

ToyPacer Machine Language Specification

ToyPacer Instruction Formats

The ToyPacer architecture has three instruction formats:

	15	12	11	4	3	2	1	0
R-Type	OP		UNUSED		RD		RS	

	15	12	11	2	1	0	
I-Type	OP		IMM			R	

	15	12	11	4	3	2	1	0
B-Type	OP		TARGET		R1		R2	

Machine Language Instructions

R-Type Instructions

Instruction	Opcode
ADD RD, RS	1000
SUB RD, RS	1001
MOVE RD, RS	1010
RFI	1011

I-Type Instructions

Instruction	Opcode
ADDI RD, IMM	0100
SUBI RD, IMM	0101
LOAD RD, ADDRESS	0110
SETSEG IMM	0010
STORE RS, ADDRESS	0111
ASSERT PORT, IMM	0001
MASKI	0000

B-Type Instructions

Instruction	Opcode
BGE R1, R2, LABEL	1100

Machine Language Implementation of Sample Pseudocode

```
# INIT:
# 0000:
#     MASKI
0000 000000000000
#     SETSEG      0
0010 000000000000
#     ASSERT      ISRADDR0, TINTR
#     0001 TINTR 00
0001 0000101010 00
#     ASSERT      ISRADDR1, VINTR
#     0001 VINTR 01
0001 0000110110 01
#     ASSERT      ISRADDR2, AINTR
#     0001 AINTR 10
0001 0001000000 10
#     SUB          R0, R0
1001 00000000 00 00
#     STORE R0, VTIME
#     0111 VTIME 00
0111 0001001010 00
#     STORE R0, ATIME
#     0111 ATIME 00
0111 0001001100 00
#     STORE R0, PTIME
#     0111 PTIME 00
0111 0001001110 00
#     MASKI
0000 000000000000

# LOOP:
# 0014:
#     LOAD          R0, VTIME
#     0110 VTIME 00
0110 0001001010 00
#     ADDI          R0, VDELAY
#     0100 VDELAY 00
0100 1111101000 00
#     LOAD          R1, PTIME
#     0110 PTIME 01
0110 0001001110 01
#     ADDI          R1, PDELAY
#     0100 PDELAY 01
0100 1111101000 01
#     BGE          R0, R1, CHK
#     1100 CHK 01 00
#     1100 +1 01 00
1100 00000001 01 00
#     MOVE          R0, R1
1010 00000000 00 01
# CHK:
# 0020:
#     LOAD          R1, CTIME
#     0110 CTIME 01
0110 0001010000 01
```

```

#      BGE          R1, R0, LOOP
#      1100 LOOP 01 00
#      1100 -8 01 00
1100 11111000 01 00
#      ASSERT      OUTPORT, PEVENT
#      0001 PEVENT 11
0001 0000000000 11
#      STORE R1, PTIME
#      0111 PTIME 01
0111 PTIME 01
#      BGE          R0, R0, LOOP
#      1100 LOOP 00 00
#      1100 -11 00 00
1100 11110101 00 00

```

```

# TINTR:
# 002A:
#      STORE R0, TSAVE
#      0111 TSAVE 00
0111 0001010110 00
#      LOAD          R0, CTIME
#      0110 CTIME 00
0110 0001010000 00
#      ADDI          R0, 1
0100 00000001 00
#      STORE R0, CTIME
#      0111 CTIME 00
0111 0001010000 00
#      LOAD          R0, TSAVE
#      0110 TSAVE 00
0110 0001010110 00
#      RFI
1011 000000000000

```

```

# VINTR:
# 0036:
#      STORE R0, VSAVE
#      0111 VSAVE 00
0111 0001010010 00
#      LOAD          R0, CTIME
#      0110 CTIME 00
0110 0001010000 00
#      STORE R0, VTIME
#      0111 VTIME 00
0111 0001001010 00
#      LOAD          R0, VSAVE
#      0110 VSAVE 00
0110 0001010010 00
#      RFI
1011 000000000000

```

```

# AINTR:
# 0040:
#      STORE R0, ASAVE
#      0111 ASAVE 00
0111 0001010100 00
#      LOAD          R0, CTIME

```

```
#      0110 CTIME 00
0110 0001010010 00
#      STORE R0, ATIME
#      0111 ATIME 00
0111 0001001100 00
#      LOAD      R0, ASAVE
#      0110 ASAVE 00
0110 000101010000
#      RFI
1011 0000000000000
```

```
# VTIME:
# 004A:
#      0
00000000000000000
# ATIME:
# 004C:
#      0
00000000000000000
# PTIME:
# 004E:
#      0
00000000000000000
# CTIME:
# 0050:
#      0
00000000000000000
# VSAVE:
# 0052:
#      0
00000000000000000
# ASAVE:
# 0054:
#      0
00000000000000000
# TSAVE:
# 0056:
#      0
00000000000000000
```