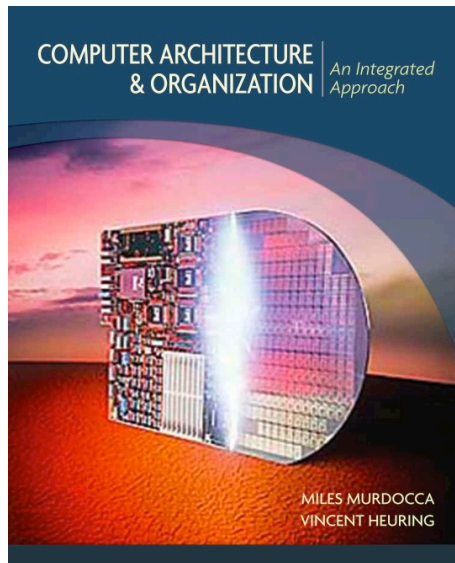


Computer Architecture and Organization

Miles Murdocca and Vincent Heuring



Appendix B – Using ARCTools

Chapter Contents

B.1 Introduction

B.2 Accessing and Launching ARCTools

B.3 The ARC Assembler

B.4 The ARC Simulator

**B.5 Instructions and Pseudo Instructions Recognized by
ARCTools**

B.6 The Macroprocessor

B.7 Measuring Program Performance

Using ARCTools

The ARCTools toolset includes the following features:

- An integrated assembler and simulator for the ARC ISA.
- Extensions to the ISA described in Chapter 4 with several additional actual and synthetic instructions.
- A trap mechanism.
- A simple macroprocessing facility.
- Ability to specify instruction timings.
- A multi-level cache memory simulator.
- A number of example programs showing the features of the toolset.

The ARCTools Simulator Window

ARC Simulator (ARCTools Version 2.1.2)

PC = 00000000 ☐ n ☐ z ☐ v ☐ c

ireq ☐ ET PIL = 0 TBR = ff000000

r0 = 00000000	r1 = 00000000	r2 = 00000000	r3 = 00000000
r4 = 00000000	r5 = 00000000	r6 = 00000000	r7 = 00000000
r8 = 00000000	r9 = 00000000	r10 = 00000000	r11 = 00000000
r12 = 00000000	r13 = 00000000	r14 = 00000000	r15 = 00000000
r16 = 00000000	r17 = 00000000	r18 = 00000000	r19 = 00000000
r20 = 00000000	r21 = 00000000	r22 = 00000000	r23 = 00000000
r24 = 00000000	r25 = 00000000	r26 = 00000000	r27 = 00000000
r28 = 00000000	r29 = 00000000	r30 = 00000000	r31 = 00000000

Exit Print Load Reload Edit Step Run Stop

Clear RegFile Clear BreakPts Clear Memory

Time Model Editor Timing Statistics

☒ Hex ☐ Dec ☒ Update Screen

Loc	BreakPt	MachWord	Source Code
[00000000]	<input type="checkbox"/>	00000000	None
[00000004]	<input type="checkbox"/>	00000000	None
[00000008]	<input type="checkbox"/>	00000000	None
[0000000c]	<input type="checkbox"/>	00000000	None
[00000010]	<input type="checkbox"/>	00000000	None
[00000014]	<input type="checkbox"/>	00000000	None
[00000018]	<input type="checkbox"/>	00000000	None
[0000001c]	<input type="checkbox"/>	00000000	None

Prev. 8 Prev. 4 Prev. 1 Next 1 Next 4 Next 8

Prev. 16

Loc	Offset 00	Offset 04	Offset 08	Offset 0c
[00000000]	00000000	00000000	00000000	00000000
[00000010]	00000000	00000000	00000000	00000000
[00000020]	00000000	00000000	00000000	00000000
[00000030]	00000000	00000000	00000000	00000000

Prev. 8 Prev. 4 Next 4 Next 8 Next 16

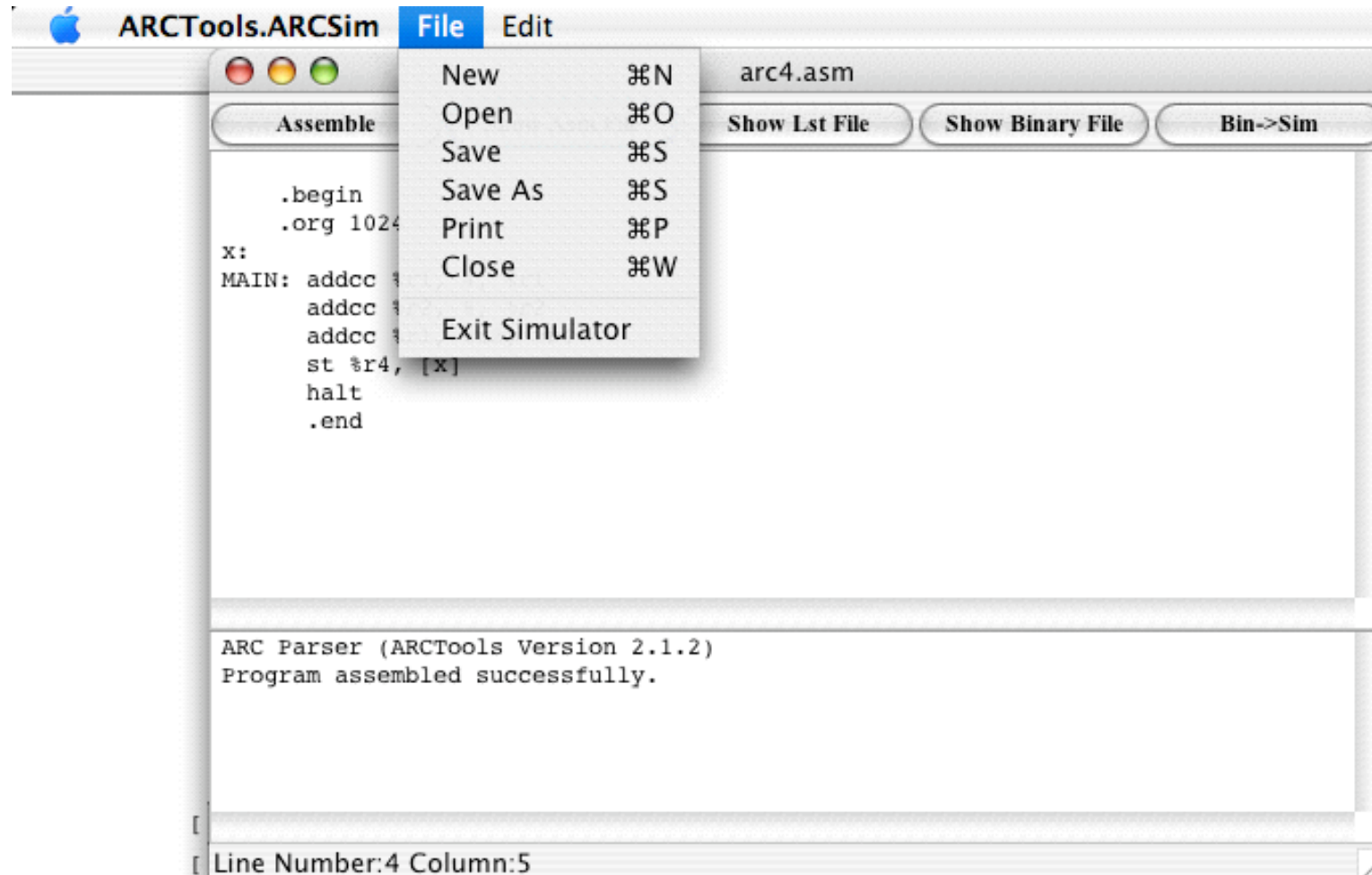
(ARCTools Version 2.1.2)

The ARCTools Edit Window



The ARCTools Edit Window

- The Edit window with an asm file and the file dialog



Assembly

- The arc4 program after assembly, showing arc4.lst, the listing file.

```

(arc4.lst)
Assemble Show Asm File Show Lst File Show Binary File Bin->Sim
(ARCTools Version 2.1.2)
HexLoc    DecLoc    MachWord    Label    Instruction    Comment
00000400  0000001024          x:    .org 1024
00000404  0000001028  82806004  MAIN:  addcc %r1, 4, %r1
00000408  0000001032  8480a008    addcc %r2, 8, %r2
0000040c  0000001036  88804002    addcc %r1, %r2, %r4
00000410  0000001040  c8202400    st %r4, [1024]
00000414  0000001044  ffffffff    halt

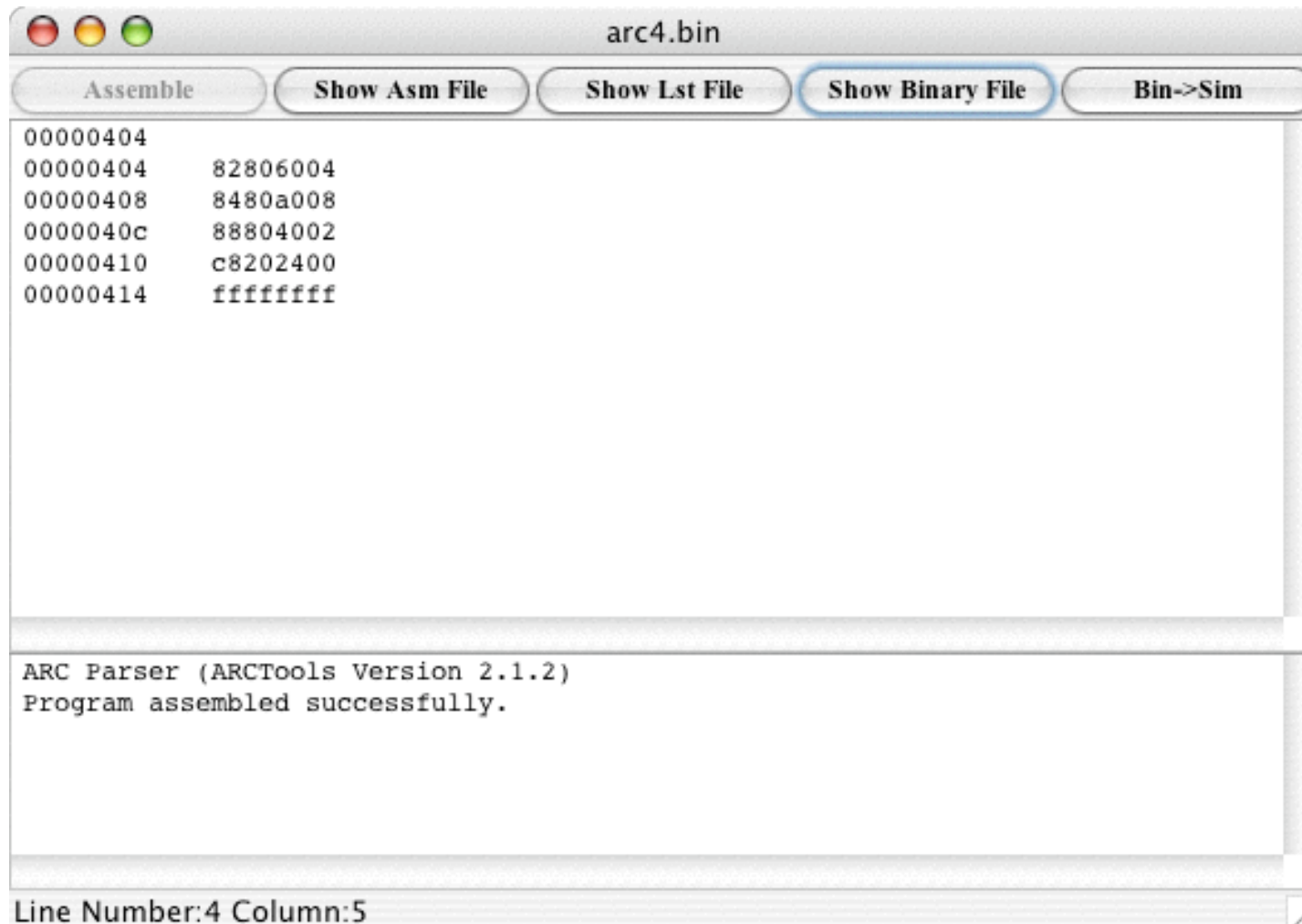
--- Symbol Table ---
x: 1024
MAIN: 1028

ARC Parser (ARCTools Version 2.1.2)
Program assembled successfully.

Line Number:4 Column:5
  
```

Binary File

- The arc4 bin file, displayed after pressing the Show Binary File button.



Setting up ARCTools

- Contents of the ARCTools directory after unzipping.

Simulation

- The ARCTools simulator window after pressing Bin -> Sim.

ARC Simulator (ARCTools Version 2.1.2)

PC = 00000404 ☐ n ☐ z ☐ v ☐ c

ireq ☐ ET PIL = 0 TBR = ff000000

r0 = 00000000	r1 = 00000000	r2 = 00000000	r3 = 00000000
r4 = 00000000	r5 = 00000000	r6 = 00000000	r7 = 00000000
r8 = 00000000	r9 = 00000000	r10 = 00000000	r11 = 00000000
r12 = 00000000	r13 = 00000000	r14 = 00000000	r15 = 00000000
r16 = 00000000	r17 = 00000000	r18 = 00000000	r19 = 00000000
r20 = 00000000	r21 = 00000000	r22 = 00000000	r23 = 00000000
r24 = 00000000	r25 = 00000000	r26 = 00000000	r27 = 00000000
r28 = 00000000	r29 = 00000000	r30 = 00000000	r31 = 00000000

Exit Print Load Reload Edit Step Run Stop

Clear RegFile Clear BreakPts Clear Memory

Time Model Editor Timing Statistics

☒ Hex ☐ Dec ☒ Update Screen

Loc	BreakPt	MachWord	Source Code
[00000404]	<input type="checkbox"/> 82806004	addcc %r1, 4, %r1	Prev. 8
[00000408]	<input type="checkbox"/> 8480a008	addcc %r2, 8, %r2	Prev. 4
[0000040c]	<input type="checkbox"/> 88804002	addcc %r1, %r2, %r4	Prev. 1
[00000410]	<input type="checkbox"/> c8202400	st %r4, [400]	Next 1
[00000414]	<input type="checkbox"/> ffffffff	halt	Next 4
[00000418]	<input type="checkbox"/> 00000000	None	Next 8
[0000041c]	<input type="checkbox"/> 00000000	None	
[00000420]	<input type="checkbox"/> 00000000	None	

Prev. 16

Loc	Offset 00	Offset 04	Offset 08	Offset 0c
[00000000]	00000000	00000000	00000000	00000000
[00000010]	00000000	00000000	00000000	00000000
[00000020]	00000000	00000000	00000000	00000000
[00000030]	00000000	00000000	00000000	00000000

Prev. 8

Prev. 4

Next 4

Next 8

Next 16

(ARCTools Version 2.1.2)

Instructions Recognized by ARCTools

add	addcc	and	andcc	andn
andncc	ba	bcc	bcs	be
bg	bge	bgu	bl	ble
bleu	bn	bne	bneg	bpos
bvc	bvs	call	jmp1	ld
ldsb	ldsh	ldub	lduh	or
orcc	orn	orncc	rd	rett
sethi	sll	sra	srl	st
stb	sth	sub	subcc	ta
wr	xnor	xnorcc	xor	xorcc

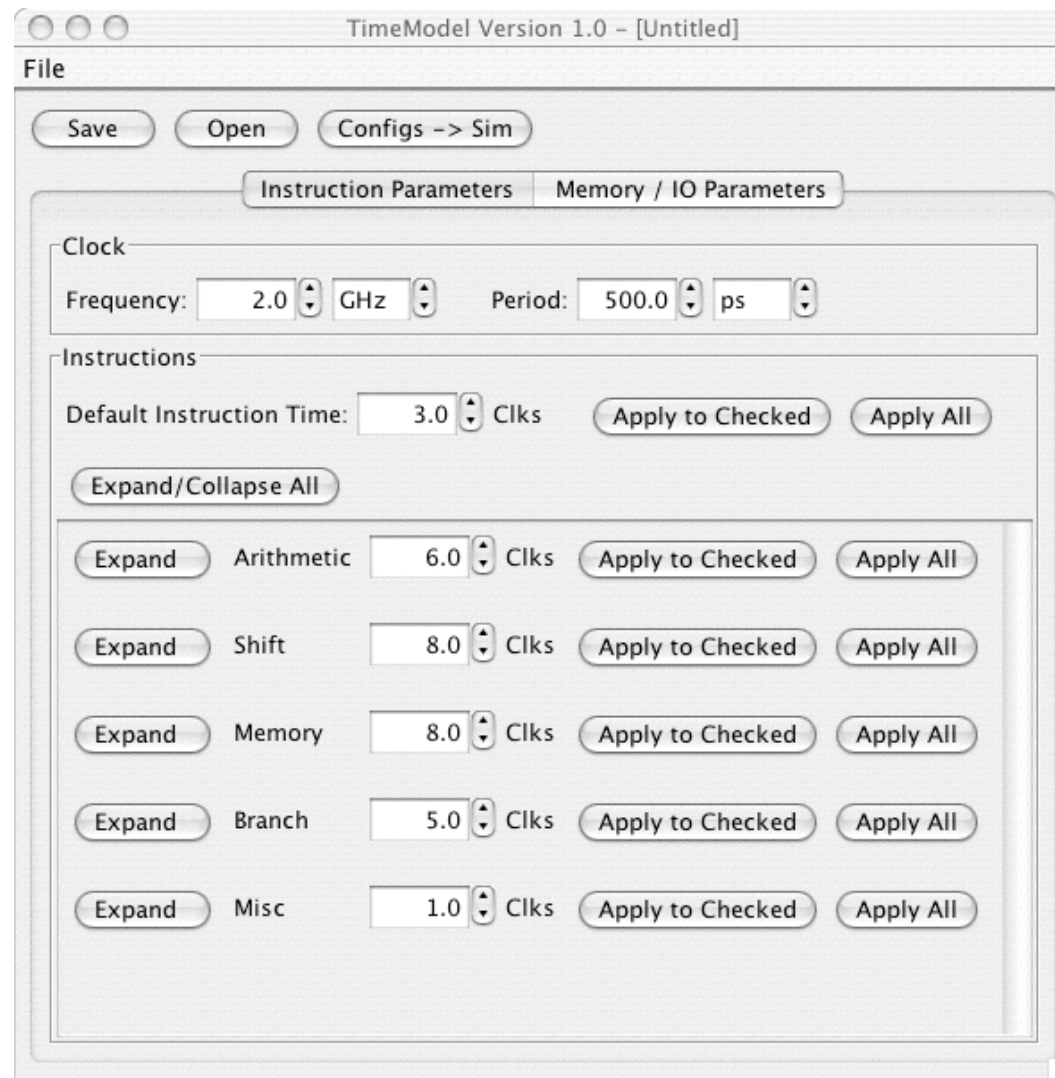
Synthetic Instructions Recognized by ARCTools

Synthetic Instruction	Instruction Generated	Comment
not rs1, rd	xnor rs1, %r0, rd	1's complement
neg rs2, rd	sub %r0, rs2, rd	2's complement
inc rd	add rd, 1, rd	increment by 1
dec rd	sub rd, 1, rd	decrement by 1
clr rd	and rd, %r0, rd	clear a register
cmp rs1, reg_or_imm	subcc rs1, reg_or_imm, %r0	compare, set cc's
tst rs2	orcc %r0, rs2, %r0	test
mov reg_or_imm, rd	or %r0, reg_or_imm, rd	move a value

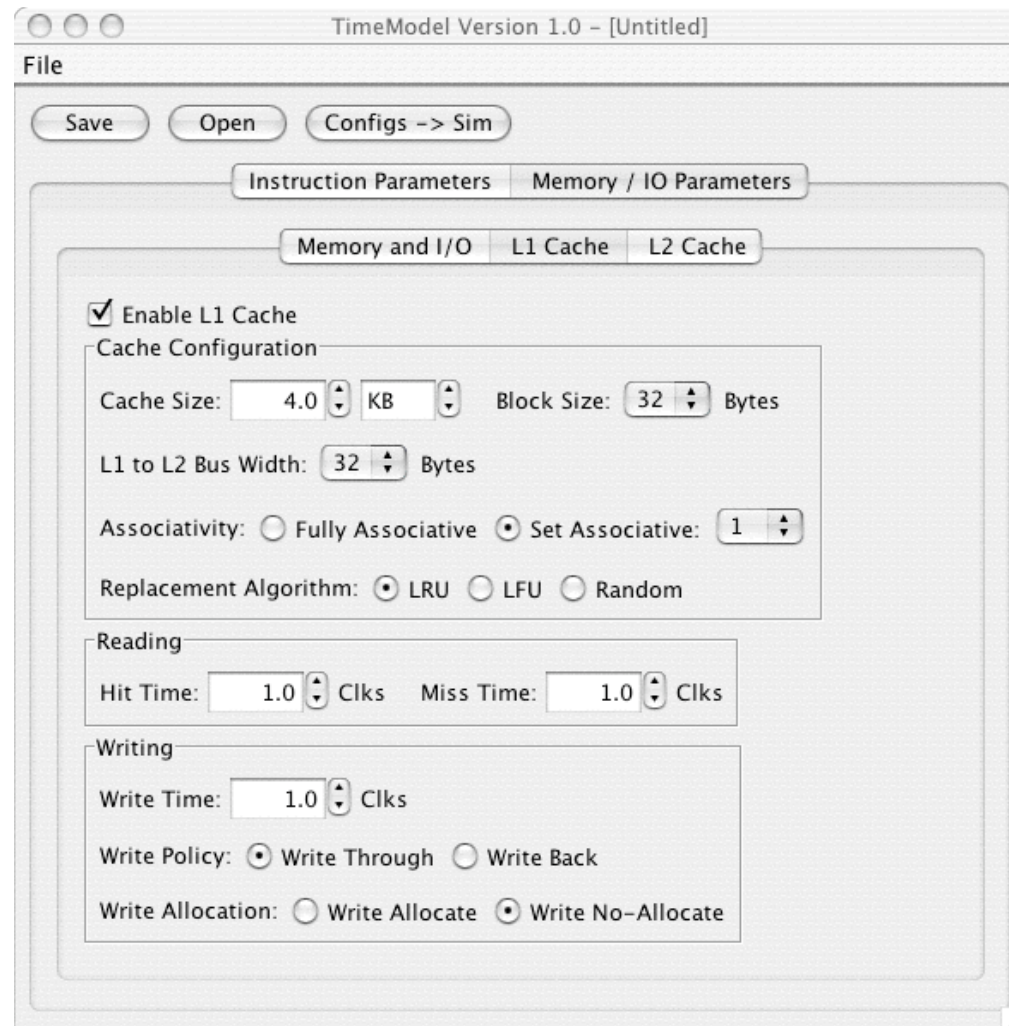
Pseudo-Ops Recognized by ARCTools

Pseudo-operations	Meaning
<code>.equ value</code>	Equate a symbol to a value
<code>.begin</code>	begin assembly
<code>.end</code>	end of assembly language text
<code>.org value</code>	move location counter to value
<code>.dwb value</code>	reserve space for value words
<code>.macro Name [,params] *</code>	begin definition of macro Name, with an optional, comma-separated parameter list
<code>.if <cond></code>	assemble if <cond> is true (only used in macros)
<code>.endif</code>	end of <code>.if</code> construct (only used in macros)
<code>.endmacro</code>	end of macro definition

Instruction Parameters Window



Adjustable Parameters in the L1 Cache Window



The Timing Statistics Window

