

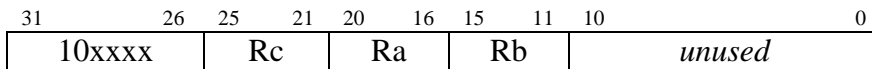
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6.004 Computation Structures
Spring 2009

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Summary of β Instruction Formats

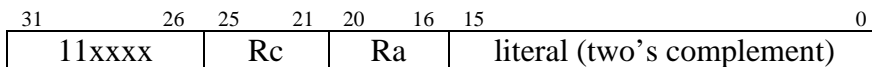
Operate Class:



Register	Symbol	Usage
R31	R31	Always zero
R30	XP	Exception pointer
R29	SP	Stack pointer
R28	LP	Linkage pointer
R27	BP	Base of frame pointer

OP(Ra,Rb,Rc): $\text{Reg}[Rc] \leftarrow \text{Reg}[Ra] \text{ op } \text{Reg}[Rb]$

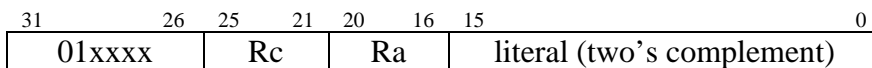
Opcodes: **ADD** (plus), **SUB** (minus), **MUL** (multiply), **DIV** (divided by)
AND (bitwise and), **OR** (bitwise or), **XOR** (bitwise exclusive or)
CMPEQ (equal), **CMPLT** (less than), **CMPLT** (less than or equal) [result = 1 if true, 0 if false]
SHL (left shift), **SHR** (right shift w/o sign extension), **SRA** (right shift w/ sign extension)



OPC(Ra,literal,Rc): $\text{Reg}[Rc] \leftarrow \text{Reg}[Ra] \text{ op } \text{SEXT}(\text{literal})$

Opcodes: **ADDC** (plus), **SUBC** (minus), **MULC** (multiply), **DIVC** (divided by)
ANDC (bitwise and), **ORC** (bitwise or), **XORC** (bitwise exclusive or)
CMPEQC (equal), **CMPLTC** (less than), **CMPLTC** (less than or equal) [result = 1 if true, 0 if false]
SHLC (left shift), **SHRC** (right shift w/o sign extension), **SRAC** (right shift w/ sign extension)

Other:



LD(Ra,literal,Rc): $\text{Reg}[Rc] \leftarrow \text{Mem}[\text{Reg}[Ra] + \text{SEXT}(\text{literal})]$
ST(Rc,literal,Ra): $\text{Mem}[\text{Reg}[Ra] + \text{SEXT}(\text{literal})] \leftarrow \text{Reg}[Rc]$
JMP(Ra,Rc): $\text{Reg}[Rc] \leftarrow \text{PC} + 4; \text{PC} \leftarrow \text{Reg}[Ra]$
BEQ/BF(Ra,label,Rc): $\text{Reg}[Rc] \leftarrow \text{PC} + 4; \text{if } \text{Reg}[Ra] = 0 \text{ then } \text{PC} \leftarrow \text{PC} + 4 + 4 * \text{SEXT}(\text{literal})$
BNE/BT(Ra,label,Rc): $\text{Reg}[Rc] \leftarrow \text{PC} + 4; \text{if } \text{Reg}[Ra] \neq 0 \text{ then } \text{PC} \leftarrow \text{PC} + 4 + 4 * \text{SEXT}(\text{literal})$
LDR(label,Rc): $\text{Reg}[Rc] \leftarrow \text{Mem}[\text{PC} + 4 + 4 * \text{SEXT}(\text{literal})]$

Opcode Table: (*optional opcodes)

	2:0								
5:3		000	001	010	011	100	101	110	111
	000								
	001								
	010								
	011	LD	ST		JMP		BEQ	BNE	LDR
	100	ADD	SUB	MUL*	DIV*	CMPEQ	CMPLT	CMPLT	CMPLT
	101	AND	OR	XOR		SHL	SHR	SRA	
	110	ADDC	SUBC	MULC*	DIVC*	CMPEQC	CMPLTC	CMPLTC	CMPLTC
	111	ANDC	ORC	XORC		SHLC	SHRC	SRAC	