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

```
31        26 25    21 20    16 15    11 10            0
  10xxxx  |   Rc   |   Ra   |   Rb   |     unused      |
```

OP(Ra,Rb,Rc):   Reg[Rc] ← Reg[Ra] op Reg[Rb]

Opcodes: **ADD** (plus), **SUB** (minus), **MUL** (multiply), **DIV** (divided by)
AND (bitwise and), **OR** (bitwise or), **XOR** (bitwise exclusive or), **XNOR** (bitwise exclusive nor),
CMPEQ (equal), **CMPLT** (less than), **CMPLE** (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)

```
31        26 25    21 20    16 15                      0
  11xxxx  |   Rc   |   Ra   |   literal (two's complement) |
```

OPC(Ra,literal,Rc):   Reg[Rc] ← Reg[Ra] op SEXT(literal)

Opcodes: **ADDC** (plus), **SUBC** (minus), **MULC** (multiply), **DIVC** (divided by)
ANDC (bitwise and), **ORC** (bitwise or), **XORC** (bitwise exclusive or), **XNORC** (bitwise exclusive nor)
CMPEQC (equal), **CMPLTC** (less than), **CMPLEC** (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:

```
31        26 25    21 20    16 15                      0
  01xxxx  |   Rc   |   Ra   |   literal (two's complement) |
```

LD(Ra,literal,Rc):   Reg[Rc] ← Mem[Reg[Ra] + SEXT(literal)]
ST(Rc,literal,Ra):   Mem[Reg[Ra] + SEXT(literal)] ← Reg[Rc]
JMP(Ra,Rc):   Reg[Rc] ← PC + 4; PC ← Reg[Ra]
BEQ/BF(Ra,label,Rc):   Reg[Rc] ← PC + 4; if Reg[Ra] = 0 then PC ← PC + 4 + 4*SEXT(literal)
BNE/BT(Ra,label,Rc):   Reg[Rc] ← PC + 4; if Reg[Ra] ≠ 0 then PC ← PC + 4 + 4*SEXT(literal)
LDR(label,Rc):   Reg[Rc] ← Mem[PC + 4 + 4*SEXT(literal)]

Opcode Table: (*optional opcodes)

5:3 \ 2:0	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	CMPLE	
101	AND	OR	XOR	XNOR	SHL	SHR	SRA	
110	ADDC	SUBC	MULC*	DIVC*	CMPEQC	CMPLTC	CMPLEC	
111	ANDC	ORC	XORC	XNORC	SHLC	SHRC	SRAC	