
512 1	- <u>i </u>	20	0.979633	0.514758	0.061130	1	0.998982	1.000000	239.641006
513 0		20 20	0.979633	U.514766 U.514766	0.081130	1	0.998982	1.000000	239.641005 239.641008
489 0 632 -1	8	20	0.979833	0.514766	0.061130	 i 	0.998982	1.000000	239.641006
632 0	- ĭ - 	20	0.979833	0.514766	0.061130		0.998982	1.000000	239.641006
635 -1	0	20	0.979633	0.514766	0.061130	\vdash	0.998982	1.000000	239.841008 239.841008
835 0	0	20 20	0.979633 0.979633	0.514788 0.514785	0.061130	 	0.998982	1.000000	239.641008
705 -1 148 -1	- Y -	20	0.979633	0.514766	0.061130	 	0.998982	1.000000	239.541005
333 -1	Ö	40	0.959257	0.501668	0.060420		D.998982	0.941844 0.941844	267.203003 267.203003
861 -1		40	0.959267	0.501668	0.060420		0.998982	0.941844	267.203003
869 I 742 0		40	0.959267	0.501668	0.060420	 i- 	0.998982	0.941844	267.203003
 	- i -	40	0.959267	0.501668	0.080420		0.998982	0.941844	-267.203003
743	1	40	0.959267	0.501668	0.060420	1	0.998982 0.998982	0.941844 0.941844	267.203003 267.203003
585 U	- 0	40 40	0.959267	0.501668 0.501668	0.060420	 	0.998982	0.941844	267.203003
524 0	- i 	40	0.959267	0.501668	0.060420		0.998983	0.941844	267.203003
851 1	0	40	0.959267	0.501668	0.080420		0.998982	0.941844	267.203003 267.203003
853 I	- 1	40	0.959267	0.501668	0.060420	 -<u>2</u> 	0.997963	0.941844	267.203003
844 T	- 8	- 40	0.959267	0.501668	0.060420	 ī- 	0.998982	0.941844	267.203003
835	Ĩ	40	0.959267	0.501668	0.060420	7	0.997963	0.941844	267.203003
333 1		40	0.959267	0.501668 0.501668	0.060420 0.060420	++	0.998982 0.998982	0.941844	267.203003 267.203003
582 -1 682 1	-	40	0.959267	0.501668	0.080420	 i 	0.998982	0.941844	267,203003
744 -1	i	40	0.959267	0.501668	0.060420		0.998982	D.941844	267.203003
822 1		40	0.959267	0.501668	0.060420	\vdash	0.998982	0.941844	267.203003 267.203003
812 1 877 -1	<u> </u>	40	0.959267	0.501668 0.501668	0.060420 0.060420	 	0.997983	0.941844	267.203003
1 1 1	- i	1	0.998982	1.000000	0.034356		0.998982	1.000000	28.804199
284 -1		16	0.983707	0.527155	0.081143	3	0.997963	0.934540 0.934540	232.552002 232.552002
400 -1 348 0	0	16	0.983707	0.527155	0.061143	+ + +	0.998982	0.934540	232.552002
784	Ť	16	0.983707	0.527155	0.061143		0.998982	0.934540	232.552002
284 3		16	0.983707	0.527155	0.061143	1	0.998982	0.934540	232.552002 232.552002
451 -1 210 -1	0	16	0.983707	0.527155 0.527155	0.061143	┼ ॉ ┤	0.997963	0.934540	232.552002
219 -1	- 8 -	16	0.983707	0.527155	0.061143		0.998982	0.934540	232.552002
228 -1	0	16	0.983707	0.527155	0.081143		0.998982	0.934540	232.552002
237 -1 246 -1	0	16	0.983707	0.527155	0.061143 0.061143	+ + -	0.998982	0.934540	232.552002
488 -1		35	0.964358	0.507495	0.061380	 i 	0.998982	1.0000000	366.920013
569 1	1	35	0.964358	0.507495	0.061380		0.998982	1.000000	388.920013 388.920013
510 0 540 1		35	0.964358 0.964358	0.507495	0.061380	1 1	0.998982	1.000000	366.920013
511 1	9	335	0.964358	0.507495	0.061380	 i 	0.998982	1.000000	386.920013
488	Ö	35_	0.984358	0.507495	0.061380		0.998983	1.0000000	386.920013
525 -1	1	335	0.964358	0.507495	0.061380 0.061380		0.998982	1.000000	388.920013 388.920013
625 1 628 -1		35 35	0.964358	0.507495	0.061380	 i 	0.998982	1.000000	386,920013
528 I	- 6	35	0.964358	0.507495	0.061380		0.998983	1.000000	355.920013
597 -1		35	0.964358	0.507495	0.061380		0.998982 0.998982	1.000000	388.920013 388.920013
734 -1 773 0	-	35	0.964358	0.507495	0.061380	 	0.908982	1.000000	366.920013
762 0	 	35	0.964358	0.507495	0.061380	1	0.998982	1.0000000	366,920013
773 2		35	0.984358	0.507495	0.061380	\Box	0.998982	1.000000	386.920013 386.920013
783 I 734 0		35	0.964358	0.507495	0.061380	+	0.998982	1.000000	366.920013
734 2	 	35	0.964358	0.507495	0.061380	<u> </u>	0.998982	1.000000	366.920013
143	i	35	0.964358	0.507495	0.051380	\Box	0.998982 0.998982	0.931427	386.920013 233.216995
334 ·1 845 ·1	9	34	0.965377	0.502047	0.056617	+ +	0.998982	0.931427	233.216995
845 -1 854 l	 	34	0.968377	0.502047	0.055517	 i 	0.998982	0.931427	233.215995
745 0	<u> </u>	34	0.965377	0.502047	0.055517	1	0.998982	0.931427	233.216995 233.216995
772	0	34	0.965377	0.502047	0.055617	+ 1	0.998982	0.931427	233.216995
748 1 596 0	1 0 -	34	0.965377	0.502047	0.056617	 	0.998982	0.931427	233.215995
624 L	i	34	0.965377	0.502047	0.086617		0.998982	0.931427	233.216995
525 0	1	34	0.965377	0.502047	0.056617	++-	0.998982 0.998982	0.931427	233.216995
845 1 836 1	9	34	0.965377 0.965377	0.502047	0.056617	 	0.998982	0.931427	733.716995
806 0	i i	34	0.965377	1 0.502047	0.058617	1 2	0.997963	0.931427	233.218995
825 1	9	34	0.965377	0.502047	0.056617	1	0.998982	0.931427	233.215995 233.215995
334	1-1-	34	0.965377 0.965377	0.502047	0.056517	 1 	0.998982	0.931427	233.216995
592 -1	i	34	0.965377	0.502047	0.055517	<u> </u>	0.998982	0.931427	233.216995
692 1	1	34	0.965377	0.502047	0.056617	1 1	0.998982	0.931427 0.931427	233.216995 233.216995
332 -1	1	34	0.965377	0.502047	0.06431X		0.997963	0.947298	293.464996
868 -1	ō	44	0.955193	0.501480	0.064318 0.064318	1 2	0.991963	0.947296	293.464996
770 0	0	44	0.955193	0.501480	0.064318		0.998982	0.947298	293.464996 293.464996
739 1		44	0.955193	0.501480	0.064318	+	0.998982	0.947298 0.947298	293.484998
868 2	+ 	44	0.955193	0.501480	0.084318		0.998982	0.947298	293.484998
	1	44	0.955193	0.501480	0.084318		0.998982	0.947296	293.464996 293.464996
605 0	0	44	0.955193	0.501480	0.064318 0.064318	+ +	0.998982	0.947298	293.484998
677 L	$\overline{}$		0.955193	0.501480	0.064318		0.998982	0.947296 0.947296	293.464996
577 1 523 1 852 0	1 -	44		0.501480	0.064318	1	0.998982	0.947296	293.464996
577 1 523 1 852 0	- 0	44	0.955193	1 01001100					
523 1 852 0 843 0 832 1	1 0 0	44	0.955193	0.501480	0.084318	1 3	0.997963	0.947296	293,464996
677 1 523 1 852 0 843 0 832 1 833 0	0 0	44	0.955193	0.501480	0.084318	1	0.997963	0.947296 0.947296	293.464996 293.464996
677 1 523 1 852 0 843 0 833 0 332 0	1 0 0	44	0.955193	0.501480 0.501480 0.501480 0.501480	0.064318 0.064318 0.064318	1	0.997963 0.998982 0.998982	0.947296 0.947296 0.947296	293.484998 293.484998 293.484998
677 1 523 1 852 0 843 0 832 1 833 0 332 0 673 -1 673 0	1 0 1 1	44 44 44 44 44	0.955193 0.955193 0.955193 0.955193 0.955193	0.501480 0.501480 0.501480 0.501480 0.501480	0.064318 0.064318 0.064318 0.064318	1 1	0.997983 0.998982 0.998982 0.998982	0.947298 0.947298 0.947298	293.464996 293.464996 293.464996 293.464996
677 1 523 1 852 0 843 U 832 1 832 1 833 0 332 0 673 -1 673 0	1 0 0 1 1	44 44 44 44 44	0.955193 0.955193 0.955193 0.955193 0.955193	0.501480 0.501480 0.501480 0.501480 0.501480	0.064318 0.064318 0.064318 0.064318 0.064318	1 1 1	0.997963 0.998982 0.998982	0.947296 0.947296 0.947296 0.947296 0.947296	293.484998 293.484998 293.484998
677 1 523 1 852 0 843 0 832 1 833 0 332 0 673 -1 673 0	1 0 0 1 1 0 1 0	44 44 44 44	0.955193 0.955193 0.955193 0.955193 0.955193 0.955193	0.501480 0.501480 0.501480 0.501480 0.501480 0.501480	0.084318 0.064318 0.064318 0.064318 0.064318 0.064318	1 1 1 1 1 1	0.997963 0.998982 0.998982 0.998982 0.998982	0.947298 0.947298 0.947298 0.947298 0.947298 0.947298	293,464996 293,484996 293,484996 293,484996 293,464996 293,464996
677 1 523 1 852 0 843 U 832 1 832 1 833 0 332 0 673 -1 673 0	1 0 0 1 1	44 44 44 44 44	0.955193 0.955193 0.955193 0.955193 0.955193	0.501480 0.501480 0.501480 0.501480 0.501480	0.064318 0.064318 0.064318 0.064318 0.064318	1 1 1 1 1 1 1.13	0.997983 0.998982 0.998982 0.998982 0.998982	0.947296 0.947296 0.947296 0.947296 0.947296	293.464996 293.464996 293.464996 293.464996 293.464998

Table D.10: Results for Benchmark C880

Appendix E

Experiment on ISCAS 89 With Testing Length 64 K

In this appendix, we present the detailed diagnostic results for ISCAS'89 benchmark circuits at the testing length = 64 K (256 blocks). 100 randomly ejected single stuckat faults are used to collect corresponding information.

Ele: element number

Inp: input order of the node to the element¹

SA: stuck-at value

N.PO: number of nodes affecting the same POs as the diagnosed fault

FE1: fault elimination rate for stage 1

Resl_1: estimation for RES1

Time.Stru: time used for structural analysis

N.Sg: number of the faults having same signatures as the diagnosed fault

Resl.2: estimation for RES2

Time, Furt: time used for building and looking up the fault dictionary

FE2: fault elimination rate for stage 2

¹⁻¹ means that the node is just the output of the element itself.

Ele		length = 84 SA	N.PO 2 2 2 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	PE1 0.598400 0.598400 0.5988000	Real_1 0.50000 0.500000 0.500000 0.498245 0.498245 0.498245 0.498246	Tim.Str. 0.09/2076 0.109/2076 0.12/3168 0.12/3168 0.12/3168 0.12/3168 0.12/3168 0.12/3168 0.12/3168 0.12/3168 0.12/3168 0.12/3168 0.12/3168 0.12/3168 0.12/3168 0.12/3168 0.12/3168 0.12/3168 0.12/3168	N.Sg	FE2 0.999200 0.999200 0.999200 0.999200 0.999200 0.999200 0.999200 0.999200 0.999200 0.999200 0.999200 0.999200 0.999200 0.999200 0.999200 0.999200 0.999200 0.999200 0.999200	Resl_2 1.000000 1.000000 1.000000 1.000000 1.000000 1.000000 1.000000 1.000000 1.000000 1.000000 1.000000 1.000000 1.000000 1.000000 1.000000 1.000000	Tim. Furt 75, 581800 26, 581800 741, 853027 741, 853027
594 335 397 337 337 337 337 337 783 367 783 367 783 367 1085 1085 1085 1085 1085 1085 1085 1085	11 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1		2 2 2 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	0.985000 0.985000	U.500000 U.495245 U.49524 U.49524 U.49524 U.49524 U.49524 U.49524 U.49524 U.49524 U.49524 U.49524 U.49	U.123168 U.123168 U.123168 U.123168 U.123168 U.123168 U.123168 U.123168 U.123168 U.123168 U.123168 U.123168 U.123168 U.123168 U.123168 U.123168 U.123168 U.123168		0.99200 0.99200 0.99200 0.99200 0.99200 0.99200 0.99200 0.99200 0.99200 0.99200 0.99200 0.99200 0.99200	1.000000 1.000000 1.000000 1.000000 1.000000 1.000000 1.000000 1.000000 1.000000 1.000000 1.000000 1.000000 1.000000	28.581800 741.853027 741.853027 741.853027 741.853027 741.853027 741.853027 741.853027 741.853027 741.853027 741.853027 741.853027 741.853027 741.853027
335 336 337 337 337 337 337 337 338 338 338 338	-1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -		56 55 55 55 55 55 55 55 55 55 55 55 55 5	0.988000 0.988000	U.495245 U.495245 U.495245 U.495245 U.495245 U.495245 U.495245 U.495245 U.495245 U.495245 U.495245 U.495245 U.495245 U.495245 U.495245 U.495245 U.495245 U.495245	U.123168 U.123168 U.123168 U.123168 U.123168 U.123168 U.123168 U.123168 U.123168 U.123168 U.123168 U.123168 U.123168 U.123168 U.123168		0.999200 0.999200 0.999200 0.999200 0.999200 0.999200 0.999200 0.999200 0.999200 0.999200 0.999200 0.999200	1.000000 1.000000 1.000000 1.000000 1.000000 1.000000 1.000000 1.000000 1.000000 1.000000 1.000000 1.000000 1.000000	741.853027 741.853027 741.853027 741.853027 741.853027 741.853027 741.853027 741.853027 741.853027 741.853027 741.853027 741.853027 741.853027
336 387 387 387 387 387 387 3884 384 474 474 474 474 474 474 474 474 474 474 474 474 474 474 474 474 474 474 474 4801 505 367 367 367 360	-1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -		55 55 55 55 55 55 55 55 55 55 55 55 55	0.988000 0.988000 0.988000 0.988000 0.988000 0.988000 0.988000 0.988000 0.988000 0.988000 0.988000 0.988000 0.988000 0.988000 0.988000 0.988000 0.988000 0.988000 0.988000 0.988000	0.495245 0.495245 0.495245 0.495245 0.495245 0.495245 0.495245 0.495245 0.495245 0.495245 0.495245 0.495245 0.495245 0.495245 0.495245 0.495245 0.495245	U.123168 U.123168 U.123168 U.123168 U.123168 U.123168 U.123168 U.123168 U.123168 U.123168 U.123168 U.123168 U.123168 U.123168 U.123168		0.999200 0.999200 0.999200 0.999200 0.999200 0.999200 0.999200 0.999200 0.999200 0.999200 0.999200	1.000000 1.000000 1.000000 1.000000 1.000000 1.000000 1.000000 1.000000 1.000000 1.000000 1.000000 1.000000	741.853027 741.853027 741.853027 741.853027 741.853027 741.853027 741.853027 741.853027 741.853027 741.853027 741.853027 741.853027
367 367 367 367 367 378 367 367 367 367 367 378 378 378 378 378 378 378 378 378 37	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1		58 55 55 55 55 55 55 55 55 55 55 55 55 5	0.988000 0.988000 0.988000 0.988000 0.988000 0.988000 0.988000 0.988000 0.988000 0.988000 0.988000 0.988000 0.988000 0.988000 0.988000 0.988000 0.988000 0.988000	0.495245 0.495245 0.495245 0.495245 0.495245 0.495245 0.495245 0.495245 0.495245 0.495245 0.495245 0.495245 0.495245 0.495245 0.495245 0.495245 0.495245 0.495245	0.123168 0.123168 0.123168 0.123168 0.123168 0.123168 0.123168 0.123168 0.123168 0.123168 0.123168		0.999200 0.999200 0.999200 0.999200 0.999200 0.999200 0.999200 0.999200 0.999200	1.000000 1.000000 1.000000 1.000000 1.000000 1.000000 1.000000 1.000000 1.000000 1.000000	741.853027 741.853027 741.853027 741.853027 741.853027 741.853027 741.853027 741.853027 741.853027 741.853027
387 783 805 871 1048 871 1048 1048 1048 1048 1048 1048 1048 1045 1045 1045 1045 1045 1045 1045 1045 1045 1045 1046 1046 1047 1048	-1 -1 -1 -1 -1 0 0 0 1 1 2 2 0 0 1 1 1 2 2 0 0 0 1 1 1 1	0 0 1 1 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	55 55 55 55 55 55 55 55 55 55 55 55 55	0.988000 0.988000 0.988000 0.988000 0.988000 0.988000 0.988000 0.988000 0.988000 0.988000 0.988000 0.988000 0.988000 0.988000	0.495245 0.495245 0.495245 0.495245 0.495245 0.495245 0.495245 0.495245 0.495245 0.495245 0.495245 0.495245 0.495245	0.123168 0.123168 0.123168 0.123168 0.123168 0.123168 0.123168 0.123168 0.123168 0.123168		0.999200 0.999200 0.999200 0.999200 0.999200 0.999200 0.999200 0.999200	1.000000 1.000000 1.000000 1.000000 1.000000 1.000000 1.000000 1.000000	741.853027 741.853027 741.853027 741.853027 741.853027 741.853027 741.853027 741.853027 741.853027
805 871 1045 1085 1085 1085 1085 1085 1085 1085 108	-1 -1 -1 0 0 0 1 1 2 1 0 0 1 1 2 1 1 2 1 1 0 0 0 1 1 1 1		55 55 55 55 55 55 55 55 55 55 55 55 55	0.958000 0.958000 0.958000 0.958000 0.958000 0.958000 0.958000 0.958000 0.958000 0.958000 0.958000 0.958000 0.958000 0.958000	0.495245 0.495245 0.495245 0.495245 0.495245 0.495245 0.495245 0.495245 0.495245 0.495245 0.495245 0.495245	U.123168 U.123168 U.123168 U.123168 U.123168 U.123168 U.123168 U.123168 U.123168 U.123168		0.999200 0.999200 0.999200 0.999200 0.999200 0.999200 0.999200 0.999200	1.000000 1.000000 1.000000 1.000000 1.000000 1.000000 1.000000 1.000000	741.853027 741.853027 741.853027 741.853027 741.853027 741.853027 741.853027 741.853027
871 1045 1045 1045 1045 1045 1045 1045 104	-1 -1 -1 0 0 1 1 2 1 1 2 3 0 1 1 2 1 1 0 0 0 1 1 0 0 0 1 1 0 0 0 0		58 58 58 58 58 58 58 58 58 58 58 58 58 5	0.988000 0.988000 0.988000 0.988000 0.988000 0.988000 0.988000 0.988000 0.988000 0.988000 0.988000 0.988000	0.495245 0.495245 0.495245 0.495245 0.495245 0.495245 0.495245 0.495245 0.495245 0.495245 0.495245	0.123168 0.123168 0.123168 0.123168 0.123168 0.123168 0.123168 0.123168 0.123168		0.999200 0.999200 0.999200 0.999200 0.999200 0.999200 0.999200	1.000000 1.000000 1.000000 1.000000 1.000000 1.000000 1.000000	741.853027 741.883027 741.883027 741.863027 741.863027 741.883027 741.883027
1048 10	1 2 2 3 3 5 1 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5		38 38 38 38 38 38 38 38 38 38 38 38 38 3	0.988000 0.988000 0.988000 0.988000 0.988000 0.988000 0.988000 0.988000 0.988000 0.988000 0.988000 0.988000	U.495245 U.495245 U.495245 U.495245 U.495245 U.495245 U.495245 U.495245 U.495245 U.495245 U.495245	U.123168 U.123168 U.123168 U.123168 U.123168 U.123168 U.123168 U.123168		0.999200 0.999200 0.999200 0.999200 0.999200 0.999200	1.000000 1.000000 1.000000 1.000000 1.000000 1.000000	741.883027 741.883027 741.883027 741.883027 741.883027 741.883027 741.883027
1088 1048 10445 694 694 694 694 694 694 694 694 694 694	-1 0 0 1 1 2 1 1 2 2 1 1 2 2 3 0 0 1 1 1 0 0 1 1 0 0 1 1 0 0 1 0 1 0		55 55 55 55 55 55 55 55 55 55 55 55 55	0.988000 0.988000 0.988000 0.988000 0.988000 0.988000 0.988000 0.988000 0.988000 0.988000	0.495245 0.495245 0.495245 0.495245 0.495245 0.495245 0.495245 0.495245 0.495245	U.123168 U.123168 U.123168 U.123168 U.123168 U.123168 U.123168		0.999200 0.999200 0.999200 0.999200 0.999200	1.000000 1.00000 1.00000 1.00000 1.00000	741.853027 741.853027 741.853027 741.853027 741.853027
1045 694 694 694 594 694 7513 7513 7513 7513 7513 7513 7513 7513	0 0 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2		58 58 58 58 58 58 58 58 58 58 58 58 58 5	0.988000 0.988000 0.988000 0.988000 0.988000 0.988000 0.988000 0.988000 0.988000	0.495245 0.495245 0.495245 0.495245 0.495245 0.495245 0.495245 0.495245	0.123168 0.123168 0.123168 0.123168 0.123168 0.123168		0.999200 0.999200 0.999200	1.000000 1.00000 1.00000 1.00000	741.853027 741.853027 741.853027 741.853027
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594 1045 855 846 446 855 855 855 855 855 876 877 897 997 997 997 997 997 997			55 55 55 55 55 55	0.958000 0.958000 0.958000	0.495245 0.495245					
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446 446 855 855 855 856 876 877 887 877 877 877 877 877 877 87			55 55 55 55	0.958000	0.480240	0.123168	-	0.999200	1.000000	741.853027
446 855 855 855 855 855 857 897 997 997 997 998 673 898 673 898 876 878 877 899 789 789 789 789 789 789 789	3 0 - 0 0 -	I 0 1 1	55 55 55	0.955000		0.123168		0.999200	1.000000	741.883027
855 1045 1045 1047 1047 1047 1045 1045 1045 1045 1045 1045 1045 1045		I 0 1 1	55 55		0.495245	0.123168		0.999200	1.000000	741.883027
1048 997 997 997 997 997 898 673 673 876 876 876 876 877 877 878 878 878 878				0.958000	0.495245	0.123168		0.999200	1.000000	741.853027
997 997 997 895 873 873 875 876 876 876 877 805 789 789 789 789 789 789 749 384 384 384 474 474 474 474 474 601	0 - 0 0			0.956000	0.495245	0.123168		0.999200	1.000000	741.853027
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895 876 876 876 877 805 805 805 789 789 718 718 718 718 743 384 384 384 474 474 474 474 474 601	Ü		55	0.956000	0.495245	0.123168		0.999200	1.000000	741.853027
876 876 871 805 805 805 789 789 718 718 718 718 384 384 474 474 474 474 474 601	Ü		35	0.986000 0.986000	0.495245	0.123168	 	0.999200	1.000000	741.853027
876 871 805 805 805 805 789 789 718 718 718 718 718 718 744 384 384 384 384 474 474 474 474 474 601 801	1	- 0	58 55	0.955000	0.495245	0.123168	l i	0.999200	1.000000	741.853027
805 805 789 789 718 718 718 718 718 718 743 384 384 374 474 474 474 474 474 474 601		i	55	0.955000	0.495245	0.123168		0.999200	1.000000	741.853027
805 789 789 789 718 718 718 718 384 384 384 374 474 474 474 474 474 801 801		Í	55	0.955000	0.495245	0.123168		0.999200	1.0000000	741.853027
789 789 789 718 718 718 718 718 718 384 384 384 384 474 474 474 474 474 474 601	0		5.5	0.956000	0.495245	0.123168		0.999200	1.000000	741.853027
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789 718 718 718 718 793 384 384 384 474 474 474 474 474 601	- Y	<u> </u>	55	U.956UUU	0.495245	0.123168	<u> </u>	0.999200	1.000000	741.853027
718 718 718 384 384 384 384 474 474 474 474 601 801	2	ī	55	0.956000	0.495245	0.123168		0.999200	1.000000	741.883027
793 384 384 384 384 474 474 474 474 474 601 801	0	- 0	55	0.958000	0.495245	0.123168		0.999200	1.0000000	741.853027
384 384 384 384 474 474 474 474 474 601 801	<u>. I</u>	0	35 35	0.958000	0.495245	0.123168	 	0.999200	1.000000	741.883027
384 384 384 474 474 474 474 474 601 801	+	- 6	55	0.958000	0.495245	0.123168	 	0.999200	1.0000000	741.883027
384 474 474 474 474 474 601 801	-i-	i	38	0.988000	0.495245	0.123168		0.999200	1.000000	741.853027
474 474 474 474 474 601 601	0_	0	35	0.956000	0.495245	0.123158		0.999200	1.000000	741.853027
474 474 474 474 601		0	55	0.956000	0.495245	0.123168	┷	0.999200	1.000000	741.853027
474 474 474 801 601	-1-	, o	55 55	0.958000	0.495245	0.123168	 	0.999200	1.000000	741.853027
474 474 601 601	-1	1	35	0.955000	0.495245	0.123168	 	0.999200	1.000000	741.853027
474 601 601	Ť		55	0.986000	0.495245	0.123168	1	0.999200	1.0000000	741.853027
601	2		55	0.956000	0.495245	0.123168		0.999200	1.000000	741.853027 741.853027
9U1 [-1	0 -	55 55	0.955000	0.495245	0.123168	 	0.999200	1.000000	741.853027
- DIO	-1	 	30	0.997600	0.557886	0.117359	 	0.999200	1.000000	40.350899
910		- i -	3	0.997600	0.557886	0.117359	1	0.999200	1.000000	40.350899
910	0	- i	3	0.997600	0.557886	0.117359		0.999200	1.000000	40.350899
910	1	1 1	3	0.997600	0.557886	0.117359	+	0.999200	1.000000	40.350899 94.971901
247 247		9	5	0.996000	0.526803	0.101698	1 i	0.999200	1.000000	94.971901
462	+	 8	 3 	0.996000	0.526803	0.101698	 i 	0.999200	1.000000	94.971901
462	-i-	 ĭ	3	0.996000	0.526803	0.101698		0.999200	1.000000	94.971901
462	0	1	5	0.998000	0.526803	0.101595		0.999200	1.000000	94.971901
462			3	0.996000	0.526803	0.101695		0.999200	1.000000	56.408501
567 567	-1	0		0.994400	0.530329	0.084875	1 i -	0.999200	1.000000	56.408501
367	-1	0	 	0.994400	0.530329	0.084875	<u> </u>	0.999200	1.000000	56.408501
567	Τ_	Ū	7	11 0044400	0.530329	0.084875		0.999200	1.0000000	36.408501
765	-1	0	7	0.994400	0.530329	0.084875	+	0.999200	1.000000	56.408501 56.408501
765 765	-1	1	+ +	0.994400	0.530329	0.084875	+ +	0.999200	1.000000	56.408501
765	- 1 -	 	 - 	0.994400	0.530329	0.084875	1 i	0.999200	1.0000000	36,408501
765	- ż-	 	7	0.994400	0.530329	0.084875	1 1	0.999200	1.000000	56,408501
353	-1	0	21	0.983200	0.495961	0.096793		0.999200	1.000000	122.525002
353			21	0.983700	0.495961 0.495981	0.096793	++	0.999200	1.000000	122.525002
1146	-1	0	21	0.983200	0.495961	0.098793	+ i -	0.999200	1.000000	122.525002
1155	- 6 -	 8 -	 2i _	0.983200	0.495951	0.096793	11	0.999200	1.0000000	122.525002
875	0		21	0.983200	0.495961	0.096793		0.999200	1.000000	122.525002
875	1		21	0.983200	0.495961	0.096793	T-1-	0.999200	1.000000	122.525002
810	0	1 1	21	0.983200	0.495961	0.096793	+-+	0.999200	1.000000	122.525002
719	- ۲	 	- 21	0.983200	0.495961	0.096793	+ i -	0.999200	1.000000	122.525002
810	-i -	 ĭ 	21	0.983200	0.495961	0.088793		0.999200	1.000000	122.525002
809	Ō		21	0.983200	0.493961	0.096793	\Box	0.999200	1.000000	122.525002
809	-1	 	21	0.983200	0.495961 0.495961	0.096793	+ +	0.999200	1.000000	122.525002
708	- 6-	 	1 21 -	0.983200	0.495961	0.096793	 i 	0.999200	1.000000	122.525002
708	Ť	 6 -	1 21	0.983200	0.495961	0.096793	1_1	0.999200	T.000000	122.525002
804	Ī		21	0.983200	0.495961	0.096793		0.999200	1.0000000	122.525002
724	Ö	0	21	0.983200	0.495961	0.096793		0.999200	1.000000	122.525002 122.525002
724		0	21 21	0.983200	0.498961	0.096793	++	0.999200		122.525002
728	-I	 	1 21	0.998400	0.300000		+-i-	0.999200	1.000000	21.455099
228	-i	1 ĭ	 	0.998400	0.500000	0.107821	<u> </u>	0.999200	1.0000000	21.455099
524	-1	- i	10	0.992000	0.519041	0.118163	1 1	0.999200	1.0000000	182.257995
524	-1	L	10	0.992000	0.519041	0.118163	1	0.999200	1.000000	182.257996 182.257996
524	Q.	0	10	0.992000	0.519041 0.519041	0.118163	+-+-	0.999200	1.000000	182.257996
524	 -	1 0	10	0.992000	0.519041	0.118163	 i	0.999200	1.000000	182.257998
531		 ĭ	 10 	0.992000	0.519041	0.118163	 i	0.999200	1.000000	182.257998
							1.00	T IN DESIGNATION		1 427,135373
 +		Mean val	34.0	0.972816	0.504563	0.111697	1.00	0.999200	1.000000	[741.1303/3

Table E.1: Results for Benchmark S1196

397 0 0 61 0.984982 0.501954 0.138482 1 0.999282 0.842143 85.1.83992 406 -1 0 61 0.984982 0.501954 0.138482 1 0.999282 0.842143 85.1.83992 406 -1 0 61 0.984982 0.501954 0.138482 1 0.999282 0.842143 85.1.83992 406 0 1 61 0.984982 0.501954 0.138482 1 0.999282 0.842143 85.1.83992 405 0 1 61 0.984982 0.501954 0.138482 1 0.999282 0.842143 85.1.83992 405 0 1 61 0.984982 0.801954 0.138482 1 0.999282 0.842143 85.1.83992 405 1 1 61 0.984982 0.801954 0.138482 1 0.999282 0.842143 85.1.83992 405 1 1 61 0.984982 0.801954 0.138482 1 0.999282 0.842143 85.1.83992 405 1 1 61 0.984982 0.801954 0.138482 1 0.999282 0.842143 85.1.83992 405 -1 0 81 0.984982 0.801954 0.138482 1 0.999282 0.842143 85.1.83992 407 -1 1 81 0.984982 0.801954 0.138482 1 0.999282 0.842143 85.1.83992 409 -1 1 81 0.984982 0.801954 0.138482 1 0.999282 0.842143 85.1.83992 400 -1 1 81 0.984982 0.801954 0.138482 1 0.999282 0.842143 85.1.83992 400 -1 1 61 0.984982 0.801954 0.138482 1 0.999282 0.842143 85.1.83992 400 -1 1 61 0.984982 0.801954 0.138482 1 0.999282 0.842143 85.1.83992 401 -1 1 61 0.984982 0.801954 0.138482 1 0.999282 0.842143 85.1.83992 407 -1 1 61 0.984982 0.801954 0.138482 1 0.999282 0.842143 85.1.83992 407 -1 1 61 0.984982 0.801954 0.138482 1 0.999282 0.842143 85.1.83992 408 -1 1 6 0.984982 0.801954 0.138482 1 0.999282 0.842143 85.1.83992 409 -1 1 6 0.984982 0.801954 0.138482 1 0.999282 0.842143 85.1.83992 409 -1 1 6 0.984982 0.801954 0.138482 1 0.999282 0.842143 85.1.83992 409 -1 1 6 0.984982 0.801954 0.138482 1 0.999282 0.842143 85.1.83992 409 -1 1 6 0.984982 0.801954 0.138482 1 0.999282 0.842143 85.1.83992 409 -1 1 6 0.984982 0.801954 0.138482 1 0.999282 0.842143 85.1.83992 400 -1 1 6 0.984982 0.801954 0.138482 1 0.999282 0.842143 85.1.83992 400 -1 1 6 0.984982 0.801954 0.138482 1 0.999282 0.842143 85.1.83992 400 -1 1 6 0.984982 0.801954 0.138482 1 0.999282 0.842143 85.1.83992 400 -1 1 6 0.984982 0.801954 0.138482 1 0.999282 0.842143 85.1.83992 400 -1 1 6 0.984982 0.801954 0.138482 1 0.999282 0.842143 85.1.83992 400 -1 1 6 0.984982 0.801954 0.138	<u> च्यानवास ४०</u>		length = 841	K							
170	Ele I	np	SA	N.PO	FEI	Resl_I	Tim.Str.	N.Sg	FE2		Tim,Furt
TYPE	579	न ।		3							
1	379						0.095424	·			
1775	379			5	0.996310	0.526803	0.095424	1		1.000000	
SEC.			- 0	5	0.996310	0.526803	0.095424	+-			
1885						0.357886	0.088197	_ i _	0.999262	1.000000	26.563801
185	485	-1	ī	3	0.997786	0.557886					26.563801
Title	485			3				-	0.999262	1.000000	26.563801
11				-34		0.500000	0.115844	·i	0.999262	0.978508	188.591003
T15	411	-1									
1.							0.115844	+		0.978508	
1					0.974908		0.113844	i	0.999262	0.978508	186.591003
1797 1	888						0.115844			0.978508	
1719							0.1139444		0.999262	0.978508	186.591003
1719 0		-1		34	0.974908	0.500000	0.115844		0.999262	0.978508	186.591003
SER	1219	0	0				0.115844		0.999262	0.978508	
REST							0.118844	- i -	0.999262	0.978508	186.591003
TREAT	889	2	i	34	0.974908		0.115844		0.999262		
TST	782				0.974908					0.978508	186.591003
TYPE						0.500000		l i	0.999262	0.978508	186.591003
USB	751		0	34	0.974908	0.500000	0.115844		0.999262	0.978508	
7715				34	0.974908	0.500000	0.115844		0.999262		
7712 1 34 0.977408 0.30000 0.118844 1 0.99782 0.978508 186.391003	715	ᢡ╌┤	- i - l		0.974908	0.500000	0.115844	 	0.999262	0.978508	185.591003
TYTE	715	1		34	0.974908	0.500000	0.115844		0.999262	0.978508	188.591003
7712				34			0.115844	 	U.M/9202		
772			 ₹	34	0.974908		0.115844	_ <u>i</u> _	0.999262	U.978508	186.591003
714 1 1 1 34 U974098 0.500000 U.115844 1 0.997824 0.978098 186.991003 714 1 1 1 34 U974098 0.500000 U.115844 1 0.997824 0.978098 186.991003 714 1 1 34 U974098 0.500000 U.115844 1 0.997825 0.978098 186.991003 714 1 0 0 34 U974098 0.500000 U.115844 1 0.997825 0.978098 186.591003 717 1 0 0 34 U974098 0.500000 U.115844 1 0.997825 0.978098 186.591003 717 1 0 0 34 U974098 0.500000 U.115844 1 0.997825 0.978098 186.591003 717 1 0 0 34 U974098 0.500000 U.115844 1 0.997825 0.978508 186.591003 717 1 0 0 34 U974098 0.500000 U.115844 1 0.997825 0.978508 186.591003 717 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	712	_			0.974908		0.115844	\Box			
713				34		0.800000	0.115844	 - -	0.998324	0.978508	188.591003
713	714		i	34	0.974908	0.500000	0.115844		0.999262	0.978508	188.591003
417 1 0 34 0.974008 0.300000 0.115844 1 0.999782 0.978508 186.591003 411 1 0 34 0.974008 0.300000 0.115844 1 0.999782 0.978508 186.591003 411 1 0 34 0.974008 0.300000 0.115844 1 0.999782 0.978508 186.591003 411 1 0 34 0.974008 0.300000 0.115844 1 0.999782 0.978508 186.591003 411 1 0 34 0.974008 0.300000 0.115844 1 0.999782 1.000000 3.5408690 440 1 1 0 1 0.999782 1.000000 0.1158733 1 0.999782 1.000000 3.5408690 443 1 1 0 1 0.999785 0.557868 0.088630 1 0.999782 1.000000 2.4188701 443 1 1 2 3 0.997785 0.557868 0.088630 1 0.999782 1.000000 2.4188701 443 1 1 3 0.997785 0.557868 0.088630 1 0.999782 1.000000 2.4188701 445 1 1 3 0.997785 0.557868 0.088630 1 0.999782 1.000000 2.4188701 445 1 1 1 0 0.99782 0.488283 0.0992777 1 0.999782 1.000000 2.4188701 914 1 1 0 0 10 0.992820 0.488283 0.0992777 1 0.999782 1.000000 4.9124901 10723 1 1 1 1 0 0.992820 0.488283 0.0992777 1 0.999782 1.000000 4.9124901 10723 1 1 1 1 0 0.992820 0.488283 0.0992777 1 0.999782 1.000000 4.9124901 10723 1 1 1 0 0.992820 0.488283 0.0992777 1 0.999782 1.000000 4.9124901 10723 1 1 1 0 0.992820 0.488283 0.0992777 1 0.999782 1.000000 4.9124901 10723 1 1 1 0 0.992820 0.488283 0.0992777 1 0.999782 1.000000 4.9124901 10724 1 1 1 0 0.992820 0.488283 0.0992777 1 0.999782 1.000000 4.9124901 10725 1 1 1 0 0.992820 0.488283 0.0992777 1 0.999782 1.000000 4.9124901 10725 1 1 1 0 0.992820 0.488283 0.0992777 1 0.999782 1.000000 4.9124901 10725 1 1 0 0 0.992820 0.488283 0.0992777 1 0.999782 1.000000 4.9124901 10725 1 1 0 0 0.992820 0.488283 0.0992777 1 0.999782 1.000000 4.9124901 10725 1 1 0 0 0.992820 0.488283 0.0992777 1 0.999782 1.000000 4.9124901 10725 1 1 0 0 0.992820 0.488283 0.0992777 1 0.999782 1.000000 4.9124901 10725 1 1 0 0 0.992820 0.488283 0.0992777 1 0.999782 0.000000 4.9124901 10725 1 1 0 0 0.992820 0.488283 0.0992777 1 0.999782 0.000000 4.9124901 10725 1 1 0 0 0.992820 0.488283 0.0992777 1 0.999782 0.000000 4.9124901 10725 1 1 0 0 0.992820 0.488283 0.0992777 1 0.999782 0.000000 4.9124901 10725		1		34	0.974908					0.978508	
411 0 0 34 0.974908 0.500000 0.118844 1 0.999282 0.978508 186.591003		 		34	0.974908		0.115844	- i -	0.999262	0.978508	186.591003
140	412		0	34	0.974908	0.500000	0.115844		0.999262		
140								├-}-		0.978508	186.591003
140					0.999262	1.0000000			0.999262	1.000000	33.908599
48.5	140	-1				1.000000	0.133733		0.999262	1.000000	
483 0 1 3 0.997788 0.357888 0.088030 1 0.999782 1.000000 24.188701 914 -1 0 10 0.997820 0.488283 0.080030 1 0.999782 1.000000 34.188701 914 -1 0 10 0.997820 0.488283 0.0802777 1 0.999782 1.000000 49.124901 1023 1 0 10 0.997820 0.488283 0.092777 1 0.999782 1.000000 49.124901 1023 1 0 10 0.997820 0.488283 0.092777 1 0.999782 1.000000 49.124901 1023 1 0 10 0.997820 0.488283 0.092777 1 0.999782 1.000000 49.124901 1003 0 0 10 0.997820 0.488283 0.092777 1 0.999782 1.000000 49.124901 1003 1 0 10 0.997820 0.488283 0.092777 1 0.999782 1.000000 49.124901 1003 1 0 10 0.997820 0.488283 0.092777 1 0.999782 1.000000 49.124901 1003 1 0 10 0.997820 0.488283 0.092777 1 0.999782 1.000000 49.124901 1003 1 0 10 0.997820 0.488283 0.092777 1 0.999782 1.000000 49.124901 1003 1 0 0 10 0.997820 0.488283 0.092777 1 0.999782 1.000000 49.124901 1003 1 0 0 10 0.997820 0.488283 0.092777 1 0.999782 1.000000 49.124901 1003 1 0 0 10 0.997820 0.488283 0.092777 1 0.999782 1.000000 49.124901 1003 1 0 0 10 0.997820 0.488283 0.092777 1 0.999782 1.000000 49.124901 1003 1 0 0 10 0.997820 0.488283 0.092777 1 0.999782 1.000000 49.124901 1003 1 0 0 10 0.997820 0.488283 0.092777 1 0.999782 1.000000 49.124901 1003 1 0 0 10 0.997820 0.488283 0.092777 1 0.999782 1.000000 10.81997 1003 1 0 0 10 0.997820 0.088283 0.092777 1 0.999782 1.000000 10.81997 1003 1 0 0 10 0.997820 0.088283 0.092777 1 0.999782 1.000000 10.81997 1003 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0			0		0.997786	0.557886	0.086030				
914 - 1			i			0.557886	0.088030	 	0.999262	1.000000	24.186701
10			1						0.999262		
1023 1			¥ —		0.992620			 	0.999262	1.000000	49.124901
TOOS	1023		Ó	10	0.992620	0.488293	0.092277		0.999262	1.000000	49.134901
TOGS		1						 		1.000000	
914 0 0 10 0.992820 0.488293 0.092277 1 0.999282 1.000000 49.124801 914 1 0 10 0.992820 0.488293 0.092277 1 0.999282 1.000000 49.124801 914 2 0 10 0.992820 0.488293 0.092277 1 0.999282 1.000000 49.124801 914 2 0 1 0 0.992820 0.488293 0.092277 1 0.999282 1.000000 101.810997 286 -1 1 4 0.997048 0.563791 0.093683 1 0.999282 1.000000 101.810997 31 -1 1 4 0.997048 0.563791 0.093683 1 0.999282 1.000000 101.810997 31 -1 1 4 0.997048 0.563791 0.093683 1 0.999282 1.000000 101.810997 31 -1 0 4 0.997048 0.563791 0.093683 1 0.999282 1.000000 101.810997 31 -1 0 4 0.997048 0.563791 0.093683 1 0.999282 1.000000 101.810997 30 -1 1 4 0.997048 0.563791 0.093683 1 0.999282 1.000000 101.810997 50 -1 0 4 0.997048 0.563791 0.093683 1 0.999282 1.000000 101.810997 50 -1 0 10 0.992820 0.583791 0.093683 1 0.999282 1.000000 101.810997 50 -1 0 10 0.992820 0.583791 0.093683 1 0.999282 1.000000 101.810997 596 -1 1 10 0.992820 0.519041 0.133277 1 0.999282 1.000000 108.841985 596 -1 1 1 0.992820 0.519041 0.133277 1 0.999282 1.000000 168.841998 598 1 0 1 0.992820 0.519041 0.133277 1 0.999282 1.000000 168.841998 609 -1 0 10 0.992820 0.519041 0.133277 1 0.999282 1.000000 168.841998 609 -1 0 10 0.992820 0.519041 0.133277 1 0.999282 1.000000 168.841998 609 -1 1 1 0.992820 0.519041 0.133277 1 0.999282 1.000000 168.841998 609 -1 1 1 0.992820 0.519041 0.133277 1 0.999282 1.000000 168.841998 609 -1 1 1 0.992820 0.519041 0.133277 1 0.999282 1.000000 168.841998 609 -1 1 1 0.992820 0.519041 0.133277 1 0.999282 1.000000 168.841998 609 -1 1 0 0.992820 0.519041 0.133277 1 0.999282 1.000000 168.841998 609 -1 1 0 0.992820 0.519041 0.133277 1 0.999282 1.000000 168.841998 609 -1 1 0 0.992820 0.519041 0.133277 1 0.999282 0.00000 168.841989 609 -1 1 0 0.992820 0.519041 0.133277 1 0.999282 0.00000 168.841989 609 -1 1 1 0.992820 0.519041 0.133277 1 0.999282 0.00000 168.841989 609 -1 1 1 1 0.992820 0.519041 0.133277 1 0.999282 0.00000 168.841989 609 -1 1 1 1 0.992820 0.519041 0.133277 1 0.999282 0.000000 168.841989 609 -1 1 1 1 0.992820 0.519041 0.133277 1 0.999282	1003	Ī	0	10	0.992520	0.488293	0.092277	<u>i</u>	0.999262	1.0000000	49.124901
1714 2	914			10						1.000000	
186				10				 •	0.999262	1.000000	49,124901
31 -1	266			4	0.997048	0.563791			0.999262		
31 1 0 4 0.997048 0.563791 0.095863 1 0.999262 1.000000 101.810997 50 1 1 4 0.997048 0.563791 0.095863 1 0.999262 1.000000 101.810997 50 1 0 4 0.997048 0.563791 0.095863 1 0.999262 1.000000 101.810997 50 1 0 10 0.992620 0.519041 0.132277 1 0.999262 1.000000 168.841993 598 1 0 1 0 0.992620 0.519041 0.132277 1 0.999262 1.000000 168.841993 598 1 0 0 10 0.992620 0.519041 0.132277 1 0.999262 1.000000 168.841993 598 1 0 10 0.992620 0.519041 0.132277 1 0.999262 1.000000 168.841993 598 1 0 10 0 0.992620 0.519041 0.132277 1 0.999262 1.000000 168.841993 598 1 0 10 0 0.992620 0.519041 0.132277 1 0.999262 1.000000 168.841993 509 1 0 10 0.992620 0.519041 0.132277 1 0.999262 1.000000 168.841993 609 1 0 10 0.992620 0.519041 0.132277 1 0.999262 1.000000 168.841993 609 1 0 10 0.992620 0.519041 0.132277 1 0.999262 1.000000 168.841993 609 1 0 10 0.992620 0.519041 0.132277 1 0.999262 1.000000 168.841993 609 1 0 10 0.992620 0.519041 0.132277 1 0.999262 1.000000 168.841993 609 1 0 10 0.992620 0.519041 0.132277 1 0.999262 1.000000 168.841993 609 1 0 10 0.992620 0.519041 0.132277 1 0.999262 1.000000 168.841993 609 1 0 10 0.992620 0.519041 0.132277 1 0.999262 1.000000 168.841993 609 1 0 10 0.992620 0.519041 0.132277 1 0.999262 1.000000 168.841993 609 1 0 10 0.992620 0.519041 0.132277 1 0.999262 1.000000 168.841993 609 1 0 10 0.992620 0.519041 0.132277 1 0.999262 1.000000 168.841993 609 1 0 10 0.992620 0.519041 0.132277 1 0.999262 1.000000 168.841993 609 1 0 10 0.992620 0.519041 0.132277 1 0.999262 1.800000 168.841936 609 1 1 0 10 0.992620 0.519041 0.132277 1 0.999262 0.842143 851.152992 378 1 0 6 10 0.894982 0.519041 0.132277 1 0.999262 0.842143 851.152992 378 1 0 6 1 0.864982 0.51904 0.136482 1 0.999262 0.842143 851.152992 378 1 0 6 1 0.864982 0.501964 0.136482 1 0.999262 0.842143 851.152992 389 1 0 6 1 0.864982 0.501964 0.136482 1 0.999262 0.842143 851.152992 390 1 1 6 1 0.964982 0.501964 0.136482 1 0.999262 0.842143 851.152992 468 1 1 6 1 0.964982 0.501964 0.136482 1 0.999262 0.842143 851.152992 469 1 0 6 1 0.964982 0.501964 0.13648					0.997048			 		1.000000	101.810997
SU -1 U 4 U.997048 U.583791 U.099883 1 U.999262 1.000000 101.810997 598 -1 U 11 U.992820 U.519041 U.133277 1 U.999262 1.000000 188.841995 598 -1 I 1 U 0.992820 U.519041 U.133277 1 U.999262 1.000000 188.841995 598 -1 U 0 U 0.992820 U.519041 U.133277 1 U.999262 1.000000 188.841995 598 U 0 U 10 U.992820 U.519041 U.133277 1 U.999262 1.000000 188.841995 598 U 0 U 10 U.992820 U.519041 U.133277 1 U.999262 1.000000 188.841995 609 -1 U 10 U.992820 U.519041 U.133277 1 U.999262 1.000000 188.841995 609 -1 U 10 U.992820 U.519041 U.133277 1 U.999262 1.000000 188.841995 609 U 0 U 10 U.992820 U.519041 U.133277 1 U.999262 1.000000 188.841995 609 U 0 U 10 U.992820 U.519041 U.133277 1 U.999262 1.000000 188.841995 609 U 0 U 10 U.992820 U.519041 U.133277 1 U.999262 1.000000 188.841995 609 U 0 U 10 U.992820 U.519041 U.133277 1 U.999262 1.000000 188.841995 609 U 0 U 10 U.992820 U.519041 U.133277 1 U.999262 1.000000 188.841995 609 U 0 U 10 U.992820 U.519041 U.133277 1 U.999262 1.000000 188.841995 609 U 0 U 10 U.992820 U.519041 U.133277 1 U.999262 1.000000 188.841995 609 U 0 U 10 U.992820 U.519041 U.133277 1 U.999262 1.000000 188.841995 609 U 1 U 10 U.992820 U.519041 U.133277 1 U.999262 1.000000 188.841995 609 U 1 U 10 U.992820 U.519041 U.133277 1 U.999262 1.000000 188.841995 609 U 1 U 10 U.992820 U.519041 U.133277 1 U.999262 1.000000 188.841995 609 U 1 U 10 U.992820 U.519041 U.133277 1 U.999262 1.000000 188.841995 609 U 1 U 10 U.992820 U.519041 U.133277 1 U.999262 U.000000 188.841995 609 U 1 U 10 U.992820 U.51904 U.138282 1 U.999262 U.000000 188.841995 609 U 1 U 10 U.992820 U.51904 U.138282 1 U.999262 U.000000 188.841995 609 U 1 U 1 U.992820 U.51904 U.138282 1 U.999262 U.000000 188.841995 609 U 1 U 1 U.992820 U.51904 U.138282 1 U.999262 U.000000 188.841995 609 U 1 U 1 U.992820 U.51904 U.138282 1 U.999262 U.000000 188.841995 609 U 1 U 1 U.992820 U.51904 U.138282 1 U.999262 U.000000 188.841995 609 U 1 U 1 U.992820 U.501904 U.138282 1 U.999262 U.000000 188.841995 609 U 1 U 1 0 U.992820 U.501904 U.138282 1 U.999262 U.000000 188.841995 609					0.997048	0.563791	0.098693	l i	0.999262	1.000000	101.810997
598					T 0.997048			1	0.999262	1.000000	
1				10	0.992620	0.519041		 		1.0000000	168.841995
\$88 1 0 10 0.992820 0.519041 0.133277 0.999282 1.000000 168.841995 609 1 1 1 1 10 0.992820 0.519041 0.133277 1 0.999282 1.000000 168.841995 609 1 0 1 10 0.992820 0.519041 0.133277 1 0.999282 1.000000 168.841995 609 1 0 1 10 0.992820 0.519041 0.133277 1 0.999282 1.000000 168.841995 609 1 0 1 10 0.992820 0.519041 0.133277 1 0.999282 1.000000 168.841995 692 1 1 0 10 0.992820 0.519041 0.133277 1 0.999282 1.000000 168.841995 692 1 1 1 10 0.992820 0.519041 0.133277 1 0.999282 1.000000 168.841995 692 1 1 1 10 0.992820 0.519041 0.133277 1 0.999282 1.000000 168.841995 844 1 1 1 10 0.992820 0.519041 0.133277 1 0.999282 1.000000 168.841995 844 1 1 1 10 0.992820 0.519041 0.133277 1 0.999282 1.000000 168.841995 844 1 0 1 10 0.992820 0.519041 0.133277 1 0.999282 1.000000 168.841995 378 1 1 0 51 0.984820 0.519041 0.133277 1 0.999282 1.000000 168.841995 378 1 1 0 51 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.153992 378 1 1 0 51 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.153992 378 1 1 0 51 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.153992 397 1 1 0 51 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.153992 397 1 1 0 51 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.153992 397 1 0 0 51 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.153992 397 1 0 0 51 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.153992 466 1 0 0 61 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.153992 466 1 0 0 61 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.153992 466 1 0 0 61 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.153992 466 1 0 0 61 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.153992 466 1 0 0 61 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.153992 466 1 0 0 61 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.153992 466 1 1 6 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.153992 466 1 1 6 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.153992 466 1 1 6 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.153992 466 1 1 6 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.153992 4	596	-1	1	10	0.992520	0.519041	0.133277		0.999262	1.000000	155.841995
809 -1						0.519041		1		1.000000	108.841995
609 -1 1 1 10 0.992820 0.519041 0.133277 1 0.999282 1.000000 168.841995 600 1 0 10 0.992820 0.519041 0.133277 1 0.999282 1.000000 168.841995 600 1 0 10 0.992820 0.519041 0.133277 1 0.999282 1.000000 168.841995 692 -1 1 1 10 0.992820 0.519041 0.133277 1 0.999282 1.000000 168.841995 692 -1 1 1 10 0.992820 0.519041 0.133277 1 0.999282 1.000000 168.841995 844 0 0 0 10 0.992820 0.519041 0.133277 1 0.999282 1.000000 168.841995 844 0 0 0 10 0.992820 0.519041 0.133277 1 0.999282 1.000000 168.841995 844 0 0 0 10 0.992820 0.519041 0.133277 1 0.999282 1.000000 168.841995 844 0 0 0 10 0.992820 0.519041 0.133277 1 0.999282 1.000000 168.841995 844 0 0 0 10 0.992820 0.519041 0.133277 1 0.999282 1.000000 168.841995 378 -1 0 61 0.954982 0.501954 0.138482 1 0.999282 0.842143 851.13392 378 -1 0 61 0.954982 0.501954 0.138482 1 0.999282 0.842143 851.13392 397 -1 0 61 0.954982 0.501954 0.138482 1 0.999282 0.842143 851.13392 397 0 0 0 61 0.954982 0.501954 0.138482 1 0.999282 0.842143 851.13592 397 1 0 61 0.954982 0.501954 0.138482 1 0.999282 0.842143 851.13592 397 1 0 61 0.954982 0.501954 0.138482 1 0.999282 0.842143 851.153992 466 -1 0 61 0.954982 0.501954 0.138482 1 0.999282 0.842143 851.153992 466 -1 0 61 0.954982 0.501954 0.138482 1 0.999282 0.842143 851.153992 466 -1 0 61 0.954982 0.501954 0.138482 1 0.999282 0.842143 851.153992 466 1 1 61 0.954982 0.501954 0.138482 1 0.999282 0.842143 851.153992 466 1 1 61 0.954982 0.501954 0.138482 1 0.999282 0.842143 851.153992 466 1 1 61 0.954982 0.501954 0.138482 1 0.999282 0.842143 851.153992 466 1 1 61 0.954982 0.501954 0.138482 1 0.999282 0.842143 851.153992 466 1 1 61 0.954982 0.501954 0.138482 1 0.999282 0.842143 851.153992 466 1 1 61 0.954982 0.501954 0.138482 1 0.999282 0.842143 851.153992 466 1 1 61 0.954982 0.501954 0.138482 1 0.999282 0.842143 851.153992 466 1 1 61 0.954982 0.501954 0.138482 1 0.999282 0.842143 851.153992 467 1 1 61 0.954982 0.501954 0.138482 1 0.999282 0.842143 851.153992 467 1 1 61 0.954982 0.501954 0.138482 1 0.999282 0.842143 851.153992 400 -1 1 61 0.954982 0.	609			10	0.992620	0.519041	0.133277	<u></u>	0.999262	1.000000	168.841995
800 T 0 10 0.992820 0.519041 0.133277 1 0.999282 1.000000 168.841995 692 -1 1 1 10 0.992820 0.519041 0.133277 1 0.999282 1.000000 168.841995 844 -1 1 1 10 0.992820 0.519041 0.133277 1 0.999282 1.000000 168.841995 844 -1 1 10 0.992820 0.519041 0.133277 1 0.999282 1.000000 168.841995 844 -1 1 10 0.992820 0.519041 0.133277 1 0.999282 1.000000 168.841995 844 -1 1 1 10 0.992820 0.519041 0.133277 1 0.999282 1.000000 168.841995 844 -1 1 1 10 0.992820 0.519041 0.133277 1 0.999282 1.000000 168.841995 844 -1 1 1 10 0.992820 0.519041 0.133277 1 0.999282 1.000000 168.841995 844 -1 1 1 1 1 0.994822 0.519041 0.133482 1 0.999282 0.842143 851.133992 8378 -1 1 1 5 1 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.133992 8397 -1 1 0 51 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.133992 8397 1 1 0 5 1 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.133992 8397 1 0 0 0 61 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.133992 8397 1 0 0 5 1 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.133992 8466 -1 0 5 1 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.133992 8466 -1 0 5 1 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.133992 8466 0 1 5 1 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.133992 8466 0 1 5 1 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.133992 8466 0 1 5 1 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.133992 8466 0 1 5 1 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.133992 8466 0 1 5 1 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.133992 8466 0 1 5 1 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.133992 8466 0 1 5 1 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.133992 8466 0 1 5 1 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.133992 8466 0 1 5 1 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.133992 8466 0 1 5 1 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.133992 8466 0 1 5 1 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.133992 8469 0.1 1 6 1 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.133992 8469 0.1 1 6 1 0.984982 0.501984 0.1384	609	-1		10	0.992520	0.519041	0.133277				158.841995
Fig. 1	609				0.992620	0.519041		+ +	0.999262		168.841995
844 -1 1 10 0.992820 0.519941 0.133277 1 0.999282 1.000000 168.841998 844 0 0 10 10 0.992820 0.519941 0.133277 1 0.999282 1.000000 168.841998 378 -1 0 61 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.153992 377 -1 0 61 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.153992 397 -1 0 61 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.153992 397 -1 0 61 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.153992 397 -1 0 61 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.153992 397 -1 0 61 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.153992 397 -1 0 61 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.153992 397 -1 0 51 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.153992 466 -1 0 51 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.153992 466 -1 1 51 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.153992 466 -1 1 51 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.153992 466 1 1 51 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.153992 468 1 1 51 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.153992 469 -1 0 51 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.153992 469 -1 0 51 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.153992 469 -1 0 51 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.153992 469 -1 1 51 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.153992 469 -1 1 51 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.153992 469 -1 1 51 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.153992 469 -1 1 51 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.153992 469 -1 1 51 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.153992 469 -1 1 51 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.153992 469 -1 1 51 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.153992 469 -1 1 51 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.153992 469 -1 1 51 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.153992 469 -1 1 51 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.153992 469 -1 1 51 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.153992 469 -1 1 51 0.98	692	न		10	0.992620	0.519041	0.133277		0.999262	1.000000	158.841995
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165	466	-1		61	0.954982	0.501954	0.138482	ī	0.999262	0.842143	851.153992
#86 7 1 61 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.183992 469 -1 0 6 61 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.183992 469 -1 1 51 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.183992 900 -1 1 61 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.183992 1141 -1 1 61 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.183992 1141 -1 1 61 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.183992 1153 -1 0 51 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.183992 1153 0 1 61 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.183992 1153 0 1 61 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.183992 1153 0 1 61 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.183992 1141 1 0 61 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.183992 1141 1 61 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.183992 1153 0 1 61 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.183992 1153 0 1 61 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.183992 1153 0 1 61 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.183992 1153 0 1 61 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.183992 1153 0 1 61 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.183992 1153 0 1 61 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.183992 1153 0 1 61 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.183992 1153 0 1 61 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.183992 1153 0 1 61 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.183992 1153 0 1 61 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.183992 1153 0 1 61 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.183992 1153 0 1 61 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.183992 1153 0 1 61 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.183992 1153 0 1 61 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.183992 1153 0 1 61 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.183992 1153 0 1 61 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.183992 1153 0 1 61 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.183992 1153 0 1 61 0.						0.501984	0.138482			0.842143	
469 -1 0 51 0,984982 0.501984 0.138482 1 0.999282 0.842143 851.153992 469 -1 1 5 61 0,984982 0.501984 0.138482 1 0.999282 0.842143 851.153992 900 -1 1 61 0,984982 0.501984 0.138482 1 0.999282 0.842143 851.153992 1141 -1 1 6 61 0,984982 0.501984 0.138482 1 0.999282 0.842143 851.153992 1153 -1 0 61 0,984982 0.501984 0.138482 1 0.999282 0.842143 851.153992 1153 -1 0 61 0,984982 0.501984 0.138482 1 0.999282 0.842143 851.153992 1153 0 1 6 61 0,984982 0.501984 0.138482 1 0.999282 0.842143 851.153992 1141 1 0 61 0,984982 0.501984 0.138482 1 0.999282 0.842143 851.153992 1141 1 0 61 0,984982 0.501984 0.138482 1 0.999282 0.842143 851.153992 1141 1 61 0,984982 0.501984 0.138482 1 0.999282 0.842143 851.153992 901 1 1 61 0,984982 0.501984 0.138482 1 0.999282 0.842143 851.153992 901 1 1 61 0,984982 0.501984 0.138482 1 0.999282 0.842143 851.153992 901 2 1 61 0,984982 0.501984 0.138482 1 0.999282 0.842143 851.153992 901 2 1 61 0,984982 0.501984 0.138482 1 0.999282 0.842143 851.153992 901 2 1 61 0,984982 0.501984 0.138482 1 0.999282 0.842143 851.153992 901 1 1 61 0,984982 0.501984 0.138482 1 0.999282 0.842143 851.153992 901 2 1 61 0,984982 0.501984 0.138482 1 0.999282 0.842143 851.153992 901 1 1 61 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.153992 901 1 1 61 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.153992 901 1 1 61 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.153992 901 1 1 61 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.153992 901 1 1 61 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.153992 901 1 1 61 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.153992 901 1 1 61 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.153992 901 1 1 61 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.153992 901 1 1 61 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.153992 901 1 1 61 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.153992 901 901 901 901 901 901 901 901 901 901			 		0.954982	0.501954	0.138482		0.999262	0.842143	851.153992
900 -1 1 61 0.954982 0.501954 0.138482 1 0.999282 0.842143 851.153992 1133 -1 0 61 0.954982 0.501954 0.138482 1 0.999282 0.842143 851.153992 1153 -1 0 61 0.954982 0.501954 0.138482 1 0.999282 0.842143 851.153992 1153 0 1 61 0.954982 0.501954 0.138482 1 0.999282 0.842143 851.153992 1141 1 0 61 0.954982 0.501954 0.138482 1 0.999282 0.842143 851.153992 1141 1 0 61 0.954982 0.501954 0.138482 1 0.999282 0.842143 851.153992 1141 1 61 0.954982 0.501954 0.138482 1 0.999282 0.842143 851.153992 1 0 0 1 61 0.954982 0.501954 0.138482 1 0.999282 0.842143 851.153992 1 0 0 0 0 0 0.954982 0.501954 0.138482 1 0.999282 0.842143 851.153992 1 0 0 0 0 0 0.954982 0.501954 0.138482 1 0.999282 0.842143 851.153992 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	489			61	0.984982	0.501954	0.138482		0.999262	0.842143	851.153992
1141					0.954982	0.501984		1	0.999262	0.842143	
1153 - 1					0.954982	0.501954	0.138482	+ i	0.999262	0.842143	851.153992
1141 0 81 0.984982 0.501954 0.138482 1 0.999282 0.842143 851.153992 901 0 1 81 0.984982 0.501954 0.138482 1 0.999282 0.842143 851.153992 901 1 1 81 0.984982 0.501954 0.138482 1 0.999282 0.842143 851.153992 901 2 1 81 0.984982 0.501954 0.138482 1 0.999282 0.842143 851.153992 787 0 1 61 0.984982 0.501954 0.138482 1 0.999282 0.842143 851.153992 787 1 1 61 0.984982 0.501954 0.138482 1 0.999282 0.842143 851.153992 0.842143 0.942143	1153	-1		61	0.954982	0.501954	0.138482	1 1	0.999262	0.842143	851.153992
901 0 1 81 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.153992 901 1 1 61 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.153992 901 2 1 61 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.153992 787 0 1 61 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.153992 787 1 1 61 0.984982 0.501984 0.138482 1 0.999282 0.842143 851.153992 [Mean val 28.5 0.978974 0.521747 0.116647 1.02 0.999247 0.986386 295.917012	1153 T	0 -	1 1					+ +		0.842143	851.153992
901 1 1 81 0.984982 0.501954 0.138482 1 0.999282 0.842143 851.153992 901 2 1 6 61 0.984982 0.501954 0.138482 1 0.999282 0.842143 851.153992 787 0 1 61 0.984982 0.501954 0.138482 1 0.999282 0.842143 851.153992 787 1 1 61 0.984982 0.501954 0.138482 1 0.999282 0.842143 851.153992 [901	-i-	t i	61	0.954982	0.501954	0.138482	<u>li</u>	0.999262	0.842143	851.153992
787 0 1 61 0.984982 0.501954 0.138482 1 0.999282 0.821243 851.153992 787 1 1 61 0.984982 0.501954 0.138482 1 0.999282 0.821243 851.153992 [Mean val 28.5 0.978974 0.321747 0.116647 1.02 0.999247 0.956386 295.917012	901			61			0.138482	1	0.999262		
787 1 1 61 0.954982 0.501954 0.138482 1 0.999282 0.842143 851.153992 Mean val 28.5 0.978974 0.521747 0.116647 1.02 0.999247 0.956386 295.917012		- 6	 - 			0.501954	0.130402	+ +		0.842143	851.153992
		Ť	ī					ŢĪ		0.842143	851.153992
Std devi 21.8 0.015932 0.072049 0.018135 0.14 0.000104 0.083454 310.430983									0.999247		295.917012
			Std devi	21.5	0.015932	1 0.072049	0.018135	0.14	0.000104	0.063454	310.430953

Table E.2: Results for Benchmark S1238

Ele 2823 2823 2823 3907 4255 4255 4255 4980 4842 4542 8458 8458	Inp -1 -1 -1 -1 -1 -1 -1 -	length = 64 SA U I U	N.PO	FE1 0.990358 0.999358 0.999358	Res)_1 U.48623U U.48623U U.48623U	Tim.Str. 1.553770 1.553770 1.553770	N.SR	PE2 0.999715 0.999715	Resl.2 0.500000 0.500000	Tim,Furt 597.558030 597.568030
3907 3907 4255 4255 4960 4960 4542 4542 8458	7	0	9	0.999358	0.486230	1.553770		0.999715	0.800000	897.889030
3907 3907 4255 4255 4960 4960 4542 4542 8458	777777777777777777777777777777777777777	Ü	9							
3907 4255 4255 4960 4960 4842 4542 8458 8458	77 77 77 77							0.999715	0.600000	897,668030
4255 4960 4960 4542 4542 8458 8458	-1 -1 -1			0.999358	0.486230	1.553770		0.999715	0.500000	597.558030 597.568030
4960 4960 4542 4542 8458 8458	-1		- 0	0.999358	0.486230	1.583770	1 1	0.999715 0.999715	0.600000	697.868030
4542 4542 8458 8458		Û	- 5	0.999358	0.486230	1.553770	4	0.999715	0.600000	697.668030
4542 8458 8458			9	0.999358	0.486230	1.553770	4	0.999715	0.800000	597.558030 347.795990
8458 8458	-1	-		0.999715 0.999715	0.500000	1.528180	 - 2 - 	0.999887	0.555557	347.795990
		Ö	1	0.999715	0.500000	1.528180	7	0.999837	0.666667	347.795990
	-1		4	0.999715	0.500000	1.528180		0.999857 0.999929	1.000000	347.795990 173.227005
912	1	9	3	0.999857	0.500000	1.517990	 i 	0.999929	1.0000000	173.227005
2416		- i	4	0.999715	U.500000	1.537210	_2	0.999857	0.565657	360.678009
7416	-1		-	0.999715	0.500000	1.537210		0.999857	0.566667	360.678009 360.678009
3741 3741		- 0	1	0.999715	0.500000	1.537210	-2	0.999887	0.565557	380.678009
1831	-1	- i	19	0.998645	0.484970	1.634020		0.999929	0.700269	1390.260010
1831			19	0.998645 0.998645	0.484970	1.834020	7	0.999857	0.700269	1390.260010
6368 7075	-1		19	0.998645	0.484970	1.634020	 i 	0.999715	0.700269	1390.260010
9778	-1	Ī.,	19	0.998545	0.484970	1.634020	-	0.999715	0.700269	1390.260010
9778	0	I I	19	0.998645	0.484970	1.634020		0.999929	0.700269	1390.260010
7075 6861	0	- 0	19	0.998645 0.998645	0.484970	TRUMPAT	- 2	0.9888857	0.700269	1390.260010
6561	1		19	0.998645	0.404970	1.634020	7	0.999857	0.700269	1390.260010
6365 10679	0		19	0.998845	0.484970 0.484970	1.634020	7	0.999857 0.999715	0.700269	1390.260010
10679	1:1	 	19	0,998845	0.484970	1.634020	_i_	0.999715	0.700269	1390.260010
10819	1-1	- O	19	0.998843	0.484970	1.634020	1	0.999715	0.700269	1390.260010
10819	-1	0	19	0.998845	0.484970	1.634020	1 7	0.999715	0.700269	1390.260010
10841	न		19	0.998845	0.484970	1.634020	1	0.999715	0.700269	1390.260010
2638	-1	9	10	0.999287	0.500000	1.564400	5 5	0.999844	0.588592	867.579993 867.579993
2636 3370	1 -1	0	10	0.999287	0.300000	1.554400	- 5	0.999844	0.588592	867.679993
3370	-1_	ì	10_	0.999287	0.500000	1.554400	3	0.999644 0.999644	0.588592	867.579993 867.679993
4806	1 -1	0	10	0.999287	0.500000	1.584400	3 -	0.999644	0.588592	867.679993
3040	 ii -	 	l iŏ 	0.999287	0.500000	1.584400	3	0.999644	0.588592	867.679993
5040	-1	1	10	0.999287	0.500000	1.584400	3	0.999644	0.588592	867.579993 867.579993
8580 8580	1 1	9	10	0.999287	0.500000	1.564400	 3 -	0.999644	0.588592	867.679993
2726	 	 	17	0.998788	111.404503	1.730460	3	0.999788	0.731964	1386.209961
2726	-1	1	17	0.998788	0.494593 0.494593	1.730480	3	0.999786	0.731964 0.731964	1386.209961
3411	1 :1	9	17	0.998788	I I JULKUT	1.730460	3	0.999786	0.731964	1388,209961
11963	1 1	6 -	17	0.998788	0.494593	1.730460	3	0.999788	0.731984	1386.209961
11963	-1		17	0.998788	0.494593 0.494593 0.494593	1.730460	1-1-	0.999929	0.731964	1386.209961 1386.209961
12290	1 -1	1 0	17	0.998788	0.494593	1.730460	1 3	0.999786	0.731964	1386.209961
12477	1 0	†ŏ	17	0.998788	0.494593	1.730460		0.999929	0.731964	1386,209961
12253	0		17	0.998788	0.494593 0.494593	1.730460	-	0.999929	0.731964 0.731964	1386.209961
12253	0	 	17	0.998788	0.494593	1.730460	+ 3	0.999788	0.731964	1386.209961
13203	1 1	ō	17	0.998788	0.494593	1.730460	3	0.999788	0.731964	1386.209961
13203	1:1		17	0.998788	0.494593	1.730460	1 3	0.999786	0.731964	1386.209961
13271	-1	 	1-17	0.998788	0.494593	1.730460	3	0.999788	0.731964	1386.209961
3540	1.1	ō	6	0.999572	0.500000	1.541430	3	0.999786	0.619906	521.357971
3540	1 :1	1 0	6	0.999572	0.500000	1.541430	+ 3 -	0.999786	0.619906	521.357971
5712	+ -1	1	6 6	0.999572	0.500000	1.541430	1 3	0.999786	0.619906	521.357971
8523	-1	Ū	5	0.999572	0.500000	1.541430	3-	0.999786	0.519906	521.357971 521.357971
8523 1892	1 -1	1 0	14	0.999572	0.500000	1.541430	+ + + + + + + + + + + + + + + + + + + +	0.999572	0.611193	1222.109985
1892	-1	1 1	14	0.999002	0.500000	1.601440	7	0.999857	0.611193	1222.109985
2730	-1	0	14	0.999002	0.500000	1.601440	1 1	0.999929	0.811193	1222.109985
7056	-1	 	14	0.999002	0.500000	1.601440	3	0.999844	T-0.611193	1222.109985
7056	1	Ō	14	0.999002	0.500000	1.601440	7	0.999857	0.611193	1222.109985
8957		9	14	0.999002	0.500000	1.601440	5 6	0.999644	0.611193	1222.109985
8957 9121	-1	 	14	0.999002	0.500000	1.501440	5	0.999644	0.611193	1222.109985
9121	1-1	T	14	0.999002	0.500000	1.601440	- 6	0.999572	0.811193	1222.109985
9215	1 1	0	14	0.999002	0.500000	1.801440	5	0.999544	0.611193	1222.109985
9308	+ : 1	 	+ 12	0.999002	0.500000	1.601440	5	0.999844	0.611193	1222.109985
9308	1-1	i i	14	0.999002	0.500000	1.601440	- 6	0.999572	0.811193	1222.109985
5445 5445	 :	+ 0	15	0.998931	0.505888	1.712200	+ 1	0.999857 0.999929	0.907449	1839.939941
6448	1 -1	i	15	0.998931	0.505888	1.712200		0.999929	0.907449	1839.939941
9992	1-1		15	0.998931	0.305888	1.712200	1-7	0.999857	0.907449	1639.939941 1639.939941
9992	1 1	1 1	15	0.998931	0.505888	1.712200	+ - i -	0.999929	0.907449	1639.939941
5447 5447	 0	 	15	0.9808933	0.505888	1.712200		0.999929	D.907449	1639.939941
6447	1 1	1	15	0.998931	0.505888	1.712200	- -	0.999929		1839.939941 1839.939941
6447 6447	$\frac{2}{3}$		15	0.998931	0.505888	1.712200	+ +	0.999929	0.907449	1639.939941
6446	1 8	 	13	0.998931	0.505888	1.712200	1 1	0.999929	0.907449	1639.939941
5446	1		15	0.998931	0.505888	1.712200		0.999929		1639.939941
5445 5448	3	++-	15	0.998931	0.505888	1.712200	 	0.999929	0.907449	1839.939941
11509	-1	ò	15	0.998931	0.505888	1.712200	2	0.999857	0.907449	1639.939941
11509		1	15	0.998931			1 2	0.999857		
		Mean val		0.999057		1.627785	3.00	0.999785		1128.528546 428.767579
		Std devi	4.9	0.000352	0.007203	0.073869	1.59	T 0.000112	1 0.117421	1 420.101315

Table E.3: Results for Benchmark S13207

Ele 1101 1101 1101 1101 1101 43 43 774 774 1489 1489 1485 1462	Inp Inp Inp	length = 64 SA U I	N.PO	0.997380 0.997380	Resl_I 0.563791 0.563791	Tim.Str. 0.411556 0.411556	N.Sg	FE2 0.999345 0.999345	Resl_2 1.000000 1.000000	Tim,Furt 190.130997 190.130997
1101 1101 1101 1101 43 43 774 774 1489 1489 1485 1462				0.997380		0.411356	+			190.130997
1101 1101 43 43 774 774 1489 1489 1485 1482 1462	1	i								
1101 43 43 774 774 1489 1489 1485 1462 1462	+	- i		0.997380	0.563791	0.411556		0.999345	1.000000	190.130997
43 774 774 1489 1489 1485 1462			4	0.997380	0.563791	0.411556		0.999345	1.000000	190.130997
774 774 1489 1489 1485 1462	-1	1		0.997380 0.997380	0.583791	0.411556 0.411556		0.999345	1.000000	190.130997 190.130997
774 1489 1489 1485 1462 1462	-	0	11	0.997380	0.489862	0.344609		0.999345	0.849915	112.926003
1485 1485 1462 1462		- i -	- ii -	0.992798	0.489862	0.344609	Ť	0.999345	0.849915	112.926003
1485 1462 1462	-1		11	0.992796	0.489852	0.344609 0.344609		U.999345 U.999345	0.849915	112.926003
1462	H	1	11	0.992796 0.992796	0.489862	0.344609		0.999345	0.849915	112.926003
1462	9	0	- 11	0.992796	0.489852	0.344609	1	0.998690	0.849915	112.926003
	Ť	ŏ	īī	0.992798	0.489862	0.344609	ř	0.998690	0.849915	112.926003
1485		0	- 11	0.992798	0.489862	0.344609	7	0.999345	0.849915 0.849915	112.926003
1473	4			0.992796	0.489852 0.489852	0.344609	 	0.998690	0.849915	112.926003
1473 839	-1-	i i	11	0.992796	0.489862	0.234008	- i -	0.999345	0.849915	113.117996
839	·i	1	-11	0.992796	0.489862	0.234008	I	0.999345	0.849915	113.117996
901	ij		11	0.992798	0.489862 0.489882	0.234008	┡-	0.999345	0.849915 0.849915	113.117996
940	-		11	0.992796	0.489882	0.234008	 	0.999345	0.849915	113.117996
901	- i -	- 6 -	- ii	0.992798	0.489882	0.234008	1	0.999345	0.849915	113.117996
858	Ü		11	0.992795	0.489862	0.234008	2	0.998690	0.849915	113.117996
856			1	0.992796	0.489862 0.489862	0.234008 0.234008	 3	0.998690	0.849915	113.117996
839	-	0	11	0.992798	0.489862	0.234008	 	0.998690	0.849915	113.117996
850	-	ŏ	9	0.994106	0.486230	0.229370		0.999345	1.000000	90.497597
850	÷	ī	9	0.994108	0.486230	0.229370		0.999345	1.000000	90.497597
985 950	-1	0	9	0.994106	0.486230 0.486230	0.229370 0.229370		0.999345	1.000000	90.497597
980	-1		 6	0.994106	0.486230	0.229370	l i	0.999345	1.000000	90.497597
884	9	Ö	<u> </u>	0.994108	0.486230	0.229370	Ī	0.999345	1.000000	90.497597
884		0	9	0.994108	0.486230	0.229370		0.999345	1.000000	90.497597
885 290	-1		7	0.994106	0.486230 1.000000	0.229370	 	0.999345	1.000000	75.914001
700	+	 	 	0.999345	1.000000	0.365714	 i 	0.999345	1.000000	75.914001
331	ŀ	ŏ	3	0.998035	0.557886	0.225422	1	0.999345	1.000000	128.779007
331		1	3	0.998035	0.557886 0.557886	0.226422 0.226422	H-F	0.999345	1.000000	128.779007
51 51	-1	 }	-3	0.998035	U.557886	0.226422	 	0.999345	1.000000	128,779007
- 5 90	 	- 6 -	 ñ	0.992798	0.489862	0.274609	l i	0.999345	0.849915	113.184998
590	-1	ī	11	0.992798	0.489862	0.274609		0.999345	0.849915	113.184998
1232	·I	I	11	0.992796	0.489862 0.489862	0.274609	1	0.999345	0.849915	113.184998
1232	0	1	11	0.992798	0.489862	0.274809	 	0.999345	0.849913	113.184998
1120	 ŏ -	 	l ii	0.992796	0.489882	0.274809	1 2	0.998690	0.849915	113,184998
1120	1	0	11	0.992798	0.489862	0.274609	2	0.998690	0.849915	113.184998
1202			11	0.992796	0.489862 0.489862	0.274609	1	0.999345	0.849915	113.184998
1137	7	 	11	0.992796	0.489862	0.274609	1 2	0.998890	0.849915	113.184998
598	-i-	i i	l ii	0.992796	0.489862	0.281461		0.999345	0.849915	113.205002
596	-1		11	0.992796	0.489862	0.281461		0.999345	0.849915	113.205002
1242	-1		111	0.992796	0.489852 0.489882	0.281461 0.281461	1-1-	0.999345	0.849915 0.849915	113.205002
1242	1 6			0.992795	0.489882	0.281461	 i 	0.999345	0.849913	113.208002
1131	 ŏ -	 	l ii	0.992796	0.489882	0.281461	1 2	0.998690	0.849915	113.205002
1131		Ū.	11	0.992796	0.489862	0.281461	7 2	0.998690	0.849915	113.205002
1204		1	11	0.992798	0.489852	0.281461	1 2	0.999345	0.849915	113.205002 113.205002
1138	-		11	0.992798	0.489862	0.281461	 1	0.998690	0.849915	113.205002
580		 6 -	l ii	0.992796	0.489862	0.263901	1	0.999345	0.849915	113.186996
580	-1	1	11	0.992796	0.489862	0.263901		0.999345	0.849915	113.186996
1149	1		1 11	0.992796	0.489862	0.263901		0.999345	0.849915	113.186996
1134	0	1	111	0.992796	0.489882	0.263901	l i	0.999345	0.849915	113.186998
1077	6	Ŏ.	11	0.992796	0.489862	0.263901	2	0.998690	0.849915	113.186996
1077		0	11	0.992796	0.489862 0.489862	0.263901	7	0.998890	0.849915	113.186996
1134	1 1	 	111	0.992798	0.489862	0.263901 0.263901	+ +	0.998690	0.849915	113.186996
1083	 ĭ 	 i 	I ii	0.992796	0.489862	0.263901	1 2	0.998690	0.849915	113,186996
620_	<u> </u>	ò	116	0.924034	0.502638	0.394658	1	0.999345	0.942810	4496.220215
520	-1		116	0.924034	0.502638	0.394658		0.999345	0.942810	4496.220215
859	-1	1 0	116	0.924034	0.502638	0.394658 0.394658	+-+-	0.999348	0.942810	4496.220215
918	 'i' -	 	118	0.924034	0.502638	0.394658	1 i -	0.999345	0.942810	4498.220215
893	i i	- 6 .	118	0.924034	0.502638	D. SUARSK	1 1	0.999345	0.942810	4498.220215
893		0	116	0.924034	0.502638	0.394658 0.394658 0.394658	1	0.999345	0.942810	4496.220215
832 832	9		118	0.924034 0.924034	0.502638	U.394008	 	0.999345	0.942810	4498,220215
559	1 0	 	116	0.924034	0.502638	0.394658	 i 	0.999345	0.942810	4495.220215
621	-1	Ŏ	116	0.924034	0.502638	0.394658	1	0.999345	0.942810	4496.220215
621	-1	I	118	0.924034	0.502638	0.394658		0.999345	0.942810	4498.220215 4498.220215
550 922	 	0	116	0.924034	0.502638	0.394558	 	0.988345	0.942810	4496.220215
922	1 7	 	116	0.924034	T 0.502638	11.39485R	1 i	0.999345	0.942810	4496.220215
894	Ō	ő	116	0.924034	0.502638	0.394558		0.999345	0.942810	4495.220215
894		0	116	0.924034	0.502638 0.502638	0.394658 0.394658	+	0.999345	0.942810	4498.220215 4496.220215
833 833	1	 	116	0.924034	0.502638	0.394658	++-	0.999345	0.942810	4496.220215
660	+ + + + + + + + + + + + + + + + + + + +	1 6	116	0.924034	0.502638	0.394558	1 i	0.999348	0.942810	4496.220215
622	-1	<u> </u>	116	0.924034	0.502638	0.394658	1	0.999345	0.942810	4496.220215
622	-1		116	0.924034	0.502638	0.394858 0.394858	T	0.999345	0.942810	4496.220215
661			116	0.924034	0.502638	0.394658	+ +	0.999345	0.942810	4496.220215 4496.220215
926 926	1	+ +	116	0.924034	0.502638	0.394658	+++	0.999345	0.942810	4496.220215
895	 i	 6	116	0.924034	0.502638	D BUARKE	<u> </u>	0.999345	0.942810 0.942810	4496.220215
895	T	ŏ	116	0.924034	0.502638	0.394858	1	0.999345	0.942810	4496.220215
834 834	10	Ţ	116	0.924034 0.924034	0.502638 0.502638	0.394658 0.394658	17	0.999345	0.942810	4496.220215 4496.220215
551	+ + +	1 1	116	0.924034	0.502638	0.394658	+ +	0.999345	0.942810	4498.220215
===	÷	Mean val		0.972888	0.510764	0.317670	1.20	0.999214	1 0.907801	1430.745272
	+	Std devi	49.1	0.032184		0.068815	0.40	0.000263	0.061490	2017.040580

Table E.4: Results for Benchmark S1423

	S1488.1	esting	length = 64	ĸ							
Table	Ble	Inp	5A	N.PO	PEI			N.Sg	n uouaka	Rest_2	785 510010
1327 1				- 55		0.500000	0.047310	 i 		0.972987	285.510010
1785	1327	-1	0	- 55	0.957309		0.047310				
1985 1					0.957309		0.047310	 			
1775 7			· i	- 66	0.957309	0.500000	0.047310		0.999353	0.972987	285.510010
1006 1				86	0.957309				0.999353		
1985 7						0.500000	0.047310		0.999353	0.972987	285.510010
1429	1055	2		66	0.957309		0.037310		0.999353	0.972987	
THE COLOR	1442			- 66 - 86	0.957309	0.500000	0.047310	 	0.999353		
1851 U			i		0.987309	0.500000	0.047310		0.999353	0.972987	285.510010
1985 1				- 66 - 68				1	0.999353		
101			-	58	0.957309	0.500000	0.047310	1	0.999353	0.972987	285.510010
1777 1										0.972987	
987						0.500000	0.047310	 i 	0.999353	0.972987	285.510010
1787 0 1 66	667	9		55	0.957309	0.500000	0.047310				
1282 7	867	-7-	-				0.047310	 	0.999353		
1987 0	1282	Ū		65	0.957309	0.500000	0.047310			0.972987	
1987 7			T T				0.047310	 		0.972987	
1198	982		 		0.957309	0.500000	0.047310		0.999353	0.972987	285.510010
1777 0 1 68		1				0.300000					
1729			 				0.047310	;	0.999353	0.972987	285.510010
1482 1	1129	1		56	0.987309	0.500000	0.047310		0.999353	0.972987	285.510010
1485 -1								 		0.972987	
STI 1	1463		Ü	66	0.957309	0.500000	0.047310		0.998708	0.972987	285.510010
1746	631				0.914618					0.980301	571.088989 571.0009
1388 1				132		0.500000	0.064521	i	0.999353	0.980301	571.DKR989
1	1301	-1	0	132	0.914818	0.500000	0.064521		0.999353	0.980301	571.088989 571.088989
1851				132	0.91481K	0.500000	0.064521	+	0.998708	0.980301	571.088989
1975 0	1451	0	Ŏ	132	0.914618	0.500000	0.064521		0.999353	0.980301	571.088989
Title							0.064521	 	0.999353	0.980301	
SSS	1191	ĭ		132	0.914818	0.500000	0.084521		0.999353	0.980301	571.088989
Table			I I							0.980301	571.088989 571 (BRORG
788			 			0.500000	0.064521	 i 	0.999383	0.980301	571.088989
1387 U	786		Ü	132	0.914618	0.500000	0.084521				
1387 O		1						 	0.999353	0.980301	571.088989
1347 0	1387			132	0.914618	0.300000	0.064521		0.999353	0.980301	571.088989
1794						0.500000	0.064521	┼╌┼╌┤	0.999353		571.088989
978 1 1 132 0.914618 0.500000 0.084521 1 0.994533 0.90501 571.085989 1 1732 0.914618 0.500000 0.084521 1 0.994535 0.90501 571.085989 1 1732 0.914618 0.500000 0.084521 1 0.994535 0.980501 571.085989 1 1732 0.914618 0.500000 0.084521 1 0.994535 0.980501 571.085989 0 1 1732 0.914618 0.500000 0.084521 1 0.994535 0.980501 571.085989 0 1 1732 0.914618 0.500000 0.084521 1 0.994535 0.980501 571.085989 0 1 1732 0.914618 0.500000 0.084521 1 0.994535 0.980501 571.085989 0 1 1732 0.914618 0.500000 0.084521 1 0.994535 0.980501 571.085989 0 1 1732 0.914618 0.500000 0.084521 1 0.994535 0.980501 571.085989 0 1 1732 0.914618 0.500000 0.084521 1 0.994535 0.980501 571.085989 0 1 1732 0.914618 0.500000 0.084521 1 0.994535 0.980501 571.085989 0 1 1732 0.914618 0.500000 0.084521 1 0.994535 0.980501 571.085989 0 1 1732 0.914618 0.500000 0.084521 1 0.994535 0.980501 571.085989 0 1 1732 0.914618 0.500000 0.084521 1 0.994535 0.980501 571.085989 0 1 1 1732 0.914618 0.500000 0.084521 1 0.994535 0.980501 571.085989 0 1 1 1732 0.914618 0.500000 0.084521 1 0.994535 0.980501 571.085989 0 1 1 1732 0.914618 0.500000 0.084521 1 0.994535 0.980501 571.085989 0 0 1 1 1732 0.914618 0.500000 0.084521 1 0.994535 0.980501 571.085989 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	1294		- 6 -	132	0.91451B	0.500000	0.064521	<u> </u>	0.999353	0.980301	571.088989
1735			ļ		0.914618	0.500000	0.064521	+ +			
S59					0.914618	0.500000	0.064521		0.999353	0.980301	571.088989
TAX	659						0.084521				\$71.088989 \$71.088989
1102 2	1439		 			0.500000	0.064521		0.999353	0.980301	571.088989
1727 0								\vdash	0.999353		571.088989
1732 0			 			0.500000	0.064521	 i 	0.999353		
1733 1	1153			132	0.914618	0.500000	0.064521				
1975 1							0.064521	+ +	0.999353	0.980301	571.088989
1377 T	1025	Ť	1	132	0.914618	0.500000	0.064521	<u> </u>	0.999353	0.980301	571.088989
132	1408	-3						1			571.088989 571.088989
132		- 6 -					0.084821	1 i	0.999353	0.98030T	571.088989
1773	999		1	132	0.914618	0.500000	0.064521		0.999353		
1015					0.914618 0.914818			+ 1	0.999353	0.980301	571.088989
TORSD	1045	Ū	1	132	0.914818	0.500000	0.084521	T-1	0.999353	0.980301	571.0808989
132			9			0.500000	0.064521	1	0.999353		571.088989
137 0	1225		<u> </u>	132	0.914618	0.500000	0.064521	i	0.999353	0.980301	571.088989
1137 1	1137		0				0.064521				571.088989 571.080000
1		i i	+ + + +		0.914818	0.300000	0.064521	Li	0.999353	0.980301	571.088989
1389 1 1 132 0.914618 0.500000 0.064521 1 0.996353 0.980301 571.088988 1018 0 1 132 0.914618 0.500000 0.064521 1 0.996353 0.980301 571.088988 1018 2 1 132 0.914618 0.500000 0.064521 1 0.996353 0.980301 571.088988 1770 0 1 132 0.914618 0.500000 0.064521 1 0.996353 0.980301 571.088988 185 0 0 132 0.914618 0.500000 0.064521 1 0.996353 0.980301 571.088988 185 0 1 132 0.914618 0.500000 0.064521 1 0.996353 0.980301 571.088988 185 3 1 132 0.914618 0.500000 0.064521 1 0.996353 0.980301 571.088988 185 0 1 132 0.914618 0.500000 0.064521 1 0.996353 0.980301 571.088988 186 0 1 132 0.914618 0.500000 0.064521 1 0.996353 0.980301 571.088988 186 0 1 132 0.914618 0.500000 0.064521 1 0.996353 0.980301 571.088988 1301 0 0 132 0.914618 0.500000 0.064521 1 0.996353 0.980301 571.088988 1301 0 0 132 0.914618 0.500000 0.064521 1 0.996353 0.980301 571.088988 1118 1 1 122 0.914618 0.500000 0.064521 1 0.996353 0.980301 571.088988 1148 0 0 132 0.914618 0.500000 0.064521 1 0.996353 0.980301 571.088988 1148 0 0 132 0.914618 0.500000 0.064521 1 0.996353 0.980301 571.088988 671 1 1 132 0.914618 0.500000 0.064521 1 0.996353 0.980301 571.088988 671 3 1 132 0.914618 0.500000 0.064521 0.996353 0.980301 571.088988 531 0 1 132 0.914618 0.500000 0.064521 1 0.996353 0.980301 571.088988 531 0 1 132 0.914618 0.500000 0.064521 1 0.996353 0.980301 571.088988 531 0 1 132 0.914618 0.500000 0.064521 1 0.996353 0.980301 571.088988 531 0 1 132 0.914618 0.500000 0.064521 1 0.996353 0.980301 571.088988 531 0 1 132 0.914618 0.500000 0.064521 1 0.996353 0.980301 571.088988 531 0 1 1		Ī		132	0.914618	0.500000	0.064521		0.999353	0.980301	571.088989
1018 0	1398	7	1 1	1 130		0.500000	0.064521	 i 	0.999353	0.980301	T 571.088989
1770 U 1 132 0.914618 0.500000 0.064521 1 0.996353 0.996301 571,088989 183 0 0 132 0.914618 0.500000 0.064521 1 0.996353 0.996301 571,088989 684 1 1 132 0.914618 0.500000 0.064521 1 0.996353 0.980301 571,088989 1085 0 1 132 0.914618 0.500000 0.064521 1 0.996353 0.980301 571,088989 1085 0 1 132 0.914618 0.500000 0.064521 1 0.996353 0.980301 571,088989 1085 0 1 132 0.914618 0.500000 0.064521 1 0.996353 0.980301 571,088989 1085 2 1 132 0.914618 0.500000 0.064521 1 0.996353 0.980301 571,088989 1301 0 0 132 0.914618 0.500000 0.064521 1 0.996353 0.980301 571,088989 1301 0 0 132 0.914618 0.500000 0.064521 1 0.996353 0.980301 571,088989 1301 0 1 132 0.914618 0.500000 0.064521 1 0.996353 0.980301 571,088989 1116 1 1 132 0.914618 0.500000 0.064521 1 0.996353 0.980301 571,088989 1145 0 1 1 132 0.914618 0.500000 0.064521 1 0.996353 0.980301 571,088989 671 1 1 132 0.914618 0.500000 0.064521 1 0.996353 0.980301 571,088989 671 1 1 132 0.914618 0.500000 0.064521 1 0.996353 0.980301 571,088989 671 1 1 132 0.914618 0.500000 0.064521 1 0.996353 0.980301 571,088989 671 1 1 132 0.914618 0.500000 0.064521 1 0.996353 0.980301 571,088989 671 1 1 132 0.914618 0.500000 0.064521 1 0.996353 0.980301 571,088989 671 1 1 132 0.914618 0.500000 0.064521 1 0.996353 0.980301 571,088989 671 1 1 132 0.914618 0.500000 0.064521 1 0.996353 0.980301 571,088989 671 1 1 132 0.914618 0.500000 0.064521 1 0.996353 0.980301 571,088989 671 1 1 132 0.914618 0.500000 0.064521 1 0.996353 0.980301 571,088989 671 1 1 132 0.914618 0.500000 0.064521 1 0.996353 0.980301 571,088989 671 1 1 1 132 0.914618 0.500000 0.064521 1 0.996353 0.980301 571,088989 671 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	1018		ī	132	0.914618	0.300000	0.084521		0.999353	0.980301	571.088989
THEST 0			 	132	U.914618	0.500000	0.064521	 			571.088989
1084 3	1183			132	0.914618	0.500000	0.064521	1	0.999353	0.980301	571.088989
1088 0 1 132 0.914818 0.500000 0.084321 1 0.998333 0.998301 \$71.088989 1088 2 1 132 0.914818 0.500000 0.084321 1 0.999333 0.998301 \$71.088989 1301 0 132 0.914818 0.500000 0.084321 1 0.999333 0.980301 \$71.088989 1116 1 132 0.914818 0.500000 0.084321 1 0.999333 0.980301 \$71.088989 1146 0 0 132 0.914818 0.500000 0.084321 1 0.999333 0.980301 \$71.088989 1146 0 0 132 0.914818 0.500000 0.084321 1 0.999333 0.980301 \$71.088989 871 1 1 132 0.914818 0.500000 0.084321 1 0.999335 0.980301 \$71.088989 1009 1 1 132 0.914818 0.500000 0.084321 1 0.999335 0.980301 \$71.088989 1009 1 1 132 0.914818 0.500000 0.084321 1 0.999333 0.980301 \$71.088989 1009 1 1 132 0.914818 0.500000 0.084321 1 0.999335 0.980301 \$71.088989 1009 1 1 132 0.914818 0.500000 0.084321 2 0.998708 0.980301 \$71.088989 1476 1 0 132 0.914818 0.500000 0.084321 2 0.998708 0.980301 \$71.088989 1476 1 1 132 0.914818 0.500000 0.084321 2 0.998708 0.980301 \$71.088989 1476 1 0 1 1 1 1 1 1 1 1										0.980301	
132	1088	6	 -i	132	0.914818	0.500000	0.064521		0.999353	0.980301	571.088989
1118 1 1 132 0.914618 0.500000 0.084321 1 0.998333 0.980301 571.088989 671 1 1 132 0.914618 0.500000 0.084321 1 0.998333 0.980301 571.088989 671 1 1 132 0.914618 0.500000 0.084321 1 0.998333 0.980301 571.088989 671 3 1 132 0.914618 0.500000 0.084321 1 0.998333 0.980301 571.088989 671 3 1 132 0.914618 0.500000 0.084321 1 0.998333 0.980301 571.088989 1 1 1322 0.914618 0.500000 0.084321 1 0.998333 0.980301 571.088989 631 0 1 1322 0.914618 0.500000 0.084321 2 0.987308 0.980301 571.088989 631 0 1 132 0.914618 0.500000 0.084321 2 0.988708 0.980301 571.088989 631 0 1 132 0.914618 0.500000 0.084321 2 0.998708 0.980301 571.088989 631 0 1 1 132 0.914618 0.500000 0.084321 1 0.998308 0.980301 571.088989 631 0 1 1 132 0.914618 0.500000 0.084321 1 0.998308 0.980301 571.088989 632 0.980301 0.998308 0.980301 0.998308 0.980301 0.980301 0.980308 0.980301 0.980308 0.980301 0.980308 0.980301 0.980308 0.980301 0.980308 0.980301 0.980308 0.980301 0.980308 0.980301 0.980308 0.980301 0.980308 0.980301 0.980308 0.980301 0.980308 0.980308 0.980301 0.980308	1086	7		132	0.914818	0.500000	0.064521				571.088989
1145						0.500000	0.064521	 	0.999353	0.980301	571.088989
671 3 1 132 0.914618 0.500000 0.064521 1 0.993533 0.996301 571.089898 1009 1 1 132 0.914618 0.500000 0.064521 1 0.999353 0.996301 571.089898 631 0 1 132 0.914618 0.500000 0.064521 2 0.998708 0.990301 571.088980 1476 -1 0 132 0.914618 0.500000 0.064521 2 0.998708 0.990301 571.088980 1478 -1 0 132 0.914618 0.500000 0.064521 2 0.998708 0.990301 571.088980 1488 -1 1 132 0.914618 0.500000 0.064521 1 0.999353 0.990301 571.088980 1488 -1 0 2 0.994508 0.500000 0.084521 1 0.999353 0.990301 571.088980 1488 -1 0 2 0.994508 0.500000 0.084521 1 0.999353 0.990301 571.088980 1488 -1 0 0 2 0.994508 0.500000 0.084521 1 0.999353 0.990301 571.088980 1488 -1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	1146	0_		132	0.914818	0.500000	0.064521		0.999353	0.980301	371.088989
1009 1 1 132 0.914618 0.500000 0.064521 1 0.999333 0.990301 571.088989 831 0 1 132 0.914618 0.500000 0.064521 2 0.998706 0.980301 571.088989 1476 -1 0 132 0.914618 0.500000 0.064521 2 0.998706 0.980301 571.088989 1485 -1 1 132 0.914618 0.500000 0.064521 1 0.999333 0.990301 571.088989 1485 -1 1 132 0.914618 0.500000 0.064521 1 0.999333 0.990301 571.088989 274 -1 0 2 0.998706 0.500000 0.078023 1 0.999333 0.990301 0.978084 471.361205			T	132	0.914518			+ T			571.088989
S31	1009	1	1 i	132	0.914618	0.500000	0.064521		0.999353	0.980301	571.088989
1285 I 132 0.914518 0.500000 0.084521 1 0.999833 0.980001 571,088989 924 -1 0 2 0.989708 0.500000 0.029023 1 0.999833 1.000000 22.416901 Mean val 108.9 0.929547 0.500000 0.088488 1.08 0.999801 0.978084 471,361205	631			132	0.914618	0.300000	0.064521		0.998706		571.088989
924 -1 0 2 0.998706 0.500000 0.029023 1 0.999383 1.000000 22.416901 Mean val 108.9 0.929547 0.500000 0.058486 1.08 0.999301 0.978084 471.361205	1475			132		0.500000		+ 1	0.999353	0.980301	371.088989
		·Ī	1 0			0.500000	0.029023	T	0.999353	1.000000	22.416901
										0.978084	
	Ц		1 2rd devi	37.6	1 0.024297		U.UU9787	1 0.27	_ A.MANT 10	, 0.00-300	104.014.008

Table E.5: Results for Benchmark S1488

	= 11b = 41								
Ele Inp_	g length = 64	N.PO	FEI	Rest.1	Tim.Str.	N.Sg	FE2	Resl_2	Tim,Furt
1100 -1	- 6	18	0.988447	0.500000	0.033655		0.999358	0.918457	88.621002
1331 -1	0	18	0.988447	0.500000	0.033655	2	0.998716	0.918457	86.621002
1359 -1		18	0.988447 0.988447	0.500000	0.033888 0.033888	- 2	0.998716 0.999358	0.918457	86.621002 86.621002
1369 1	1	18	0.988447	0.500000	0.033688	÷	0.999358	0.918457	88.621002
1258 0	 î - -	18	0.988447	0.500000	0.033655		0.999358	0.918487	86.521002
1258 2	1	18	0.988447	0.500000	0.033655		0.999358	0.918457	88.821002
1100 1		18	0.988447 0.988447	0.500000	0.033655	+	0.999358 0.998716	0.918457 0.918457	86.621002 86.621002
1422 -1 635 -1	8	- 18	0.956354	0.300000	0.046545	-i- -	0.999358	0.981992	328.158997
760 -1	- ŏ	- 68	0.956354	0.500000	0.046545		0.999358	0.981992	328.158997
1335 -1	0	68	0.956354	0.500000	0.046545		0.999358	0.981992	328.158997
1410 -1	0	58	0.986354 0.986354	0.500000	U.U46545 U.U46545		0.998716 0.999358	0.981992 0.981992	328.158997 328.158997
1278 0	1	88 88	0.956354	0.500000	0.046845	- i -	0.999358	0.981992	328.158997
663 I	 	68	0.956354	0.500000	0.046545	1	0.999358	0.981992	328.158997
1410 2	Ü	68	0.956354	0.500000	0.046545		0.999358	0.981992	328.158997
1379 1		68	0.956354	0.500000	0.046545	-	0.999358	0.981992	328.158997 328.158997
1091 0		68	U.956354 U.956354	0.500000	0.046545		0.990358	0.981992	328.158997
1243 0	 i 	68	0.956354	0.500000	0.046545	-	0.999358	0.981992	328.158997
1243 2	i	68	0.955354	0.500000	0.046545		0.999358	0.981992	328.158997
671 0	1	68	0.958354	0.500000	U.046545		0.999358	0.981992	328.158997 328.158997
1198 1	0	68 68	U.958354 U.958354	0.500000	0.048545	- i -	0.999358	0.981992	328.158997
1055 1	0	68	0.956354	0.500000	0.046545	i	0.999358	0.981992	328.158997
1261 1	1	68	0.955354	0.500000	0.046845	i	0.999358	0.981992	328.158997
646 0		68	0.986354	0.500000	U.U46545 U.U46545		0.999358	0.981992 0.981992	328.158997 328.158997
1137 1	8 -	68	U.958354 U.958354	0.500000	0.046545		0.999358	0.981992	328.158997
1105	 ĭ 	58	0.956354	0.500000	0.045545	 i 	0.999358	0.981992	328,158997
1262 0	<u> </u>	68	0.388354	0.500000	0.046545		0.999358	0.981992	328.158997
1206 0	0	58	0.986354	0.500000	0.046545	H	0.999358	0.981992	328.158997 328.158997
1206 2	9-	58 58	0.956354	0.500000	0.046545	 	0.999358	0.981992	328.158997
713 1	 0	68	0.956354	0.500000	0.046545	□i	0.999358	0.981992	328.158997
1263 0	11	68	0.956354	0.500000	0.048848		0.999358	0.981992	328.158997
1175 0	0	68	0.956354	0.500000	U.U46545 U.U46545	-	0.999358	0.981992	328.158997 328.158997
1018 1	+ + -	58	0.956354	0.500000	0.046545	 i 	0.999358	0.981992	328.158997
1104 0	1 1	68	0.956354	0.500000	0.046545		0.999358	0.981992	328.158997
635 0	1	68	0.956354	0.500000	0.046545	1 1	0.999358	0.981992	328.158997 328.158997
1428 -1 911 -1	0	68	0.956354	0.500000	0.048848	 	0.998715	1.000000	17.081100
625 -1	+ - 6	75	0.951861	0.499222	0.049122	l i	0.999358	0.976273	357.023010
701 -1	Ŏ	75	0.951861	0.499222	1 0.049122		0.999358	0.976273	357.023010
1187 -1	0	75	0.951861	0.499222	0.049122	1 1	0.999358 0.999358	0.976273	357.023010 357.023010
1324 -1 1513 -1	0	75	0.951861	0.499222	0.049122	 	0.998716	0.976273	357.023010
1390 0	+	75	0.951861	0.499222	0.049122	1 1.	0.999358	0.976273	357.023010
1333 0	0	75	0.951861	0.499222	0.049122		0.999358	0.975273	357.023010
1333 1	0	75	0.951861	0.499222	0.049122		0.999358	0.976273	357.023010 357.023010
1260 1	+ + -	1 18	0.951861	0.400222	0.049122	 •	0.999358	0.976273	357.023010
1068 0	 	75	0.951861	0.499222	0.049122		0.999358	0.976273	357.023010
1205 1	0	75	0.951861	0.499222	0.049122		0.999358	0.976273	357.023010 357.023010
1089 1	+	75 75	0.951861	0.499222	0.049122	 	0.999358	0.976273	357.023010
1492 0	 	75	0.951861	0.499222	0.049122	1	0.999358	0.976273	357.023010
1385		75	0.981861	0.499222	0.049122		0.999358	0.976273	357.023010
1315 1		75	0.951861	0.499222	0.049122	\vdash	0.999358	0.976273 0.976273	357.023010
1488 0	+	75	0.951861	0.499222	0.049122	l ì	0.999358	0.976273	357.023010
1448 0	 - i -	75	0.951861	0.499222	0.049122	1 1	0.999358	0.975273	357.023010
1119 1		75	0.951861	0.499222	0.049122		0.999358	0.976273	357.023010
1119 3	1	75	0.951861	0.499222 0.499222	0.049122	7	0.998716	0.976273	357.023010
781 I	0	75	0.951861	0.499222	0.049122	 	0.999358	0.976273	357.023010
1431 0	- i - i i	75	0.951861	0.499222	0.049122		0.999358	0.976273	357.023010
1391 0	0	75	0.951861	0.499222	0.049122	1	0.999388	0.976273	357.023010 357.023010
1101 1	0	75	0.951861	0.499222	0.049122	++	0.999358	0.976273	357.023010
1349 - 1	 Y	75	0.951881	0.499222	0.049122	 i	0.999358	0.976273	357.023010
1324 0	Ō	75	0.951861	0.499222	0.049122	1	0.999358	0.975273	357.023010
1003		75	0.951861	0.499222	0.049122	1 -1 -	0.999358	0.976273	357.023010
1249 0 1038 0	1	75	0.951861	0.499222	0.049122	+ +-	0.999358	0.976273	357.023010
1037 0	 	75	0.951881	0.499222	0.049122	<u> </u>	0.999358	0.976273	357.023010
526 U	<u> </u>	75	0.951881	0.499222	0.049122		0.999358	0.976273	357.023010
625 0	1	75	0.951851	0.499222	0.049122	1	0.999358	0.976273	357.023010
1518 -1 589 -1	- 8	1 75 B	0.994865	0.559300	0.030207	 1	0.999358	1.000000	313.998993
55 -1	 ĭ 	8	0.994865	0.559300	0.030207	<u>Li</u>	0.999358	1.000000	313.998993
95 -1	J I	8	0.994868	0.559300	0.030207		0.999358	1.000000	313.998993
131 -1	1 1	8	0.994865	0.559300	0.030207	\Box	0.999358	1.000000	313,998993
223 -1	+ i -	+ 8 -	0.994865	0.559300	0.030207	 i	0.999358	1.000000	313.998993
272 -1	<u> </u>	8	0.994865	0.559300	0.030207	1	U.99935B	1.000000	313.998993
644 -1	0	84	0.948085	0.500000	0.050605	1	0.999358	0.979461	405.203003
1131 -1	0	84	0.946085 0.946085	0.500000	0.050605	T T	0.999358	0.979461	405.203003
1452 -1	+ - 8	84	0.946085	0.500000	0.050605	1 2	0.998715	0.979461	405.203003
1283 0	<u> </u>	84	0.946085	0.500000	0.050605	1	0.999358	0.979461	405.203003
1283 2		84	0.945085	0.500000	0.050605	T 1	0.999358	0.979461	405.203003
1034 0 1185 1	1 6	84	0.948085	0.500000	0.050605	+ i	0.999358	0.979461 0.979461	405.203003
1035 1	+ i	84	0.948085	0.500000	0.050605		0.999358	0.979461	405.203003
1438 0	<u> </u>	84	0.946085	0.500000		I	0.999358	0.979461	405.203003
1407 0	0	84	0.946085	0.500000	0.050605	1	0.999358	0.979461	405.203003
1372 1							0.999300	0.975295	322.243564
	Std devi	63.1 21.9	0.959467	0.503863		0.30	0.000194	0.025112	110.209484

Table E.6: Results for Benchmark S1494

STARSON Leafing Epich SA	ETEREN	testine	Inneth - 84	K							
Test				N.PO T	FEI I	Rest_I	Tim.Str.	N.Sg		Rest.2	Tim,Furt
Test	763	- 17 +		- !!!	0.999938	1.000000	19.489799	1	0.999938		
1.	763		0	i		1.000000					
13 1	2460		-		0.999440		11.085400	4	0.999751	0.600000	
1313 -1			1		0.999440		11.085400	4	0.999751		019.34/9/4
3817 - 1			0		0.999440	0.486230	11.085400		0.999751		
1198 - 1					0.999440						A1G 547074
1198 - 1	3817				0.999440		11.000400				619.547974
11,000,000 10,					0.555440		11.000400	-1-	0.999751	0.500000	619.547974
909 -1 1 1					0.000440		11.0805400	1	0.999751		619.547974
1				7	0.999938			i			154.716003
1677	0000		- 6	- i -	0.999938		10.929200				154.716003
				- i	0.999938	1.0000000	10.964800		0.999938	1.0000000	157.031998
Test			- 0	1						1.000000	
12577 -1.	1817	-1								1.000000	
28777 1		-1								1.000000	
SART -1	2577		0			0.493549	11.215600	3		0.022094	
SART -1	2577				0.999067					0.022094	1079.000024
7476 -1 0 15 U990087 U493549 11.715800 8 U.99087 U.897354 U1974.880024	3441		9				11.213000			0.022384	1117U ASIRI7A
7476 -1			 				11 21 0000			0.672504	
BOSS								 ' -	0.9900.01	0.622594	1079.550024
B858					0.000007		11.215600	- i -		0.622594	1079.680024
9892 - 1							11.215600	1 3		I 622504	1079.650024
9802 -1 1 1 15			 i -		0.999067	0.493549	11.215600	- 8	0.999627	0.622594	1079.650024
9982 1 0 18 0.999087 0.483549 11.215800 4 0.99951 0.22594 (07):850074 982 1 1 15 0.999087 0.483549 11.215800 4 0.99951 0.22594 (07):850074 10007 1 0 18 0.999087 0.483549 11.215800 4 0.99951 0.22594 (07):850074 10007 1 1 1 18 0.999087 0.483549 11.215800 4 0.99951 0.22594 (07):850074 10007 1 1 1 18 0.999087 0.483549 11.21590 6 0.99951 0.22594 (07):850074 10007 1 1 1 18 0.999880 0.483649 11.277900 1 0.999888 0.597102 1252.579958 6 7474 1 1 1 18 0.998880 0.508950 11.277900 5 0.999688 0.597102 1525.579958 6 7474 1 1 1 18 0.998880 0.508950 11.277900 2 0.999817 0.697102 1525.579858 6 7474 1 1 1 18 0.998880 0.508950 11.277900 2 0.999817 0.697102 1525.579858 6 7474 1 1 1 18 0.998880 0.508950 11.277900 2 0.999817 0.697102 1525.579858 6 7474 1 1 1 18 0.998880 0.508950 11.277900 2 0.999817 0.697102 1525.579858 6 7474 1 1 1 18 0.998880 0.508950 11.277900 2 0.999817 0.697102 1525.579858 6 7474 1 1 1 18 0.998880 0.508950 11.277900 2 0.999817 0.697102 1525.579858 6 7474 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1			- i -		0.999057	0.493549			0.999751	0.622594	1079.550074
9862 1 1 1 5 C.990057 C.432549 11.275500 4 C.999751 C.522594 (CP)-850024 (CP)-			- 0		0.999087	0.493549	11.215600		0.999627	0.622594	1079.650024
TODION 1	9962		- i	15	0.999057	0.493549	11.215600			0.622594	1079.650024
10002	10002		0	15		0.493549	11.215600		0.999627	0.622594	1079.650024
2778					0.999067	0.493549					
SAT74	2726		0						0.999938		
6474 1 1 18 0.998880 0.508950 11.277900 2 0.999876 0.697102 1526.579586 6474 1 1 18 0.998880 0.508950 11.277900 2 0.999876 0.697102 1526.579586 6474 1 1 1 18 0.998880 0.508950 11.277900 2 0.999876 0.697102 1526.579586 6477 1 1 1 18 0.998880 0.508950 11.277900 2 0.999876 0.697102 1526.579586 6477 1 1 1 18 0.998880 0.508950 11.277900 2 0.999876 0.697102 1526.579586 6477 1 1 1 18 0.998880 0.508950 11.277900 2 0.999876 0.697102 1526.579586 6477 1 1 1 18 0.998880 0.508950 11.277900 2 0.999876 0.697102 1526.579586 6479 1 1 18 0.998880 0.508950 11.277900 2 0.999876 0.697102 1526.579586 6479 1 1 18 0.998880 0.508950 11.277900 2 0.999876 0.697102 1526.579586 6478 1 1 18 0.998880 0.508950 11.277900 3 0.999876 0.697102 1526.579586 6478 1 1 18 0.998880 0.508950 11.277900 3 0.998876 0.697102 1526.579586 6477 0 1 1 18 0.998880 0.508950 11.277900 3 0.998876 0.697102 1526.579586 6477 1 1 1 18 0.998880 0.508950 11.277900 3 0.998876 0.697102 1526.579586 6477 1 1 1 18 0.998880 0.508950 11.277900 3 0.998876 0.697102 1526.579586 6477 1 1 1 18 0.998880 0.508950 11.277900 3 0.998878 0.697102 1526.579586 6477 1 1 1 18 0.998880 0.508950 11.277900 3 0.998813 0.697102 1526.579586 6477 1 1 1 18 0.998880 0.508950 11.277900 3 0.99881 0.697102 1526.579586 6477 1 1 1 18 0.998880 0.508950 11.277900 3 0.998880 0.598702 1526.579586 6477 1 1 1 18 0.998880 0.508950 11.277900 3 0.999880 0.598702 1526.579586 75395 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1			T						0.200033		
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Table	5477	-0-	1						0.999876		
Table	6477		1		0.998880				0.999813		
Tobal	7339								0.999689	0.097102	1520.579900
TOOL							11.277900		0.999751		
1	7509		0							0.097102	1826 K700KA
1			<u> </u>							0.097102	1828 570058
7823 1 0 10 0.999378 0.500000 11.103500 5 0.999889 0.388992 783.484985 7	9923								1 GOORKO	0.697102	1525.579956
Test					11 QUQ378		13.103500				
3487 -1					0.99937N						763.484985
Teach Teac							11.103500	5	0.999889		763.484985
3350	3487				0.999378	0.500000	11.103500				
3550			- 0	10	0.999378	0.500000	11.103500				
1094 1	3550	-1		10			11.103500				753.484985
Fig.									0.999689	0.588592	703.484985
Fig. 2					0.999378	0.500000			0.999999		783.484965 783.48409k
Total	6926										783 AHAUNA
7770 -1					0.303378		11.100000				762.86984K
SU24	2750						11.100000		O. OROBORO		762.869995
3074 -1					11 000372						762.869995
3634 -1				l iň						0.588592	762.869995
3834 -									0.999689	0.588592	762.869995
4100 -1 0 10 0.999378 0.500000 11.100600 5 0.999689 0.588392 762.869995 6400 -1 1 1 10 0.999378 0.500000 11.100600 5 0.999689 0.588392 762.869995 6400 -1 1 1 10 0.999378 0.500000 11.100600 5 0.999689 0.588392 762.869995 6400 -1 1 1 10 0.999378 0.500000 11.100600 5 0.999689 0.588392 762.869995 2600 -1 1 1 1 10 0.999378 0.500000 11.100600 5 0.999689 0.588392 762.869995 2600 -1 1 1 1 0 0.999340 0.488230 14.358800 4 0.999751 0.500000 1310.899951 2600 -1 1 1 9 0.999440 0.488230 14.358800 4 0.999751 0.500000 1310.899951 2600 -1 1 1 9 0.999440 0.488230 14.358800 4 0.999751 0.500000 1310.899851 2600 -1 1 1 9 0.999440 0.488230 14.358800 4 0.999751 0.500000 1310.899851 2600 -1 1 1 9 0.999440 0.488230 14.358800 4 0.999751 0.500000 1310.899851 2600 -1 1 1 9 0.999440 0.488230 14.358800 4 0.999751 0.500000 1310.899851 2610 -1 1 9 0.999440 0.488230 14.358800 4 0.999751 0.500000 1310.899851 2610 -1 1 9 0.999440 0.488230 14.358800 4 0.999751 0.500000 1310.899851 2610 -1 1 9 0.999440 0.488230 14.358800 4 0.999751 0.500000 1310.899851 2610 -1 1 9 0.999440 0.488230 14.358800 4 0.999751 0.500000 1310.899851 2610 -1 1 9 0.999440 0.488230 14.358800 4 0.999751 0.500000 1310.899851 2610 -1 1 9 0.999440 0.488230 14.358800 4 0.999751 0.500000 1310.899851 2610 -1 1 9 0.999440 0.488230 14.358800 4 0.999751 0.500000 1310.899851 2610 -1 1 9 0.999440 0.488230 14.358800 4 0.999751 0.500000 1310.899851 2610 -1 1 9 0.999440 0.488230 14.358800 4 0.999751 0.500000 1310.899851 2610 -1 1 1 9 0.999440 0.488230 14.358800 4 0.999751 0.500000 1310.899851 2610 -1 1 1 9 0.999440 0.488230 14.358800 4 0.999751 0.500000 1310.899851 2610 -1 1 1 9 0.999440 0.488230 14.358800 4 0.999751 0.500000 1310.899851 2610 -1 1 1 9 0.999440 0.488230 14.358800 4 0.999751 0.500000 1310.899851 2610 -1 1 1 9 0.999440 0.488230 14.358800 4 0.999751 0.500000 1310.899851 2610 -1 1 1 9 0.999440 0.488230 14.358800 4 0.999751 0.500000 1310.899851 2610 -1 1 1 9 0.999440 0.488230 14.358800 4 0.999751 0.500000 1310.899851 2610 -1 1 1 9 0.999440 0.488230 14.358800 4 0.999752 0.500000 13					0.999378	0.500000	11.100600	5	0.999689		762.869995
## 100 -1 1 10 0.999378 0.500000 11.100800 5 0.999689 0.588592 762.869995 638872 1 0 10 0.999378 0.500000 11.100800 5 0.999689 0.588592 762.869995 638872 1 1 10 0.999378 0.500000 11.100800 5 0.999689 0.588592 762.869995 2462 -1 1 0 9 0.999440 0.486230 14.358800 4 0.999751 0.500000 1310.899951 2462 -1 1 9 0.999440 0.486230 14.358800 4 0.999751 0.500000 1310.899951 3146 -1 0 9 0.999440 0.486230 14.358800 4 0.999751 0.500000 1310.899851 3146 -1 0 9 0.999440 0.486230 14.358800 4 0.999751 0.500000 1310.899851 3146 -1 1 9 0.999440 0.486230 14.358800 4 0.999751 0.500000 1310.599851 3819 -1 0 9 0.999440 0.486230 14.358800 4 0.999751 0.500000 1310.599851 3819 -1 0 9 0.999440 0.486230 14.358800 4 0.999751 0.500000 1310.599851 3819 -1 1 9 0.999440 0.486230 14.358800 4 0.999751 0.500000 1310.599851 4202 -1 0 9 0.999440 0.486230 14.358800 4 0.999751 0.500000 1310.599851 4202 -1 1 9 0.999440 0.486230 14.358800 4 0.999751 0.500000 1310.599851 4202 -1 1 9 0.999440 0.486230 14.358800 4 0.999751 0.500000 1310.599951 4202 -1 1 9 0.999440 0.486230 14.358800 4 0.999751 0.500000 1310.599951 4202 -1 1 1 9 0.999440 0.486230 14.358800 4 0.999751 0.500000 1310.599951 4202 -1 1 1 9 0.999440 0.486230 14.358800 4 0.999751 0.500000 1310.599951 4202 -1 1 1 9 0.999440 0.486230 14.358800 4 0.999751 0.500000 1310.599951 4202 -1 1 1 9 0.999440 0.486230 14.358800 4 0.999751 0.500000 1310.599951 4202 -1 1 1 9 0.999440 0.486230 14.358800 4 0.999751 0.500000 1310.599951 4202 -1 1 1 9 0.999440 0.486230 14.358800 4 0.999751 0.500000 1310.599951 4202 -1 1 1 9 0.999440 0.486230 14.358800 4 0.999751 0.500000 1310.599951 4202 -1 1 1 0 9 0.999440 0.486230 14.358800 4 0.999751 0.500000 1310.599951 4202 -1 1 1 0 9 0.999440 0.486230 14.358800 4 0.999751 0.500000 1310.599951 4202 -1 1 1 0 9 0.999550 0.569554 11.703672 3.82 0.999762 0.667054 995.284957					0.999378	0.500000	11.100600	3_	0.999689		752.859995
9882 -1 1 10 0.99978 0.500000 11.100600 5 0.990889 0.588592 762.889995 2462 -1 0 9 0.999440 0.486230 14.358800 4 0.999751 0.500000 1310.899851 2462 -1 1 9 0.999440 0.486230 14.358800 4 0.999751 0.500000 1310.899851 3146 -1 0 9 0.999440 0.486230 14.358800 4 0.999751 0.500000 1310.899851 3146 -1 0 9 0.999440 0.486230 14.358800 4 0.999751 0.500000 1310.899851 3146 -1 1 9 0.999440 0.486230 14.358800 4 0.999751 0.500000 1310.899851 3519 -1 0 9 0.999440 0.486230 14.358800 4 0.999751 0.500000 1310.899851 3519 -1 0 9 0.999440 0.486230 14.358800 4 0.999751 0.500000 1310.899851 3519 -1 1 9 0.999440 0.486230 14.358800 4 0.999751 0.500000 1310.899851 4202 -1 0 9 0.999440 0.486230 14.358800 4 0.999751 0.500000 1310.899851 4202 -1 1 9 0.999440 0.486230 14.358800 4 0.999751 0.500000 1310.899851 4202 -1 1 9 0.999440 0.486230 14.358800 4 0.999751 0.500000 1310.899851 4202 -1 1 1 9 0.999440 0.486230 14.358800 4 0.999751 0.500000 1310.899851 4202 -1 1 1 9 0.999440 0.486230 14.358800 4 0.999751 0.500000 1310.899851 4202 -1 1 1 9 0.999440 0.486230 14.358800 4 0.999751 0.500000 1310.899851 4202 -1 1 1 9 0.999440 0.486230 14.358800 4 0.999751 0.500000 1310.899851 4202 -1 1 1 9 0.999440 0.486230 14.358800 4 0.999751 0.500000 1310.899851 4202 -1 1 1 9 0.999440 0.486230 14.358800 4 0.999751 0.500000 1310.899851 4202 -1 1 1 9 0.999440 0.486230 14.358800 4 0.999751 0.500000 1310.899851 4202 -1 1 1 0 9 0.999440 0.486230 14.358800 4 0.999751 0.500000 1310.899851 4202 -1 1 1 0 9 0.999440 0.486230 14.358800 4 0.999751 0.500000 1310.899851 4202 -1 1 1 0 9 0.999440 0.486230 14.358800 4 0.999751 0.500000 1310.899851 4202 -1 1 1 0 9 0.999440 0.486230 14.358800 4 0.999751 0.500000 1310.899851 4202 -1 1 1 0 9 0.999440 0.486230 14.358800 4 0.999751 0.500000 1310.899851 4202 -1 1 1 0 9 0.999555 0.569594 11.703672 3.82 0.999762 0.667054 995.284957	4100		1	10			11.100800				
2482 -1			0						0.999689		/62.86VV95
2482 -1 1 9 0.999440 0.488230 14.38800 4 0.999751 0.500000 1310.599951 3145 -1 1 9 0.999440 0.488230 14.38800 4 0.999751 0.500000 1310.599951 3145 -1 1 9 0.999440 0.488230 14.388800 4 0.999751 0.500000 1310.599951 3319 -1 0 9 0.999440 0.488230 14.358800 4 0.999751 0.500000 1310.599951 3319 -1 1 9 0.999440 0.488230 14.358800 4 0.999751 0.500000 1310.599951 4202 -1 0 9 0.999440 0.488230 14.358800 4 0.999751 0.500000 1310.599951 4202 -1 1 9 0.999440 0.488230 14.358800 4 0.999751 0.500000 1310.599951 4202 -1 1 9 0.999440 0.488230 14.358800 4 0.999751 0.500000 1310.599951 4202 -1 1 1 9 0.999440 0.488230 14.358800 4 0.999751 0.500000 1310.599951 4202 -1 1 1 9 0.999440 0.488230 14.358800 4 0.999751 0.500000 1310.599951 4202 -1 1 1 9 0.999440 0.488230 14.358800 4 0.999751 0.500000 1310.599951 4202 -1 1 1 9 0.999440 0.488230 14.358800 4 0.999751 0.500000 1310.599951 4202 -1 1 1 9 0.999440 0.488230 14.358800 4 0.999751 0.500000 1310.599951 4202 -1 1 1 9 0.999440 0.488230 14.358800 4 0.999751 0.500000 1310.599951 4202 -1 1 1 9 0.999440 0.488230 14.358800 4 0.999751 0.500000 1310.599951 4202 -1 1 1 9 0.999440 0.488230 14.358800 4 0.999751 0.500000 1310.599951 4202 -1 1 1 9 0.999440 0.488230 14.358800 4 0.999751 0.500000 1310.599951 4202 -1 1 1 9 0.999440 0.488230 14.358800 4 0.999751 0.500000 1310.599951 4202 -1 1 1 9 0.999440 0.488230 14.358800 4 0.999751 0.500000 1310.599951 4202 -1 1 1 9 0.999440 0.488230 14.358800 4 0.999751 0.500000 1310.599951 4202 -1 1 1 9 0.999440 0.488230 14.358800 4 0.999751 0.500000 1310.599951 4202 -1 1 1 9 0.999440 0.488230 14.358800 4 0.999751 0.500000 1310.599951 4202 -1 1 1 9 0.99940 0.488230 14.358800 4 0.999751 0.500000 1310.599951 4202 -1 1 1 9 0.99940 0.488230 14.358800 4 0.999751 0.500000 1310.599951 4202 -1 1 1 9 0.99940 0.488230 14.358800 4 0.999751 0.500000 1310.59951 4202 -1 1 1 1 9 0.99940 0.488230 14.358800 4 0.999751 0.500000 1310.59951 4202 -1 1 1 1 9 0.99940 0.488230 14.35880 4 0.999751 0.500000 1310.59951 4202 -1 1 1 1 9 0.99940 0.488230 14.35880 4 0.999751 0.500000 1310.5995					0.999378						
2402 1			0		0.999440						
3145 -1 1 9 0.999440 0.488230 14.358800 4 0.999751 0.600000 1310.699951 3819 -1 0 9 0.999440 0.488230 14.358800 4 0.999751 0.600000 1310.699951 3819 -1 1 9 0.999440 0.488230 14.358800 4 0.999751 0.600000 1310.699951 4202 -1 0 9 0.999440 0.488230 14.358800 4 0.999751 0.600000 1310.699951 4202 -1 1 9 0.999440 0.488230 14.358800 4 0.999751 0.600000 1310.699951 4202 -1 1 9 0.999440 0.488230 14.358800 4 0.999751 0.600000 1310.699951 1310.69951 1310.699951 1310.69951 1310.69951 1310.69951 1310.69951 1310.69951 1310.69951 1310.69951 1310.69951 1310.69951 1310					0.999440		14.358800				
3310								+		1 O'DOTOOO	
3819 -1 1 9 0.999440 0.488230 14.358800 4 0.999751 0.800000 1310.699951 4202 -1 0 9 0.999440 0.488230 14.358800 4 0.999751 0.800000 1310.899951 4202 -1 1 9 0.999440 0.488230 14.358800 4 0.999751 0.800000 1310.899951 0.800000 1310.899951 0.800000 1310.899951 0.800000 1310.899951 0.800000 1310.899951 0.800000 1310.899951 0.800000 1310.899951 0.800000 1310.899951 0.800000 1310.899951 0.800000 1310.899951 0.8000000 0.80000000 0.80000000 0.80000000 0.80000000 0.80000000 0.80000000 0.80000000 0.8000000 0.80000000 0.8000000 0.8000000 0.8000000 0.8000000 0.80000000 0.8000000 0.8000000 0.80000000 0.8000000 0.80000000 0.80000000 0.80000000 0.80000000000					0.999440	U.450230		+ -	1 0.3555/31	0.000000	
1					0.555540			++			
4202 -1 1 9 0.999440 0.488230 14.338800 4 0.999751 0.600000 1310.699951					0.99940						
Mean val 11.8 0.999265 0.549594 11.703672 3.82 0.999762 0.567084 995.284957					1 0.555-10			+ 7		0.600000	1310.699981
Middle And 121'0 Granded I discussed 1 Street	1404	<u> </u>						+			
Std devi 5.1 U.UUUSZU U.153401 1.604618 1.51 U.UUUU94 U.121014 431.396767											
			Std devi	5.1	0.000320	U.153451	1 1.004618	1.51	1 0.000094	1 0.121014	1 401.980101

Table E.7: Results for Benchmark S15850

Section SA S.P. O	S208.	testing	length = 5	IK.							
THAT	Ele		SA	N.PO	PEI	Rest_1	Tim.Str.	N.Sg			Tim,Furt
Text Text	194				0.949772				0.990868		
10					0.949772	0.508910	0.006802	7	0.990868	0.814897	39.754398
Text Text	210	0	Ü		0.949772			7	0.990868	0.814897	39.754398
1	194		1		0.949772			├-┼-	0.998434		39.754398
Tell	218				0.949772			1 2		0.814897	39.754398
1	218		1	11	0.949772				0.995434	0.814897	39.754398
Title					0.949772			 	0.995434	U.514597	39.754398
1	21R				0.949772				0.990888	0.814897	39.754398
1.	218		Ö		0.949772	0.508910	0.006802			0.814897	39.754398
155	143		0		0.940639		0.006908	\Box	0.995434	0.924957	39.750198
203	143		 		0.940039		0.006908	⊢ i −	0.995434		39.750198
183 0 1 3 0 14000 0 149075 0.000008 1 0.000008 0.071077 1770708 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	203				0.940839	0.492075	0.006908	i	0.995434	0.924957	39.750198
183								Ţ	0.995434	0.924987	
15		0			0.940639	0.492075	0.006908	 		0.924957	
181 1 1 1 1 1 1 1 1 1	161	 6						-i-	0.995434	0.924957	39.750198
159 T 0 0 13 0.540839 0.409079 0.009088 2 0.090888 1 0.994887 39.759188 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	161	1	0	13	0.940639	0.492075			0.995434		39.750198
1	161				0.940639		0.006908	1 - 1 -	0.995434	0.924957	39.750198
1		 			0.940639		0.006908	⊢ i −	0.995434		39.750198
87 -1 0 101 0.358813 0.43875 0.008818 1 0.09534 1.00000 288.77297 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	34	-1	ī	1	0.995434	1.000000	0.006396		0.995434	1.0000000	
87 - 1								\Box	0.998434		17.167900
131			0		U.538813	0.4930/3		 	0.995434		298.722992
187 - 1			 		0.538813	0.493675	0.008818	i	0.995434	1.000000	298.722992
10	137		1		0.538813	0.493875	0.008818				
2726							U.UU8818	 			298,722992
278 1					0.538813	0.493875	0.008818	i_	0.995434	1.0000000	298.722992
198 1	226	-1		101	0.538813	0.493675	0.008818	1			298.722992
198								 	0.995434	1.000000	295. (22992 208. 722902
198					0.538813	0.493675	0.008818	 i 	0.995434	1.0000000	298.722992
179	198	Ō	1 1	101	0.538813	0.493675	0.008818		0.995434	1.0000000	298.722992
TYPE					0.538813	0.493873		1	0.998434		296.722992 208.722002
179		 					0.008818	 i 	0.995434	1.000000	298.722992
102 0	179		ō	101	0.538813	0.493675	0.008818				298.722992
202 0					0.538813	0.493675	0.008818		0.995434		298.722992
196					0.538813	0.493075		! 		1.000000	298.722992
198		l ĭ			0.538813	0.493675	0.008818	1 1	0.995434	1.000000	298.722992
139	156		1						0.995434	1.000000	298.722992
1			 		0.538813	0.493675		∤− ौ−	0.995434		
1272					0.538813		0.008818	l i	0.995434	1.000000	298.722992
188	222	Ť	1	101	0.538813	0.493875	0.008818		1 0.995434		298.722992
185			0			0.493875			0.995434		
185	158		l i				0.008818	 i 	0.998434	1.000000	298.722992
138	155	0		101	0.538813	0.493675	0.008818	1	0.995434		
T.	155								0.998434	1.000000	298.722992 208.722002
201		 ' ''				0.493675			0.998434	1.000000	298.722992
197 I 101 0.538813 0.493875 0.008818 1 0.998434 1.000000 298.72399; 177 I 0 0 101 0.538813 0.493875 0.008818 1 0.998434 1.000000 298.72399; 177 I 0 0 101 0.538813 0.493875 0.008818 1 0.998434 1.000000 298.72399; 177 I 0 0 101 0.538813 0.493875 0.008818 1 0.998434 1.000000 298.72399; 272 I 101 0.538813 0.493875 0.008818 1 0.998434 1.000000 298.72399; 2719 0 0 101 0.538813 0.493875 0.008818 1 0.998434 1.000000 298.72399; 2719 1 0 101 0.538813 0.493875 0.008818 1 0.998434 1.000000 298.72399; 178 1 0 101 0.538813 0.493875 0.008818 1 0.998434 1.000000 298.72399; 198 0 1 101 0.538813 0.493875 0.008818 1 0.998434 1.000000 298.72399; 198 1 1 101 0.538813 0.493875 0.008818 1 0.998434 1.000000 298.72399; 198 1 1 101 0.538813 0.493875 0.008818 1 0.998434 1.000000 298.72399; 178 0 0 0 101 0.538813 0.493875 0.008818 1 0.998434 1.000000 298.72399; 178 1 0 0 101 0.538813 0.493875 0.008818 1 0.998434 1.000000 298.72399; 178 1 0 0 101 0.538813 0.493875 0.008818 1 0.998434 1.000000 298.72399; 178 1 0 0 101 0.538813 0.493875 0.008818 1 0.998434 1.000000 298.72399; 178 1 0 0 101 0.538813 0.493875 0.008818 1 0.998434 1.000000 298.72399; 178 1 0 0 101 0.538813 0.493875 0.008818 1 0.998434 1.000000 298.72399; 179 0 0 101 0.538813 0.493875 0.008818 1 0.998434 1.000000 298.72399; 170 0 101 0.538813 0.493875 0.008818 1 0.998434 1.000000 298.72399; 170 0 101 0.538813 0.493875 0.008818 1 0.998434 1.000000 298.72399; 170 0 101 0.538813 0.493875 0.008818 1 0.998434 1.000000 298.72399; 170 0 101 0.538813 0.493875 0.008818 1 0.998434 1.000000 298.72399; 170 0 101 0.538813 0.493875 0.008818 1 0.998434 1.000000 298.72399; 170 1 0 101 0.538813 0.493875 0.008818 1 0.998434 1.000000 298.72399; 170 1 0 101 0.538813 0.493875 0.008818 1 0.998434 1.000000 298.72399; 171 1 0 101 0.538813 0.493875 0.008818 1 0.998434 1.000000 298.72399; 171 1 0 101 0.538813 0.493875 0.008818 1 0.998434 1.000000 298.72399; 171 1 1 101 0.538813 0.493875 0.008818 1 0.998434 1.000000 298.72399; 171 1 1 101 0.538813 0.493875 0.008818 1 0.998434 1.000000 298.72399; 172 1 1 10	211			101	0.538813	0.493675	0.008818	1	0.995434	1.0000000	298.722992
177		0			0.538813	0.493675		T -			
177		 	 					 	0.995434	1.000000	298.722992
177 2		1 1			0.538813	0.493675		 	0.005434	1.000000	298.722992
219 0	177		0		0.538813	0.493675	0.008818		0.998434	1.000000	
Text	710		T		0.538813 0.538813			+-+	0.995434		
195		1		101	0.538813	0.493875	0.008818	1 i	0.998434	1.000000	298.722992
178	195	Ü	1	101	0.538813	0.493675	0.008818	1	0.995434	1.000000	298.722992
178	195	1	1 7		0.538813	0.493675	0.008818	+ - 1			
Total						0.493675	0.008818		0.998434	1.0000000	298.722992
162 1	208	Ŏ	1	101	0.538813	0.493875	0.008818		0.995434	TOTAL	298.722992
132 0		1 0			0.538813	0.493875	0.008818	+ +	0.995434	1 LUUUUUU	
132 1	132	1 6			0.538813	0.493675	0.008818	 i 	0.995434	1.000000	298.722992
201 0	132			101	0.538813	0.493873	0.008818		0.995434	1.000000	298.722992
201 0			1 1					+	0.995434	1.00000	298.722992
176 0				1 101 T	0.538813	0.493875		 i 	0.998434	1.000000	298.722992
180	176		Ü	101	0.538813	0.493675	0.008818	11	0.995434	1.000000	298.722992
TIT 0		1			0.538813	0.493875	0.008818	+	0.995434	1.000000	298.722992
11			 		0.538813	0.493675	0.008818	+ i	0.998434	1.000000	298.722992
131 Y	111		<u> </u>	101	0.538813	0.493675	0.008818	Ī	0.995434	1.000000	298.722992
88 -1 1 1 101 0.538813 0.493875 0.008818 1 0.998434 1.000000 298.72299 88 -1 1 1 101 0.538813 0.493875 0.008818 1 0.998434 1.000000 298.72299 91 -1 1 101 0.538813 0.493875 0.008818 1 0.998434 1.000000 298.72299 97 -1 0 101 0.538813 0.493875 0.008818 1 0.998434 1.000000 298.72299 97 -1 1 101 0.538813 0.493875 0.008818 1 0.998434 1.000000 298.72299 97 -1 1 101 0.538813 0.493875 0.008818 1 0.998434 1.000000 298.72299 100 -1 0 101 0.538813 0.493875 0.008818 1 0.998434 1.000000 298.72299 100 -1 0 101 0.538813 0.493875 0.008818 1 0.998434 1.000000 298.72299 120 -1 1 101 0.538813 0.493875 0.008818 1 0.998434 1.000000 298.72299 120 -1 1 101 0.538813 0.493875 0.008818 1 0.998434 1.000000 298.72299 120 -1 1 101 0.538813 0.493875 0.008818 1 0.998434 1.000000 298.72299 120 -1 1 101 0.538813 0.493875 0.008818 1 0.998434 1.000000 298.72299 120 -1 1 101 0.538813 0.493875 0.008818 1 0.998434 1.000000 298.72299 120 -1 1 101 0.538813 0.493875 0.008818 1 0.998434 1.000000 298.72299 120 -1 1 101 0.538813 0.493875 0.008818 1 0.998434 1.000000 298.72299 120 -1 1 101 0.538813 0.493875 0.008818 1 0.998434 1.000000 298.72299 123 -1 1 101 0.538813 0.493875 0.008818 1 0.998434 1.000000 298.72299 123 -1 1 101 0.538813 0.493875 0.008818 1 0.998434 1.000000 298.72299 123 -1 1 101 0.538813 0.493875 0.008818 1 0.998434 1.000000 298.72299 123 -1 1 101 0.538813 0.493875 0.008818 1 0.998434 1.000000 298.72299 123 -1 1 101 0.538813 0.493875 0.008818 1 0.998434 1.000000 298.72299 123 -1 1 101 0.538813 0.493875 0.008818 1 0.998434 1.000000 298.72299 123 -1 1 101 0.538813 0.493875 0.008818 1 0.998434 1.000000 298.72299 123 -1 1 101 0.538813 0.493875 0.008818 1 0.998434 1.000000 298.72299 124 -1 1 101 0.538813 0.493875 0.008818 1 0.998434 1.000000 298.72299 125 -1 1 101 0.538813 0.493875 0.008818 1 0.998434 1.000000 298.72299			1			0.493675	0.008818				296.722992
10						0.493675	0.008818	+ i	0.995434	1.000000	298.722992
91 -1 0 101 0.538813 0.493875 0.008818 1 0.995434 1.000000 298.72299 97 -1 0 101 0.538813 0.493875 0.008818 1 0.995434 1.000000 298.72299 97 -1 0 101 0.538813 0.493875 0.008818 1 0.995434 1.000000 298.72299 100 -1 1 101 0.538813 0.493875 0.008818 1 0.995434 1.000000 298.72299 100 -1 1 101 0.538813 0.493875 0.008818 1 0.995434 1.000000 298.72299 100 -1 1 101 0.538813 0.493875 0.008818 1 0.995434 1.000000 298.72299 170 -1 1 101 0.538813 0.493875 0.008818 1 0.995434 1.000000 298.72299 170 -1 1 101 0.538813 0.493875 0.008818 1 0.995434 1.000000 298.72299 170 -1 1 101 0.538813 0.493875 0.008818 1 0.995434 1.000000 298.72299 170 -1 1 101 0.538813 0.493875 0.008818 1 0.995434 1.000000 298.72299 170 -1 1 101 0.538813 0.493875 0.008818 1 0.995434 1.000000 298.72299 170 -1 1 101 0.538813 0.493875 0.008818 0.995434 1.000000 298.72299 170 -1 1 101 0.538813 0.493875 0.008818 0.995434 1.000000 298.72299 170 -1 1 101 0.538813 0.493875 0.008818 0.995434 1.000000 298.72299 170 -1 1 0.0 0.538813 0.493875 0.008818 0.995434 1.000000 298.72299 170 -1 1 0.0 0.538813 0.493875 0.008818 0.995434 1.000000 298.72299 170 -1 1 0.0 0.538813 0.493875 0.008818 0.995434 1.000000 298.72299 170 -1 1 0.0 0.538813 0.493875 0.008818 0.995434 1.000000 298.72299 170 -1 1 0.0 0.538813 0.493875 0.008818 0.995434 1.000000 298.72299 170 -1 1 0.0 0.538813 0.493875 0.008818 0.995434 1.000000 298.72299 170 -1 1 0.0 0.538813 0.493875 0.008818 0.995434 1.000000 298.72299 170 -1 1 0.0 0.538813 0.493875 0.008818 0.995434 1.000000 298.72299 170 -1 1 0.0 0.538813 0.493875 0.008818 1 0.995434 1.000000 298.72299 170 -1 1 0.538813 0.493875 0.008818 1 0.995434 1.000000 298.72299	88	1 -1	Ť	101	0.538813	0.493575	0.008818	1 1	0.3645434	1.0000000	298.722992
97 -1 0 101 0.538813 0.493675 0.008818 1 0.996434 1.000000 298.72299 97 -1 1 101 0.538813 0.493675 0.008818 1 0.995434 1.000000 298.72299 100 -1 0 101 0.538813 0.493675 0.008818 1 0.995434 1.000000 298.72299 100 -1 1 101 0.538813 0.493675 0.008818 1 0.995434 1.000000 298.72299 120 -1 0 101 0.538813 0.493675 0.008818 1 0.995434 1.000000 298.72299 120 -1 1 101 0.538813 0.493675 0.008818 1 0.995434 1.000000 298.72299 120 -1 1 101 0.538813 0.493675 0.008818 1 0.995434 1.000000 298.72299 120 -1 1 101 0.538813 0.493675 0.008818 1 0.995434 1.000000 298.72299 120 -1 1 101 0.538813 0.493675 0.008818 1 0.995434 1.000000 298.72299 120 -1 1 101 0.538813 0.493675 0.008818 1 0.995434 1.000000 298.72299 123 -1 1 101 0.538813 0.493675 0.008818 1 0.995434 1.000000 298.72299 123 -1 1 101 0.538813 0.493675 0.008818 1 0.995434 1.000000 298.72299 123 -1 1 101 0.538813 0.493675 0.008818 1 0.995434 1.000000 298.72299 123 -1 1 101 0.538813 0.493675 0.008818 1 0.995434 1.000000 298.72299 123 -1 1 101 0.538813 0.493675 0.008818 1 0.995434 1.000000 298.72299 123 -1 1 101 0.538813 0.493675 0.008818 1 0.995434 1.000000 298.72299 123 -1 7 1 101 0.538813 0.493675 0.008818 1 0.995434 1.000000 298.72299 124 -1 7 101 0.538813 0.493675 0.008818 1 0.995434 1.000000 298.72299 125 -1 7 1 101 0.538813 0.493675 0.008818 1 0.995434 1.000000 298.72299								1	0.995434	1.000000	
97 -1 1 101 0.538813 0.493875 0.008818 1 0.995434 1.000000 298.72299 100 -1 0 101 0.538813 0.493575 0.008818 1 0.995434 1.000000 298.72299 100 -1 1 101 0.538813 0.493575 0.008818 1 0.995434 1.000000 298.72299 120 -1 0 101 0.538813 0.493575 0.008818 1 0.995434 1.000000 298.72299 120 -1 1 101 0.538813 0.493575 0.008818 1 0.995434 1.000000 298.72299 120 0 1 101 0.538813 0.493575 0.008818 1 0.995434 1.000000 298.72299 120 0 1 101 0.538813 0.493575 0.008818 1 0.995434 1.000000 298.72299 123 -1 0 101 0.538813 0.493575 0.008818 1 0.995434 1.000000 298.72299 123 -1 1 101 0.538813 0.493575 0.008818 1 0.995434 1.000000 298.72299 123 -1 1 101 0.538813 0.493575 0.008818 1 0.995434 1.000000 298.72299 123 -1 1 101 0.538813 0.493575 0.008818 1 0.995434 1.000000 298.72299 123 -1 1 101 0.538813 0.493575 0.008818 1 0.995434 1.000000 298.72299 123 -1 7 1 101 0.538813 0.493575 0.008818 1 0.995434 1.000000 298.72299 123 -1 7 7.5 0.645480 0.505438 0.008298 1.10 0.995434 1.000000 298.72299 123 -1 77.5 0.645480 0.505438 0.008298 1.10 0.995437 0.968782 230.93892					0.530013	0.493875		 	0.998434	1.000000	298.722992
100	97		1	101	0.538813	0.493675	0.008818	<u> </u>	0.995434	1.000000	298.722992
170	100		0	101	0.538813	0.493875	0.008818	+	0.995434	1.000000	298.722992
170			1 1		0.538813	0.493675		+-+		1.0000000	298.722992
101 0.538813 0.493675 0.008818 1 0.995434 1.000000 298.72299 170 1 1 101 0.538813 0.493675 0.008818 1 0.995434 1.000000 298.72299 173 -1 0 101 0.538813 0.493675 0.008818 1 0.995434 1.000000 298.72299 123 -1 1 101 0.538813 0.493675 0.008818 1 0.995434 1.000000 298.72299 123 -1 1 101 0.538813 0.493675 0.008818 1 0.995434 1.000000 298.72299 123 -1 1 101 0.538813 0.505438 0.008298 1.10 0.994977 0.968782 230.93892 1.10 0.994977 0.968782 230.93892 1.10 0.994977 0.968782 230.93892 1.10 0.994977 0.968782 230.93892 1.10 0.994977 0.968782 0.988782					0.538813	0.493575	0.008818		0.995434	1.000000	298.722992
123 -1 0 101 0.538813 0.493675 0.008818 1 0.995434 1.000000 298.72296 123 -1 1 101 0.538813 0.493675 0.008818 1 0.995434 1.000000 298.72296 123 -1 1 101 0.538813 0.008298 1.10 0.994977 0.968782 230.93892 1.10 0.994977 0.968782 230.93892	120	0		101	0.538813	0.493675	0.008818		0.995434	1.000000	298.722992
123 -1 1 101 0.538813 0.493675 0.008818 1 0.995434 1.000000 298.72299 Mean val 77.5 0.645480 0.505438 0.008298 1.10 0.994977 0.968782 230.93892			1					+	0.995434		798,777997
Mean val 77.5 0.645480 0.505438 0.008298 1.10 0.994977 0.968782 230.93892					0.538813	0.493675		+ +			298.722992
	=	1						1.10			230.938924
	\vdash	╅~~	Std devi	39.6							114.972910

Table E.8: Results for Benchmark S208

S27.	testing	length = 641								
Ele	anl	SA	N.PO	FEI	Restal	Tim.Str.	N.Sg	FE2	Rest_2	Tim, Furt
- 8	-1	0	14	0.562500	0.512337	0.004355	. 1	0.968750	0.907449	61.602200
8	-1		14	0.562500	0.512337	0.004358		0.988750	0.907449	61.602200
11	-1	0	14	0.562500	0.512337	0.004355		0.968750	0.907449	61.602200
\neg r	1 -1	1	14	0.562500	0.512337	0.004355	3	0.937800	0.907449_	61.602200
11	0	1_	14	0.552500	0.512337	0.004355	1	0.968750	0.907449	61.602200
$\overline{\Pi}$			14	0.562500	0.512337	0.004355	Ī	0.988750	0.907449	61.602200
14	-i-	0	14	0.562500	0.512337	0.004355		0.968750	0.907449	61.602200
14	-1-		14	0.582500	0.512337	0.004355		0.988750	0.907449	61.602200
21	-1	0	14	0.562500	0.512337	0.004355	2	0.937500	0.907449	61.602200
72	-1	1	14	0.562500	0.512337	0.004355		0.968750	0.907449	61.602200
72	0	0	14	0.552500	0.512337	0.004355	1	0.968750	0.907449	61.602200
- 21		1	14	0.582500	0.512337	0.004355		0.968750	0.907449	61.602200
- 20	-	0	14	0.562500	0.512337	0.004355	1	0.968750	0.907449	61.602200
20	1	-	14	0.552500	0.512337	0.004355	2	0.937500	0.907449	61.502200
14	6	- 0	14	0.562500	0.512337	0.004355	7	0.937500	0.907449	61.602200
14		0	14	0.562500	0.512337	0.004358		0.968750	0.907449	61.602200
18	1.	. 0	4	0.875000	0.500000	0.004514	1	0.968750	1.000000	9.476070
18	-1		4	0.875000	0.500000	0.004514	1	0.968750	1,000000	9.476070
18	0		4	0.875000	0.500000	0.004514	1	0.968750	1.0000000	9.476070
18			4	0.875000	0.500000	0.004514		0.968750	1.000000	9.476070
26	ा	9	2	0.937500	0.500000	0.004403		0.968750	1.000000	4.690810
26	-1		2	0.937500	0.500000	0.004403	1	0.968750	1.000000	4.590810
	1	Mean val	11.1	0.553409	0.508972	0.004388	1.18	0.963068	0.932690	45.950959
		Std devi	4.9	0.152761	0.005624	0.000062	0.39	0.012337	0.042189	24.518070

Table E.9: Results for Benchmark S27

	Lockin.	Teneds - 84								
S298,	Inp	length = 641	N.PO	FEL	Resi_1	Tim.Str.	N.Sg T	PE2	Resl_2	Tim,Furt
198		- 30		0.987500	0.500000	0.007672	7 2 1	0.993750	0.656667	14.181800
198		Ť		0.987500	0.500000	0.007672	7	0.993750	0.666667	14.181600
246	-1	- 6 -	4	0.987500_	0.300000	0.007672	2	0.993750	0.888887	14.181600
248	-1	i 		0.987500	0.500000	0.007672	2	0.993750	0.555557	14.181600
128		- 6 - 1	18	0.980000	0.500000	0.008427		0.996875	0.907449	118.709999
128	·i		18	0.950000	0.500000	0.008427		0.996875	0.907449	118.709999
270	-1	- 6 -	15	0.950000	0.500000	0.008427	2	0.993750	0.907449	118.709999
270	-	i	16	0.950000	0.500000	0.008427		0.996875	0,907449	118.709999
270	7		18	0.950000	0.500000	0.008427		0.996875	0.907449	T18.709999
270	-3	i 	16	0.930000	0.500000	0.008427		0.996875	0.907449	118.709999
129		Ö	16	0.980000	0.500000	0.008427	1	0.996875	0.907449	118.709999
129		ī	16	0.950000	0.500000	0.008427	2	0.993750	0.907449	118.709999
240	-1		16	0.950000	0.500000	0.008427		0.996875	0.907449	118.709999
240	-6-	Ü	16	0.950000	0.500000	0.008427		0.995875	0.907449	118.709999
T30	-	- ò	18	0.950000	0.500000	0.008427	7	0.993750	0.907449	118.709999
130	-1	- i	16	0.950000	0.500000	0.008427		0.996875	0.907449	118.709999
134	-1	- 6	16	0.950000	0.500000	0.008427		0.996875	0.907449	118.709999
134		i	16	0.950000	0.500000	0.008427		0.996875	0.907449	118.709999
137	-	- 0	16	0.950000	0.500000	0.008427	7	0.993750	0.907449	118.709999
137	1		15	0.950000	0.500000	0.008427		0.996875	0.907449	118.709999
184		0	14	0.956250	0.476061	0.008323		0.996875	0.863489	39.455002
184		ī	14	0.956250	0.476061	0.008323	2	0.993750	0.883489	39.455002
268			14	0.955250	0.476061	0.008323		0.996875	0.863489	39.455002
276	-1	ī	14	0.956250	0.476061	0.008323		0.996875	0.863489	39.455002
276	- 0	Ö	14	0.956250	0.476061	0.008323		0.996875	0.863489	39.455002
276		ő	14	0.956250	0.476061	0.008323		0.996875	0.863489	39.455002
218	1 0	ī	14	0.956250	0.476061	0.008323	2	0.993750	0.863489	39.455002
218	ī		14	0.956250	0.476061	0.008323	2	0.993750	0.863489	39.455002
268	1	1	14	0.956250	0.476061	0.008323	2	0.993750	11.863489	39.455002
1334	-1	0	14	C.956250	0.476061	0.008323		0.996875	0.863489	39.455002
194	-1		14	0.956250	0.476061	0.008323		0.996875	0.863489	39.455002
149	-1	-	13	0.989375	0.492075	0.009371		0.996875	0.924957	43.043999
149	-1	1	13	0.959375	0.492075	0.009371		0.996875	0.924957	43.043999
210	1		13	0.959375	0.492075	0.009371		0.996875	0.924957	43.043999
307	-ī	1	13	0.959375	0.492075	0.009371	1	0.995875	0.924957	43.043999
307	1	0	13	0.959375	0.492075	0.009371		0.996878	0.924957	43.043999
211	0		13	0.959375	0.492075	0.009371	1 2	0.993750	0.924957	43.043999
211	$\overline{}$		13	0.959375	0.492075	0.009371	1	0.995875	0.924957	43.043999
307	1 3	-	13	0.959375	0.492075	0.009371		U.996875	0.924957	43.043999
212	0		13	0.959375	0.492075	0.009371	2	0.993750	0.924957	43.043999
212			13	0.959375	0.492075	0.009371		0.995875	0.924957	43.043999
307	3	0	13	0.959375	0.492075	0.009371		0.996875	0.924957	43.043999
310	0		13	0.959375	0.492075	0.009371		0.996875	0.924957	43.043999
179	-1	0	14	0.955250	0.476061	0.008345	1 1	0.996875	0.883489	39.473400
179	-1		14	0.956250	0.475051	0.008345		0.993750	0.883489	39.473400
267	1-1		14	0.956250	0.476061	0.008345	1	0.996875	0.883489	39.473400
_ 275	-1_		14	0.956250	0.476061	0.008345		0.996875	0.853489	39,473400
275	0	0	14	0.956250	0.476061	0.008345		0.996875	0.863489	39.473400
275		0.	14	0.956250	0.476061	0.008345		0.998875	0.863489	39.473400
217	1 0		14	0.956250	0.476061	0.008345	1 2	0.993750	0.863489	39.473400
217			14	0.956250	0.475051	0.008345	2	0.993750	0.883489	39.473400
267		1	14	0.956250	0.476061	0.008345	2	0.993750	0.883489	39.473400
180	-1	0	14	0.956250	0.476081	0.008345		0.996875	0.883489	39.473400
180	-1		14	0.956250	0.476061	0.008345	I	0.998875	0.863489	39.473400
95	-1	1	1	0.996875	1.000000	0.007640	1	0.996875	1.000000	8.484700
95	न	0	T	0.996875	1.000000	0.007840	1	0.998875	1.000000	8.484700
174	-ī	0	17	0.946875	0.494593	0.009382		0.996875	0.946708	57.428699
174	-1	T T	17	0.946875	0.494593 0.494593	0.009382		0.996875	0.946708	57.428599
216	-1		17	0.946875	0.494593	0.009382		0.998875	0.946708	57.428699
312	-1		17	0.946875	T 0.494593	0.009382	1	0.996875	0.946708	57.428699
312		0	17	0.946875	0.494593	0.009382		0.996875	0.946708	57.428599
306	0	1	17	0.946875	0.494593	0.009382	1 1 -	0.996875	0.946708	57.428699
227	0	0	17	0.946875	0.494593	0.009382	I	0.996875	0.946708	57.428699
227	T	0	17	0.946875	0.494593	0.009382	2	0.993750	0.948708	57.428699
306	1		17	0.946875	0.494593	0.009382	1	0.998875	0.946708	57.428699
728	1 0	0	17	0.946875	0.494593 0.494593	0.009382	7_2_	0.993750	0.946708 0.946708	57.428699 57.428699
228		0	17	0.946875	0.494593	0.009382	+	U.996875	0.340/08	
308	2		17	0.946875	0.494593	0.009382	1 1	0.998875	0.946708	57.428899 57.428699
229	U	0	17	0.946875	0.494593	0.009382	┴─ ┴─		0.940/08	
229		0	17	0.946875	0.494593	0.009382	1	0.996875	0.946708 0.946708	57.428699
306	3		17	0.946875	0.494593	0.009382		0.996875	0.946708	57.428699
215	0		17	0.946875	0.494593	0.009382		0.996875	0.946708	57.428699
53	-1	1		0.996875	1.000000	0.007665	I	0.996875	1.000000	15.206599
53	-1	D		0.996875	1.000000	0.007665		0.996875	1.0000000	15.205699
108	-1	0	4	0.987500	0.500000	0.007945	1 T	0.996875	1.000000	22.098400
108	-1		1 4	0.987500	0.500000	0.007945		0.996875	1.000000	22.098400
115	-1	0	4	0.987500	0.500000	0.007945	T	0.996875	1.0000000	22.098400
115	-1	1	4	0.987500	0.500000	0.007945	1 1	0.996875	1.000000	22.098400
	7	Mean val	13.2	0.958814	0.516561	0.008839	1.25	0.996074	0.902941	56.377723

Table E.10: Results for Benchmark S298

SSSM_ Lesting Length = 54K P21		
102	Resi_2	Tim,Furt
SS	1.000000	10.815800
106 1	1.000000	10.815800
106	1.0000000	12.213000
106	1.000000	137.970001
16	1.000000	137.970001
16	1.000000	137.970001 137.970001
Total	1.000000	137.970001
Total	1.000000	137.970001
1	1.000000	137.970001
19	1.000000	137.970001
18	1.000000	137.970001
19	1.000000	137.970001
19	1.000000	137.970001
100	1.000000	137.970001
1	1.000000	137.970001
1	1.0000000	137.970001
1	1.000000	137.970001
185 1	1.0000000	137.970001
1	1.000000	137.970001
1	0.934540	102.600998
1	0.934540	102.600998
1	0.934540	102.600998
280	0.934540	102.600908
1	0.934540	102.600998
STA	0.934540	102.600998
1	0.934540	102.600998
1	0.934540	102.600998
1	0.934540	102.600998
1	0.934840	102.600998
319	0.934540	102.600998
1	0.934540	102.800998
1	0.934540	102.600998
1	0.934540	102.600998
1	0.934540	102.600998
1	0.934540	102.600998
1	0.934540	102.600998
1.0	1.000000	102.600998
1735	1.000000	27.947901 27.947901
213 -1	1.000000	27.947901
1725	1.000000	27.947901
122	1.000000	27.947901 27.947901
1727	1.000000	64.373596
1722 1	1.000000	64.373596
122 2	1.000000	64.373596 64.373596
181	1.0000000	64.373596
181	0.875000	55,934898
717	0.875000	55.934898
220 -1	0.875000	55.934898 55.934898
239 1	0.875000	55.934898
239 0 0 12 0.987742 0.500000 0.009964 1 0.997312	0.875000	55.934898
12	0.875000	55.934898 55.934898
12	0.875000	55.934898
717 U 0 12 0.987742 0.500000 0.009884 2 0.994624 188 -1 0 12 0.987742 0.500000 0.009884 2 0.994624 188 -1 0 18 0.98889 0.500000 0.010713 1 0.987312 188 -1 1 18 0.98889 0.500000 0.010713 1 0.987312 188 -1 1 1 18 0.98889 0.500000 0.010713 1 0.987312 205 -1 1 1 18 0.98889 0.500000 0.010713 2 0.994624 228 -1 1 1 18 0.98889 0.500000 0.010713 2 0.994624 228 0 0 16 0.888989 0.500000 0.010713 2 0.994624 128 0 0 1 1 18 0.988899 0.500000 0.010713 1 0.997312 184 0 1 1 1 18 0.988899 0.500000 0.010713 1 0.997312 184 1 1 1 18 0.988899 0.500000 0.010713 1 0.997312 205 0 1 1 18 0.988899 0.500000 0.010713 1 0.997312 275 -1 0 18 0.988899 0.500000 0.010713 1 0.997312 275 -1 1 1 18 0.988899 0.500000 0.010713 1 0.997312 275 -1 1 1 18 0.988899 0.500000 0.010713 1 0.997312 2799 -1 1 1 18 0.988899 0.500000 0.010713 1 0.997312 299 1 1 0 18 0.988899 0.500000 0.010713 1 0.997312 299 1 1 0 18 0.988899 0.500000 0.010713 1 0.997312 299 1 1 0 18 0.988899 0.500000 0.010713 2 0.994624 2288 0 1 1 18 0.988899 0.500000 0.010713 2 0.994624 2288 1 1 1 18 0.988899 0.500000 0.01071	0.875000	55.934898
12	0.875000	55.934898
188	0.875000	55.934898 74.583397
205 -1 1 18 0.986989 0.500000 0.010713 2 0.994624	0.907449	74.583397
236	0.907449	74.583397
198 0 1 18 0.988989 0.500000 0.010713 1 0.997312 194 1 1 18 0.988989 0.500000 0.010713 1 0.997312 205 0 1 16 0.988989 0.500000 0.010713 1 0.997312 275 -1 0 18 0.988989 0.500000 0.010713 1 0.997312 275 -1 1 18 0.988989 0.500000 0.010713 1 0.997312 279 -1 1 18 0.988989 0.500000 0.010713 1 0.997312 299 -1 1 18 0.988989 0.500000 0.010713 1 0.997312 288 0 1 1 6 0.988989 0.500000 0.010713 1 0.997312 288 1 1 18 0.988989 0.500000 0.010713 2 0.994624 288 0 1 16 0.988989 0.500000 0.010713 2 0.994624 275 0 1 16 0.988989 0.500000 0.010713 2 0.994624		74.583397
194 1 1 16 0.988989 0.500000 0.010713 1 0.997312	0.907449 0.907449	74.583397
205	0.907449	74.583397
275 -1 0 18 0.958989 0.500000 0.010713 1 0.997312 275 -1 1 18 0.958989 0.500000 0.010713 1 0.997312 299 -1 1 18 0.958989 0.500000 0.010713 1 0.997312 298 1 0 18 0.958989 0.500000 0.010713 2 0.994624 288 0 1 18 0.958989 0.500000 0.010713 2 0.994624 288 1 1 18 0.958989 0.500000 0.010713 2 0.994624 288 1 1 16 0.958989 0.500000 0.010713 2 0.997312 280 1 1 16 0.958989 0.500000 0.010713 2 0.997312 275 0 1 16 0.958989 0.500000 0.010713 1 0.997312 289 1 1 18 0.958989 0.500000 0.010713 1 0.997312 280 1 18 0.958989 0.500000 0.010713 1 0.997312 280 1 18 0.958989 0.500000 0.010713 1 0.997312 280 1 18 0.958989 0.500000 0.010713 1 0.997312 280 1 18 0.958989 0.500000 0.010713 1 0.997312 280 1 18 0.958989 0.500000 0.010713 1 0.997312 280 1 18 0.958989 0.500000 0.010713 1 0.997312 280 1 18 0.958989 0.500000 0.010713 1 0.997312 280 1 18 0.958989 0.500000 0.010713 1 0.997312 280 18 18 0.958989 0.500000 0.010713 1 0.997312 280 18 0.958989 0.500000 0.010713 1 0.997312 280 18 0.958989 0.500000 0.010713 1 0.997312 280 18 0.958989 0.500000 0.010713 1 0.997312 280 18 0.958989 0.500000 0.010713 1 0.997312 280 18 0.958989 0.9500000 0.010713 1 0.997312 280 18 0.958989 0.9500000 0.010713 1 0.997312 280 18 0.958989 0.9500000 0.010713 1 0.997312 280 18 0.958989 0.9500000 0.010713 1 0.997312 280 18 0.958989 0.9500000 0.010713 1 0.997312 280 18 0.958989 0.9500000 0.010713 1 0.997312 280 180 0.958989 0.9500000 0.010713 1 0.998889 0.9500000 0.010713 1 0.998889 0.9500000 0.010713 1 0.998889 0.9500000	0.907449	74.583397
299 -1 1 18 0.988889 0.500000 0.010713 1 0.997312	0.907449	74.583397
285 1 1 16 0.986889 0.500000 0.010713 2 0.994624 288 0 1 16 0.986889 0.500000 0.010713 1 0.997312 285 1 1 18 0.98889 0.500000 0.010713 2 0.994624 278 0 1 16 0.98889 0.500000 0.010713 1 0.997312		74.583397
288 0 1 16 0.386889 0.500000 0.010713 1 0.997312 288 1 1 18 0.958989 0.500000 0.010713 2 0.994824 275 0 1 16 0.998989 0.500000 0.010713 1 0.997312	0.907449	74.583397
278 0 1 16 0.988989 0.500000 0.010713 1 0.997312		74.583397
210 0 1 10 0.500000 0.5000000	0.907449	74.583397
	0.907449	74.583397
180 -1 0 10 0.973118 0.500000 0.010060 1 0.997312	0.849915	46.478901
160 -1 1 10 0.973118 0.800000 0.010060 1 0.997312	0.849915	46.478901
[198] -1 [10	0.849915 0.849915	45.478901 45.478901
232 -1 1 10 0.973118 0.500000 0.010080 2 0.994624 232 0 0 10 0.973118 0.500000 0.010080 1 0.997312	0.849915	46.478901
190 0 1 10 0.973118 0.500000 0.010060 1 0.997312	0.849915	46.478901
190 1 1 10 0.973118 0.500000 0.010080 1 0.997312	0.849915	46.478901
198 0 1 10 0.973118 0.500000 0.010060 1 0.997312		48.478901 48.478901
309 -1 0 10 0.973118 0.500000 0.010060 2 0.994824 309 -1 1 10 0.973118 0.500000 0.010060 2 0.994824	0.849913	46.478901
		82,963970
Mean val 15.3 0.958800 0.500740 0.011225 1.17 0.996859		37.545672
Total des I am I describe I among I among I among I among I		

Table E.11: Results for Benchmark S334

S349, testing	length = 64								
Ele Inp	SA 0	N.PO	PE1 0.960526	0.505888	Tim.Str. 0.013560	N.Sg	FE2 0.997368	Resl_2 1.000000	Tim,Furt 85.860802
118 -1		15	0.960526	0.505888	0.013560		0.997368	1.0000000	88.860802
118 0		15	0.960526	0.505888	0.013560	1 1	0.997368	1.000000	85.850802 85.860802
118 1	- i -	15	0.960526	0.505888	0.013560	- i -	0.997368	1.000000	86.860802
177 -1		15	0.980528	0.505888	0.013560		0.997368	1.000000	85.850802 85.860802
339 -1 339 I		15	0.960526 0.960526	0.505888	0.013560	 	0.997388	1.0000000	86.860802
335 0	1	15	0.960526	0.505888	0.013560		0.997388	1.000000	86.860802
189 0	. 0	15	0.960526	0.505888	0.013560	1	0.997368 0.997368	1.000000	85.850802 85.850802
335 1	- 0	15	0.950525	0.505888	0.013560	 	0.997368	1.000000	85.860802
177 0	Ť	15	0.960526	0.505888	0.013560		0.997368	1.000000	85.860802 85.860802
329 -1	0	15	0.960526 0.960526	0.505888 0.505888	0.013560	 	0.997368	1.000000	85.850802
329 -1	1	15	0.960526	0.505888	0.013560		0.997368	1.0000000	85.860802
748 -1	- 0	23	0.939474	0.496430	0.013404	1 1	0.997368	0.934540 0.934540	102.912003
248 -1 353 -1		23	0.939474	0.496430	0.013404	-2-	0.994737 0.994737	0.934540	102.912003
353	0	23	0.939474 0.939474	0.496430	0.013404		0.997368	0.934540	102.912003
349 0 349 1		23 23	0.939474	0.498430	0.013404	 	0.997368 0.997368	0.934540 0.934540	102.912003
342 0	ō	23	0.939474	0.496430	0.013404		0.997388	0.934540	102.912003
298 0 298 1		23	0.939474	0.498430	0.013404		0.997368 0.997368	0.934540 0.934540	102.912003
298 2		23	0.939474	0.496430	0.013404	 i 	0.997368	0.934540	102.912003
342	Ö	23	0.939474	0.496430	0.013404		0.997368	0.934540	102.912003
336 U	- U	23	0.939474	0.496430	0.013404		0.997368 0.997368	0.934540	102.912003
308 1	- 8	23	0.939474	0.496430	0.013404		0.997388	0.934540	102.912003
306 2	0	23	0.939474	0.496430	0.013404		0.997368 0.997368	0.934540 0.934540	102.912003
336 I I		23 23	0.939474	0.496430 0.496430	0.013404 0.013404	 -i - 	0.997368	0.934540	102.912003
248 1	i	23	0.939474	0.496430	0.013404		0.997368	0.934540	102.912003
380 -1		23	0.939474	0.496430 0.496430	0.013404	1 2	0.997368 0.994737	0.934540	102.912003
360 0	<u> </u>	23	0.939474	0.496430	0.013404	l i	0.997368	0.934540	102.912003
360		23	0.939474	0.496430	0.013404		0.994737	1.000000	98.717903
117 1 1	0	15	0.960526	0.505888 0.505888	0.012973	 	0.997358 0.997358	1.000000	98.717903
117 0	i	18	0.960526	0.505888	0.012973		0.997368	1.000000	98.717903
117	0	15	0.960526	0.505888 0.505888	0.012973		0.997368 0.997368	1.000000	98.717903
178 -1		15	0.960526	0.505888	0.012973	 i 	0.997368	1.000000	98.717903
311 -1		15	0.960526	0.505888	0.012973		0.997368	1.0000000	98.717903 98.717903
311 1 299 0	-	15	0.960526	0.505888 0.505888	0.012973 0.012973	 	0.997368	1.000000	98.717903
190 0	i i	15	0.960526	0.505888	0.012973		0.997388	1.0000000	98.717903
190 1	· · · · ·	15	0.960526	0.505888	0.012973		0.997368 0.997368	1.0000000	98.717903
178 0	1	15	0.960526	0.505888 0.505888	0.012973	 	0.997368	1.000000	98.717903
178 1	ì	15	0.960526	0.505888	0.012973	1 i	0.997368	1.000000	98.717903
281 -1 281 -1	9	15	0.960526 0.960526	0.505888 0.505888	0.012973	+	0.997368	1.000000	98.717903 98.717903
180 -1	- 6 -	211	0.944737	0.503791	0.011516	<u> </u>	0.997368	0.891309	102.880997
180 -1		21	0.944737	0.503791	0.011616	7 2	0.994737 0.994737	0.891309	102.880997 102.880997
272 1	 	21 21	0.944737 0.944737	0.503791	0.011616	+ 1	0.997368	0.891309	102.880997
253 0	ĭ	21	0.944737	0.503791	0.011616		0.997368	0.891309	102.880997
253 I 180 0		21	0.944737	0.503791	0.011616		0.997368	0.891309	102.880997
180 T	 i 	1 21 -	0.944737	0.503791	0.011616	 i 	0.997368	0.891309	102.880997
192 -1	Ō	21	0.944737	0.503791	0.011618	1 2	0.994737	0.891309	102.880997
192 -1 267 -1	1 0	21 21	0.944737	0.503791	0.011616	1 1	0.997368 0.994737	0.891309	102.880997
267	1	21	0.944737	0.503791	0.011616	<u> </u>	0.997368	0.891309	102.880997
192 0	9	21_	0.944737 0.944737	0.503791	U.U11516 U.U11516		0.997368	0.891309	102.880997
301 -1	- 8	21	0.944737	0.503791	0.011616	1 2	0.994737	0.891309	102.880997
301 -1	I I	21	0.944737	0.503791	0.011616	1	0.997368	0.891309	102.880097
315 -1 315 1	- 1	21 21	0.944737 0.944737	0.503791	0.011616	1 2	0.997368	0.891309	102.880997
302 0	<u> </u>	21	0.944737	0.503791	0.011616	_i_	0.997368	0.891309	102.880997
302		21	0.944737	0.503791	0.011616	7	0.994737	0.891309	102.880997
301 0		21	0.944737	0.503791	0.011616	+	0.994737	0.891309	102.880997
187 -1	- ō_	10	0.973684	0.500000	0.010230	Ī	0.997368	0.849915	48.598499 48.598499
187 -1 279 -1		10	0.973884	0.500000	0.010230	1 - 2	0.994737	0.849915	1 45.598499
279	6	10	0.973584	0.500000	0.010230	<u> Li</u>	0.997368	0.849915	46,598499
260 0		το	0.973884	0.500000	0.010230	1	0.997368	0.849915	48.598499 48.598499
260 I 187 0	 - 	10	0.973884	0.500000	0.010230	+ i -	0.997368	0.849915	1 45.598499
187 1	1	10	0.973684	0.500000	0.010230		0.997368	0.849915	45,598499
328 -1 328 -1	9	10	0.973684	0.500000	0.010230	1 2	0.994737	0.849915	48.598499 48.598499
67 -1	- ô	1 2	0.994737	0.500000	0.009346		0.997368	1.000000	12.261600
67 -1	1	1	0.994737 0.994737 0.973584	0.500000	0.009346		0.997368	0.849915	12.261600 46.592400
184 -1 184 -1	0	10	0.973684	0.500000	0.010075	1 2	0.994737	0.849915	48.592400
276 -1	1	10	0.973684	0.500000	0.010075	1 2	0.994737	1 0.840015	46.592400
276 1	0	10	0.973684	0.500000	0.010075	 	0.997358	0.849915	48.592400
257 0 257 1	+ + -	10	0.973584	0.500000	0.010075	 i 	0.997388	0.849915	46.592400
184 0	<u> </u>	10	0.973884	0.500000	0.010075	<u> </u>	0.997368	0.849915	46.592400
184 1 325 -1		10	0.973884 0.973684	0.500000	0.010075		0.997358	0.849915	48.592400 46.592400
325 -1	 ĭ	10	0.973684	0.500000	0.010075	1 2	0.994737	0.849915	46.392400
56 -1	0	5	0.986842	0.462756	0.009787	1	0.997368	1.000000	18.639401
56 -1	<u> </u>	1 5	0.986842	0.462755	0.009787	1 1 22	0.997368		
 	Mean val	16.5	0.956263	0.501188	0.012163		0.996842	0.931670	84.904563 25.827714
	1 200 CIEAL	1 3.9	1 0.017741	,	, 4.40.000				

Table E.12: Results for Benchmark S349

535932.	testing	length = 64	ĸ							
Ele	Inp	5.8	N.PO_	PEI	Resi_1 0.507930	Tim.Str. 1.557180	N.S _K	FE2 0.999831	Resl_2 0.675382	Tim,Furt 15984.000000
33163	-1	- 8	63 63	0.998478 0.998478	0.507930	1.557180	 	0.999831	0.675382	15984.000000
32875		Ĭ	63	0.998478	0.507930	1.557180	13	0.999686	0.675382	15984.000000
31380			63	0.998478 0.998478	0.507930 0.507930	1.557180	13	0.999686	0.675382 0.675382	15964.000000
31381 16833	-1	 	63 63	0.998478	0.507930	1.557180	3	0.999928	0.675382	15964.000000
16836	-1	Ö	63	0.998478	0.507930	1.557180		0.999976	0.675382	15964.000000 15964.000000
16838	1 0		63	0.998478 0.998478	0.507930 0.507930	1.557180	2 -	0.999952	0.675382 0.675382	15964.000000
16841		 	83	0.998478	0.507930	1.357180_	3	0.999928	0.675382	15964.000000
16844	-1	0	53	0.998478	0.507930	1.557180		0.999976 0.999952	0.675382 0.675382	15984.000000
16846	-		63 63	0.998478 0.998478	0.507930	1.557180	2 2	0.999952	0.675382	15984.000000 15984.000000
18849	1 3	i i	63	0.998478	0.507930	1.557180	3	0.999928	0.675382	15964.000000
15852	-1	0	63	0.998478	0.507930	1.557180	1 2	0.999976	0.875382 0.675382	15984.000000 15984.000000
16854	 		63 63	0.998478 0.998478	0.507930	1.557180	-	0.999952	0.675382	15964.000000
16857	-1	1	63	0.998478	0.507930	1.557180	3	0.999928	0.675382	15954.000000
16860	1	0	63 63	0.998478	0.507930	1.557180 1.557180	2	0.999855 0.999952	0.675382 0.675382	15964.000000
16862 16860	 	 	63	0.998478	0.507930	1.557180		0.999952	0.675382	15964.000000
27578	-1	Ī	63	0.998478	0.507930	1.557180	- 5	0.999855 0.999686	0.675382	15984.000000 15984.000000
31377	1	- 0	63 63	0.998478 0.998478	0.507930	1.557180	13	U.999686	0.875382 0.875382	13984.000000
31377	+	 	- 23	0.999978	1.000000	1.054320	T T	0.999978	1.000000	447.283997
1483	-1	0	1	0.999978	1.0000000	1.111540		0.999976	1.000000	843.648010
30850 32898	7		63	0.998478	0.507930 0.507930	1.591340	- 5	0.999855	0.675382 0.675382	15054.000000
31518	0	 	63	0.998478	0.507930	1.591340	13	0.999686	0.675382	16084.000000
31519	0		63	0.998478	0.507930	1.591340	13	U.999988 U.999982	0.675382	18084.000000
17739	-1	0	63 63	0.998478 0.998478	0.507930	1.591340	1 2 -	0.999952	0.675382	15084.000000
17744	 -i_	i i	63	0.998478	0.507930	1.591340	7	0.999952	0.675382	15084.000000
17743		1	63	0.998478	0.507930	1.591340	$\frac{3}{2}$	0.999928	0.675382 0.675382	15054.000000
17747	1		63	0.998478	0.507930 0.507930	1.591340	 	0.999952	0.675382	16064.000000
17752	1	 	- 63	0.998478	0.507930	1.591340	1 2	0.999952	0.675382	16064.000000
17751	1		63	0.998478	0.507930	1.591340	3	0.999928	0.675382 0.675382	18084.000000
17755	T -1		63	0.998478	0.507930	1.591340	1 2	0.999952	0.575382	16064.000000
17760	1	i i	63	0.998478	0.507930	1.591340	2_	0.999952	0.575382	16084.000000
17759	1	1	63	0.998478	0.507930	1.591340	3	0.999928	0.675382 0.675382	16064.000000
17763	1-1	0	63	0.998478	0.507930	1.591340	 '2 -	0.999952	0.675382	15054.000000
17768	1 -1	i d	63	0.998478	0.507930	1.591340	7	0.999831	0.675382	15084.000000
17767		1	63	0.998478	0.507930	1.591340	3	0.999928	0.675382	15084.000000
29713	-1	9	63	0.998478	0.507930	1.591340	6	0.999855	0.675382	16064.000000
31515	1 0	 	63	0.998478	0.507930	1.591340	13	0.999686	0.675382	18084.000000
33682	1		63_	0.998478	0.507930	1.391340	1 5	0.999855	0.675382	15084.000000 3570,030029
18651	[·1	 	15	0.999638	0.505888	1.170660	 3 -	0.999928	0.794407	3570.030029
18654	1 -1	 6	15	0.999638	0.505888	1.170660	1	0.999978	0.794407	3570.030029
28787	-1		15	0.999638 0.999638	0.505888	1.170660	1 7 -	0.999976	0.794407	3570.030029 3570.030029
18655	1 9		15	0.999638	0.505888	1.170680	+ 3	0.999928	0.794407	3570.030029
11004	1 -1	i d	63	0.998478	0.507930	1.564750	7	0.999831	0.524477	18204.000000
33239	1	0 -	63	0.998478	0.507930	1.564750	18	0.999831	0.824477	16204.000000
32951 31835	++	 	63	0.998478	0.507930	1.564750	18	0.999565	0.624477	18204.000000
31837	i	T .	63_	0.998478	0.507930	1.564750	18	0.999565	0.624477	16204.000000
19545	-1	1 0	63	0.998478	0.507930	1.564750	18	0.999565	0.824477	16204.000000
19550	+ +	 	63	0.3838478	0.507930	1.564750	4.4	0.999903	0.524477	15204.000000
19548	0	1	63	0.998478	0.507930	1.564750	3	0.999928	0.524477	16204.000000
19553	1 :1	1 0	63 63	0.998478	0.507930	1.564750	1 3	0.999928	0.624477	18204.000000
19558	+ +	Ť	63	0.998478	0.507930	1.564750	1 2	0.999952	0.624477	16204.000000
19556	0	I	63	0.998478	0.507930	1.564750	3	0.999952	0.624477	16204.000000
19561	1 -1	1 1	63 63	0.998478	0.507930	1.564750	+ 1	0.999976	0.624477	16204.000000
19566		<u>1 </u>	63_	0.998478	0.507930	1.564750	1 2	0.999952	0.624477	16204.000000
19564	0	1	83	0.998478	0.507930	1.564750	1 - 3	0.999952	0.824477	16204.000000
19569	1 :1	1 0	63	0.998478	0.507930	1.564750	1 3	0.999855	0.624477	18204.000000
19574		Ĭ	63	0.998478	0.507930	1.564750	12	0.999952	0.624477	16204.000000
19572 27858	0		63	0.998478	0.507930	1.564750	8	0.999952	0.624477	16204.000000
31833	-1	 	63	0.998478	0.507930	1.564750	18	0.999565	0.624477	16204.000000
31833	17	<u> </u>	63	0.998478	0.507930	1.564750	18	0.999555	0.624477	16204.000000
3634	1	1	63	0.999976	0.507930	1.055220	18	0.999976	0.824477	16059.799805
11488 33262	1-1-	1 6	63	0.998478	0.507930	1.570700	18	0.999555	0.524477	16089.799808
31976	i i	ĭ	63	0.998478	0.507930	1.570700	18	0.999565	0.624477	16059.799805
31976 30926	\Box	1	63	0.998478	0.507930	1.570700	18	0.999565	0.624477	16059.799805
20251	+ 6	 	63	I O GRUEATR	0.507930	1.570700	18	0.999565	0.524477 0.524477	16059.799805
20454	-1	1	63	0.998478	0.507930	1.570700	18	0.999868	0.624477	16059.799805
20455 20454	1 9	1 1	63	0.998478	0.507930	1.570700	18	0.999928	0.624477	16059.799805
20459	1 6	 	63	0.998478	0.507930	1.570700	1 2	0.999952	0.624477	16059.799805
20462	L -1	Ī	63	0.998478	0.507930	1.570700	1 2	0.999952	0.524477	15059.799805
20463 20462	1 0	+ 7	63 63	0.998478	0.507930	1.570700	$\frac{7}{3}$	0.999952 0.99992B	0.624477	16059.799805
20467	T ō	 	+ 83	0.998478	0.507930	1.570700		0.999952	0.824477	16059,799805
20470 20471	1.1	1	63	0.998478	0.507930	1.570700	7	0.999952	0.624477	16059.799805
20471	1 0		63	0.998478	0.507930	1.570700	7 2	0.999982	0.624477	16059.799805
20470	1 0	 	+ 83	0.998478	0.507930	1.570700	1 2	0.999952	0.624477	18059.799805
20478		i i	63_	0.998478	0.507930	1.570700	2	0.999952	0.624477	16059.799805
		Mean val	58.3	0.998593	0.522570	1.532068	5.71	0.999862	0.670373	14858.666705
		Std devi	12.4	0.000300	0.097044	0.097437	4.52	7 0.000109	0.068441	3066.686633

Table E.13: Results for Benchmark S35932

		length = 641	K							
le	Inp	SA	N.PO	FEI	Resl_1	Tim.Str.	N.Sg	FE2	Resl_2	Tim,Furt
28	-1	- 0	12	0.971768	0.500000	0.010557		0.997647	0.875000	53.684898
28	-1	1 1	12	0.971765	0.500000	0.010557		0.997647	0.875000	53.684898
5 4	-1	1	12	0.971765	0.500000	0.010557	2	0.995294	0.875000	53.884898
22	-1	Ü	12	0.971765	0.500000	0.010557	7	0.998294	0.875000	53.584898
22	a i		12	0.971765	0.500000	0.010557		0.997647	0.875000	53.684898
83 	-ĭ	- 6	12	0.971765	0.500000	0.010857	1	0.997647	0.875000	53.684898
a 	-2 	- 5 - 1	 iž	0.971765	0.500000	0.010557	- i	0.997647	0.875000	53.584898
- 1		8 1	- 12 -	0.971765	0.500000	0.010557	 - 2 - 	0.995294	0.875000	53.684898
¤ 	-1 1		12		0.500000	0.010557		0.997647	0.875000	53.584898
*	-1	1 1		0.971765	0.500000	0.010557		0.997647	0.875000	53.884898
94	0	0	12	0.971765					0.875000	53.684898
94	1	0	12	0.971765	0.500000	0.010557		0.997647	0.875000	33.003090
प्रद	7	. 0	12	0.971765	0.800000	0.010557	2	0.995294	0.875000	53.684898
67	-1	0 1	4	0.990588	0.500000	0.009467	2	0.995294	0.666667	17.743000
67	-1		4	0.990588	0.500000	0.009467_	2	0.995294	0.858587	17,743000
93	-1	0-	4	0.990588	0.500000	0.009467	2	0.995294	0.555557	17.743000
93	-1	1		0.990588	0.800000	0.009467	7	0.995294	0.666667	17.743000
13	.i 		14	0.987059	0.522725	0.010941	1 1	0.997647	1.0000000	160.962997
13	-1	- i -	- 14	0.967059	0.522725	0.010941	l i l	0.997647	1.000000	160.962997
			- i 	0.967059	0.522725	0.010941	 i 	0.997647	1.000000	150.952997
81	<u> </u>	- i - l				0.010941	├─ ┼─┼	0.997647	1.000000	160.962997
81			14	0.967059	0.522725	0.010941		0.997647	1.000000	160.962997
57	0	0	14	0.967059	0.522725					160.96299
57		. 0	14	0.967059	0.522725	0.010941		0.997647	1.000000	100.90120
57	. 2	0	14	0.987059	0.522725	0.010941		0.997647	1.000000	160.96299
81	7	U	14	0.967059	0.522725	0.010941		0.997647	1.000000	160.96299
70	-I	- 0 -	14	0.967059	0.522725	0.010941		0.997647	1.000000	160.96299
70	-1		14	0.967059	0.522725	0.010941	1 1	0.997647	1.0000000	160.96299
70	- 6 - 1	ŏ	14	0.987059	0.522725	0.010941		0.997647	T.0000000	150.952997
70	ī	0	14	0.967059	0.522725	0.010941		0.997647	1.000000	160.962997
57	-1		14	0.967059	0.522725	0.010941		0.997647	1.000000	160.962997
57	-1	- ò -i	14	0.957059	0.522725	0.010941	 	0.997647	1.000000	160.96299
			- 14	0.967059	0.522725	0.010941	 -i -	0.997647	1.000000	160.96299
75	Ė		- 13	0.967059	0.042120	0.010941		0.997647	1.000000	160.962997
78	<u></u>	0			0.522725		+	0.997647	1.000000	160.962997
80		1	14	0.967059	0.522725	0.010941		0.99/04/		160.96299
80	-1	0	14	0.967089	0.522725	0.010941		0.997547	1.000000	
20	į	0	2	0.995294	0.500000	0.009985	1 1	0.997647	1.000000	10.263500
20	-1	1	2	0.995294	0.500000	0.009985		0.997547	1.0000000	10.263500
177	-	-0-	12	0.971765	0.507925	0.011593	1	0.997647	0.884870	58.132702
77	-1	i	12	0.971765	0.507925	0.011593	7 2	0.995294	0.884870	58.132702
24	-i	Ŭ.	12	0.971765	0.507925	0.011593	1 2	0.995294	0.884870	58.132702
24	-6-	ŏ	12	0.971765	0.507925	0.011593	1 1	0.997647	0.884870	58.132702
77		Ö	12	0.971765	0.507925	0.011593	 	0.997547	0.884870	58.132702
!??	Ť	- 6	12	0.971765	0.507925	0.011593	+- i- 	0.997647	0.884870	58.132702
						0.011593	 i 	0.997647	0.884870	58.132702
77	7	0	12	0.971765	0.507925			0.997647	0.884870	58.132702
177	3	0	12	0.971765	0.507925	0.011593			0.884870	58.132702
195	ļ.,	- 6	12	0.971765	0.507925	0.011593	7	0.995294	U.55457U	
195	-1		12	0.971765	0.507925	0.011593		0.997647	0.884870	58.132702
195	-		13	0.971765	0.507925	0.011593		0.997647	0.884870	58.132702
195	ī	Ü	12	0.971765	0.507925	0.011593		0.997847	0.884870	58.132702
198	- 2		12	0.971765	0.507925	0.011593	7 2	0.995294	0.884870	38.132702
37	-i-	ŏ	3	IT GGPGAT	0.386853	0.009065	T I	0.997647	1.000000	32.944099
37	-:	Ť	3	0.002021	0.386853	0.009065	 	0.997647	1.000000	32.944095
i či l	-1	D D	- 5	0.992941 0.988238	0.462756	0.009413	1 2	0.995294	0.555557	17.770596
104				0.988235	0.462758	0.009413	+ +	0.998294	0.686667	17.770596
		- h	3	0.988235	0.462756	0.009413	 	0.995294	0.666667	17.770594
225		<u> </u>	3			0.009413	+	0.998294	0.666667	17.77089
125	-1		5	0.988235	0.462756			0.000254	0.836914	62.64970
103	-1	-0	17	0.960000	0.482260	0.010769	7	0.995294	0.836914	62.649700
103	-1		17	0.960000	0.482260	0.010769		0.997647	U.530V14	1 04.049/00
241	-1	0	17_	0.960000	0.482260	0.010769	1 2	0.995294	0.836914	62.649700
252	-1	0	17	0.960000	0.482260	0.010769	7	0.995294	0.836914	62.649700
252	0	1	17	0.960000	0.482260	0.010769		0.997647	0.836914	62.64970C
234	ō	0	17	0.950000	0.482260	0.010769	2	0.995294	0.835914	62.649700
234	ĩ	- 6 -	17	0.960000	0.482260	0.010769	2	0.995294	0.836914	62.649700
241	-i -	- ŏ -	17	0.960000	0.482260	0.010769	1 2	0.995294	0.836914	62.649700
138	-i-	6 -	17	0.960000	0.482260	0.010769	+ i	0.997647	0.836914	62.649700
				0.960000	0.482250	0.010769	+ + -	0.997647	0.836914	62.6497U
136	<u></u> I	 	17		U.40440U		+ + -	0.995294	0.838914	62.64970
214	•1	0	17	0.960000	0.482260	0.010769	+		0.836914	52.549700
214	•1	1 1	17	0.960000	0.482250	0.010769	↓	0.997647	0.836914	62.64970
319	-1	I	17	0.960000	0.482260	0.010769		0.997647		
319			17	0.960000	0.482260	0.010769	2	0.995294	0.836914	62.64970
		Mean val	12.1	0.971492	0.498383	0.010708	1.35	0.996829	T 0.884832	78.30207
$\overline{}$										51.689174

Table E.14: Results for Benchmark S382

Section Sect	STREET FASTIN	g length = 54	K							
Sect	Ele Inp		N.PO		Rest_I	Tim.Str.	N.Sg I			Tim,Furt
Color	656K -1			0.999795		7.663440	4	0.999897	0.500000	1808.790039
1000 1	11858 -1			0.999795		9.055310			1.000000	458.015015
1885 1	16060 -1	1	231	0.994081	0.500982	14.133400	1		0.505021	49401.898438
1906 1	16060 2		231	0.994081		14.133400	140			49401.598438
1985 U			231	0.994081		14.133400		0.999949	0.506021	49401.898438
SSECT	13885 0		231		0.500982	14.133400			0.506021	
1887 1		0		0.994081	0.500982	14.133400				
1,000 1		+ +	231	TO GOVERNMENT	0.500982	14.133400	1 +	0.999974	0.506021	49401.898438
1389F U		 i 	231	0.994081	0.500982	14.133400		0.999872	0.506021	49401.898438
1996 T.	13575 1	1	231	0.994081		14.133400 (0.506021	49401.898438 202017 NOWAYN
18976				TO COLUMN 1	0.500962	14.133400				49401.898438
17258 -1			231	0.994081	0.500982	14.133400	2	0.999949	0.506021	49401.898438
17258 -1	17121 -1			0.994081	0.500982	14.133400	-3			49401.898438
17313				0.994081		14.133400	7		0.505021	AGAIN AGRAM
27117 - 1			231	IT OCCUPANT		14.133400		0.999897	0.506021	49401.898438
23774 1	21117 -1	0	231	0.994081	0.500982	14.133400				
STORY			231	0.994081	0.500982				0.000021	49401.898438
1	23774 1 -1			0.994081	0.500982			0.996413	0.506021	49401.898438
25047 2	23026		231	A OCLARA	0.500982	14.1332000		0.996413		49401.898438
2342 2	23070	1	231	0.994081	0.500982	14.133400				49401.898438 40401.808438
1	23442 7			0.994081		14.133400		0.998413	0.506021	49401.898438
252477 2	23441 2		231	0.994081	0.500982	14.133400	140	0.996413	0.506021	49401.898438
20056 2	23447 2	1	231	0.994081	0.500982	14.133400	140			
1	23056 2	 	231				140	0.996413	0.506021	49401.898438
23775 0 0 231	23525 1	1 1	231	0.994081	0.500982	14:133400	140	0.996413	0.506021	49401.898438
1	23773 0	0	331	0.994081	0.500982	14.133400		0.999897	0.506021	
1	73061 3	+ + -		0.994081						49401.898438
1		 i - 		IL UGADRI	0.500982	14.133400	140	0.996413	0.505021	1 49401.898438
1987	22812 1		231	0.994081	0.500982	14.133400	140	0.996413	0.506021	49401.898438
125443				0.994081 11.002min	0.500982	14.133400		0.996413		49401.898438
124548 T	23443 0	+	231	0.994081	0.500982	14.133400	- 6	0.999846	0.506021	49401.898438
12515		1		0.994081	0.500982	14.133400			0.506021	49401.898438
23771 1				0.994081		14.133400	140	0.990413	0.500021	
23463		+		0.994081	0.500982	14.133400	4	0.999897	0.506021	49401.898438
22474	23463 0	Ť		0.994081		14.133400				49401.898438
23035				0.994081	0.500982	14.133400	140	0.996413	0.506021	49401.898438 40401.898438
23974				0.994081	0.500982	14.133400		0.998413	0.506021	49401.898438
22715 3 U 231 U.994081 U.500982 (4.135400 (40 U.99413 U.50021 49401.8984. 22848 2 1 231 U.994081 U.500982 (4.135400 (40 U.99413 U.50021 49401.8984. 22848 2 1 231 U.994081 U.500982 (4.135400 (40 U.99413 U.50021 49401.8984. 23937 U 1 231 U.994081 U.500982 (4.135400 (40 U.99413 U.50021 49401.8984. 23938 1 U 231 U.994081 U.500982 (4.135400 (40 U.99413 U.50021 49401.8984. 23939 1 U 231 U.994081 U.500982 (4.135400 (40 U.99413 U.50021 49401.8984. 23930 2 1 U.50000 (40 U.994081 U.500982 (4.135400 (40 U.99413 U.50021) 49401.8984. 23930 2 1 U.50000 (40 U.994081 U.500982 (4.135400 (40 U.99413 U.50021) 49401.8984. 23930 2 1 U.50000 (40 U.994081 U.500982 (4.135400 (40 U.99413 U.50021) 49401.8984. 23930 2 1 U.50000 (40 U.994081 U.500982 (4.135400 (40 U.994013 U.50021) 49401.8984. 23931 1 U.994081 U.500982 (4.135400 (40 U.994013 U.500821 (4.9013894) (4.00000 (4.00000 (4.00000 (4.00000 (4.00000 (4.00000 (4.00000 (4.00000 (4.00000 (4.00000 (4.00000 (4.13000 (4.00000 (4.13000 (4.00000 (4.1300 (4.13000 (4.	23044 0		231	0.994081	0.500982	14.133400		0.996413	0.506021	49401.898438
23485 3 7 251				0.994081	0.500982	14.133400		0.996413	0.506021	49401.898438 40401.898438
23037	23775 3	 		0.994061		14.133400		0.996413	0.506021	49401.898438
27908 1	23483 2	 i 	231		0.500982	14.133400	140	0.996413		49401.898438
23000 3				0.994081		14.133400	140			49401.898438 20201 RORASK
23507 7	23795 1			11.002/061			140	0.996413	0.305021	49401.898438
231834	23501 2	- i - i	231	0.994081	0.500982	14.133400	140	0.996413	0.505021	49401.898438
23113 1	23034 0	1	231	1 0.994081			140		0.505021	49401.898438
18175 1						14.133400	 			49401.898438
10175	946 -1	 1		0.994081	0.500982	14.133400		0.999974	0.506021	49401.898438
1030	16175 -1	1		0.996900					0.995316	75181.699219
1							 			25181.609219
14164				0.996900	0.500000		<u> </u>	0.999974	0.995316	75181.699219
14162	14164 0		121	0.995900	0.500000	10.914700				25181.699219
1235		0		0.996900			 			25181.699219
14753				0.998900			 i 	0.999974	0.995316	25181.699219
18215	14163 -1	i	121	0.995900	0.500000	10.914700			0.995316	25181.699219
18713		Ţ		0.996900		10.914700	\Box		0.99K41K	25181.699219
18713		+ 1					 i 	0.999974	0.995316	25181.699219
10228 1	16213 2		121	0.996900	0.500000	10.914700		0.999974	0.998318	25181.699219
14470	14252 1			0.996900	0.500000					
1422 1 1 121	10228 1 14420 n		121	0.200000				0.999974	0.995316	25181.699219
14384	14362 -1	Ö	121	0.996900	0.500000	10.914700		0.999974		25181.699219
121	14421 0		121	0.996900	0.500000	10.914700		0.999974	0.995316	25181.699219
14324 1	14364 -1	1	121	0.996600	0.500000	10.914700	 		0.995316	25181.699219
10380	14424	i	121	0.996900	0.500000	10.914700		0.999974	0.995316	75181.699219
18380 2		1						0.999974	0.995316	25181.699219
1422		+ 1		0.550500	0.500000 0.500000		 	0.999974	0.995316	25181.699219
14886 U	14422	- ī	121	1 0.996900	0.500000	10.914700	Ī	0.999974	0.995316	25181.699219
14838 -1 0 171 0.988900 0.500000 10.914700 1 0.999974 0.998316 25181.6992 14836 0 1 1 121 0.998900 0.500000 10.914700 1 0.999974 0.998316 25181.6992 14837 0 1 1 121 0.998900 0.500000 10.914700 1 0.999974 0.998318 25181.6992 14830 1 1 121 0.998900 0.500000 10.914700 1 0.999974 0.998318 25181.6992 14834 1 1 14 0.999841 0.517740 7.888710 1 0.999974 1.000000 3682.79003 14834 1 1 14 0.999841 0.517740 7.888710 1 0.999974 1.000000 3682.79003 14834 0 1 1 14 0.999841 0.517740 7.888710 1 0.999974 1.000000 3682.79003 14838 -1 0 1 1 0.999718 0.500000 7.818890 1 0.999974 1.000000 3682.79003 13988 -1 0 11 0.999718 0.500000 7.818890 1 0.999974 1.000000 2598.97998 13970 0 1 11 0.999718 0.500000 7.818890 1 0.999974 1.000000 2598.97998 14021 1 1 1 0.999718 0.500000 7.818890 1 0.999974 1.000000 2598.97998 14021 1 1 1 0.999718 0.500000 7.818890 1 0.999974 1.000000 2598.97998 14021 1 1 1 0.999718 0.500000 7.818890 1 0.999974 1.000000 2598.97998 14021 1 1 1 0.999718 0.500000 7.818890 1 0.999974 1.000000 2598.97988 14021 1 1 1 0.999718 0.500000 7.818890 1 0.999974 1.000000 2598.97988 14021 1 1 1 0.999718 0.500000 7.818890 1 0.999974 1.000000 2598.97988 14021 1 1 1 0.999718 0.500000 7.818890 1 0.999974 1.000000 2598.97988 14021 1 1 1 0.999718 0.500000 7.818890 1 0.999974 1.000000 2598.97988	16276 1	0		0.996900	0.500000			0.999974		25181.699219
14587 U		1 1		0.996900	0.500000	10.914700	+ + -	0.999974		25181.699219
14830 1	14587 0	 		0.996900		10.914700	i_	0.999974	0.995316	25181.699219
T4834 1	14630	Ī	121	0.996900	0.500000					25181.699219
T4554 0		1							1.000000	3662.790039
1821 -1 1 4 0.99841 0.517740 7.858710 1 0.99974 1.000000 3682,79000 1.3858 -1 0 11 0.999718 0.500000 7.818690 1 0.999974 1.000000 2598.9798 1.3970 0 1 11 0.999718 0.500000 7.818690 1 0.999974 1.000000 2598.9798 14021 1 1 1 1 0.999718 0.500000 7.818690 1 0.999974 1.000000 2598.9798 14021 1 1 2 0.999978 0.500000 7.818690 1 0.999974 1.000000 458.45880 1 0.999974 1.000000 458.45880 1 0.999974 1.000000 458.45880 1 0.999978 0.900000 458.45880 1 0.999978 0.900000 458.45880 1 0.999978 0.900000 458.45880 1 0.999978 0.900000 458.45880 1 0.99978 0.900000 458.45880 1 0.999978 0.900000 458.45880 1 0.999978 0.900000 458.45880 1 0.999978 0.900000 458.45880 1 0.999978 0.900000 458.45880 1 0.999978 0.90000000 458.45880 1 0.999978 0.9000000 458.45880 0.900000 458.45880 0.9000000 458.45880 0.900000 458.45880 0.900000 458.45880 0.900000 458.45880 0.9000000 458.45880 0.900000 458.45880 0.900000 458.45880 0.900000 458.45880 0.9000000 458.45880 0.900000 458.45880 0.900000 458.45880 0.900000 458.45880 0.900000 458.45880 0.900000 458.45880 0.900000 458.45880 0.900000 458.45880 0.9000000 458.45880 0.9000000 458.45880 0.900000 458.45880 0.900000 458.45880 0.900000 458.45880 0.900000 458.45880 0.900000 458.45880 0.9000000 458.45880 0.9000000 458.45880 0.9000000 458.45880 0.9000000 458.45880 0.900000 458.45880 0.900000 458.45880 0.900000 458.45880 0.900000 0.900000 0.9000000 0.9000000 0.9000000 0.9000000 0.9000000 0.9000000 0.9000000 0.9000000 0.90000000 0.90000000000	14594 0	 		0.999641	0.517740	7.858710	 	0.999974	1.000000	3662.790039
13970	1821 -1	<u> </u>	14	0.999641	0.517740	7.858710		0.999974	1.000000	3662,790039
14021 1				0.999718		7.818890				2598.979980
5138 -1 1 2 0.999949 0.500000 9.085840 1 0.999974 1.000000 458.45800 Mean val 173.7 0.995550 0.501289 12.498505 55.64 0.998574 0.699147 38987.4513				0.999718			 		1.000000	2598.979980
Mean val 173.7 0.995550 0.501289 12.496505 55.64 0.998574 0.699147 36967.4513		- 			0.500000	9.065840	<u> </u>			458.458008
		Mean val	173.7	0.995550	0.501289	12.498505				36967.451376
				0.001952	0.000503	2.136030		0.001683	0.191128	16386.478158

Table E.15: Results for Benchmark S38417

Rest	S38584,testin	e leneth	= 64K								
1885	Ele Inp	S	A	N.PO]		Resl_I	Tim.Str.	N.Sg			Tim,Furt
Trips					0.999768	0.530721	3.031420	i	0.999974	T.0000000	2405.189941
Type	1718 -1				0.999768	0.530721					7405.189941
1774		+	-					- i -	0.999974	1.0000000	2405.189941
1	1734 -1			9	0.999758	0.530721	3.031420				2405.189941
17747 1		+			0.999974		2.899240	 i 	0.999974	1.0000000	388.027008
1771 7	17747 -1				0.999897						
This -1				-1-1	0.999897		2.972440	 	0.999974	1.0000000	976.476013
1855 0	1818 -1		5	_ i	0.999974	1.000000	2.863750				
1885 1	18463 -1 38029 -1		} 					 		1.0000000	3850.189941
37745 0 1 21 0.99267 1.000000 3350.18941 1.000000 3350.18941 1.00000 3350.18941 1.00000 3350.18941 1.00000 3350.18941 1.00000 3350.18941 1.00000 3350.18941 1.000000 3350.18941 1.000000 3350.18941 1.000000 3350.18941 1.000000 3350.18941 1.000000 3350.18941 1.000000 3350.18941 1.000000 3350.18941 1.0000000 3350.18941 1.000000 3350.18941 1.0000000 3350.18941 1.00000000000000000000000000000000000	18555 0	T		71	0.999459	0.495961	3.414780			1.000000	3850.189941
2246			} 		0.999459	0.495961		 		1.0000000	3850.189941
373173	32446 1			21	0.999459	0.495961					3850.189941
28007 - 1					0.999459			i i	0.999974	1.0000000	3850.189941
1	28007 -1			21	0.999459	0.495961	3.414780			1.000000	3850.189941
1		+	} 					 	0.999974	1.000000	383.937988
1	14565 -1			28	0.999278	0.500000	3.507170			0.820948	5383.319824
37685 1 28 0.99978 0.50000 3.50710 1 0.999974 0.50000 3.50710 1 0.999974 0.50000 3.50710 2 0.509988 0.502988 3.503.10824 0.502988 0.502978 0.502988 0.502988 0.502978 0.502988 0.502988 0.502988 0.502988 0.502978 0.502988 0.502978 0.502988 0.502988 0.502988 0.502978 0.502988 0.502978 0.502988 0.502978 0.502988 0.502978 0.502988 0.502978 0.502988 0.502978 0.502988 0.502978 0.502988 0.502978 0.502988 0.502978 0.502988 0.502978 0.502988 0.502978 0.502988 0.502978 0.502988 0.502978 0.502988 0.502978 0.502988 0.502988 0.502978 0.502988 0.502988 0.502978			7		0.999278	0.500000		 		0.820948	5383.319824
1986 1 28	34626 1			28	0.999278	0.500000	3.507170	1	0.999974	0.830948	5383.319824
19858			1 1					 2	0.999948	0.820948	5383.319824
1985 1	19566 1	1	ī	28	0.999278	0.500000	3.507170		0.999948	0.820948	5383.319824
1996 1		1	1							0.820948	5383.319824
1985	30910			28	0.999278	0.500000	3.507170	1	0.999897	0.820948	5383.319824
18572 1					0.999278 0.999278		3.507170	1 2	0.999948	0.820948	5383.319824
Sect -1	28522 -1			28	0.999278	0.500000	3.507170	1	0.999974	0.820948	5383.319824
9975 - 1							3.507170	+ 1		1.000000	2692.500000
171277	9075 -1		<u>i</u>	11	0.999715	0.523939	3.084710	T I	0.999974	1.000000	2692.500000
T1727	21277 -1		<u>. </u>					 			2692.500000
102472	21287 -1			11	0.999715	0.523939	3.064710		0.999974	1.000000	2592.500000
102422						0.523939	3.064710	++-	0.999974	1.000000	
11432 -1	10242 -1	+	ĭ	137	0.998468	0.502519	5.552830	Ť	0.999974	0.973774	28033.000000
120471		\perp	-		0.996468		5.552830	1-1-			28033.000000
20471	20471 -1	+	† 		0.996468	0.502519	5.552830		0.999923	0.973774	28033.000000
120476	20471 1		-	137		0.502519			0.999948	0.973774	28033.000000 28033.000000
20474 1	20476 1		† 			0.502519	5.552830	1 2	0.999948	0.973774	28033.000000
271513 - 1 137 0.998488 0.502519 5.552830 1 0.999974 0.973774 28035.00000 21543 - 1 1 137 0.998488 0.502519 5.552830 1 0.999974 0.973774 28035.00000 21543 - 1 1 137 0.998488 0.502519 5.552830 1 0.999974 0.973774 28035.00000 21543 - 1 1 137 0.998488 0.502519 5.552830 1 0.999974 0.973774 28035.00000 22722 1 1 0 137 0.998488 0.502519 5.552830 1 0.999974 0.973774 28035.00000 22722 1 1 0 137 0.998488 0.502519 5.552830 1 0.999974 0.973774 28035.00000 22722 1 1 0 137 0.998488 0.502519 5.552830 1 0.999974 0.973774 28035.00000 22722 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	20475		1		0.996468		5.552830	3			
271513			†		0.996468		5.552830	+ -	0.999974	0.973774	28033.000000
71583 1 0 137 0.998468 0.502519 5.552830 1 0.999974 0.973774 28033.00000 721190 1 0 137 0.998468 0.502519 5.552830 1 0.999974 0.973774 28033.00000 721273 1 1 137 0.998468 0.502519 5.552830 1 0.999974 0.973774 28033.00000 721273 1 0 137 0.998468 0.502519 5.552830 1 0.999974 0.973774 28033.00000 721273 1 0 137 0.998468 0.502519 5.552830 1 0.999974 0.973774 28033.00000 723335 -1 1 137 0.998468 0.502519 5.552830 1 0.999974 0.973774 28033.00000 72941 -1 1 137 0.998468 0.502519 5.552830 1 0.999974 0.973774 28033.00000 72941 -1 1 137 0.998468 0.502519 5.552830 1 0.999974 0.973774 28033.00000 72941 -1 1 137 0.998468 0.502519 5.552830 1 0.999974 0.973774 28033.00000 72941 -1 1 137 0.998468 0.502519 5.552830 1 0.999974 0.973774 28033.00000 72942 0 1 137 0.998468 0.502519 5.532830 1 0.999974 0.973774 28033.00000 72943 0 1 137 0.998468 0.502519 5.532830 1 0.999974 0.973774 28033.00000 72943 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	21513			137		0.502519					
27190 -1	21543 ·1				0.996468			 	0.999974	0.973774	28033.000000
227223 1 0 137 0.996488 0.502519 5.552850 1 0.999974 0.973774 28035.000000 235355 1 1 137 0.996488 0.502519 5.552850 1 0.999974 0.973774 28035.00000 25535 1 1 137 0.996488 0.502519 5.552850 1 0.999974 0.973774 28035.00000 25536 1 1 137 0.996488 0.502519 5.552850 1 0.999974 0.973774 28035.00000 25105 0 0 137 0.996488 0.502519 5.552850 1 0.999974 0.973774 28035.00000 277320 0 1 137 0.996488 0.502519 5.552850 1 0.999974 0.973774 28035.00000 277320 1 137 0.996488 0.502519 5.552850 1 0.999974 0.973774 28035.00000 277320 1 137 0.996488 0.502519 5.552850 1 0.999974 0.973774 28035.00000 277320 1 137 0.996488 0.502519 5.552850 1 0.999974 0.973774 28035.000000 277321 1 137 0.996488 0.502519 5.552850 1 0.999974 0.973774 28035.000000 277374 1 1 137 0.996488 0.502519 5.552850 1 0.999974 0.973774 28035.000000 277377 1 1 137 0.996488 0.502519 5.552850 1 0.999974 0.973774 28035.000000 277377 3 1 137 0.996488 0.502519 5.552850 1 0.999974 0.973774 28035.000000 277926 0 1 137 0.996488 0.502519 5.552850 1 0.999974 0.973774 28035.000000 277927 1 1 137 0.996488 0.502519 5.552850 1 0.999974 0.973774 28035.000000 277928 1 1 137 0.996488 0.502519 5.552850 1 0.999974 0.973774 28035.000000 279105 3 1 137 0.996488 0.502519 5.552850 1 0.999974 0.973774 28035.000000 279105 3 1 137 0.996488 0.502519 5.552850 1 0.999974 0.973774 28035.000000 27913 1 1 137 0.996488 0.502519 5.552850 1 0.999974 0.973774 28035.000000 27913 1 1 137 0.996488 0.502519 5.552850 1 0.999974 0.973774 28035.000000 27913 1 1 137 0.996488 0.502519 5.552850 1 0.999974 0.973774 28035.000000 27915 1 1 137 0.996488 0.502519 5.552850 1 0.999974 0.973774 28035.000000 27915 2 1 137 0.996488 0.502519 5.552850 1 0.999974 0.973774 28035.000000 27915 2 1 137 0.996488 0.502519 5.552850 1 0.999974 0.973774 28035.000000 27915 2 1 137 0.996488 0.502519 5.552850 1 0.999974 0.973774 28035.000000 27915 2 1 137 0.996488 0.502519 5.552850 1 0.999974 0.973774 28035.000000 27915 2 1 137 0.996488 0.502519 5.552850 1 0.999974 0.973774 28035.0000000 27915 2 1 137 0.996488 0.502519 5.552850 1 0.99	22190 -1		I	137	0.996468						28033.000000
22323 1 1 37 0.998468 0.507519 5.552830 1 0.999974 0.973774 28033.00000 78941 -1 1 137 0.998468 0.507519 5.552830 1 0.999974 0.973774 28033.00000 78941 -1 1 137 0.998468 0.507519 5.552830 1 0.999974 0.973774 28033.00000 78941 -1 1 137 0.998468 0.507519 5.552830 1 0.999974 0.973774 28033.00000 78940 -1 0 137 0.998468 0.507519 5.552830 1 0.999974 0.973774 28033.00000 78940 1 137 0.998468 0.507519 5.552830 1 0.999974 0.973774 28033.00000 78940 1 137 0.998468 0.507519 5.552830 1 0.999974 0.973774 28033.00000 78940 1 137 0.998468 0.507519 5.552830 1 0.999974 0.973774 28033.00000 78940 1 137 0.998468 0.507519 5.552830 1 0.999974 0.973774 28033.00000 78940 1 137 0.998468 0.507519 5.552830 1 0.999974 0.973774 28033.00000 78940 1 137 0.998468 0.507519 5.552830 1 0.999974 0.973774 28033.00000 78940 1 137 0.998468 0.507519 5.552830 1 0.999974 0.973774 28033.00000 78940 1 137 0.998468 0.507519 5.552830 1 0.999974 0.973774 28033.00000 78940 1 137 0.998468 0.507519 5.552830 1 0.999974 0.973774 28033.00000 78940 1 137 0.998468 0.507519 5.552830 1 0.999974 0.973774 28033.00000 78940 1 137 0.998468 0.507519 5.552830 1 0.999974 0.973774 28033.00000 78943 1 137 0.998468 0.507519 5.552830 1 0.999974 0.973774 28033.00000 78943 1 137 0.998468 0.507519 5.552830 1 0.999974 0.973774 28033.00000 78943 1 137 0.998468 0.507519 5.552830 1 0.999974 0.973774 28033.00000 78943 1 137 0.998468 0.507519 5.552830 1 0.999974 0.973774 28033.00000 78943 1 137 0.998468 0.507519 5.552830 1 0.999974 0.973774 28033.00000 78943 1 137 0.998468 0.507519 5.552830 1 0.999974 0.973774 28033.00000 77385 3 1 137 0.998468 0.507519 5.552830 1 0.999974 0.973774 28033.00000 77385 3 1 137 0.998468 0.507519 5.552830 1 0.999974 0.973774 28033.00000 77385 3 1 137 0.998468 0.507519 5.552830 1 0.999974 0.973774 28033.00000 77385 3 1 137 0.998468 0.507519 5.552830 1 0.999974 0.973774 28033.00000 77385 3 1 137 0.998468 0.507519 5.552830 1 0.999974 0.973774 28033.00000 77385 3 1 137 0.998468 0.507519 5.552830 1 0.999974 0.973774 28033.00000 77385 3 1 137 0.998468 0.507519 5	22190 1	+					5.552830	 		0.973774	28033.000000
26931 1	22223			137	0.996468	0.502519	5.552830				
31904 -			1		0.990408 0.998488	0.502519		+ +			28033.000000
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79728 7 1 137	27347 3		Ĭ	137	0.998488	0.502519	5.552830		0.999974	0.973774	28033.000000
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28114 0 1 137 0.998488 0.502519 5.552830 1 0.999974 0.973774 28033.000000 27450 1 1 137 0.998488 0.502519 5.552830 1 0.999974 0.973774 28033.000000 27450 3 1 137 0.998488 0.502519 5.552830 1 0.999974 0.973774 28033.000000 27450 3 1 137 0.998488 0.502519 5.552830 1 0.999974 0.973774 28033.000000 27873 0 1 137 0.998488 0.502519 5.552830 1 0.999974 0.973774 28033.000000	27655 1	\dashv	1	137	0.996468	0.502519	5.552830			0.973774	28033.000000
27450 1 137 0.998468 0.502519 5.552830 1 0.999974 0.973774 28033.000000 27450 3 1 137 0.998468 0.502519 5.552830 1 0.999974 0.973774 28033.000000 27873 0 1 137 0.998468 0.502519 5.552830 1 0.999974 0.973774 28033.000000			-		0.996468		5.552830	1	0.999974	0.973774	28033.000000
27873 0 1 137 0.998468 0.502519 5.352830 1 0.999974 0.973774 28033.000000 Mean val 84.2 0.997829 0.520643 4.543598 1.21 0.999989 0.960246 17215.117678	27450		ī	137	0.996468	0.502519	5.552830			0.973774	
Mean val 84.2 0.997829 0.520643 4.543598 1.21 0.999989 0.980246 17215.117676			1		0.996468 0.996468		3.352830 5.352830	 			28033.000000
			an val						0.999969		17215.117678
									0.000018	0.080338	13551.076979

Table E.16: Results for Benchmark S38584

S386, testing	Tength = 64	K					FE2	Resl.2	Tim,Furt
Sie Inp	- SA	N.PO	PE1 0.988293	Resl_1 0.538735	Tim.Str. 0.008797	N.Sg	0.997561	1.0000000	191.985992
99 -1	ī	13	0.968293	0.538735	0.008797		0.997561	1.0000000	191.985992
119 -1	9	13	0.968293 0.968293	0.538735 0.538735	0.008797		0.997561 0.997561	1.000000	191.985992
119 -1	 	13	0.968293	0.538735	0.008797	 	0.997561	1.000000	191.985992
187 -1	- 	13	0.968293	0.538735	0.008797		0.997561	1.0000000	191.985992
30 -1	1	13	0.968293	0.538735	0.008797		0.997561	1.000000	191.985992
30 -1 43 -1	O .	13	0.968293	0.538735 0.538735	0.008797	 	0.997561	1.000000	191.985992
43 -1	- 6 -	13	0.968293	0.538735	0.008797	 i 	0.997561	1.000000	191.985992
49 -1	Ť	13	0.968293	0.538735	0.008797		0.997561	1.000000	191.985992
49 -1	0	13	0.968793	0.538735	0.008797		0.997561 0.997561	1.000000	191.985997
60 -1 60 -1	0	13	0.968293	0.538735 0.538735	Q.008797 Q.008797	├─ ╈─┤	0.997561	1.000000	191.985992
67 -1	- ĭ -	13	0.968293	0.538735	0.008797		0.997561	1.000000	191.985992
87 -1	0	13	0.968293	0.538735	0.008797		0.997561	1.000000	191.985992
72 -1	1 1	13	0.968293	0.538735 0.538735	0.008797	├─┼ ─┤	0.997561 0.997561	1.000000	191.985992
78 1	- i -	13	0.968293	0.538735	0.008797	 	0.997561	1.0000000	191.985992
78 -1	0	13	0.968293	0.538735	0.008797		0.997561_	1.000000	191.985992 132.931000
88 -1	0	47	0.885366	0.498600	0.011424		0.997551 0.997561	0.971651	132.931000
238 -1	- i -	47	0.885366	0.498600	0.011424	 	0.997561	0.971631	132.931000
272 -1	0	47	0.885356	0.498600	0.011424		0.997561	0.971651	132.931000
311 -1	1	47	0.885366	0.498600	0.011424		0.997561	0.971651	132.931000
329 -1	 	47	0.885356	0.498800	0.011424	 i 	0.997561	0.971651	132.931000
357 -1	0	47	0.885386	0.498600	0.011424		0.997561	0.971551	132.931000
375 -1		47	0.885355	0.498600	0.011424	7	0.995122	0.971651 0.971651	132.931000 132.931000
379 -1	0	47	0.885366	0.498600	0.011424	├─ ई─┤	0.997561	0.971651	132.931000
322 0	l ĭ	47	0.885366	0.498600	0.011424		0.997561	0.971681	132.931000
322 1		47	0.885366	0.498600	0.011424		0.997561	0.971651	132.931000
322 2 270 0	0	47	0.885366	0.498600	0.011424	 	0.997561	0.971651	132.931000
233 0	1 -	1-37	0.885366	0.498600	0.011424		0.997561	0.971651	132.931000
233	1	47	0.885366	0.498800	0.011424		0.997561	0.971651	132.931000
270 I	- 0	47	0.885366 0.885366	0.498600	0.011424	 	0.997561	0.971651	IKVA'KODUD
234	1 :	47	0.885366	0.498800	0.011424		0.997561	0.971651	132.931000
375 0	1	47	0.885366	0.498800	0.011424		0.997561	0.971651	132.931000 132.931000
357 U	<u> </u>	47	0.885366 0.885366	U.498600 U.498600	0.011424	 	0.997551	0.971651	132.931000
269 1	<u> </u>		0.888366	0.498600	0.011424	l i	0.997561	0.971651	132.931000
259 2	1 1	47	0.885366	0.498500	0.011424		0.997561	0.971631	132.931000
259 3 258 U	1	47	0.885366 0.885366	0.498800 0.498800	0.011424	 	0.997561	0.971651	132.931000
268 1	- i -	47	0.885366	0.498600	0.011424	 	0.997581	0.971651	132,931000
258 2	i	47	0.885356	0.498600	0.011424	1	0.997561	0.971651	132.931000
350 0 329 0	1 1	47	0.885366 0.885366	0.498500	0.011424		0.997581	0.971651	132.931000
329 0	 	1 37	0.885366	0.498600	0.011424	 	0.997561	0.971651	132.931000
310 1	1	47.	0.885366	0.498600	0.011424		0.997561	0.971651	132.931000 132.931000
271 0	8	47	0.885366	0.498600	0.011424	+	0.997561	0.971681	132.931000
271 1	+ 1	47	0.885366	0.498600	0.011424	 i 	0.997561	0.971651	132.931000
235 1	<u> </u>	47	0.885366	0.498600	0.011424		0.997581	0.971651	132.931000
311 0		47	0.885366	0.498600	0.011424	-	0.997561	0.971651	132,931000
311 1 272 1	 6 	47	0.885366	0.498800	0.011424	 	0.997361	0.971651	132.931000
237 0		47	0.885366	0.498800	0.011424		0.997561	0.971651	132.931000
237 1	1 1	47	0.885366	0.498600	0.011424 0.011424	 	0.997561	0.971651	132.931000
236 2	+i -	47	0.885366	0.498800	0.011424	 	0.997361	0.971651	132.931000
387 -1	Ů	47	0.885368	0.498600	0.011424	2	0.995122	0.971651	132.931000
387 -1	1	47	0.885386	0.498600	0.011424	7	0.995122	1.000000	9.149800
181 -1	 	+ 2	0.995122	0.500000	0.008498	 - i -	0.997561	1.000000	9.149800
205 -I	Ū,	1 2	0.995122	0.500000	0.009247		0.997561	1.000000	16.648800
208 -1	1	77	0.995122	0.500000	0.009247	1	0.997581	0.947910	18.848800 79.248596
261 -1 261 -1	7 0	27	0.934146	0.500000	0.010456	 	0.997561	0.947910	79.248596
327 -1	i i	27	0.934146	D.500000	0.010456	T i	0.997561	0.947910	79.248596
349 -1		27	0.934146	0.500000	0.010456	1 - 1	0.997561	0.947910	79.248596 79.248598
356 -1 376 -1	0	27	0.934146	0.500000	0.010456	 	0.995122	0.947910	79.248596
377 -1	<u> </u>	27	0.934146	0.500000	0.010456	1 2	0.995122	0.947910	79.248596
377 0	1 1	27	0.934146	0.500000	0.010458 0.010458		0.997561	0.947910	79.248596 79.248595
377 1 376 U	++-	27	0.934146	0.500000	0.010456	 	0.997561	0.947910	79.248596
376	1	27	0.934146	0.500000	0.010456		0.997561	0.947910	79.248596
356 0	0	27	1 0.934146	0.500000	0.010456 0.010456		0.997561	0.947910	79.248596 79.248596
267 0 267 1	+ +	27	0.934148	0.500000	0.010456	+-+	0.997561	0.947910	79.248596
267 2	1 1	27	0.934146	0.500000	0.010456	1	0.997561	0.947910	79.248596
266 0		27	0.934146 0.934146	0.500000	0.010456		0.997561	0.947910	79.248596 79.248596
266 1 266 2	+ + + -	27	0.934146	0.500000	0.010456	+	0.997561	0.947910	79.248596
349 0	1 1	27	0.934146	0.500000	0.010456	<u> </u>	0.997561	0.947910	79.248596
349 1		27	0.934146	0.500000	0.010456		0.997561 0.997561	0.947910	79.248596
327 I 308 U	 	27	0.934146 0.934146	0.500000	0.010456 0.010456	+ - } -	0.997361	0.947910	79.248596
308 1	 	27	0.934146	0.500000	0.010456	<u> </u>	0.997561	0.947910	79.248596
261 0	1	27	0.934146	0.500000	0.010456		0.997561	0.947910	79.248598 79.248598
261 1 389 -1	- 1 - 1 -	27	0.934146	0.500000	0.010456	1 2	0.997561	0.947910	79.248596
389 -1 389 -1	 "	27	0.934146	0.500000	0.010456	+ 2-	0.995122	0.947910	79.248596
294 -1	Ü	7	0.995122	0.500000	0.009009	1	0.997561	1.000000	9.233570_
294 -1 240 -1	1 1	46	0.995122	0.500000	0.009009	1	0.997561	0.970922	9.233570
490					0.011301	1.08	0.997366	0.972604	122.942513
	Mean val		0.921732		0.0010488	0.27	0.000665	0.019073	
	1 240 GEAL	1 13.3	1 0.001049	, 0.010810	1 0.001013	2.4.			

Table E.17: Results for Benchmark S386

Str.	COMPANIES AND ADDRESS OF THE PARTY OF THE PA	Tonada = KI				-				
1.			N.PO				N.Sg	PE2	Resl_2	Tim,Furt
1	386 -1			0.975930	C.508910		2			
1				0.975930						54.464298
SS				0.975930		0.013731	2	0.995624	0.814897	54.464298
1				0.975930	0.508910	0.013731				
1				0.971554			 i 	0.997812		54.488400
1			13	0.971584	0.492075	0.012118			0.924957	54.488400
115					0.492075			0.997812		54.4884UU XX XXXXIII
315 0 0 0 13 0.971555 0.497075 0.072101 7 0.097812 0.092107 52.585308 52.69707 1 0 13 0.971555 0.492075 0.072107 1 0.097812 0.092837 52.585308 52.6971 1 0 13 0.971555 0.492075 0.072107 1 0.097812 0.092837 52.585308 52.6971 1 1 13 0.971555 0.492075 0.072107 1 0.097812 0.092837 52.585308 52.6971 0 1 1 1 1 1 1 0.971512 0.097812 0.092837 52.585308 52.6971 0 1 1 1 1 1 1 0.971512 0.097812 0.092837 52.585308 52.6971 0 1 1 0 1 1 0 0.971515 0.097812 0.092837 52.585308 52.6971 0 0 1 1 0 0.971515 0.097812 0.092837 52.585308 52.6971 0 0 1 1 0 0.971515 0.097812 0.092837 52.585308 52.6971 0 0 0 1 0 0.971515 0.097812 0.092837 52.585308 52.6971 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0				0.971554	0.492075		 1 			54.488400
1				0.971554	0.492075	0.012116	2	0.995624	0.924957	54.488400
Total	400 -1			0.971584	0.492075				0.924957	
1				0.971554			┝╌┼			54.668598
100 1				0.971554		0.012819		0.997812	0.924957	54.668598
1	409 0		13	0.971554			\Box			54,668598
1							├─ ╪─┤			
1	300 1 -1	├ ──Ÿ			0.474539				0.814038	36.241199
THE 1	399 0	- Ö	10	0.978118	0.474539				0.814038	
Text T					0.474839	0.012200	 3		0.814038	36.241199
10							l i l		0.814038	36.307400
13	450 I		10	0.978118	0.474539	0.012403			0.814038	36.307400
15			10							
175 1 1 1 1 1 1 1 1 1				0.971554	0.492075	0.012390	 		0.875000	54.437099
1			13	0.971554	0.492075	0.012390		0.997812	0.875000	54.437099
187 1	375 1		13		0.492075	0.012390	-7-			
Total		 		0.971554	0.492075		 			
1	187 -1	- i		0.529540	0.495189	0.027290		0.997812	U.687633	882.560974
173 1	249 -1		215	0.529540						882.560974
774	352 -1	ļ		U.529540			 	0.997812		BR2.580974
174	473 -1			0.529840	0.495169	0.027290	1	0.995524	0.687633	882.560974
1	474 0		215	0.529840	0.495159	0.027290				
173	398 1	_		0.529540						882.360974
175	351 1	- ō	215	0.529540	0.495159	0.027290	i i	0.997812	0.687633	882.560974
1	473 0	0	215		0.495169	0.027290				
1			215	0.529540			19			
1							 i 	0.997812	0.687633	882.560974
1	484		215	0.529540	0.495169	0.027290	19	0.958425	0.587633	
725.				0.529540		0.027290	 			
1	263	- 6 -		0.529540			+ 3 -	0.989059	0.687633	882.560974
1			215	0.529540	0.495159	0.027290	19	0.958425	0.587533	882.560974
348				0.529540	0.495169	0.027290	1 1		0.087633	882.50U974
1	390 1	 	715	0.529540	0.495159	0.027290	 			882.560974
350	464 2		215	0.529540	0.495169	0.027290	19			
1			215					0.997812	0.087033	882.500974
483 0 1 215 0.529840 0.495169 0.027290 1 0.997812 0.857633 882.580974 881 0 0 0 215 0.529840 0.495169 0.027290 1 0.997812 0.857633 882.580974 881 0 0 0 215 0.529840 0.495169 0.027290 1 0.997812 0.857633 882.580974 881 0 0 0 215 0.529840 0.495169 0.027290 1 0.997812 0.857633 882.580974 882 0 0 0 215 0.529840 0.495169 0.027290 1 0.997812 0.857633 882.580974 882 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	391 1			0.529540	0.495159	0.027290	 	0.997812		
405 1		 		0.529540	0,495159	0.027290		0.997812		
1	405 1		215	0.529540	0.495169		<u> </u>		0.687633	882.560974
1		-		0.529540	0.493109	0.027290	 - i -		0.687633	882.560974
1		 	218	0.529540	0.495159	0.027290	1 1 1	0.997812	0.687633	882.560974
1	313 1		215				\Box			
1							 	0.997812	0.687633	882.560974
1	394 0	 	215	0.529540	0.495169	0.027290	<u> </u>	0.997812	0.687633	882.560974
1	388 0		215	0.529540	0.495169					
1	347 0			0.529540			+ + -		0.007033	882.560974
388	136 0		215	0.529540	0.495169	0.027290	<u> Li</u>	0.997812	0.887833	882.560974
1	389 0	1	215	0.529540	0.495169	0.027290	1	0.997812		
OST				U.529540		0.027201	 			
308				0.529540	0.495169	0.027290	<u> </u>	0.997812	0.587533	882.560974
1	306 0	1	215	0.529540	0.495169	0.027290			0.687633	
1772 0 1 215 0.529540 0.495169 0.0277290 1 0.997812 0.687633 882,560974 257 0 0 215 0.529540 0.495169 0.0277290 1 0.997812 0.687633 882,560974 257 0 0 215 0.529540 0.495169 0.0277290 1 0.997812 0.687633 882,560974 257 1 0 215 0.529540 0.495169 0.0277290 1 0.997812 0.687633 882,560974 257 1 0 215 0.529540 0.495169 0.0277290 1 0.997812 0.687633 882,560974 258 1 1 215 0.529540 0.495169 0.0277290 1 0.997812 0.687633 882,560974 259 1 215 0.529540 0.495169 0.0277290 1 0.997812 0.687633 882,560974 250 1 215 0.529540 0.495169 0.0277290 1 0.997812 0.687633 882,560974 250 0 215 0.529540 0.495169 0.0277290 1 0.997812 0.687633 882,560974 250 0 215 0.529540 0.495169 0.0277290 1 0.997812 0.687633 882,560974 250 0 215 0.529540 0.495169 0.0277290 1 0.997812 0.687633 882,560974 250 0 0 215 0.529540 0.495169 0.0277290 1 0.997812 0.587633 882,560974 250 0 0 215 0.529540 0.495169 0.0277290 1 0.997812 0.587633 882,560974 250 0 0 215 0.529540 0.495169 0.0277290 1 0.997812 0.587633 882,560974 250 0 0 215 0.529540 0.495169 0.0277290 1 0.997812 0.587633 882,560974 250 0 0 215 0.529540 0.495169 0.0277290 1 0.997812 0.587633 882,560974 251 0.529540 0.495169 0.0277290 1 0.997812 0.587633 882,560974 251 0.529540 0.495169 0.0277290 1 0.997812 0.587633 882,560974 251 0.529540 0.495169 0.0277290 1 0.997812 0.687633 882,560974 251 0.529540 0.495169 0.0277290 1 0.997812 0.887633 882,560974 251 0.529540 0.495169 0.0277290 1 0.997812 0.887633 882,560974 251 0.529540 0.495169 0.0277290 1 0.997812 0.887633 882,560974 251 0.529540 0.495169 0.0277290 1 0.997812 0.887633 882,560974 251 0.529540 0.495169 0.0277290 1 0.997812 0.887633 882,560974 251 0.529540 0.495169 0.0277290 1 0.997812 0.887633 882,560974 251 0.529540 0.495169 0.0277290 1 0.997812 0.887633 882,560974 251 0.529540 0.495169 0.0277290 1 0.997812 0.887633 882,560974 251 0.529540 0.495169 0.0277290 1 0.997812 0.887633 882,560974 251 0.529540 0.495169 0.0277290 1 0.997812 0.887633 882,560974 251 0.529540 0.495169 0.0277290 1 0.997812		1 0					- i -		0.587633	882.560974
1		 		0.529840	0.495169	0.027290	<u> </u>	0.997812	0.687633	882.560974
\$\begin{array}{c c c c c c c c c c c c c c c c c c c	305 0		215	0.529540	0.495169	0.027290				
1	257 0	0	215	0.529540	1 20KTRD		++-		0.687833	
215 0 215 0.829540 0.495169 0.0277290 1 0.997812 0.887633 882.580974	303	 	215	0.529540	0.495169	0.027290	 i	0.997812	0.687633	882.560974
1	345 1	Ü	215	0.529540	0.495169	0.027290		0.997812	0.687633	882.560974
1		1 1	215	0.529540	0.495159	0.027290	+ +			
348 1 0 215 0.529540 0.495169 0.027290 1 0.997812 0.687633 882.560974 318 0 0 215 0.529540 0.495169 0.027290 1 0.997812 0.687633 882.560974 318 0 0 0 215 0.529540 0.495169 0.027290 1 0.997812 0.687633 882.560974 414 2 1 1215 0.529540 0.495169 0.027290 1 0.997812 0.687633 882.560974 403 1 0 215 0.529540 0.495169 0.027290 1 0.997812 0.687633 882.560974 313 0 1 215 0.529540 0.495169 0.027290 1 0.997812 0.887633 882.560974 213 0 1 215 0.529540 0.495169 0.027290 1 0.997812 0.887633 882.560974 213 0 1 215 0.529540 0.495169 0.027290 1 0.997812 0.887633 882.560974 213 0 1 215 0.529540 0.495169 0.027290 1 0.997812 0.887633 882.560974 215 0.529540 0.495169 0.027290 1 0.997812 0.887633 882.560974 108 1 0 215 0.529540 0.495169 0.027290 1 0.997812 0.887633 882.560974 177 1 0 215 0.529540 0.495169 0.027290 1 0.997812 0.887633 882.560974 177 1 0 215 0.529540 0.495169 0.027290 1 0.997812 0.887633 882.560974 177 1 0 215 0.529540 0.495169 0.027290 1 0.997812 0.887633 882.560974 180 1 0 215 0.529540 0.495169 0.027290 1 0.997812 0.887633 882.560974 180 1 0 215 0.529540 0.495169 0.027290 1 0.997812 0.887633 882.560974 180 1 0 215 0.529540 0.495169 0.027290 1 0.997812 0.687633 882.560974 180 1 0 215 0.529540 0.495169 0.027290 1 0.997812 0.687633 882.560974 180 1 0 215 0.529540 0.495169 0.027290 1 0.997812 0.687633 882.560974 180 1 0 215 0.529540 0.495169 0.027290 1 0.997812 0.687633 882.560974 180 1 0 215 0.529540 0.495169 0.027290 1 0.997812 0.687633 882.560974 180 1 0 215 0.529540 0.495169 0.027290 1 0.997812 0.687633 882.560974 180 1 0 215 0.529540 0.495169 0.027290 1 0.997812 0.687633 882.560974 180 1 0 215 0.529540 0.495169 0.027290 1 0.997812 0.687633 882.560974 180 1 0 215 0.529540 0.495169 0.027290 1 0.997812 0.687633 882.560974 180 1 0 215 0.529540 0.495169 0.027290 1 0.997812 0.687633 882.560974	387			0.529840	0.495169	0.027290	1 i	0.997812	0.687633	882.560974
215	346 1	i ö	215	0.529540	0.495169	0.027290		0.997812	0.687633	882.560974
414 2 1 218 0.529540 0.495169 0.0277290 1 0.997812 0.887633 882.560974 403 1 0 215 0.529540 0.495169 0.0277290 1 0.997812 0.887633 882.560974 544 1 0 215 0.529540 0.495169 0.0277290 1 0.997812 0.887633 882.560974 213 0 1 215 0.529540 0.495169 0.0277290 1 0.997812 0.887633 882.560974 311 0 1 215 0.529540 0.495169 0.0277290 1 0.997812 0.887633 882.560974 168 -1 0 215 0.529540 0.495169 0.0277290 1 0.997812 0.887633 882.560974 171 -1 0 215 0.529540 0.495169 0.0277290 1 0.997812 0.587633 882.560974 177 -1 0 215 0.529540 0.495169 0.0277290 1 0.997812 0.587633 882.560974 177 -1 0 215 0.529540 0.495169 0.0277290 1 0.997812 0.587633 882.560974 186 -1 0 215 0.529540 0.495169 0.0277290 1 0.997812 0.587633 882.560974 186 -1 0 215 0.529540 0.495169 0.0277290 1 0.997812 0.587633 882.560974 186 -1 0 215 0.529540 0.495169 0.0277290 1 0.997812 0.587633 882.560974 187 -1 0 215 0.529540 0.495169 0.0277290 1 0.997812 0.587633 882.560974 187 -1 0 215 0.529540 0.495169 0.0277290 1 0.997812 0.587633 882.560974 188 -1 0 215 0.529540 0.495169 0.0277290 1 0.997812 0.587633 882.560974 189 -1 0 215 0.529540 0.495169 0.0277290 1 0.997812 0.587633 882.560974 189 -1 0 215 0.529540 0.495169 0.0277290 1 0.997812 0.587633 882.560974 189 -1 0 215 0.529540 0.495169 0.0277290 1 0.997812 0.587633 882.560974 189 -1 0 215 0.529540 0.495169 0.0277290 1 0.997812 0.587633 882.580974				0.529540	0.495169	0.027290	+	U.997812	0.08/033	
003 1					0.495169	0.027290	1 i	0.997812	0.687633	882.560974
213 U 1 215 U.529540 U.495169 U.027290 1 U.997812 U.687833 882.560974 311 U 1 215 U.529540 U.495169 U.027290 1 U.997812 U.687633 882.560974 168 -1 U 215 U.529540 U.495169 U.027290 1 U.997812 U.687633 882.560974 171 -1 U 215 U.529540 U.495169 U.027290 1 U.997812 U.687633 882.560974 177 -1 U 215 U.529540 U.495169 U.027290 1 U.997812 U.687633 882.560974 177 -1 U 215 U.529540 U.495169 U.027290 1 U.997812 U.687633 882.560974 180 -1 U 215 U.529540 U.495169 U.027290 1 U.997812 U.687633 882.560974 186 -1 U 215 U.529540 U.495169 U.027290 1 U.997812 U.687633 882.560974 186 -1 U 215 U.529540 U.495169 U.027290 1 U.997812 U.687633 882.560974 187 -1 U 215 U.529540 U.495169 U.027290 1 U.997812 U.687633 882.580974 189 -1 U 215 U.529540 U.495169 U.027290 1 U.997812 U.687633 882.580974	403 1	Ŏ	215	0.529540	0.495169	0.027290	1	0.997812	0.687633	882.560974
311 0 1 215 0.329540 0.495169 0.0277290 1 0.997812 0.887633 882.350974 168 -1 0 215 0.329540 0.495169 0.0277290 1 0.997812 0.887633 882.350974 171 -1 0 215 0.329540 0.495169 0.0277290 1 0.997812 0.887633 882.350974 177 -1 0 215 0.329540 0.495169 0.0277290 1 0.997812 0.887633 882.350974 180 -1 0 215 0.329540 0.495169 0.0277290 1 0.997812 0.687633 882.350974 180 -1 0 215 0.329540 0.495169 0.0277290 1 0.997812 0.687633 882.350974 180 -1 0 215 0.329540 0.495169 0.0277290 1 0.997812 0.687633 882.350974 180 -1 0 215 0.329540 0.495169 0.0277290 1 0.997812 0.887633 882.350974 180 -1 0 215 0.329540 0.495169 0.0277290 1 0.997812 0.887633 882.350974 180 -1 0 215 0.329540 0.495169 0.0277290 1 0.997812 0.887633 882.350974 180 -1 0 215 0.329540 0.495169 0.0277290 1 0.997812 0.887633 882.350974 180 -1 0 215 0.329540 0.495169 0.0277290 1 0.997812 0.887633 882.350974 180 -1 0 215 0.329540 0.495169 0.0277290 1 0.997812 0.887633 882.350974 180 -1 0 215 0.329540 0.495169 0.0277290 1 0.997812 0.887633 882.350974 180 -1 0 215 0.329540 0.495169 0.0277290 1 0.997812 0.887633 882.350974 180 -1 0 215 0.329540 0.495169 0.0277290 1 0.997812 0.887633 882.350974 180 -1 0 215 0.329540 0.495169 0.0277290 1 0.997812 0.887633 882.350974 180 -1 0 215 0.329540 0.495169 0.0277290 1 0.997812 0.887633 882.350974 180 -1 0 215 0.329540 0.495169 0.0277290 1 0.997812 0.887633 882.350974 180 -1 0 215 0.329540 0.495169 0.0277290 1 0.997812 0.887633 882.350974 180 -1 0 215 0.329540 0.495169 0.0277290 1 0.997812 0.887633 882.350974 180 -1 0 215 0.329540 0.495169 0.0277290 1 0.997812 0.887633 882.350974 180 -1 0 215 0.329540 0.495169 0.0277290 1 0.997812 0.887633 882.350974 180 -1 0 215 0.329540 0.495169 0.0277290 1 0.997812 0.887633 882.350974 180 -1 0 215 0.329540 0.495169 0.0277290 1 0.997812 0.887633 882.350974 180 -1 0 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2				0.529540		0.027290	1	0.997812		
17				0.529540	0.405180	0.027200	++-	0.997812		
171 -1 0 215 0.529540 0.495169 0.027290 1 0.997812 0.887833 882.580974 177 -1 0 215 0.529540 0.495169 0.027290 1 0.997812 0.887833 882.580974 180 -1 0 215 0.529540 0.495169 0.027290 1 0.997812 0.687633 882.580974 186 -1 0 215 0.529540 0.495169 0.027290 1 0.997812 0.687633 882.580974 189 -1 0 215 0.529540 0.495169 0.027290 1 0.997812 0.687633 882.580974 189 -1 0 215 0.529540 0.495169 0.027290 1 0.997812 0.687633 882.580974 189 -1 0 215 0.529540 0.495169 0.027290 1 0.997812 0.687633 882.580974 189 -1 0 215 0.529540 0.495169 0.027290 1 0.997812 0.687633 882.580974 189 -1 0 215 0.529540 0.495169 0.027290 1 0.997812 0.687633 882.580974 189 -1 0 215 0.529540 0.495169 0.027290 1 0.997812 0.687633 882.580974 189 -1 0 215 0.529540 0.495169 0.027290 1 0.997812 0.687633 882.580974 189 -1 0 215 0.529540 0.495169 0.027290 1 0.997812 0.687633 882.580974 189 -1 0 215 0.529540 0.495169 0.027290 1 0.997812 0.687633 882.580974 189 0.027290 1 0.997812 0.687633 0.687633 0.022608	168 -1		213	0.529540	0.495169	0.027290		0.997812	0.687633	882.560974
180 -1 0 215 0.329540 0.495189 0.027290 1 0.997812 0.687633 882.560974 186 -1 0 215 0.329540 0.495189 0.027290 1 0.997812 0.687633 882.560974 189 -1 0 215 0.329540 0.495189 0.027290 1 0.997812 0.687633 882.580974 189 -1 0 215 0.329540 0.495189 0.027290 1 0.997812 0.687633 882.580974 189 -1 0 215 0.529540 0.495189 0.027290 1 0.997812 0.687633 882.580974 189 -1 0 215 0.529540 0.495189 0.027290 2 0.995142 0.745102 616.126910	171 -1	0	215	0.529540	0.495169	0.027290				882.560974
186 -1 U 215 U.529540 U.495169 U.027290 I U.997812 U.687633 882.560974 189 -1 U 215 U.529540 U.495169 U.027290 I U.997812 U.687633 882.560974 Mean val 150.0 0.671772 0.493785 0.022805 2.22 0.998142 0.745102 616.126910				0.529540		0.027290		0.997817	0.687633	
189 -1 U 215 0.529540 0.495169 0.027290 1 0.997812 0.687633 882.560974				0.529540	0.495169	0.027290	_ i i	0.997812	0.687633	882.560974
	189 -I					0.027290				
										616.126910
		Std devi	117.8	0.257715	0.009453	0.008501	5.17	0.011309	j 0.111564	482.782380

Table E.18: Results for Benchmark S420

Temporary Temp	S444, testing	length = 64	K						Peri 7	Tim Net
Total	Kle Inp	SA	N.PO	0.998031	Res[_1	Tim.Str. 0.010571	N.S _R	0.998031	Rest_2 1.000000	Tim,Furt 19.104300
107 - 1	76 -1			0.998031	1.0000000	0.010571				
177 1	106 -1		3							30.128201
Total	127 -1		21	0.958551	0.507360	0.013727		0.998031	0.752200	
The color	127 -1							0.994094		
Col.		- i		0.958661	0.507360	0.013727		0.998031	0.752200	98.678299
Total	401 2		77						0.752200	
STATE			- 21	0.958661	0.507360	0.013727		0.994094	0.752200	98.678299
Color			21		0.507380			0.994094		
Color		 		0.955551			1 2	0.996063	0.752200	98.678299
Color	439 -1		71	0.958661	0.507360	0.013727		0.992126	0.752200	
The color of the	439 -1		21	0.958661	0.507360	0.013727				
1	443		21	0.958551	0.507350	0.013727	3	0.994094	0.752200	98.578299
\$39								0.992126	0.752200	98.678299
1885 - 1	439 0	1	21	0.958661	0.507350	0.013727	4	0.992126	0.752200	98.678299
1885 1					0.507360			0.994094		
168					0.507350	0.013727	1	0.998031	0.752200	98.678299
1985 1	468 U			0.958561	0.507380					98.678299
1986 1					0.507360		1 4	0.992126	0.752200	98.678299
1984 1	294 -1	0	20	0.960630	0.511398	0.013127		0.994094	0.752200	98.599503
The color of the	294 -1			0.960630	0.511398		 	0.998031		
294 -1	294 1	0	20	0.960630	0.511398	0.013127	ī	0.998031	0.752200	98.599503
1	744 7					0.013127	1			98,599503
184 0 1 20 0.980830 0.511398 0.013127 3 0.984094 0.757200 98.599833 0.517381 0.013127 3 0.984094 0.757200 98.599833 0.517381 0.013127 3 0.984094 0.757200 98.599833 0.517381 0.013127 3 0.984094 0.757200 98.599833 0.517381 0.013127 3 0.984094 0.757200 98.599833 0.517381 0.013127 3 0.984094 0.757200 98.599833 0.517381 0.013127 3 0.984094 0.757200 98.599833 0.517381 0.013127 3 0.984094 0.757200 98.599833 0.517381 0.013127 3 0.984094 0.757200 98.599833 0.517382 0.013127 3 0.984094 0.757200 98.599833 0.577382 0.577382 0.577382 0.577382 0.577382 0.577382 0.577382 0.577382 0.5773	384 -1			0.960630	0.511398	0.013127		0.994094	0.752200	98.599503
376 - 1	364 -1		20	0.960630				0.994094		98.599503
376 1		1	20	0.960830	0.511398	0.013127	1 2	0.996063	0.752200	98.599503
1	376 -1		20	0.960630	T 0.511398	0.013127	1	0.992126		
1			 20	0.960630	0.511398		+ 3	0.994094	0.752200_	98.599503
3776 0 1 20 0.980630 0.511388 0.013127 3 0.984094 0.752200 98.598052 5776 1 1 20 0.980630 0.511388 0.013127 3 0.984094 0.752200 98.598052 5776 1 1 20 0.980630 0.511388 0.013127 3 0.984094 0.752200 98.598052 5776 1 1 20 0.980630 0.511388 0.013127 3 0.984094 0.752200 98.598052 5776 1 1 20 0.980630 0.511388 0.013127 1 0.980930 0.752200 98.598052 5776 5776 5776 5776 5776 5776 5776 57	381 1						3_			98.599503
376 0 1 20 0.980630 0.511389 0.013127 4 0.997125 0.752200 95.999635 451 1 1 20 0.980630 0.511389 0.013127 3 0.980630 0.752200 95.999635 451 1 1 20 0.980630 0.511389 0.013127 3 0.980630 0.752200 95.999635					0.511398		1 3	0.994094	0.752200	98.599503
AST	376 0	1 1	20	0.960630	0.511398	0.013127	3			98.599503
## 1	376 1				0.511398			0.004004		98.599503
## 151	451 -1	1	20	0.960630	0.511398	0.013127	Ī	0.998031	0.752200	98.599503
251 2 0 20 0.880830 0.511398 0.013127 4 0.992125 0.752200 98.999302 238 -1 0 24 0.952755 0.003191 0.014232 1 0.998031 0.903884 110.05898 1284 -1 1 24 0.952755 0.003191 0.014232 1 0.998031 0.903884 110.05898 1285 -1 1 0 24 0.952755 0.003191 0.014232 1 0.998031 0.903884 110.05898 283 -1 0 0 24 0.952755 0.003191 0.014232 1 0.998031 0.903884 110.05898 283 -1 0 0 24 0.952755 0.003191 0.014232 2 0.998031 0.903884 110.05898 283 -1 0 0 24 0.952755 0.003191 0.014232 2 0.998031 0.903884 110.05898 283 0.903884				0.960630	0.511398		 			98.599503
735 -1			20	0.960630	0.511398	0.013127		0.992126	0.752200	98.599503
785 -1				0.952756				0.998031	0.903884	110.058998
1	254 -1	 0	24	0.952756	0.503191	0.014232		0.998031	0.903884	110.058998
7857 T	263 -1							0.998031		
283 0 1 24 0.982786 0.503191 0.014232 1 0.98031 0.90384 110.035984 239 0 0 24 0.982786 0.503191 0.014232 1 0.98031 0.903884 110.035984 239 0 0 0 24 0.982786 0.503191 0.014232 1 0.98031 0.903884 110.035984 239 0 0 0 24 0.982786 0.503191 0.014232 1 0.98031 0.903884 110.035984 239 0 0 0 24 0.982786 0.503191 0.014232 1 0.98031 0.903884 110.035984 239 0 0 0 24 0.982786 0.503191 0.014232 1 0.98031 0.903884 110.035984 239 0 0 0 24 0.982786 0.503191 0.014232 1 0.98031 0.903884 110.035984 239 1 0 0 24 0.982786 0.503191 0.014232 1 0.98031 0.903884 110.03598 238 1 0 0 24 0.982786 0.503191 0.014232 1 0.98031 0.903884 110.03598 238 1 0 0 24 0.982786 0.503191 0.014232 1 0.98031 0.903884 110.03598 238 1 0 0 24 0.982786 0.503191 0.014232 1 0.98031 0.903884 110.03598 238 1 0 0 24 0.982786 0.503191 0.014232 1 0.98031 0.903884 110.03598 238 1 0 0 24 0.982786 0.503191 0.014232 1 0.98031 0.903884 110.03598 238 1 0 0 24 0.982785 0.503191 0.014232 1 0.98031 0.903884 110.03598 238 1 0 0 24 0.982785 0.503191 0.014232 1 0.98031 0.903884 110.03598 2423 -1 1 2 4 0.982785 0.503191 0.014232 1 0.98031 0.903884 110.03598 2423 -1 1 2 4 0.982785 0.503191 0.014232 1 0.98031 0.903884 110.03598 2423 -1 1 2 4 0.982785 0.503191 0.014232 1 0.98031 0.903884 110.03598 2423 -1 1 2 4 0.982785 0.503191 0.014232 1 0.98033 0.903884 110.03598 2423 -1 1 2 4 0.982785 0.503191 0.014232 1 0.98035 0.903884 110.03598 2423 -1 1 2 4 0.982785 0.503191 0.014232 1 0.98035 0.903884 110.03598 2423 -1 1 2 4 0.982785 0.503191 0.014232 2 0.98065 0.903884 110.03598 2423 -1 1 2 4 0.982785 0.503191 0.014232 2 0.98065 0.903884 110.03598 2423 -1 1 1 2 4 0.982785 0.503191 0.014232 2 0.98065 0.903884 110.03598 2423 -1 1 1 2 4 0.982785 0.503191 0.014232 2 0.98065 0.903884 110.035899 107 107 107 10 1 1 1 1 1 1 1 1 1 1 1 1						0.014232	<u> </u>	0.998031	0.903884	110.058998
10	263 0			0.952756	0.803191	0.014232				110.058998
1985 1	254 1	+			0.503191	0.014232	1-2	0.996063	0.903884	1 110.058998
238 2 0 74 0382738 0.503191 0.014232 1 0.988031 0.903884 110.08898 1 0 0 24 0.982738 0.503191 0.014232 1 0.988031 0.903884 110.08898 1 0 0 24 0.982738 0.503191 0.014232 1 0.988031 0.903884 110.08898 1 0 0 24 0.982738 0.503191 0.014232 1 0.988031 0.903884 110.08898 1 0.903884 1 0.018898 1 0 0 24 0.982738 0.503191 0.014232 1 0.988031 0.903884 1 10.08898 1 0.903884 1 0.018898 1 0.903884 1 0.018898 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0			24				+	0.998031	0.903884	110.058998
1			+ 27		0.503191		 	0.998031	0.903884	110.058998
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238 3				0.952756		0.014232	 	0.998031	0.903884	110.058998
1	238 3		24	0.952756	0.503191	0.014232	1			110.058998
A47 T					0.503191	0.014232	 i 	0.998031	0.903884	110.058998
1	447 -1	1	24	0.952756	0.503191	0.014232		0.908083	0.903884	110.058998
1		1 7				0.014232	+ 1	0.998031	0.0030084	110.058998
423 1 1 24 0.3537788 0.303191 0.014232 1 0.998083 0.903884 110.08899 423 2 1 24 0.953788 0.303191 0.014232 1 0.998083 0.903884 110.08899 423 2 1 24 0.953788 0.303191 0.014232 1 0.998083 0.878000 84.109200 107 -1 0 18 0.968504 0.472841 0.011542 1 0.998083 0.878000 84.109200 107 -1 1 18 0.968504 0.472841 0.011542 1 0.998083 0.878000 84.109200 153 -1 0 18 0.968504 0.472841 0.011542 1 0.998083 0.878000 84.109200 153 -1 1 18 0.968504 0.472841 0.011542 1 0.998083 0.878000 84.109200 153 -1 1 16 0.968504 0.472841 0.011542 1 0.998031 0.878000 84.109200 329 -1 1 16 0.968504 0.472841 0.011542 1 0.998031 0.878000 84.109200 331 -1 1 16 0.968504 0.472841 0.011542 1 0.998031 0.878000 84.109200 331 -1 1 16 0.968504 0.472841 0.011542 1 0.998031 0.878000 34.109200 331 -1 1 16 0.968504 0.472841 0.011542 1 0.998031 0.878000 34.109200 331 -1 1 16 0.968504 0.472841 0.011542 1 0.998031 0.878000 34.109200 331 0 1 1 16 0.968504 0.472841 0.011542 1 0.998031 0.878000 34.109200 329 0 1 16 0.968504 0.472841 0.011542 1 0.998031 0.878000 34.109200 329 1 1 16 0.968504 0.472841 0.011542 1 0.998031 0.878000 34.109200 329 1 1 16 0.968504 0.472841 0.011542 1 0.998031 0.878000 34.109200 329 1 1 16 0.968504 0.472841 0.011542 2 0.998083 0.878000 34.109200 329 1 1 16 0.968504 0.472841 0.011542 2 0.998083 0.878000 34.109200 329 1 1 16 0.968504 0.472841 0.011542 2 0.998083 0.878000 34.109200 329 1 1 10 0.968804 0.472841 0.011542 2 0.998083 0.878000 34.109200 329 1 1 1 0 0.968804 0.472841 0.011542 2 0.998083 0.878000 34.109200 329 1 1 1 0 0.968804 0.472841 0.011542 2 0.998083 0.878000 34.109200 320 1 1 1 0 0.968804 0.472841 0.011542 2 0.998083 0.878000 34.109200 320 1 1 1 0 0.968804 0.472841 0.011542 2 0.998083 0.878000 34.109200 320 1 1 1 0 0.968804 0.4728541 0.011542 2 0.998083 0.878000 34.109200 320 1 1 1 0 0.968804 0.4728541 0.011542 2 0.998083 0.878000 34.109200 320 1 1 1 0 0.968804 0.4728541 0.011542 2 0.998083 0.878000 34.109200 320 1 1 1 0 0.968804 0.4728541 0.011542 2 0.998083 0.878000 34.109200 320 1 1 1 0 0.988804 0.4728541 0.011542 2 0.99808	425 1	<u> </u>	724	0.952756	0.503191	0.014232			0.903884	110.058998
### 423								0.998031	0.903884	110.058998
107 -1	423 2		24	0.952756	0.503191	0.014232	2	0.996063	0.903884	110.058998
183 -1 0 18 0.988304 0.473841 0.011542 1 0.998083 0.878000 54.109200 153 -1 1 18 0.988304 0.473841 0.011542 1 0.998031 0.878000 54.109200 2329 -1 1 18 0.988304 0.473841 0.011542 1 0.998031 0.878000 54.109200 2329 -1 1 18 0.988304 0.473841 0.011542 1 0.998031 0.878000 54.109200 2329 -1 1 18 0.988304 0.473841 0.011542 1 0.998031 0.878000 54.109200 2331 -1 1 16 0.988304 0.473841 0.011542 1 0.998031 0.878000 54.109200 2331 0 1 18 0.988304 0.473841 0.011542 1 0.998031 0.878000 54.109200 2331 0 1 18 0.988304 0.473841 0.011542 1 0.998031 0.878000 54.109200 2432 0 0 16 0.988304 0.473841 0.011542 1 0.998031 0.878000 54.109200 2432 0 0 16 0.988304 0.473841 0.011542 2 0.998083 0.878000 54.109200 2432 0 0 16 0.988304 0.473841 0.011542 2 0.998083 0.878000 54.109200 2432 1 0 16 0.988304 0.473841 0.011542 2 0.998083 0.878000 54.109200 2432 1 0 1 0 10 0.988304 0.473841 0.011542 2 0.998083 0.878000 54.109200 2435 1 0 1 1 0 0.988304 0.473841 0.011542 2 0.998083 0.878000 54.109200 2435 1 0 1 1 0 0.988304 0.473841 0.011542 2 0.998083 0.878000 54.109200 2435 1 0 1 1 0 0.988303 0.473841 0.011542 2 0.998083 0.878000 54.109200 2405 1 0 0 1 1 0 0.988303 0.898025 0.011918 1 0.998031 0.878900 54.109200 2405 1 0 0 1 1 0 0.988303 0.898025 0.011918 1 0.998031 0.783973 81.498897 250 1 1 1 17 0.988338 0.809825 0.011918 3 0.994094 0.783973 81.498897 250 1 1 1 0 0.988338 0.809825 0.011918 3 0.994094 0.783973 81.498897 250 1 1 1 0 0.988338 0.809825 0.011918 2 0.998083 0.783973 81.498897 250 1 1 1 0 0.988338 0.809825 0.011918 2 0.998083 0.783973 81.498897 250 1 1 1 0 0.988338 0.809825 0.011918 2 0.998083 0.783973 81.498897 250 1 1 1 0 0.988338 0.809825 0.011918 2 0.998083 0.783973 81.498897 250 1 1 1 0 0.988338 0.809825 0.011918 2 0.998083 0.783973 81.498897 250 1 1 1 0 0.988338 0.809825 0.011918 2 0.998083 0.783973 81.498897 250 1 1 1 0 0.988338 0.809825 0.011918 2 0.998083 0.783973 81.498897 250 1 1 1 0 0.988338 0.809825 0.011918 2 0.998083 0.783973 81.498897 250 1 1 1 0 0.988338 0.809825 0.011918 2 0.998083 0.783973 81.498897 250 1 1 1 0 0.988	107 -1	- 0			0.472841	0.011542	1			54.109200
18	153 -1	 	16	0.968504	0.472641	0.011542	1 2	0.996063	0.875000	54.109200
329 -1 1 16	153 -1			0.968504	0.472641	0.011542	1	0.998031	0.875000	54.109200
331 U 1 18 U.968504 U.477841 U.011542 I U.996931 U.875000 34.109206 329 U 1 18 U.968504 U.477841 U.011542 I U.996983 U.875000 34.109206 329 U 1 18 U.968504 U.477841 U.011542 I U.996983 U.875000 34.109206 343 U 0 18 U.968504 U.477841 U.011542 2 U.996983 U.875000 34.109206 343 I 0 16 U.968504 U.477841 U.011542 2 U.996983 U.875000 34.109206 343 I 0 16 U.968504 U.477841 U.011542 2 U.996983 U.875000 34.109206 344 I 0 17 U.968504 U.477841 U.011542 2 U.996983 U.875000 34.109206 345 I 0 17 U.968505 U.509825 U.011918 I U.998081 U.785001 34.109206 341 U 1 1 U.968505 U.509825 U.011918 I U.998081 U.783975 81.496809 350 I 1 I I V.996853 U.509825 U.011918 I U.998081 U.783975 81.496809 350 I 1 I I V.996853 U.509825 U.011918 3 U.994094 U.783975 81.496809 350 U 1 I I V.996853 U.509825 U.011918 3 U.994094 U.783975 81.496809 350 U 1 I I V.9968535 U.509825 U.011918 3 U.994094 U.783975 81.496809 350 U 1 I V.9968535 U.509825 U.011918 2 U.996083 U.783975 81.496509 350 U 1 I V.9968535 U.509825 U.011918 2 U.996083 U.783975 81.496509 351 I I I V.9968535 U.509825 U.011918 2 U.996083 U.783975 81.496509 351 I I V.9968535 U.509825 U.011918 2 U.996083 U.783975 81.496509 351 I I V.9968535 U.509825 U.011918 2 U.996083 U.783975 81.496509 351 I I V.9968535 U.509825 U.011918 2 U.996083 U.783975 81.496509 351 I I V.9968535 U.509825 U.011918 2 U.996083 U.783975 81.496509 352 I I I V.9968535 U.509825 U.011918 2 U.996083 U.783975 81.496509 352 I I I V.9968535 U.509825 U.011918 2 U.996083 U.783975 81.496509 352 I I I V.9968535 U.509825 U.011918 2 U.996083 U.783975 81.496509 352 I I I V.9968535 U.509825 U.011918 2 U.996083 U.783975 81.496509 352 I I I V.9968535 U.509825 U.011918 2 U.996083 U.783975 81.496509 352 I I I V.9968535 U.509825 U.011918 2 U.996083 U.783975 81.496509 352 I I I V.9968535 U.509825 U.011918 2 U.996083 U.783975 81.496509 352 I I I V.9968535 U.509825 U.011918 2 U.996083 U.783975 81.496509 352 I I I V.9968535 U.509825 U.011918 2 U.996083 U.783975 81.496509 352 I I I V.9968535 U.509825 U.011918 2 U.996083 U.783975 81.496509	329 -1	 1	16	0.968504	0.472641	0.011542	<u> </u>	0.998031	0.875000	54.109200
329 0 1 18 0.983504 0.472841 0.011542 1 0.998031 0.875000 34.109202 243 0 0 18 0.983504 0.472841 0.011542 2 0.998083 0.875000 34.109202 243 1 0 18 0.988504 0.472841 0.011542 2 0.998083 0.875000 34.109202 2445 1 0 18 0.988504 0.472841 0.011542 2 0.998083 0.875000 34.109202 2445 1 0 18 0.988505 0.509825 0.011918 1 0.998031 0.783975 81.498597 210 -1 0 17 0.986835 0.509825 0.011918 1 0.998031 0.783975 81.498597 210 -1 1 17 0.986835 0.509825 0.011918 3 0.994094 0.783975 81.498597 250 -1 0 17 0.998633 0.509825 0.011918 3 0.994094 0.783975 81.498597 250 1 17 0.986835 0.509825 0.011918 3 0.994094 0.783975 81.498597 250 1 17 0.986835 0.509825 0.011918 2 0.998083 0.783975 81.498597 250 1 17 0.986835 0.509825 0.011918 2 0.998083 0.783975 81.498597 250 1 17 0.986835 0.509825 0.011918 2 0.998083 0.783975 81.498597 250 1 1 17 0.986835 0.509825 0.011918 2 0.998083 0.783975 81.498597 250 1 1 1 0.988535 0.509825 0.011918 2 0.998083 0.783975 81.498597 251 1 1 17 0.986835 0.509825 0.011918 2 0.998083 0.783975 81.498597 251 1 1 17 0.986835 0.509825 0.011918 2 0.998083 0.783975 81.498597 252 1 1 1 17 0.986835 0.509825 0.011918 2 0.998083 0.783975 81.498597 253 1 1 1 17 0.986835 0.509825 0.011918 2 0.998083 0.783975 81.498597 254 1 1 1 17 0.986835 0.509825 0.011918 2 0.998083 0.783975 81.498597 255 1 1 1 17 0.988535 0.509825 0.011918 2 0.998083 0.783975 81.498597 255 1 1 1 17 0.988535 0.509825 0.011918 2 0.998083 0.783975 81.498597 256 1 1 1 17 0.988535 0.509825 0.011918 2 0.998083 0.783975 81.498597 255 1 1 1 17 0.988535 0.509825 0.011918 3 0.994094 0.783975 81.498597 256 1 1 1 17 0.988535 0.509825 0.011918 3 0.994094 0.783975 81.498597 257 0 1 17 0.988535 0.509825 0.011918 3 0.994094 0.783975 81.498597 258 1 1 1 17 0.988535 0.509825 0.011918 3 0.994094 0.783975 81.498597 258 1 1 1 17 0.988535 0.509825 0.011918 3 0.994094 0.783975 81.498597 259 0 1 17 0.988535 0.509825 0.011918 3 0.994094 0.783975 81.498597 259 0 1 17 0.988535 0.509825 0.011918 3 0.994094 0.783975 81.498597 259 0 1 17 0.988535 0.509825 0.011918 3 0.994094 0.783975					0.472641		1		0.875000	54.109200
743 0 0 16 0.988504 0.472841 0.011542 2 0.996083 0.875000 54.109202 743 1 0 16 0.988504 0.472841 0.011542 2 0.996083 0.875000 54.109202 743 1 0 16 0.988504 0.472841 0.011542 2 0.996083 0.875000 54.109202 743 1 0 17 0.986535 0.509825 0.011918 0.996083 0.875000 54.109202 710 -1 0 17 0.986535 0.509825 0.011918 0.996083 0.875000 54.109202 710 -1 1 17 0.986535 0.509825 0.011918 0.996083 0.783975 81.496597 7250 -1 0 17 0.986535 0.509825 0.011918 3 0.994094 0.783975 81.496597 7250 -1 1 17 0.986535 0.509825 0.011918 3 0.994094 0.783975 81.496597 7250 -1 1 17 0.986535 0.509825 0.011918 3 0.994094 0.783975 81.496597 7250 1 1 17 0.986535 0.509825 0.011918 3 0.994094 0.783975 81.496597 7250 1 1 17 0.986535 0.509825 0.011918 3 0.994094 0.783975 81.496597 7250 1 1 1 17 0.986535 0.509825 0.011918 3 0.994094 0.783975 81.496597 7250 1 1 1 17 0.986535 0.509825 0.011918 2 0.996083 0.783975 81.496597 7251 1 1 1 17 0.986535 0.509825 0.011918 2 0.996083 0.783975 81.496597 7251 1 1 1 17 0.986535 0.509825 0.011918 2 0.996083 0.783975 81.496597 7251 1 1 1 1 0.986535 0.509825 0.011918 2 0.996083 0.783975 81.496597 7251 1 1 1 0.986535 0.509825 0.011918 2 0.996083 0.783975 81.496597 7251 1 1 1 0.986535 0.509825 0.011918 2 0.996083 0.783975 81.496597 7251 1 1 1 0.986535 0.509825 0.011918 2 0.996083 0.783975 81.496597 7251 1 1 1 0.986535 0.509825 0.011918 2 0.996083 0.783975 81.496597 7251 1 1 1 0.986535 0.509825 0.011918 2 0.996083 0.783975 81.496597 7251 1 1 1 0.986535 0.509825 0.011918 2 0.996083 0.783975 81.496597 7251 1 1 1 0.986535 0.509825 0.011918 2 0.996083 0.783975 81.496597 7251 1 1 1 0.986535 0.509825 0.011918 2 0.996083 0.783975 81.496597 7251 1 1 1 0.986535 0.509825 0.011918 2 0.996083 0.783975 81.496597 7251 1 1 1 0.986535 0.509825 0.011918 2 0.996083 0.783975 81.496597 7251 1 1 1 0.986535 0.509825 0.011918 2 0.996083 0.783975 81.496597 7251 1 1 1 0.986535 0.509825 0.011918 2 0.996083 0.783975 81.496597 7251 1 1 1 0.986535 0.509825 0.011918 2 0.996083 0.783975 81.496597 7251 1 1 1 0.986535 0.509825 0.011918 2 0.996083 0.78397	329 0			0.968504	0.472641	0.011542		0.998031	0.875000	54.109200
245 1	243 0		16	0.968504	0.472541	0.011542	7 7			54.109200
110	745			0.968504	0.472641	0.011542		0.996063	0.875000	54.109200
250 -1 0 17 0.986835 0.809825 0.011918 3 0.994094 0.783975 81.496597 250 -1 1 17 0.986835 0.809825 0.011918 3 0.994094 0.783975 81.496597 250 0 1 17 0.986835 0.809825 0.011918 2 0.996083 0.783975 81.496897 250 1 1 17 0.986835 0.809825 0.011918 2 0.996083 0.783975 81.496897 250 1 1 0 17 0.986835 0.809825 0.011918 2 0.996083 0.783975 81.496897 251 -1 0 17 0.986835 0.809825 0.011918 2 0.996083 0.783975 81.496897 251 -1 1 17 0.986835 0.809825 0.011918 2 0.996083 0.783975 81.496897 251 -1 1 17 0.986835 0.809825 0.011918 2 0.996083 0.783975 81.496897 252 0 1 17 0.986835 0.809825 0.011918 2 0.996083 0.783975 81.496897 252 0 1 17 0.986835 0.809825 0.011918 2 0.996083 0.783975 81.496897 252 0 1 17 0.986835 0.809825 0.011918 2 0.996083 0.783975 81.496897 252 0 1 17 0.986835 0.809825 0.011918 2 0.996083 0.783975 81.496897 252 0 1 17 0.986835 0.809825 0.011918 2 0.996083 0.783975 81.496897 252 0 1 17 0.986835 0.809825 0.011918 3 0.994094 0.783975 81.496897 252 0 1 17 0.986835 0.809825 0.011918 3 0.994094 0.783975 81.496897 262 1 1 1 0.986835 0.809825 0.011918 3 0.994094 0.783975 81.496897 263 1 1 1 0.986835 0.809825 0.011918 3 0.994094 0.783975 81.496897 264 1 1 0.986835 0.809825 0.011918 3 0.994094 0.783975 81.496897 265 1 0 1 17 0.986835 0.809825 0.011918 3 0.994094 0.783975 81.496897 265 1 0 0.981838 0.810817 0.013081 1.91 0.996083 0.883975 81.496897	210 -1	Ö	17	0.966535	0.509625	0.011918			0.783975	
750 -I 1 17 0.9868.35 0.809825 0.011918 3 0.994094 0.783975 81.496897 750 0 1 17 0.9868.35 0.809825 0.011918 2 0.996083 0.783975 81.496897 750 1 1 17 0.9868.35 0.809825 0.011918 2 0.996083 0.783975 81.496897 751 -I 0 17 0.9868.35 0.809825 0.011918 2 0.996083 0.783975 81.496897 751 -I 1 17 0.9868.35 0.809825 0.011918 2 0.996083 0.783975 81.496897 751 -I 1 17 0.9868.35 0.809825 0.011918 2 0.996083 0.783975 81.496897 764 -I 0 17 0.9868.35 0.809825 0.011918 2 0.996083 0.783975 81.496897 765 I 1 17 0.9868.35 0.809825 0.011918 2 0.996083 0.783975 81.496897 765 I 1 17 0.9868.35 0.809825 0.011918 2 0.996083 0.783975 81.496897 765 I 1 17 0.9868.35 0.809825 0.011918 2 0.996083 0.783975 81.496897 765 I 1 17 0.9868.35 0.809825 0.011918 3 0.996083 0.783975 81.496897 765 I 1 17 0.9868.35 0.809825 0.011918 3 0.996083 0.783975 81.496897 765 I 1 17 0.9868.35 0.809825 0.011918 3 0.996083 0.783975 81.496897 765 I 1 17 0.9868.35 0.809825 0.011918 3 0.996083 0.783975 81.496897 765 I 1 17 0.9868.35 0.809825 0.011918 3 0.996083 0.783975 81.496897 765 I 1 17 0.9868.35 0.809825 0.011918 3 0.996083 0.783975 81.496897 765 I 1 1 0.9868.35 0.809825 0.011918 3 0.996083 0.783975 81.496897 765 I 1 1 0.9868.35 0.809825 0.011918 3 0.996083 0.783975 81.496897 765 I 1 1 0.9868.35 0.809825 0.011918 3 0.996083 0.783975 81.496897 765 I 1 1 0.9868.35 0.809825 0.011918 3 0.996083 0.783975 81.496897 765 I 1 1 0.9868.35 0.809825 0.011918 3 0.996083 0.783975 81.496897 765 I 1 1 0.9868.35 0.809825 0.011918 3 0.996083 0.783975 81.496897					0.509625	0.011918	3	0.994094	0.783975	81.496597
250 1 1 17 0.966333 0.309825 0.011918 2 0.996083 0.783975 31.496597 281 -1 0 17 0.966333 0.309825 0.011918 2 0.996083 0.783975 31.496597 281 -1 1 17 0.966335 0.309825 0.011918 2 0.996083 0.783975 31.496597 284 -1 0 17 0.966335 0.309825 0.011918 2 0.996083 0.783975 31.496597 284 1 1 17 0.966335 0.309825 0.011918 2 0.996083 0.783975 31.496597 285 0 1 17 0.966335 0.309825 0.011918 2 0.996083 0.783975 31.496597 285 0 1 17 0.966335 0.309825 0.011918 2 0.996083 0.783975 31.496597 285 1 1 17 0.966335 0.309825 0.011918 3 0.996083 0.783975 31.496597 285 1 1 17 0.966335 0.309825 0.011918 3 0.996083 0.783975 31.496597 285 1 1 17 0.966335 0.309825 0.011918 3 0.996083 0.783975 31.496597 285 1 1 17 0.966335 0.309825 0.011918 3 0.996083 0.783975 31.496597	250 -1	ī	17	0.966535	0.509625	0.011918	3_			81.496597
281 -1 0 17 0.986838 0.809825 0.011918 2 0.996083 0.783975 81.496597 281 -1 1 17 0.986838 0.809825 0.011918 2 0.996083 0.783975 81.496597 284 -1 0 17 0.986838 0.509825 0.011918 3 0.994094 0.783975 81.496597 284 1 1 17 0.986838 0.509825 0.011918 2 0.996083 0.783975 81.496597 285 0 1 17 0.986838 0.509825 0.011918 2 0.996083 0.783975 81.496597 285 1 1 17 0.986838 0.509825 0.011918 2 0.996083 0.783975 81.496597 285 1 1 17 0.986838 0.509825 0.011918 3 0.994094 0.783975 81.496597 285 1 1 17 0.986838 0.509825 0.011918 3 0.994094 0.783975 81.496597 286 1 1 17 0.986838 0.509825 0.011918 3 0.994094 0.783975 81.496597 287 1 1 1 0.986838 0.509825 0.011918 3 0.994094 0.783975 81.496597 288 1 1 1 0.986838 0.509825 0.011918 3 0.994094 0.783975 81.496597		+						0.996063	0.783975	81.496597
284 -1 0 17 0.966535 0.509625 0.011918 3 0.994094 0.783975 31.496597 284 1 1 17 0.966535 0.509625 0.011918 2 0.996083 0.783975 81.496597 282 0 1 17 0.966535 0.509625 0.011918 2 0.996083 0.783975 81.496597 282 1 1 1 7 0.966535 0.509625 0.011918 3 0.996083 0.783975 81.496597 282 1 1 1 17 0.986535 0.509625 0.011918 3 0.994094 0.783975 81.496597 281 0 1 17 0.986535 0.509625 0.011918 3 0.994094 0.783975 81.496597 282 1 1 1 0.986535 0.509625 0.011918 3 0.994094 0.783975 81.496597 283 0 1 1 0.986535 0.509625 0.011918 3 0.994094 0.783975 81.496597	261 -1	<u> </u>	17	0.966535	0.509625	0.011918	2	0.996063	0.783975	81,496597
282 0 1 17 0.986835 0.809825 0.011918 2 0.996083 0.783975 81.498697 282 1 1 17 0.986835 0.809825 0.011918 3 0.994094 0.783975 81.498697 281 0 1 17 0.986835 0.809825 0.011918 2 0.996083 0.783975 81.49869 281 0 1 17 0.986835 0.809825 0.011918 2 0.996083 0.783975 81.49889 281 0 1 1 1 0.986835 0.809825 0.011918 2 0.996083 0.783975 81.49889 281 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		1							0.783975	81.496597
282 0 1 17 0.986835 0.509825 0.011918 2 0.996083 0.783975 81.496897 262 1 1 17 0.986835 0.509825 0.011918 3 0.994094 0.783975 81.496897 261 0 1 17 0.986835 0.509825 0.011918 2 0.996083 0.783975 81.496897 261 0 1 17 0.986835 0.509825 0.011918 2 0.996083 0.783975 81.496897 261 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	264 1		17	0.966535	0.509625	0.011918	2	0.996063	0.783975	81.496397
261 0 1 17 0.986835 0.509625 0.011918 2 0.996063 0.783975 81.49659	262 0	1	17	0.966535		0.011918	7	0.996063		
Mean val 19.6 0.961338 0.510817 0.013081 1.91 0.998240 0.818900 90.96095		- 		0.966535	0.509625	0.011918	1 2		0.783975	81.496597
Std devi 4.5 0.008890 0.073070 0.001099 1.01 0.001980 0.075880 21.793170			19.6						0.818900	90.960955
		Std devi	4.5	0.008890	0.073070	0.001099	1.01	0.001980	1 0.075880	21.793170

Table E.19: Results for Benchmark S444

S510, testing length =	MK.							
Ele Inp SA	N.PO	PEI	Rest_1	Tim.Str.	N.Sg	FE2 0.998227	Resl_2 1.000000	Tim,Furt 32.088799
439 -1 0 482 -1 0		0.984043	0.500000	0.012969	├─╁─ ┤	0.998227	1.0000000	32.088799
445 0 0	1 5 1	0.984043	0.500000	0.012969		0.998227	1.000000	32.088799 32.088799
439 0 0 430 7 0	- 8	0.984043 0.984043	0.500000	0.012969	- 1 - 1	0.998227	1.000000	32.088799
439 7 0 107 -1 1	+ - 22 +	0.960993	0.516032	0.018041	1	0.998227	1.000000	119.056999
110 -1 1	72	0.960993	0.516032	0.018041		0.998227	1.000000	119.056999
286 -1 1 286 1 0	72	0.960993	0.516032	0.018041	 i 	0.998227	1.0000000	119.056999
290 -1 0	22	0.960993	0.516032	0.018041		0.998227	1.000000	119.056999
304 -1 0	22	0.960993	0.516032 0.516032	0.018041	├ ┼	0.998227	1.000000	119.056099
304 -1 0	72	0.960993	0.516032	0.018041		0.998227	1.000000	119.058999
358 -1 0	72	0.960993	0.516032	0.018041		U.998227 U.998227	1.000000	119.056999
358 0 1 362 -1 0	72	0.960993	0.516032	0.018041	l i l	0.995227	1.000000	119.056999
362 0 1	22	0.980993	0.516032	0.018041		0.998227 0.998227	1.000000	119.056999
344 -1 0	72	0.960993	0.515032	0.018041	├─╁─ ┤	0.998227	1.000000	33.320499
344 0 1	- 6	0.989362	0.537157	0.014616		0.998227	1.000000	33.320499 33.320499
388 -1 0 388 0 1	5 5	0.989362	0.537157 0.537157	0.014616	 	0.998227 0.998227	1.000000	33.320499
257 -1 0	- 	0.987589	0.541977	0.014912	ī	0.998227	1.000000	48.063099
257 0 0	77	0.987589	0.541977 0.541977	0.014912		0.998227 0.998227	1.000000	48.063099 48.063099
264 -1 U	- 	0.987589	0.541977	0.014912	 i 	0.998227	1.000000	48.083099
8 -1 1	1 7	0.987589	0.541977	0.014912		0.998227	1.000000	48.063099
125 -1 0	2 5	0.996454 0.991135	0.500000	0.012229	 	0.998227	1.000000	14.129700 59.732399
151 -1 0	1 3 1	0.991135	0.526803	0.013189		0.998227	1.0000000	59.732399
47 -1 1	5	0.991135	0.526803	0.013189		0.998227 0.998227	1.0000000	59.732399 139.785995
178 -1 0	40	0.929078 0.929078	0.498278	0.017635		0.998227	1.000000	139.785995
451 -1 0	40	0.929078	0.498278	0.017635		0.998227	1.000000	139.785995
512 -1 0 406 0 0	40	0.929078 0.929078	0.498278	0.017635	┤╌ ┼╌┤	0.998227	1.000000	139.785995
329 0 1	40	0.929078	0.498278	0.017635		0.998227	1.000000	139.785995
221 1 1	40	0.929078	0.498278	0.017635	 	0.998227	1.0000000	139.785995
512 I I	40	0.929078	0.498278	0.017635	<u> i</u>	0.998227	1.000000	139.785995
501 0 0	40	0.929078	0.498278	0.017635		0.998227	1.000000	139.785995
426 I I	40	0.929078 0.929078	0.498278	0.017635	 i 	0.998227	1.000000	139.785995
438 0 0	40	0.929078	0.498278	0.017635		0.998227	1.000000	139.785995
501 2 0 490 1 1	40	0.929078	0.498278	0.017635	 	0.998227 0.998227	1.000000	139.785995
188 0 0	40	0.929078	0.498278	0.017635		0.998227	1.000000	139.785995
457 1 1	40	0.929078	0.498278	0.017635		0.998227	1.000000	139.785995
436 1 0 451 1 0	40	0.929078	0.498278	0.017635	 i 	0.9898227	1.000000	139.785995
181 0 1	40	0.929078	0.498278	0.017635		0.998227	1.000000	139.788995 352.843994
105 -1 1 503 -1 1	102	0.819149	0.497828 0.497828	0.024664	 	0.998227	1.000000	THE PARTY OF THE P
317 -1 -1	102	0.819149	U.497828	0.034664		0.998227	1.000000	352.843994 352.843994
522 0 1	102	0.819149 0.819149	U.497828 U.497828	0.024684	+ + -	0.998227	1.000000	352.843994
376 I I	102	0.819149	0.497828	0.024664	<u> </u>	0.998227	1.000000	352.843994
400 1 0	102	0.819149	0.497828	0.024664		0.998227	1.0000000	352.843994 352.843994
517 0 0 510 1 1	102	0.819149	0.497828	0.024884	 i 	0.998227	1.0000000	352,843004
340 0 1	102	0.819149	0.497828	0.024664		0.998227	1.000000	352.843994 352.843994
340 2 1 480 0 1	102	0.819149	0.497828	0.024564	 	0.998227	1.000000	352.843994
495 2 1	102	0.819149	0.497828	0.024554		0.998227	1.000000	352.843994
182 0 0	102	0.819149	0.497828	0.024564	++-	0.998227	1.000000	357.843994 357.843994
481 1 1 474 0 0	102	0.819149	0.497828	0.024664	<u>ti</u>	0.998227	1.000000	352,843994
427 1 1	102	0.819149	0.497828	0.024564		0.998227 0.998227	1.000000	352.843994 352.843994
428 0 1 516 0 1	102	0.819149	U.497828 U.497828	0.024664	+-+-	0.998227	1.000000	352.843994
282 0 0	102_	0.819149	0.497828	0.024664	1 1	0.998227	1.000000	352.843994 352.843994
178 1 1	102	0.819149	0.497828	0.024664	 	0.998227 0.998227	1.000000	352.843994
444 1 0	102_	0.819149	0.497828	0.024664	<u> </u>	0.998227	1.000000	352,843994
508 0 0	102	0.819149	0.497828	0.024884	+	0.998227	1.000000	352.843994 352.843994
289 0 0 177 1 1	102	0.819149	0.497828	0.024684	 i 	0.998227	1.000000	352.843994
180 0 1	102	0.819149	0.497828	0.024664	1	0.998227	1.000000	352.843994 352.843994
433 1 1 390 1 0	102	0.819149	0.497828 0.497828	0.024664	1 1	0.998227	1.0000000	357 843984
506 1 0	102	0.819149	0.497828	0.024664		0.998227	1.000000	352.843994 352.843994
493 I I	102	0.819149	0.497828	0.024864 0.024664	1	0.998227 0.998227	1.0000000	352 843984
331 0 1 331 2 1	:02	0.819149	0.497828	0.024004	 i	0.998227	1.000000	352.843994
434 0 1	102	0.819149	0.497828	0.024664 0.024664	 	0.998227	1.000000	352.843994 352.843994
434 2 1 491 0 1	102	0.819149 0.819149	0.497828	0.024884		0.998227	1.000000	352.843994
468 0 1	102	0.819149	0.497828	0.024884		0.998227	1.000000	352.843994 352.843994
442 1 0 449 0 0	102	0.819149	0.497828	0.024864	┿╌╁╌	U.998227	1.0000000	352,843994
468 2 1	102	0.819149	0.497828	0.024664		0.998227	1.000000	352.843994 352.843994
456 1 1	102	0.819149 0.819149	0.497828	0.024664	1 1	0.998227	1.000000	352.843384
479 1 0 373 0 1	102	0.819149	0.497828	0.024664	<u> </u>	0.998227	1.000000	352,843994
432 1 1	102	0.819149	0.497828	0.024664		0.998227	1.0000000	352.843994 352.843994
374 T 1 416 -1 1	102	0.819149	0.497828	0.024864 0.024864	- 	0.998227	1.000000	352.843994
5 -1 0	102	0.819149	0.497828	0.024564		0.998227	1.000000	352.843994 352.843994
23 -1 0 30 -1 0	102	0.819149 0.819149	0.497828	0.024664	1-1	0.998227	1.000000	352.843994
		0.889982		0.020454	1.00	0.998227	1.000000	223.601850
Mean v		0.073320				0.000000		132.528619

Table E.20: Results for Benchmark S510

	esting	length = 641	K							
Ele	Inp -I	SA 0	N.PO	FEI 0.987654	Resl_1 0.516585	Tim.Str. 0.012793	N.Sg	0.998236	Resi_2 1.000000	Tim,Furt 52.181801
245 245	-i-	- i	- ; -	0.987854	0.516586	0.012793	1	0.998236	1.0000000	52.181801
397	-1	Ö	7	0.987884	0.516586	0.012793		0.998236	1.000000	52.181801 52.181801
397 397	-1		7	0.987654	0.516586 0.516586	0.012793		0.998236	1.000000	32.181801
397	ĭ	- i	- ; -	0.987654	0.516586	0.012793		0.998236	1.000000	52.181801
397	2		7	0.987654	0.516586	0.012793		0.998236	1.000000	52.181801 52.181801
397	3_	1	7	0.987854 0.989418	0.516586 0.537157	0.012793		0.998238 0.998238	1.000000	85.888603
183		0	8	0.989418	0.837157	0.012932	 i- 	0.998238	1.000000	86.888603
208	-1	- 6	- 6	0.989418	0.537157	0.012932		0.998236	1.0000000	86.888603
205	-1		6	0.989418 0.989418	0.537157	0.012932		0.998236	1.000000	86.888603 86.888603
16		- 6	8	0.7892419	0.537157	0.012932	 	0.998238	1.000000	86.888603
51	-:-	Ť	8	0.989418 0.989418 0.989418	0.537157	0.013933	i	0.998238	1.0000000	86.888603
51	-1	0	- 5	0.989418	0.537157	0.012932		0.998238	1.000000	86.888603 143.188004
340	÷	0	31	0.945326	0.500000	0.016012		0.998236 0.998236	0.975971	143.188004
340 414	+		31	0.945326	0.500000	0.016012	 i -	0.998238	0.975971	143.188004
461	-1	i	31	0.945326	0.500000	0.016012		0.998236	0.975971	143.188004
489	H		31	0.945325 0.945326	0.500000	0.015012 0.015012		0.998238 0.998238	0.975971	143.188004 143.188004
489 462	9	-	31	0.945326	0.500000	0.016012	 	0.998235	0.975971	143.188004
462	Ť	- i -	31	0.945326	0.500000	0.016012	1	0.998235	0.975971	143.188004
452	2		31	0.945326	0.500000	0.016012		0.998238	0.975971	143.188004
489	- 2		31 31	0.945326	0.500000 0.500000	0.016012		0.998238	0.975971	143.188004
355	- 6 -	- 6 -	31	0.945326	0.500000	0.016012	<u> </u>	0.998236	0.975971	143.188004
365		Ö	31	0.945328	0.500000	0.016012		0.998236	0.975971	143.188004
365 365	3	0	31	0.945325 0.945326	0.500000	0.016012	+ +	0.998235	0.975971	143.188004
480	- i -	- ĭ -	31	0.945326	0.500000	0.016012	 i	0.998235	0.975971	143.188004
356	-i	Ö	31	0.945326	0.500000	0.018012	1	0.998235	0.975971	143.188004
366	- -	- 8	31	0.945326	0.500000	0.016012		0.998238 0.998238	0.975971	143.188004
480			31	0.945326	0.500000	0.016012	_ i_	0.998238	0.975971	143.188004
367	Ū.	0	31	0.945326	0.500000	0.016012		0.998238	0.975971	143.188004
387		0	31	0.945326	0.500000	0.016012	+	0.998236 0.998236	0.975971	143.188004
480	3	- i -	31	0.945326	0.500000	0.016012	 	0.998236	0.975971	143.188004
461	Ť	- i	31	0.945326	0.500000	0.016012		0.998236	0.975971	143.188004
451	3_		31	0.945326 0.945326	0.500000	0.016012		0.998236	0.975971 0.975971	143.188004
341	-0-	9	31	0.945326	0.500000	0.018012	+	0.995473	0.975971	143.188004
जो 	Ť	l i	31	0.945326	0.500000	0.018012		0.998236	0.975971	143.188004
340	0		31	0.945326	0.500000	0.016012	1 3	0.996473	0.975971	143.188004
340	1	0	31	0.945326	0.500000	0.016012	+	0.998238	1.0000000	18.636200
176			+ 2	0.996473	0.500000	0.011778	 i 	0.998236	1.000000	16.636200
257	-1_	0	15	0.971781	0.500000	0.014756		0.998236	0.907449	131.985001
257 482	-1	 6	16	0.971781	0.500000	0.014756	1 2	0.998238	0.907449	131.988001
482	-1	- ĭ	18	0.971781	0.500000	0.014756	 i 	0.998236	0.907449	131.985001
482		ī	16	0.971781	0.500000	0.014756	1	0.998238	0.907449	131.985001
482	3	<u>_</u>	16	0.971781	0.500000	0.014756	+ +	0.998235	0.907449	131.985001
258 258	-1 -1	- 0	16	0.971781	0.500000	0.014756	+ -2 -	0.996473	0.907449	131.985001
422	-1	— i	16	0.971781	0.500000	0.014756		0.998236	0.907449	131.985001
422	0		15	0.971781	0.500000	0.014758	1 1	0.998236	0.907449	131.985001
259 259	-1	0	16	0.971781	0.500000	0.014756	 	0.998236	0.907449	131,985001
763	-:i-	 	15	0.971781	0.500000	0.014756	1	0.998238	0.907449	131.985001
263	-1		16_	0.971781	0.500000	0.014756	1 1	0.998238	0.907449	131.985001
266 266	-1	- 9	16	0.971781	0.500000	0.014756 0.014756	+ 1	0.996473 0.998236	0.907449	131.985001
454	-:-	 6 -	19	0.966490	0.500000	0.014211	1 2	0.998473	0.956634	87.901001
454	-1	Ī	19	0.968490	0.500000	0.014211		0.998238	0.956634	87.901001
190	1	1	19	0.966490	0.500000	0.014211	++-	0.998238	0.956634 0.956634	87.901001 87.901001
311	-1	1 0	10	0.966490	0.500000	0.014211	+-i-	0.998236	0.955634	87.901001
463	Ū	ī	19	0.965490	0.500000	0.014211		0.998236	0.956634	87.901001
463	1		19	0.966490	0.500000	0.014211		0.998238	0.956634	87.901001 87.901001
463	3		19	0.966490	0.500000	0.014211	+ 1	0.998236	0.955634	87.901001
511	-ī.	i	19_	0.966490	0.500000	0.014211		0.998238	0.956634	87.901001
464	0		19	0.966490	0.500000	0.014211	1	0.998238	0.956634	87.901001 87.901001
464	- 1	1-1-	19	0.966490	0.500000	0.014211	+ + -	0.998236	0.956634	87.901001
490	î	- 6	19	0.988490	0.500000	0.014211	<u> </u>	0.998238	0.956634	87.901001
455	0		19	0.966490	0.500000	0.014211	11	0.998235	0.956634 0.956634	87.901001 87.901001
455	-	 	19	0.966490	0.500000	0.014211	+ +	0.998236	0.956634	87.901001
454	7	 	19	0.988490	0.500000	0.014211	<u> </u>	0.998236	0.956634	87.901001
454	2	1	19	0.966490	0.500000	0.014211	1.1	0.998236	0.956634	87.901001 89.030298
363		0	19	0.988490	0.500000	0.012937	++-	0.998236	0.896638	89.030296
179	+ + +	 6 -	19	0.966490	0.500000	0.012937	<u> </u>	0.998236	0.896638	89.030296
487	-1	ī	19	0.966490	0.500000	0.012937	1	0.998236	0.896638	89.030296
457	9	- 0	19	0.968490	0.500000	0.012937		0.998236	0.896638	89.030296 89.030296
458	-6	1	19	0.966490	0.500000	0.012937	+ 2	0.996473	T I RUKKU	89.030296
384	ò	 i 	19	0.965490	0.500000	0.012937	1	0.998238	U.896638	89.030296
384		1	19	0.966490	0.500000	0.012937	1	0.998238	0.896638	89.030296 89.030296
384	7	+	19	0.966490	0.500000	0.012937	+	0.998236	0.896638	89.030296
364	l à	 6	19	0.966490	0.500000	0.012937	1 2	0.996473	0.896638	89.030295
364	Ť	Ŏ	19	0.966490	0.500000	0.012937	2	0.998473	0.896838	89.030298
384	7	9	19	0.966490	0.500000	0.012937	+ -	0.998236	0.896638 0.896638	89.030296
							+	0.998238	0.898638	89.030296
479		1 0	19	0.966490	0.500000	0.012937	1	1 0.880330	1 0.020030	1 00.000
	Ó	Mean val		0.966490	0.504299	0.012837	1.11	0.998042 0.000854	0.952965	107.91027

Table E.21: Results for Benchmark S526

55378.	testing	length = 64	K							
Ele	Inp	SA	N.PO	7E1 0.998498	Resl_I 0.500000	Tim.Str. 0.407165	N.Sg	FE2 0.999437	Resl_2 0.559947	Tim,Furt 227.796997
857	\dashv	0	- 8	0.998498	0.500000	0.407168	3	0.999437	0.659947	227.798997
4417		Ť	16	0.996995	0.480549	0.517940	3	0.999437	0.754262 0.754262	384.412994 384.412994
4768 5159	<u> </u>		16	0.996995	0.480549 0.480549	0.517940	3	0.999437	0.754252	384.412994
2122		- i	151	0.971643	0.496919	0.839712	Ī	0.999812	0.852228	4894.529785
916	-1	1	151	0.971843	0.496919	0.839712	2 2	0.999524	0.862228 0.862228	4894.529785 4894.529785
924	-1	-	151	0.971843 0.971843	0.496919	0.839712	 i 	0.999812	0.862228	4694.529785
945	-ī	Ö	151	0.971643	0.496919	0.839712	2	0.999624	0.852228	4894.529785
950 957	-	0	151 151	0.971643 0.971643	0.496919	0.839712 0.839712	7	0.999624	0.862228	4594.529785 4594.529785
989	-:-	1	151	0.971843	0.496919	0.839712	Ť	0.999812	0.862228	4894.529785
983	-1		151	0.971843	0.496919 0.496919	0.839712	$\frac{2}{2}$	0.999624	0.852228 0.852228	4894.529785 4894.529785
3405	-		151	0.971543 0.971643	0.496919	0.839712	- i	0.999812	0.862228	4894.529785
3405	2	Ö	151	0.971643	0.496919	0.839712		0.999812	0.852228	4894.529788 4894.529785
2728	7		151	0.971543 0.971543	0.496919 0.496919	0.839712 0.839712	3 3	0.999437	0.862228	4694.529785
2725 2730	- 6	- 8	151	0.971843	0.496919	0.839712	3	0.999437	0.862228	4894.529785
2731		0	151	0.971843	0.496919 0.496919	0.839712 0.839712	3 3	0.999437	0.862228 0.862228	4594.529785 4594.529785
2732 2733	-7	9	151	0.971643 0.971643	0.496919	0.839712	1	0.999812	0.862228	4894.529785
2734	2	- 6	151	0.971643	0.496919	0.839712	3	0.999437	0.862228	4894.529785
3411	_3_		151	0.971643	0.496919	0.839712	1 3	0.999812	0.862228	4594.529785 4594.529785
3749		0	151	0.971643	0.496919	0.839712	7	0.999524	0.852228	4694.529785
3758	-1	Ö	151	0.971643	0.496919	0.839712	2 2	0.999624	0.862228	4894.529785 4894.529785
3763 4164	-1	-	151	0.971843 0.971843	0.496919	0.839712 0.839712	1 1	0.999812	0.862228	4594.529785
4165	-Ţ	0	151	0.971843	0.496919	0.839712	3	0.999437	0.862228	4694.529785
4155	3	0	151	0.971843 0.971843	0.496919	0.839712	3	0.999437	0.862228 0.862228	4894.529785 4894.529785
1748		8	133	0.975023	0.495548	0.772883	7	0.999624	0.854421	4407.080078
1754	-1		133	0.975023	0.495548 0.495548	0.772883	7	0.999624 0.999812	0.854421 0.854421	4407.080078 4407.080078
1787	-1	9	133	0.975023	0.495548	0.772883 0.772883	 _i 	0.999812	0.854421	4407.080078
1795	-1	<u> </u>	133	0.975023	0.495548	0.772883	1 3	0.999624	0.854421	4407.080078 4407.080078
1801	-1		133	0.975023	0.495548 0.495548	0.772883	2 2	0.999624	0.854421 0.854421	4407.080078
1823	-i -	 	133	0.975023	0.498548	0.772883	<u> </u>	0.999812	0.854421	4407.080078
3483	-1	0	133	0.975023	0.495548 0.495548	0.772883	- i	0.999812	0.854421 0.854421	4407.080078 4407.080078
3483 2813	- 2	- 8	133	0.975023	0.495548	0.772883	3	0.999437 0.999437	0.854421	4407.080078
2810	7	Ö	133	0.975023	0.495548	0.772883	3	0.999437	0.854421	4407.080078
2815 2816	-1	0	133	0.975023	0.495548 0.495548	0.772883 0.772883	 1	0.999812	0.854421	4407.080078
2817		 	133	0.975023	0.495548	0.772883	3	0.999437	D.854421	4407.080078
3469	3		133	0.975023	0.495548 0.495548	0.772883 0.772883	1 1	0.999812	0.884421	4407.080078 4407.080078
2816 3921	7	7	133	0.975023	0.495548	0.772883	1 2	0.999624	0.854421	4407.080078
3930	-1	Ö	133	0.975023	0.495548	0.772883	$\frac{2}{2}$	0.999524	0.854421	4407.080078 4407.080078
3935 4221	-1	1 - 0 -	133	0.975023	0.495548	0.772883 0.772883	+ 7	0.999524	0.854421	4407.080078
4222		8-	133	0.975023	0.495548	0.772883	3	0.999437	0.854421	4407.080078
4223	- 2	-8	133	0.975023	0.495548	0.772883 0.772883	$\frac{3}{3}$	0.999437	0.854421	4407.080078
4221 2273		 8 -	133	0.969202	0.505053	0.857807	1 1	0.999812	0.902417	5505.520117
3584		0	164	0.969202	0.505053	0.857807	\Box	0.999812	0.902417	5505.620117 5505.620117
2673 2679	-1	0	184	0.969202	0.505053	0.857807 0.857807	 	0.999812	0.902417	5505.620117
2685	Ť	 0 -	164	0.969202	0.505053	0.857807	ī	0.999812	0.902417	5505.620117
2691	7	0	184	0.969202	0.505083	0.857807 0.857807	 	0.999812	0.902417	5505.620117
2859 2871	7	│ 	164	0.969202	0.505053	0.857807	 i	0.999812	0.902417	5505.520117
2872	-1	1	164	0.969202	0.505053	0.857807		0.999812	0.902417	5505.620117 5505.620117
2873 2874	0	0	184	0.969202	0.505053	0.857807	+ +	0.999812	0.902417	5505.620117
3059	-1	0	1182	0.969202	0.505053	0.857807		0.999812	0.902417	5505.620117
3486	1	8	184	0.969202	0.505053	0.857807		0.999812	0.902417	5505.520117 5505.520117
3487	-	 	164	0.969202	0.505053	0.857807		0.999812	0.902417	5505.620117
3489		0	184	0.969202	0.505053	0.857807	+ 1	0.999812	0.902417	5505.620117 5505.620117
3491		0	164	0.969202	0.505053	0.857807	+ i -	0.999812	0.902417	5505.620117
3492	i	0	164	0.969202	0.505053	0.857807	Ţ.	0.999812	0.902417	5505.620117
3578	1	8	164	0.969202	0.505053	0.857807	+	0.999812	0.902417	5505.620117
3579 3580	1	 8	164	0.969202	0.505083	0.857807	<u> </u>	0.999812	0.902417	5505.620117
3581	Ī	Ö	164	0.969202	0.505053	0.857807	1	0.999812	0.902417	5505.620117 5505.620117
3582 3583	1	- 8	164	0.969202	0.505053	0.857807 0.857807	+ + + -	0.999812	0.902417	5505.620117
3585	i	Ŏ,	184	0.969202	0.505053	0.857807	1	0.999812	0.902417	5505.620117
3586 4597	H	8	184	0.959202	0.505053	0.857807	+ +	0.999812	0.902417	5505.620117 5505.620117
4298	L i	- - - - - -	164	0.969202	0.505053	0.857807	1	0.999812	0.902417	5505.620117
5222	-1		164	0.969202	0.505053	0.857807 0.857807	7	0.999524 0.999812	0.902417 0.902417	5505.620117 5505.620117
5183	1 2	0	184	0.969202	0.505053	0.857807	1	0.999249	0.902417	5505.620117
5184	Ü	Ü	164	0.969202	0.505053	0.857807	1 3	0.999524	0.902417	5505.620117 5505.620117
5029 5030	1	0	184	0.969202	0.505053	0.857807 0.857807	1 2	0.999624		5505.62U117
5182	- 2	Ö	164	0.969202	0.505053	0.857807	3	0.999437	0.902417	5505.620117
5022	LĪ	ŏ	184	0.969202	0.505053	0.857807	1 7	0.999824	0.902417	5505.620117 501,429993
3589 4685		0	17	0.996808	0.504993	0.478484 0.478484	+ +	0.999812	0.889079	501.429993
4308	2	Ö	17	0.996808	0.504993	0.475484	Ī	0.999812	0.859079	501.429993
2920 2923	-1	0	72	0.986479	0.509518	0.585340	+	0.999812	0.885375	3217.510010 3217.510010
2923	-1	1 6	+ 1/2	0.985479	0.509518	0.585340	<u> </u>	0.999812	0.885375	3217.510010
	Ť	Mean val	138.2	0.974049	0.499790	0.793536	1.72	0.999677	0.889040	4538.303532
		Std devi	58.8	0.011048	0.007430	0.154073	0.84	0.000157	0.070498	1950.768704
							_			

Table E.22: Results for Benchmark S5378

S841. t	esting	length = 64	ıĸ	-						
Ele	Tap	SA	N.PO	FEI	Rest_1	Tim.Str.	N.Sg	FE2	Rest_2	Tim,Furt
278	-1	0	12	0.982222	0.500000	0.074320	1	0.998519	0.733827 0.733827	84.973900 84.973900
278	-1		12	0.982222	0.500000	0.074320	- 3 -	0.995555	0.733827	84.973900
610	-1		12	0.982222	0.500000	0.074320	- 3	0.995556	0.733027	84.973900
514	-1	 0	12	0.982222	0.500000	0.074320		0.998519	0.733827	84.973900
514 512	-		12	0.982222	0.500000	0.074320		0.997037	0.733827	84.973900
612			1 12	0.982222	0.500000	0.074320	- -	0.998519	0.733827	84.973900
610	-i -	- i -	12	0.982222	0.500000	0.074320		0.998519	0.733827	R4.973900
6304	-i-	- i -	12	0.982222	0.500000	0.074320	- 3	0.995556	0.733827	84.973900
6308	-i-		12	0.982222	0.500000	0.074320	3	0.995555	0.733827	84.973900
664	-Ĩ	ō	12	0.982222	0.500000	0.074320	3	0.995586	0.733827	84.973900
884	न	1	12	0.982222	0.500000	0.074320	3	0.995556	0.733827	84.973900
493	-1	- 0	2	0.997037	0.500000	0.059910		0.998519	1.0000000	16.516800
493	-1	1	2	0.997037	0.500000	0.059910		0.998519	1.000000 0.742422	16.516800
96	-1	Ū	11	0.983704	0.489852	0.056248	-2	0.997037		
96	-1		11	0.983704	0.489852	0.056248	3	0.995556 0.995556	0.742422 0.742422	70.729698 70.729698
170	∸キ┷	0	П	0.983704	0.489882	0.056248		0.998519	0.742422	70.729898
210	: -		11	0.983704	0.489862	0.056248		0.997037	0.742422	70.729698
210			l ii	0.983704	0.489862	0.056248		0.997037	0.742422	70.729698
744	-	- i -	ii -	0.983704	0.489862	0.056248	3	0.995556	0.742422	70.729698
744	÷		lii	0.983704	0.489862	0.056248	7	0.997037	0.742422	70.729598
287	-ii -	i	 ii	0.983704	0.489862	0.056248	ï	0.998519	0.742422	70.729698
287	0	i	111	0.983704	0.489862	0.056248	ī	0.998519	0.742422	70.729698
199	-1	Ü	11	0.983704	0.500000	0.056394	3	0.995556	0.725790	77.812202
199	-1	1	11	0.923704	0.500000	0.056394	3	0.995556	0.725790	77.812202
199	- 0	1	11	0.983704	0.500000	0.056394		0.998519	0.725790	77.812202
199		I	11	0.983704	0.500000	0.056394	1	0.998519	0.725790	77.812202
199	7	Ī	-11	1 0.983704	0.500000	0.058394	 	0.998519	0.725790	
236	Ė		11	0.983704	0.300000	0.058394	3_	0.995556	0.725790	77.812202 77.812202
236	-1	-	T	0.983704	0.500000	0.056394 0.056394	3	0.995555	0.725790	77.812202
253	<u>.i</u>	¥	- 11	0.983704	0.500000	0.056394	3 -	0.995556	0.725790	77.812202
253		- 	 	0.983704	0.500000	0.056394	 	0.998519	0.725790	77.812202
290	-6		l ii	0.983704	0.500000	0.056394	l i	0.998519	0.725790	77.812202
466	-i -	- i	1 3	0.986667	0.486230	0.071391	3	0.995555	0.689947	154.121002
466	-i-	- Ť	1 5	0.986667	0.488230	0.071391	3	0.995556	0.559947	154.121002
468		- 6	1 0	0.986567	0.486230	0.071391	3	U.995556	0.669947	154.121002
488	-1		9	0.986687	0.486230	0.071391	3	0.995556	0.659947	154.121002
470	-1	0	V.	0.988687	0.486230	0.071391	3	0.995556	0.669947	154.121002
470	-1		1 9	0.986667	0.486230	0.071391	3_	0.995556	0.559947	154.121002
474	-1	0	9	0.986667	0.486230	0.071391		0.998519	0.669947	154.121002
474	-1		9	0.986667	0.486230	0.071391	 	0.998519	0.000047	70.587799
382	-1	0	9	0.986667	0.511707	0.057728		0.994074	0.630002	70.587799
382	- 1	-	 	0.986567	0.511707	0.057728		0.998519	0.630002	70.587799
382	 -		1 - 5 -	0.986887	0.511707	0.057728	l i	0.998319	0.630002	70.587799
427	- i -	- 6 -	+	0.960001	0.511707	0.057728	 	0.994074	0.630002	70.587799
327	-i-	— ў —	 	0.986667	0.511707	0.057728	 i 	0.994074	0.636002	70.587799
130	-i -		+ 5	0.986667	0.511707	0.057728	1 4	11.004074	0.630002	70.587799
230	-1	—	1 5	0.986887	0.511707	0.057728	4	0.994074	0.630002	70.587799
449	-i -		1 š	0.986887	0.511707	0.057728	4	0.994074	0.830002	70.587799
449	-1	ī	7	0.988857	0.511707	0.057728	4	0.994074	0.530002	70.587799
91	-1	Ö	1 4	0.994074 0.994074	0.500000	0.051544	2	0.997037	0.555557	28.222700
91	-1	1	4	0.994074	0.500000	0.051544	2	0.997037	0.666667	28.222700
223	-1	0	1	0.994074	0.500000	0.051544	1 2	0.997037	0.666667	28.222700
223	- 1		1 4	0.994074	0.500000	0.051544	1 - 2 -	0.997037	0.555557	28.222700 75.682503
228	-1	0	10	0.985185	0.474539	0.058667	 4 -	0.997037	0.750000	75.582503
228		L	10		0.474539 0.474539	0.058667	+	0.997037	0.750000	75.682503
251		9	10	0.985185	0.474539	U.U58667	+ +-	0.997037	0.750000	75.682503
344	-:-	 	10	0.985185	0.474539	0.058667	+	0.997037	0.750000	75.682503
344	÷	 	10	0.985185	0.474539	0.058667	1 2	0.997037	0.750000	75.582503
333	- 1	 0 -	10	0.985185	0.474539	0.058667	1 2	0.997037	0.750000	75.682503
354	-1		10	0.985185	0.474539	0.058667	7	0.997037	0.750000	75.682503
216	-1	0	17	0.974815	0.509625	0.057010		1.0000519	0.725710	442.242004
216	-1		17	0.974815	0.509625	0.057010	1	0.994074	0.725710	442.242004
222	-1	0	17	0.974815	0.509625	0.057010	1 4		0.725710	442.242004
222		0	17	0.974815	0.509625	0.057010	1	0.998519	0.725710	442.242004
222	- 2	0	17	0.974815	0.509625	0.057010	1	0.998519	0.725710	442.242004 442.242004
220	Ь	1	17	0.974815	0.509625	0.057010	┿	0.998519	0.725710	442.242004
220	7	F	177	0.974815	0.509625	0.057010	+-+	0.998519	0.725710	442.242004
220	3	 	1-17	0.974815	0.509625	0.057010	++	0.998519	0.725710	442.242004
216	3	 	+ 17	0.974815	0.509625	0.057010	i i	0.998519	0.725710	442,242004
216	+	 	+ 17	0.974815	0.509625	0.057010	t i	0.998519	0.725710	442.242004
255	-1	1 0	- 17-	0.974815	0.509625	0.057010	+ - 1 -	0.994074	0.725710	442.242004
255	-:- -	 ĭ 	+ 17	0.974813	0.509625	0.057010	+ 4	0.994074	0.725710	442.242004
280	 	 	1 17	0.974815	0.509625	0.057010	1 4	0.994074	0.725710	442.242004
280		t ĭ	17	0.974815	0.509625	0.057010	1 4	0.994074	0.725710	442.242004
	- i-	 	17	0.974815	0.509825	0.057010	4	0.994074	0.725710	442.242004
294			17	0.974815	0.509625	0.057010	1 1	0.998519	0.725710	442.242004
704	-1				0.509625	0.057010		0.998519	0.725710	442.242004
294 762	+	ī	17	0.974815						7 PM W PM
764		<u> </u>	17	0.974815	0.509625	0.057010	1 4	0.994074	0.725710	442.242004
294 762	Ü	Mean val	17				2.29	0.994074	0.718197	162.806506
294 762	Ü	Mean val	17	0.974815	0.509525	0.087010		0.994074	1	442.242004

Table E.23: Results for Benchmark S64

S713.	testins	length =	64K							
Ele	Inp	SA	N.PO	FEI	Rest_I	Tim.Str.	N.Sg	FE2	Rest_2 1.000000	Tim,Furt 13.966600
625	-1		3	0.995929	0.388853 0.386853	0.071108		0.998643	1.000000	13.966600
525		1	+ 3	0.995929	0.515555	0.073481		0.997286	0.814038	161.787994
120			 	0.990502	0.516586	0.073481	- 2	0.997288	0.814038	161.787994
354	-:-	- i	 	0.990502	0.516586	0.073481	7	0.997288	0.814038	161.787994
354	•	1	7	0.990502	0.518886	0.073481		0.998543	0.814038	161.787994
387		1	7	0.990502	0.515585	0.073481 0.073481		0.998643	0.814038 0.814038	161.787994
387	8		+ 7	0.990502	0.516586 0.516586	0.073481	- i -	0.998843	0.814038	151.787994
354 354	┝╌╬╌┤		+	0.990502	0.516886	0.073481	- i -	0.998643	0.814038	181.787994
104		- 0	- 11	0.985075	0.489862	0.060411	7	0.997286	0.742422	70.122803
TOT		ī	11	0.985075	0.489852	0.060411	3	0.995929	0.742422	70.122803
111		0		0.985075	0.489862	0.080411	3	0.995979	0.742422	70.122803 70.122803
171			111	0.985075	0.489852 0.489852	0.060411	1 2	0.997288	0.742422	70.122803
211	-1		- 11	0.985075	0.489862	0.060411		0.997286	0.742422	70.122803
247		- 6	 ii	0.985075	0.489862	0.080411	3	0.995929	0.742422	70.122803
247		ī	11	0.988075	0.489852	0.060411	2	0.997286	0.742422	70.122803
296	-1		11	0.985075	0.489862	0.060411	-	0.998843 0.998843	0.742422	70.122803 70.122803
296	0		11	0.985075	0.489862	0.080411	├	0.998643	1.000000	249.063004
59 59	-;-	-	12	0.983718	0.480959	0.082996	- i -	0.998643	1.000000	249.063004
86		- 6	12	0.983718	0.480959	0.082998		0.998543	1.000000	249.083004
88	-i-	1	12	0.983718	0.480959	0.082996		0.998843	1.0000000	249.083004
87	-1	0	12	0.983718	0.480959	0.082996		0.998843	1.000000	249.063004 249.063004
87		1	12	0.983718	0.480959	U.U82996 U.U82996		0.998843	1.000000	249.063004
183	-1	0	12	0.983718	0.480959	0.082996	 	0.998643	1.000000	249.083004
183	-1	- 6	12	0.983718	0.480959	0.082996	 i 	0.998843	1.0000000	749.063004
190	-1	Ť	12	0.983718	0.480989	0.082996		0.998843	1.000000	249.063004
112	-1	Ü	5	0.991859	0.500000	0.060357	7	0.997286	0.759176	52.529900
112	-1	1	- 6	0.991859	0.500000	0.060357	7	0.997286	0.759176	52.529900 52.529900
346 346	1	0	6	0.991859	0.500000	0.060357	 1 	0.998643	0.759175	52.529900
348	 -:	 	+ 8	0.991859	0.500000	0.060357	 i 	0.998643	0.759176	52.529900
348	10	 	- 8	0.991859	0.500000	0.080357	2	0.997286	0.759176	52.529900
230	-1	0	10	0.986431	0.474539	0.068764	7	0.997286	0.750000	70.239197 70.239197
230	_ · I		10	0.986431 0.986431	0.474539 0.474539	0.068784	 - 2 -	0.997288	0.750000	70.239197
251		0	10	0.986431	0.474539	0.068764	 	0.997286	0.750000	70.239197
251 326	-1	 	10-	0.986431	0.474839	0.068764	2	0.997286	0.750000	70.239197
526	1 1	— ř	10	0.986431	U.474539	0.068754	7	0.997285	0.750000	70.239197
530	-1	0	10	0.986431	0.474539	0.068764	2	0.997286	0.750000	70.239197
530	ı	11	10	0.986431	0.474539	0.068764	3	0.997288	0.750000	144.020004
508	T-T		3	0.987788	0.486230	0.079011	 3 -	0.995929	0.559947	144.020004
508 510	1:1	 - 6	1 5	0.987788	0.486230	0.079611	+ 3	0.995929	0.669947	144.020004
510	1 1	- ĭ -	9	0.987788	0.485230	0.079611	3	0.995929	0.669947	144.020004
512	-1	0	9 "	0.987788	0.486230	0.079611	3	0.995929	0.889947 0.889947	144.020004
512	-1	1	9	0.987788	0.485230	0.079611	3	0.995929	0.669947	144.020004
516	1.1	0	9	0.987788	0.488230	0.079611		0.998843	0.659947	144.020004
516 287	- :	1	18	0.975577	0.495007	0.065530	l i	0.998643	0.700987	119.253998
287	 	 ĭ-	- iš	0.975577	0.495007	0.088530	2	0.997288	0.700987	119.253998
400	1 -1	1	18	0.975577	0.495007	0.085530		0.994573	0.700987	119.253998
406	-1	0	15	0.975577	0.495007	0.065530	1 4	0.994573	0.700987	119.253998
408	1-1-	0	18	0.975577	0.495007	0.065530	3	0.995929	0.700987	119.253998
402	0	l -i -	18	0.975577	0.495007	0.055530	 2	0.997285	0.700987	119.253998
402	+ 2	 	18	0.975577	0.498007	0.065530	1	0.998643	0.700987	119.253998
400	+ +	1	18	0.975577	0.498007	0.065530		0.998643	0.700987	119.253998
455	-1	0-	18	0.975577	0.495007	0.065530	4	0.994573	0.700987	119.253998
455	-1		18	0.975577	0.495007	0.065530	1 1	0.994573	0.700987	119.253998
462	1-1		18	0.975577	0.495007	0.065530	+ - 2 -	0.994573	0.700987	119.253998
462	-1	1 0	- 18	0.975577	0.495007	0.065530	1	0.994573	0.700987	119.253998
481	 	1 1	18	0.975577	0.495007	0.085530	3	0.995929	0.700987	119.253998
478	0	1	18	0.975577	0.495007	0.065530	3	0.998929	0.700987	119.253998
478	ŢŢ		18	0.975577	0.495007	0.068530	+ +-	0.994573	0.703370	56.078300
689	-1	7	7	0.990502	0.516586	0.076801	+ 3	0.995929	0.703370	56.078300
710	 : 	 -6-	- 	0.990802	0.516586	0.078801	3	0.995929	0.703370	56.078300
710	+ -1	 	1 7	0.990502	0.516586	0.076801	2	0.997288	0.703370	56.078300
710	ď	1	7	0.990502	0.516586	0.076801	I	0.998643	0.703370	56.078300 56.078300
710			7	0.990502	0.516586	0.078801	1 7	0.997288	0.703370	56.078300
749	1 -1	1 0	+ 7	0.990502	0.516586	0.076801	+ 3	0.995929	0.703370	56.078300
545	+ :1	+ 6	- 17	0.976934	0.500000	0.071844	1 5	0.993216	0.651660	119.265998
545	1 -1	 	i i i i i i i i i i i i i i i i i i i	0.976934	0.500000	0.071844	1	0.994573	0.851660	119.256998
552	-ì.	0	17	0.976934	0.500000	0.071844	1 2	0.993216	0.851660	119,266998
552		0	17	0.976934	0.500000	0.071844 0.071844	+	0.993216	0.851860	119.200998
350	1 0	1	17	0.976934	0.500000	0.071844	+ + +	0.997286	0.651660	119.255998
550	+	1 - 1	 17	0.976934	0.500000	0.071844	1 5	0.993216	0.651660	119.265998
345	┤~ 脊~	+ 	1 17	0.976934	0.500000	0.071844	1 2	0.997286	0.651660	119.266998
545	1 2	1	17_	0.976934	0.500000	0.071844	5	0.993216	0.651660	119.255998
578	-1	0	177	0.976934	0.500000	1 0.071844	1 4	0.994573 0.993216	0.651660	119.266998
578	-1		17	0.976934	0.500000	0.071844	5	0.993216	0.651660	119.266998
384	1-1	7	17	0.978934	0.500000	0.071844	+-2	0.994573	0.851660	119.266998
584 599	1 -1	1 6		0.976934	0.500000	0.071844	+	0.994573	0.851880	119.268998
399	+ +	+ +	17	0.976934	0.500000	0.071844	5	0.993216	0.651660	119.266998
597	1 0	1	17	0.976934	0.500000	J.071844	3	0.993216	0.651660	119.266998
				0.976934	0.500000	0.071844	5	0.993216	0.851660	1 12.400930
597										
		Mean v	al 12.0	0.983675 0.006179	0.493070	0.070883		0.996709		117.519485 57.899816

Table E.24: Results for Benchmark S713

	esting	length = 64	K							
151e	Inp	-5A	734	PE1 0.842353	Resi_1 0.497246	Tim.Str. 0.030136	N.Sg	PE2 0.998824	Resl_2 0.987212	Tim,Furt 535.833008
495	-1 -	- i - 	134	0.842353	0.497246	0.030136		0.998824	0.987212	535.833008
841	-1	1	134	0.842353	0.497246	0.030136 0.030136	-	0.998824	0.987212 0.987212	535.833008 535.833008
841	-	1	134	0.842353	0.497248	0.030136	- i - 	0.998824	0.987212	535.833008
769	ŏ	Ü	134	0.842353	0.497246	0.030136		0.998824	0.987212	535.833008
769	1	8	134	U.842353 U.842353	0.497248 0.497246	0.030138 0.030138	-	0.998824 0.998824	0.987212 0.987212	535.833008 535.833008
769 64B	- 6		134	0.842353	0.497246	0.030136	- i -	0.998824	0.987212	535,833008
848	ī	1	134	0.842353	0.497246	0.030136		0.998824	0.987212	535.833008 535.833008
769	3		134	0.842353 0.842353	0.497246 0.497246	0.030136	 } 	0.998824	0.987212	535.833008
688	ŏ	- ŏ	134	0.842353	0.497246	0.030136		0.998824	0.987212	535.833008
688		0	134	0.842353	0.497246 0.497246	0.030138		0.998824 0.998824	0.987212	535.833008 535.833008
588 837	7	- 0	134 134	0.842353 0.842353	0.497248	0.030136	 	0.998824	0.987212	535.833008
804	0	Ü	134	0.842353	0.497245	0.030138		0.998824	0.987212	535.833008
751	1		134	0.842353	0.497246	0.030136 0.030136		0.998824 0.998824	0.987212	535.833008
751 751	- 2 -	i	134	0.842353	0.497248	0.030136		0.998824	0.987212	535.833008
751	3	1	134	0.842353	0.497248	0.030136 0.030136		0.998824 0.998824	0.987212	535.833008 535.833008
592 592	-	0	134 134	0.842353 0.842353	0.497245	0.030136	 i 	0.998824	0.987212	535.833008
592	-	Ū	134	0.842353	0.497246	0.030136		0.998824	0.987212	535.833008
804		-	134	0.842353 0.842353	0.497248	0.030136	-	0.998824 0.998824	0.987212	535.833008 535.833008
760 760	4		134	0.842353	0.497246	0.030136	- i	0.998824	0.987212	535.833008
760	1	Í	134	0.842353	0.497246	0.030136		0.998824	0.987212	535.833008 535.833008
760 711	3	0	134 134	0.842353 0.842353	0.497248	0.030136		0.998824 0.998824	0.987212	535.833008
573	-6 -	ř	134	0.842353	0.497246	0.030136		0.998824	0.987212	535.833008
573	=		134	0.842353 0.842353	0.497248	0.030136	\Box	0.998824	0.987212	535.833008 535.833008
711 590	-		134	0.842353	0.497246	0.030138	ᆣ	0.998824	0.987212	535.833008
590			134	0.842353	0.497246	0.030138		0.998824 0.998824	0.987212	535.833008 535.833008
711 598	7	9	134	0.842353 0.842353	0.497246	0.030136	-	0.998824	0.987212	535.833008
598	-ĭ_	-	134	0.842353	0.497248	0.030136		0.998824	0.987212	535.833008
598	7		134	0.842353 0.842353	0.497248	0.030138		0.998824 0.998824	0.987212	535.833008 535.833008
837	2	0	134	0.842353	0.497248	0.030136	 i 	0.998824	0.987212	53(5, R330)0N
819	$\neg \neg$	0	134	0.842353	0.497246	0.030138		0.998824	0.987212	535.833008 535.833008
819	3	- 0	134	0.842353	0.497248	0.030136	 	0.998824 0.998824	0.987212 0.987212	535.833008
796	-ö-			0.842353	0.497246	0.030136		0.998824	0.987212	535.833008
728	-		134	0.842353	0.497246	0.030136		0.998824	0.987212	535.833008 535.833008
728 509	0	9	134	0.842353 0.842353	0.497246	0.030136	 	0.997647	0.987212	535.R3300B
609	_1_	1	134	0.842353	0.497246	0.030138		0.998824	0.987212	535.833008
728	7	0	134	0.842353	0.497246	0.030136	1 1	0.998824	0.987212	535.833008 535.833008
610	-ï- -	- i -	134	0.842353	0.497248	0.030138	 i 	0.998824	0.987212	535.833008
796	1		134	0.842353	0.497248	0.030136	\Box	0.998824 0.998824	0.987212	535.833008 535.833008
778	7	- 0	134	0.842353 0.842353	0.497246	0.030136	 i 	0.998824	0.987212	535.833008
778	2	Ŏ	134	0.842353	0.497248	0.030138		0.998824	0.987212	535.833008
647	7		134	0.842353	0.497248	0.030136	++-	0.998824 0.998824	0.987212	535.833008
778	- 3	 	134	0.842353	0.497246	0.030136		0.998824	0.987212	535,833008
675	-0		134	0.842353 0.842353	0.497248	0.030138	T-1-	0.998824	0.987212	535.833008 535.833008
675 837	3		134	0.842353	0.497246	0.030136	 i 	0.998874	0.987212	535.833008
835	ō	0	134	0.842353	0.497246	0.030138		0.998824	0.987212	535.833008
835	-	0	134	0.842353	0.497248	0.030138	++-	0.998824 0.998824	0.987212 0.987212	535.833008
765	ö	<u> </u>	134	0.842353	0.497246	0.030136	<u> Li</u>	0.998824	0.987212	535.833008
765	-1		134	0.842353	0.497246	0.030136		0.998824	0.987212	535.833008 535.833008
765 682	- 0		134	0.842353 0.842353	0.497246	0.030136	++-	0.998824	0.987212	535.833008
625	0	Ö	134	0.842353	0.497246	0.030138	1	0.998824	0.987212	535.833008
625		8	134	0.842353	0.497246	0.030138	1 1	0.998824	0.987212	535.833008
682	1	1	134	0.842353	0.497246	0.030136	<u> i</u>	0.998824	0.987212	535.833000
645	0	9	134	0.842353	0.497246	0.030136		0.998824	0.987212	535.833000 535.833000
645 645	1 2	- 0	134	0.842353 0.842353	0.497246 0.497246	0.030136	 	0.998824	0.987212	535.833008
765	3	1 1 1	134	0.842353 0.842353	0.497246	0.030136	I I	0.998824	0.987212	535.833000
584 584	9	8	134	0.842353	0.497246	0.030136	+	0.998824	0.987212	535.83300
827		0	134	0.842353	0.497246	0.030136	<u> </u>	0.998824	0.987212	535.83300
799	0	0	134	0.842353	0.497246	0.030136	1	0.998824	0.987212	535.83300 535.83300
677	7	 	134	0.842353	0.497246	0.030136		0.998824	0.987212	535.83300
618	ō	Ō	134	0.842353	0.497248	0.030136	3	0.997647	0.987212	535.83300 535.83300
618 677	-1-	0	134	0.842353	0.497248	0.030136	+ +	0.998824	0.987212	535.83300
639	ő	 	134	0.842353	0.497248	0.030136	1 2	0.997647	0.987212	535.83300
639	-1	Ų.	134	0.842353	0.497248	0.030136	7 7	0.997647	0.987212	535.83300
577 540	3	1 0	134	0.842353	0.497246	0.030136	 	0.997647	0.987212	535.83300
640	Ī	ō	134	0.842353	0.497246	0.030136		0.998824	0.987212	535.83300 535.83300
799 752	-	1 0	134	0.842353	0.497248	0.030136	1	0.998824	0.987212 0.987212	
752	- "		134	0.842353	0.497248	0.030136	 	0.998824	0.987212	538 83300
658	-		134	0.842353	0.497246	0.030136	1	0.998824	0.987212	535.83300 535.83300
658 827	1	1 0	134	0.842353 0.842353	0.497248 0.497248	0.030136		0.998824	0.987212	535.83300
814	ô	 	134	0.842353	0.497246	0.030136	1	0.998824	0.987212	535.83300
814 805	-	1 1	134	0.842353	0.497248	0.030136	+	0.998824 0.998824	0.987212 0.987212	535.83300 535.83300
	þ							0.998753		535.83300
800		Mean val	134.0	0.842353	0.497246	0.030136	1.06		0.987212	

Table E.25: Results for Benchmark S820

S832, testing	length = 64	K .							
Ele Inp	5A	N.PO	PE1 0.910345	Resi_1 0.498505	Tim.Str. 0.023235	N.Sg	7E2 0.998851	Resl_2 0.919783	Tim,Furt 320.794006
311 -1	0	78 78	0.910345	0.498505	0.023235	- i 	188869.0	0.919783	320.794008
821 -1	Ĭ	78	0.910345	0.498505	0.023235		0.998851	0.919783	320.794006 320.794006
821 I 782 0	- 1 0	78 78	0.910345 0.910345	0.498505 0.498505	0.023235	++	0.998851	0.919783 0.919783	320.794008
716 0	 	78	0.910345	0.498505	0.023235		0.998851	0.919783	320.794006
716 I	0	78	0.910345	0.498505	0.023235		0.998851 0.998851	0.919783	320.794006 320.794008
716 2	-	78 78	0.910345	0.498505 0.498505	0.023235	2	0.997701	0.919783	320.794006
571 0 571 1	- i -	78	0.910345	0.498505	0.023235	-	0.997701	0.919783	320.794006
716 3	0	78	0.910345	0.498505	0.023235		0.998851	0.919783	320,794008 320,794008
703 0	0	78	0.910345	U.498505 U.498505	0.023235		0.997701 0.998851	0.919783	320.794006
572 0 572 1	 	78 78	0.910345	0.498505	0.023235	- i - 	0.998851	0.919783	320.794006 320.794006
572 2	i	78_	0.910345	0.498505	0.023235		0.998851	0.919783	320.794006
572 3		78	0.910345	0.498505	0.023235	1 2	0.998851	0.919783	320.794008 320.794008
703 1 573 0	- 0	78	0.910345	0.498505	0.023235	- i - 	0.998851	0.919783	170 702008
573 1	- i -	78	0.910345	0.498505	0.023235		0.998851	0.919783	320.794006 320.794006
573 2		78	0.910345	0.498505	0.023235		0.998851 0.998851	0.919783	320.794006
782 1 758 0	9	78	0.910345	U.498505 U.498505	0.023235	 	0.998851	0.919783	320.794006
758 1	- i -	78	0.910345	0.498505	0.023235		0.998851	0.919783	320,794006
711 0	0	78	0.910345	0.498505	0.023235		0.998851 0.998851	0.919783	320.794006 320.794006
711	- 0	78 78	0.910345	0.498505	0.023235	 	0.998851	0.919783	320,794006
711 2	 	78	0.910345	0.498505	0.023235		188899.0	0.919783	320.794008
712 0	Ů	78	0.910345	0.498505	0.023235		0.998851 0.998851	0.919783	320.794006 320.794008
712 1	0	78 78	0.910345	0.498505	0.023235 0.023235	┡┼┦	0.998851	0.919783	320.794006
$\frac{712}{712} = \frac{2}{3}$	 	1 18	0.910345	0.498505	0.023235		0.998851	0.919783	320.794005
758 3	- i	78	0.910345	0.498505	0.023235		0.998851	0.919783	370 704008
713 0	0	78	0.910345	0.498505	0.023235	├	0.998881	0.919783	320.794008 320.794008
588 U	1	78 78	0.910345	0.498505	0.023235	┝╌╬╌┤	0.998851	0.919783	320.794006
713	Ö	78	0.910345	0.498505	0.023235		0.998851	0.919783	320.794006
589 0		78	0.910345	0.498505	0.023235	1 2 7	0.997701 0.998851	0.919783	320,794006 320,794006
782 1	1 0	78	0.910345	0.498505	0.023235	 	U.998851	0.919783	T 320.794008
759 0	1	78	0.910345	0.498505	0.023235		0.998861	0.919783	320.794005 320.794005
759 1		78_	0.910345	0.498505	0.023235		0.998851 0.998851	0.919783	320.794006
759 2 759 3	 	78	0.910345	0.498805	0.023235	⊢i ⊢	0.998851	0.919783	320.794008 320.794008
714 0	 0	78_	0.910345	0.498505	0.023235	T.	0.998851	0.919783	320.794006
509 0		78	0.910345	0.498505	0.023235	1 2	0.998851	0.919783	320.794006 320.794006
509 1 609 2	 	78 78	0.910345	0.498505	0.023235	1 1	0.998402	0.919783	320.794008
714 1	1 6	78	0.910345	0.498505	0.023235		0.998851	0.919783	320.794006
510 0	1	78	0.910345	0.498505	0.023235	-	0.995402	0.919783	320.794006 320.794006
510 1 510 2		78 78	0.910345	0.498505	0.023235	1 2	0.997701	0.919783	320.794006 320.794006
714 2	i ô	78	0.910345	0.498505	0.023235	T -	0.998851	0.919783	320.794006
611 0	1	78	0.910345	0.498505	0.023235	1	0.998402 0.998851	0.919783	320.794006 320.794006
714 3	1 1	78 78	0.910348	U.498505 U.498505	0.023235		0.998851	0.919783	320,794006
612 0	 	78	0.910345	0.498505	0.023235	4_	0.995402	0.919783	320.794006
612 1	1	78	0.910345	0.498505	0.023235		U.998851 U.998851	0.919783	320.794006 320.794006
782 3 780 0	0	78	0.910345	0.498505	0.023235		0.998851	0.919783	320.794008
760 1	 i 	78	0.910345	0.498505	0.023235	<u> </u>	0.998851	0.919783	320.794008 320.794008 320.794008
760 2		78	0.910345	0.498805	0.023235		0.998851	0.919783	320.794006
760 3 715 0	1 0	78	0.910348	U.498505 U.498505	0.023235	 	0.998881	0.919783	320.794006
615 0	- 1	78	0.910345	0.498505	0.023235	<u> </u>	0.998851	0.919783	320.794006 320.794006
615 1	1 1	78	0.910345	0.498505	0.023235		0.998851	0.919783	320.794006
615 2 715 1	0	78	0.910348	0.498505	0.023235	 	0.998851	0.919783	320.794008
616 0	 	78	0.910345	0.498505	0.023235	Li	0.998851	0.919783	7710 7020 BB
616 1	1	78_	0.910345	0.498505	0.023235		0.998851	0.919783	320.794006 320.794006
616 2 715 2	1 7	78 78	0.910345	0.498505	0.023235	 1	0.998851	0.919783	T 320.794006
617 0	 	78	0.910345	0.498505	0.023235		0.998851	0.919783	320.794008
617		78	0.910345	0.498505	0.023235	1 -	0.997701	0.919783	320.794008
715 3 518 0	9	78	0.910345	0.498505	0.023235	++	0.998851	0.919783	320,794006
618 U	 	78	0.910345	0.498505	0.023235	1 2	0.997701	0.919783	320.794008
152 -1	Ī	4	0.995402	0.600000	0.013935		0.998851	1.000000	134,852997
152 -1	1 0	1 1	0.995402	0.600000	0.013935	1 1	0.998851	1.0000000	134.852997
188 -1	 6 -	+	0.995402	0.600000	0.013935	1	0.998851	1.000000	134.852997
224 -1	1	1 4	0.995402	0.800000	0.013935		0.998851	1.0000000	134.852997
224 -1 260 -1	9	1	0.995402	0.600000	0.013935	 	0.998851	1.000000	134.852997
260 -1	 0	+ - } -	0.995402	U.600000	0.013935	i_	0.998851	1.000000	134.852997
44 -1	1	1	0.995402	0.600000	0.016628	1	0.998851	0.879588 0.879588	47.520701
48 :	9	1 4	0.995402	0.600000	0.015528	 }-	0.998851	0.879588	47.520701
48 -1	Ò	 	0.995402	0.600000	0.016828	i i	0.998851	0.879588	47.520701
53 -1	i	1.4	0.995402	0.600000	0.016628		0.998851	0.879588 0.879588	47.520701 47.520701
53 -1 59 -1		1	0.996402	0.800000	0.015628		0.998851	0.879588	47.620701
59 -1	 6	+ +	0.995402	0.800000	0.016628	1 2	0.997701	0.879588	47.520701
349 -1	0	3	0.996552	0.557885	0.014870		0.998851	1.000000	32.611500
349 -1		3 -	0.996552	0.557886	0.014870		0.998851	1.0000000	32.611500 32.611500
25 -1	 	3 3	0.996552	0.557886	0.014870	 i	0.998851	1.000000	32.811500
333 -1	- o	<u> </u>	0.993103	0.500000	0.017020		0.998851	1.000000	28.828800
333 -1	1	- 5	0.993103	0.500000	0.017020		0.998851	1.000000	28.828800 28.828800
336 -1 336 -1	1 9	8	0.993103			+ +	0.998851	1.000000	28.828800
	Mean val		0.930713	0.517179	0.021379	1.24	0.998575		260.858953
 	Std devi	31.7	0.036431	0.038147	0.0033B0	0.65	0.000751	0.032819	109.522932

Table E.26: Results for Benchmark S832

S838, to Ele 327 696 965	Inp -1	SA U	N.PO_	PEI	Resi_I	Tim.Str.	N.Sg	FE2	Rest_2	Tim,Furt
985		0 1						N RAMMAN		3068.679932
965			443	0.525188 0.525188	0.495984	0.139998	- i- 	0.998928 0.998928	0.521681 0.521681	3068.679932
OKO I	<u> -i </u>	Ō.	443	0.525188	0.495984	0.139998		0.998928	0.521681	3068.679932
	-1 1	6	443	0.525188	0.495984	0.139998 0.139998	-	0.995713 0.998928	0.521681 0.521681	3058.579932 3058.579932
792 695	1		443 443	0.525188 0.525188	U.495984 U.495984	0.139998	- 2	0.997856	0.521681	3068.679932
814	- 6 - 1	ŏ	443	0.525158	0.495984	0.139998	92	0.901393	0.521681	3068.679932
512	1	- 0	443	0.525188	0.495984	0.139998	92	0.901393	0.521681	3068.679932
511	9	0	443 443	0.525188 0.525188	D.495984 U.495984	0.139998	92	0.901393	0.521681 0.521681	3068.679932 3068.679932
701	i 	-	443	0.525188	0.495984	0.139998	$\neg \neg$	0.998928	0.521581	3068.679932
693		Ó	443	0.525188	0.495984	0.139998	92	0.901393	0.521681	3068.679932
694		0	443	0.525188 0.525188	U.495984 U.495984	0.139998 0.139998	92	0.998928 0.901393	0.521681 0.521681	3058.679932 3068.679932
813	++	- 8 -	443	0.525188	0.495984	0.139998	- "î" - 	0.998928	0.521681	3068.679932
616	i	- ī	443	0.525188	0.495984	0.139998	1 1	0.998928	0.521681	3068.679932
625		1	443	0.525188	0.495984	0.139998		0.998928	0.521681	3068.679932
750	-6-1		443	0.525188 0.525188	0.495984 0.495984	0.139998	\dashv	0.998928	0.521681 0.521681	3068.679932 3068.679932
691		- 6	113	0.525188	0.495984	0.139998		0.997856	0.521681	3068.679932
781	_0_	1	443	0.525188	0.495984	0.139998		0.998928	0.521681	3068.679932
967	8-	0	443	0.525188	U.495984 U.495984	0.139998	- 2 - 1	0.997855	0.521681	3068.679932 3068.679932
948			443	0.525188 0.525188	0.495984	0.139998		0.997856	0.521681	3068.679932
613	i i	-i-	43	0.525188	0.495984	0.139998		0.998928	0.521681	3058.679932
863	T	0	443	0.525188	0.495984	0.139998	92	0.901393	0.521681	3088.879932
946		<u> </u>	443	0.525188	0.495984 0.495984	0.139998 0.139998		0.998928 0.997856	0.521681 0.521681	3068.679932 3068.679932
779	-i 	i	443	0.525188	0.495984	U. 139998	1	0.998928	0.521681	3058.679932
945	Ö		443	0.525158	0.495984	0.139998	92	0.901393	0.521581	3068.679932
503	9	0	443	0.525188	0.495984 0.495984	0.139998	2 2	0.997856 0.997856	0.521681	3068.679932 3068.679932
502 502	8	- 0	443	0.525188 0.525188	U.495984	0.139998	- 1	0.998928	0.521681	3068.679932
788	ŏ	1	443	0.525188	0.495984	0.139998	1	0.998928	0.521581	3068.679932
687	Ò	0	223	0.525188	0.495984	0.139998 0.139998	92	0.901393	0.521681	3088.879932 3088.879932
930 888	0	0	443	0.525188	U.495984 U.495984	0.139998	92	0.901393	0.521681	3068.679932
810	- 6 - 	Ū	443	0.525188	0.495984	0.139998	<u> </u>	0.998928	0.521681	3068.879932
500		Ö	443	0.525188	0.495984	0.139998		0.998928	0.521681	3058.679932
622 499	9	0	443	0.525188 0.525188	U.495984 U.495984	0.139998 0.139998	1 2	0.998928 0.997856	0.521681	3068.679932
787	+ 1	 '	13	0.525188	0.495984	0.139998	i	0.998928	0.521681	3068.679932
585	i	Ö	443	0.525188	0.495984	0.139998	ī	0.998928	0.521581	3068.679932
929	1	0	443	0.525188	0.495984	0.139998		0.998928	0.521681	3058,679932
586		0	443	0.525188	U.495984 U.495984	0.139998 0.139998	-	0.998928	0.521681	3058.679932
608	- i -	- 1	43	0.525188	0.495984	0.139998	H-i	0.998928	0.521681	3068.679932
621	Ť	i	443	0.525188	0.495984	0.139998		0.998928	0.521681	3068.679932
607			443	0.525188	0.495984 0.495984	0.139998		0.998928 0.998928	0.521581	3068.679932 3068.679932
772 683	2	à	443	0.525188 0.525188	0.495984	0.139998	- 	0.998928	0.521681	3068.679932
773	ō	Ť	443	0.525188	0.495984	0.139998		0.998928	0.521581	3068.679932
963		0	443	0.525188	0.495984	0.139998		0.998928	0.521681	3068.679932 3068.679932
506 942	-0-	-	43	0.525188	U.495984 U.495984	0.139998	 	0.998928	0.521681	3068.679932
605	÷	i	443	0.525188	0.495984	0.139998	i	0.998928	0.521581	3068.679932
859	Ť	Ō	443	0.525188	0.495984	0.139998		0.998928	0.521681	3088.679932
681	┪	0	443	0.525188	0.495984 0.495984	0.139998	 	0.998928 0.998928	0.521681	3068.679932 3068.679932
927 682	+-	0	443	0.525188	0.498984	0.139998	l i	0.998928	0.521681	3088.679932
486	Ö	0	443	0,525188	0.495984	0.139998	ì	0.998928	0.521681	3058.679932
807	1	0	स्र	0.525188	0.495984	0.139998		0.998928	0.521681	3068.679932
328	<u> </u>	- 1	443	0.525188	0.495984	0.139998	 	0.998928	0.521681	3068.67993
337			443	0.525188	0.495984	0.139998	l i	0.998928	0.521581	3068.679932
346	-1	Ö	443	0.525188	0.495984	0.139998	1	0.998928	0.521681	3068.679933
355	-1	0	443	0.525188	1 0.495984	0.139998 0.139998		0.997856	0.521681	3058.679932
384 373	-1	- 0	443	0.525188	U.495984 U.495984	0.139998	+ 4-	0.997856	0.521681	3068.67993
382	-i-	 	443	0.525188	0.495984	0.139998	2_	0.997856	0.521681	3068.679932
391	-1	<u> </u>	443	0.525188	0.495984	0.139998	92	0.901393	0.521681	3068.67993
450		9	443 443	0.525188	0.495984 0.495984	0.139998		0.998928	0.521681	3068.679933 3068.67993
453 456	-1	0	443	0.525188	0.495984	0.139998	 	0.998928	0.521681	3068.67993
459		0	443	0.525188	0.495984	0.139998	i	0.998928	0.521681	3068.67993
462	-1	0	443	0.525188	1 0.495984	0.139998	1 2	0.998928	0.521681	3068.67993 3068.67993
465 468	-1	- 8	443	0.525188	0.495984	0.139998	92	0.997856	0.521681	3068.67993
471	-i -	ü	443	0.525188	0.495984	0.139998	92	0.901393	0.521681	3068.67993
487	-1	0	443	0.525188	0.495984	0.139998		0.998928	0.521681	3068.67993
487	7	0	443	0.525188	0.495984	0.139998	 	0.998928	0.521681	3068.67993
495		 	443	0.525188	0.495984	0.139998	l i	0.998928	0.521681	3068.67993
576	-1	1	443	0.525188	0.495984	U.139998		0.998928	0.521681	3068.67993
498	-1	Q.	443	0.525188	U.495984 U.495984	0.139998	1	0.998928	0.521681	3068.67993 3068.67993
582 501		 	443	0.525188	0.495984	0.139998	92	0.901393	0.521681	3068.67993
588	-1	1	443	0.525188	1 0.495984	0.139008	1	0.998928	0.521681	3068.67993
504	_2_	0	443	0.525188	0.495984	0.139998	92	0.901393	0.521581	3068.67993
507	<u> </u>	0	443	0.525188	0.495984	0.139998	1	0.998928	0.521681	3068.67993
600		 	+ 223	0.525188	0.495984	0.139998	l i	0.998928	0.521681	3068.67993
510	2	Ü	443	0.525188	0.495984	0.139998	92	0.901393	0.521681	3068.67993
655	-1	0	443	0.525188	0.495984	0.139998	1	T 0.998928	0.521681	3068.67993
658 661	-1	0	443	0.525188	0.495984 0.495984	0.139998	++	0.998928 0.998928	0.521681	3068.67993
884	- il	 6 -	1 43	0.525188	0.495984	0.139998	 î 	0.998928	0.521681	3068.67993
667	<u>-i</u>	0	443	0.525188	D.495984	0.139998	<u> </u>	0.998928	0.521681	3068.67993
870	-1	0	443	0.525188	0.495984	0.139998	92	0.998928 0.901393	0.521681	3068.67993
	-1	0	443	0.525188	0.495984	0.139998	16.62	0.982186	0.521681	
673		Mean val	443.0	0.525188	0.495984	0.139998				

Table E.27: Results for Benchmark S838

90234	estins	length =	64K							
Ele	lap	SA	N.PO	PEI	Resl_1	Tim.Str. 1.485580	N.Sg	FE2 0.999546	Resl_2 0.781764	Tim, Purt 1564.800049
6924	-1	- 0	53	0.993981	U.493682 U.493682	1.485580	-3	0.999659	0.781764	1584.800049
8221	-i 	- i -	53	0.993981	0.493582	1.485580	2_1	0.999773	0.781764	1584.800049
8223	1	1	53_	0.993981	U.493682 U.493682	1.485580		0.999773	0.781764 0.781764	1564.800049
7515	-1	0	53	0.993981	0.493682	1.485580	-1 -1	0.999886	0.781784	1554.800049
4522	-1 -1	- ŏ	81	0.990801	0.508327	1.382350	7	0.999773	0.840668	3116.659912
4526	0		81	0.990801	0.508327	1.382350	7	0.999773	U.840668 U.840668	3116.659912
4533 4538	7	- 0	81	0.990801	0.508327	1.382350		0.999773	0.840688	3115.559912
4542	ŏ		81	0.990801	0.508327	1.382350	-2	0.999773	0.840688 0.840688	3116.659912 3116.659912
4549		0	81	0.990801	0.508327	1.382350		0.999886	0.840688	3116.659912
4601 4605	-i-	- 0	81	0.990801	0.508327	1.382350		0.999773	U.840668	3116.659912
4612	-1	0	81	0.990801	0.508327	1.382350		U.999886 U.999546	U.840668 U.840668	3116.659912
4705	-1	- 0	81	0.990801	0.508327 0.508327	1.382350 1.382350		0.999773	0.840688	3116.659912
7294	-1		- 81	0.990801	0.508327	1.382350	Ť	0.999886	U.840658	3116.659912
901	-1	G G	18	0.997956	0.452284	1.308830		U.999886 U.999886	1.0000000	581.143982 581.143982
950 1059	+	- 8	18	0.997956 0.986144	0.462284	1.559930		0.999886	0.723774	5144.410156
1066	-1	- ŏ -	122	0.988144	0.505963	1.559930		0.999886	0.723774	5144.410156
1070		0	122	0.986144	0.505963 0.505963	1.559930	-7-1	0,999773	0.723774	5144.410156 5144.410158
4334 7505	-1-	 6	122	0.986144	0.505963	1.5599330	i -	0.999886	0.723774	5144.410156
6635	<u> </u>	1	122	0.988144	0.505963	1.559930	7	0.999773	0.723774	5144.410156
3975	-1	0	122	0.986144	0.505963 0.505963	1.559930	14	0.999886	0.723774	5144.410158 5144.410158
4316	 		122	0.986144	0.505963	1.559930	34	0.998410	0.723774	5144.410156
5840	0	Ŏ	122	0.985144	0.505963	1.559930		0.999886	0.723774	5144.410156
4327	7	9	122	0.986144	0.505952 0.505952	1.559930	14	0.998410	0.723774	5144.410156 5144.410156
5865 5863	1	-	122	0.988144	0.505963	1.559930		0.999773	0.723774	5144.410156
6101	-1		122	0.985144	0.505963	1.559930	-7	0.999773	0.723774	5144.410156 5144.410156
7469 152	-	0	122	0.986144	0.505963	1.559930		0.999886	0.723774	5144.410156
176		- 6	122	0.986144	0.505963	1.559930	Í	0.999886	0.723774	5144.410156
1700			53	0.993981	0.488000	1.937890	<u> </u>	0.999319	0.699238	1490.209961 1490.209961
1806	-1		83	0.993981	0.488000	1.937890		0.999546	0.699238	1490.209961
2554	-1	<u> </u>	53	0.993981	0.488000	1.937890	8	0.999091	0.699238	1490.209961 1490.209961
2678			53	0.993981	0.488000	1.937890	- 8	0.999091	0.619906	195.322006
1246	-i -	 i	538	D. SESSOCIA	0.491688	4.752050	7	0.999773	0.515009	14240.599609
1732	-1		538	0.938898	0.491588	1.752050		U.999886 U.999659	0.515009	14240.599609 14240.599609
4698 9459	- 1	0	538 538	0.938898	0.491588 0.491588	4.752050	3	0.999888	0.515009	14240.599609
4197	-ĭ-	 	538	0.938898	0.491688	4.752080		0.999886	0.515009	14240.599609
4230	0		538	0.938898	0.491688	4.752080 4.752080		U.999885 U.999885	0.515009	14240.599609
5728 5585	-1		538 538	0.938898	0.491588	4.752050		0.999886	0.515009	14240.599609
4039	-ŏ -	 i	538_	0.938898	U.491688	4.752050		0.999886	0.515009	14240.599609
4193			538 538	0.938898	0.491688	4.752050		0.999886	0.515009	14240.599609
5832	-	0	538	0.938898	0.491588	4.752050	- i	0.999773	0.515009	14240.599809
4252	1		538	0.938898	0.491688	4.752050		0.999888	0.515009 0.515009	14240.599609
5828	-0-	- 8	538	0.938898 0.938898	U.491688 U.491688	4.752050		0.999548	0.515009	14240.599609
4048 5830	Ť	1	538	0.938898	0.491688	4.752050	2	0.999773	0.518009	14240.599609
5830		9	538 538	0.938898 0.938898	U.491588 U.491588	4.752050	-	0.999886	0.515009	14240.599509
4246 5856	7		538	0.938898	0.491688	4.752050	1	0.999773	0.515009	14240.599609
7728	Ť	- 0	538	0.938898	U.491688	4.752050		0.999886	0.515009	14240.599609
423A 4429	-	-	538 538	0.938898	0.491688	4.752050		0.999319	0.515009	14240.500600
4192	- 6	 	538	0.938898	0.491688	4.752050	138	0.984327	0.515009	14240.599609
4412	1	0	538	0.938898	0.491688	4.752080	138	0.984327	0.515009	14240.599609
5724 6766	- 1	1 1	538	0.938898	0.491688 0.491688	4.752050	138	0.999888	0.515009	14240.599609
4409	0	8	538	0.938898	0.491688	4.752050		0.999705	0.515009	14240.599609
4188	Ö		538 538	0.938898	0.491688 0.491688	4.752050	138	0.984327	0.515009	14240.599609
4410 4212	-		538	0.938898	0.491688	4.752050	138	0.984327	0.515009	14240.599609
4245	å		538	0.938898	0.491688	4.752050	138	0.984327	0.515009	14240.599609
5736	- 1	 	538 538	0.938898	0.491688	4.752050	138	0.984327	0.515009	14240.599609
6584 4044	_წ	 	538	0.938898	0.491688	4.752050	138	0.984327	0.515009	14240.599609
4205	1		538	0.938898	0.491688	4.752050	138	0.984327	0.515009	14240.599609
4239 5739	0		538	0.938898	0.491688	4.752050	138	0.984327	0.515009	14240.599609
9077	Ť	0	538	0.938898	0.491688	4.752050	138	0.984327	0.515009	1 14240.599609
8736	4	<u> </u>	538 538	0.938898	0.491588	4.752050	138	0.984327 0.984327	0.515009	14240.599609
7580	- 1	1	538	0.935595	0.491688	4.752050	136	0.999888	0.515009	14240.599609
6828	- 2	i	538	0.938898	0.491688	4.752050		0.999888	0.515009	14240.599809
9353	-	1	538	898889.0	0.491588	4.752050	1	0.999888	0.515009	14240.599609
2510 2550		 	538	0.938898	0.491688	4.752050	<u> </u>	0.999886	0.515009	14240.599609
2602	-1	<u> </u>	538	0.938898	0.491688	4.752050	1	0.999886	0.515009	14240.599609
7666 7777	-1	-	538 538	0.938898 0.938898	0.491588	4.752050		0.999888	0.515009	14240.599609
3192	-1	 i 	538	0.938898	0.491588	4.752050		0.999886	0.515009	14240.599609
3226	ř	1	538	0.938898	0.491688	4.752050	1	0.999886	0.515009	14240.599609
3254	7	1	538 538	0.938898 0.938898	0.491688	4.752050 4.752050	+ 1	0.999886	0.515009	14240.599609
4465		 	538	0.938898	0.491688	4.752050	3	0.999659	0.515009	14240.599609
5325	-1		538	0.938898	0.491688	4.752050	1 3	0.999886	0.515009	14240.599609
9463 3327	-1	+ - 1	538	0.938898	0.491688	1.501450	- 5	0.999319	0.500000	198.634995
1026	1	 	79	0.991028	0.508567	1.323090	4	0.999546	0.833490	5826.399902
		Mean	al 333.5		0.495587	3.295575	22.84	0.997406	0.628578	9322.703651
		Std de	vi 267.6	0.030394	0.009328	1.873781	20.61	0.002341	0.187094	7029.276570

Table E.28: Results for Benchmark S9234

3953, te	sting	ength = 54F								
238	Inp	SA 0	N.PO	FE1 0.998193	Rest_1 0.500000	Tim.Str. 0.037036	N.Sg	PE2 0.999097	Resl_2 1.000000	Tim,Furt 42.391998
235	-1	1	2	0.998193	0.500000	0.037038		0.999097	1.000000	42.391998 311.326996
262 262	-1	0	- 8 - 8	0.992773	0.559300	0.035249	1	0.999097	1.000000	311.326996
87	3		- 8	0.992773	0.559300	0.035249		0.999097	1.000000	311.326996 311.326996
87 91	-1	- 0	8	0.992773	0.559300	0.035249		0.999097	1.000000	311.326996
91	1	O .	- B	0.992773	0.559300	0.035249		0.999097	1.000000	311.326996 311.326996
97	-1-	Ö	- 8	0.992773	0.559300	0.035249		0.999097	1.0000000	311.326996
105	-1	1	8	0.992773	0.559300	0.035249		0.999097	1.000000	311.326998 311.326996
113	-1	ī	8	0.992773	0.559300	0.035249		0.999097	1.000000	311.326996
113		0	8	0.992773	0.559300	0.035249	 	0.999097	1.000000	311.326996 311.326996
124	-1	Ö	8	0.992773	0.559300	0.035249 0.048881		0.999097	1.000000	311.326996 134.339005
554 554		- U	19	0.982836	0.495367	0.048881	i	0.999097	1.000000	134.339005
581 783	-1-	1	19	0.982836 0.982838	0.495367 0.495367	0.048881		0.999097 0.999097	1.000000	134.339005
882	-1	- i	19	0.982836	0.495367	0.048881		0.999097	1.000000	134.339005
882	-		19	0.982836 0.982836	0.495367	U.U48881 U.U48881	1-1-	0.999097	1.000000	134.339005
695	6	Ö	19	0.982836	0.495357	0.048881		0.999097	1.000000	134.339005
882		- 1	19	0.982836	0.495367	0.048881 0.048881	 	0.999097	1.000000	134.339005
823	0	Ö	19	0.982836	0.495367 0.495367	0.048881 0.048881		0.999097 0.999097	1.000000	134.339005
749	1		19	U.982836 U.982836	0.495357	0.048881	i	" U.999097	1:000000	134.339005
823 753	-	0	19	0.982838	0.495367	0.048881 0.048881	1	0.999097 0.999097	1.000000	134.339005
753	. 1		19	0.982836	0.495357	0.048881		0.999097	1.000000	134.:139005
783 581	-	9	19	0.982838	0.495367	0.048881	+ +	U.999097 U.999097	1.000000	134.339005
511	-1	Ö	5	0.995483	0.563705	0.038998		0.999097	1.000000	98.316200
511	-1	0	5	0.995483	0.563705	0.038998	 	11.999097	1.000000	98.316200 98.316200
511		Ů	5	0.995483 0.995483	0.563708 0.563708	0.038998	1	0.999097	1.000000	98.316200 98.316200
34	; ;	- 6	5	0.995483	0.563705	0.038998	i	0.999097	1.000000	98.316200
38	-1		3	0.995483	0.563705	0.038998	1	0.999097 0.999097	1.0000000	98.316200 98.316200
494	-1	0	28	0.974706	0.497257	0.045028	1	0.999097	0.947910	201.554993 201.554993
494 585	-1	0	28 28	0.974708	0.497257	0.045028	1 2	0.999097	0.947910	201.554993
885	-1	0	28	0.974706	0.497257	0.045028 0.045028	1	0.999097	0.947910	201.554993 201.554993
905	-1	0	28 28	0.974708	0.497257	0.045028	1 1	0.999097	0.947910	201.554993
905 886	-6-	0	28 28	0.974708	0.497257	U.U45028 U.U45028		0.999097	0.947910	201.554993 201.854993
886		 - i	28	0.974706	0.497257	0.045028		0.999097	0.947910	201.554993
858 858	<u> </u>	8	78 28	0.974708	0.497257	0.045028	1 1	0.999097	0.947910	201.554993 201.554993
802	0	00	28	0.974706	0.497257	0.045028		0.999097	0.947910	201.554993
743	- 1	1	28 28	0.974706	0.497257	0.045028	- i -	0.999097	1 11 047010	201.554993
743 885	1		28	0.974708	0.497257	0.045028		0.999097	0.947910	201.554993 201.554993
857	- 6	Ū	28	0.974708	0.497257	0.045028	i	0.999097	0.947910	201.554993
793	- 0	- 0	28 28	0.974708	0.497257	0.045028	1 1	0.999097	0.947910	201.554993 201.554993
793	1	Ö	28	0.974708	0.497257	0.045028	1	0.999097	0.947910	201.554993 201.554993
740	<u> </u>	 	28	0.974706	0.497257	0.045028	1	0.999097	0.947910	201.554993
585 494	0	9	28	0.974706	0.497257	0.045028		0.999097	0.947910	201.554993 201.554993
494		ī	28	0.974706	0.497257	0.045028	i	0.999097	0.947910	201.554993
961 961	: I	- 1	28	0.974706	0.497257	0.045028	1 2	0.998193	0.947910	201.554993
324	-1	Ō	26	0.976513	0.505623	0.053254	Ī	0.999097	0.888354	208.854996 208.854995
324 934	-1	0	26 26	0.976513	0.505623 0.505623	0.083254	1 3	0.999097	0.888354	208.854996
943	-1	- 0	26	0.976513	0.505623	0.083254	7	0.998193	0.888354	208.854996 208.854996
934	1	- 1	26 26	0.976513	0.505623	0.053254	<u> </u>	0.999097	0.888354	208.854996
873 873	0	1	26 26	0.976513	0.505623	0.053254		0.999097	U.888354 U.888354	208.854996 208.854996
324	Ö	Ī.,	26	0.976513	0.505623	0.053254	<u> </u>	0.999097	0.888354	208.854388
324 687	-1	0	26	0.975513 0.975513	0.505623	0.053254	+	0.999097	U.888354 U.888354	208.854996 208.854996
687	-1	i	26	0.976513	0.505623	0.053254	1-1-	0.999097	0.888354	208.854996
751 985	-1		26 26	0.976513	0.505623	0.053254 0.053254	3 2	0.997290 0.998193	0.888354	708 854996
986	1	, i	25	0.975513	0.505623 0.505623	0.053254	1	0.999097	0.888354	208.854995
955	9	à	26	0.976513	0.505623	0.053254		0.999097	0.888354	208.854996
955	- 0	0	25 25	0.976513	0.505623	0.083284	1	0.999097	0.888354	208.854996 208.854998
930		1	26	0.976513	0.505623	0.053254	1	0.999097	0.888354	208.854995 208.854995
904	0	0	26	0.976513	0.505623	0.053254		0.999097	0.888354 0.888354	208.854996
979	Ī	1	26	0.976513	0.505623 0.505623	0.083254	1 7	0.998193	0.888354	208.854996 208.854996
751 687	0	0	26 26	0.976513	0.505623	0.053254		0.999097	0.888354	208.854998
687 1003	1	0	26 26	0.976513	0.505623	0.083254	1 - 1	0.999097	0.888354	208.854996
1003		1	26_	0.976513	0.305623	0.053254		0.997290	0.888354	208,854908
514 514	-1		8	0.992773 0.992773		0.035620	T	0.999097	1.000000	72.736801 72.736801
538	-1	<u> </u>	8	0.992773	0.513770	0.035620	<u> 1 i </u>	0.999097	1.000000	72.736801
		Mean val	20.1	0.981879	0.513811	0.045731		0.998970		191.561287
		Std devi	8.8	0.007941	0.025558	0.006463	0.43	0.000386	1 0.046801	65.692972

Table E.29: Results for Benchmark S953