Instruction Encoding

September 21, 2011

1 Instructions

The computer has 12-bit words. Every instruction is exactly one word in size, although trickery can be used to write instructions which seem to be two words in length.

The table below summarizes the encoding of instructions on the machine.

Opcode						Operands		Description
0	0	C	PPP			AAA	BBB	Math
0	1	PPPP				AAA	BBB	Logic
1	0	RR		QQ		AAA	BBB	Load
1	1	0	0	1	0	AAA	BBB	Sets "compare" on equality
1	1	0	1	0	KKKK		AAA	Right rotate
1	1	0	1	1	C	PPP	BBB	Immediate math and logic

In this table:

- "AAA" is "source register;"

- "BBB" is "destination register;"

- "PPP(P)" is "function selection;"

- "KKKK" is "shift positions;"

- "RR" is "(source) address mode;"

- "QQ" is "(destination) address mode."

Both "RR" and "QQ" are encoded as:

Encoding	Description	Code
0	register direct	r
1	register dereference	(r)
2	register dereference with post-increment	$(r++)$
3	register dereference with pre-decrement	$(--r)$

2 Math

The table below summarizes the math functions.

Encoding (PPP)	Instruction	Behavior
0	add	$A + B \rightarrow B$
1	sub	$A - B \rightarrow B$
2	nsub	$B - A \rightarrow B$
3	dec	$B - 1 \rightarrow B$
4	inc	$B + 1 \rightarrow B$
5	neg	$-B \rightarrow B$
6	s.lt	Sets "compare" if $A < B$ (signed)
7	u.lt	Sets "compare" if $A < B$ (unsigned)

3 Logic

The table below summarizes the math functions.

Encoding (PPPP)	Instruction	Behavior
0	not	$\widehat{B} \rightarrow B$
1	nor	$\widehat{A + B} \rightarrow B$
2	and.n2	$\widehat{B}A \rightarrow B$
3	clr	$0 \rightarrow B$
4	nand	$\widehat{BA} \rightarrow B$
5	copy.n1	$\widehat{A} \rightarrow B$
6	xor	$B \oplus A \rightarrow B$
7	and.n1	$B\widehat{A} \rightarrow B$
8	or.n2	$\widehat{B} + A \rightarrow B$
9	xnor	$\widehat{B \oplus A} \rightarrow B$
a	copy	$A \rightarrow B$
b	and	$BA \rightarrow B$
c	set	$1 \rightarrow B$
d	or.n1	$B + \widehat{A} \rightarrow B$
e	or	$B + A \rightarrow B$
f	tst	Sets the "compare" bit if B is zero

4 Immediate math and logic

The table below summarizes the immediate-argument math and logic operations.

Encoding (PPP)	Instruction	Behavior
0	iadd	$N + B \rightarrow B$ (arithmetic $+$)
1	insub	$B - N \rightarrow B$
2	ior	$N + B \rightarrow B$ (logical $+$)
3	iand	$NB \rightarrow B$ (logical "and")