1 add

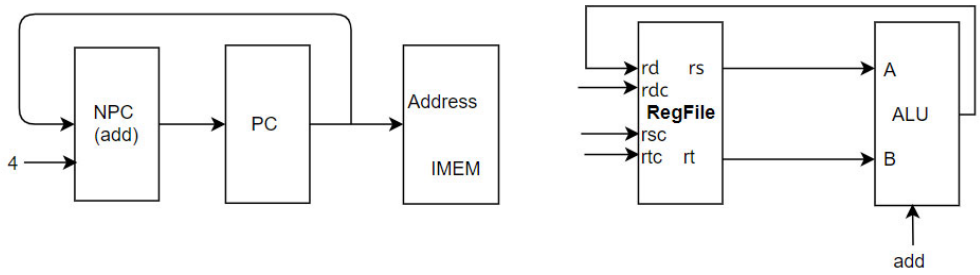
Format：add rd, rs, rt

Operation：fetch，rd←rs+rt, PC←NPC(PC+4)

digital part：PC, NPC, IMEM, Regfile, ALU

input & output relation：

	PC	NPC	IMEM	Rgefile	ALU	
				rd	A	B
add	NPC	PC	PC	ALU	rs	rt



2 addu

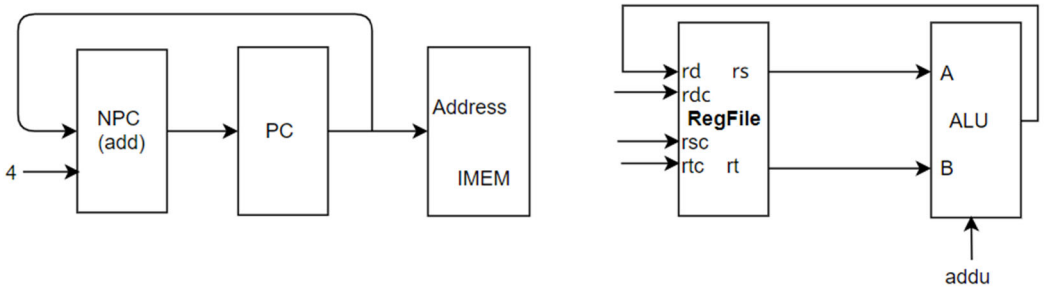
Format：addu rd, rs, rt

Operation：fetch，rd←rs+rt, PC←NPC(PC+4)

digital part：PC, NPC, IMEM, Regfile, ALU

input & output relation：

	PC	NPC	IMEM	Rgefile	ALU	
				rd	A	B
addu	NPC	PC	PC	ALU	rs	rt



3 sub

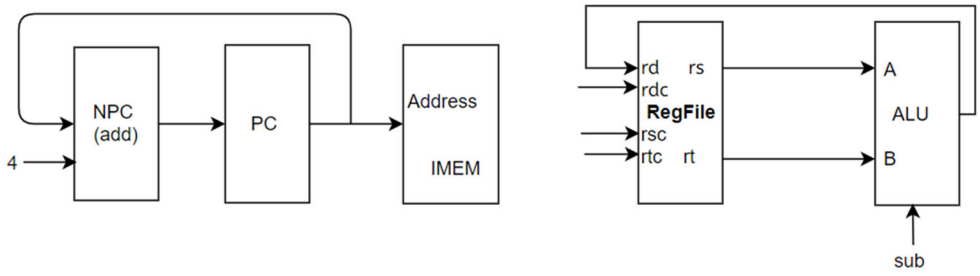
Format：sub rd, rs, rt

Operation：fetch，rd←rs-rt, PC←NPC(PC+4)

digital part：PC, NPC, IMEM, Regfile, ALU

input & output relation：

	PC	NPC	IMEM	Rgefile	ALU	
				rd	A	B
sub	NPC	PC	PC	ALU	rs	rt



4 subu

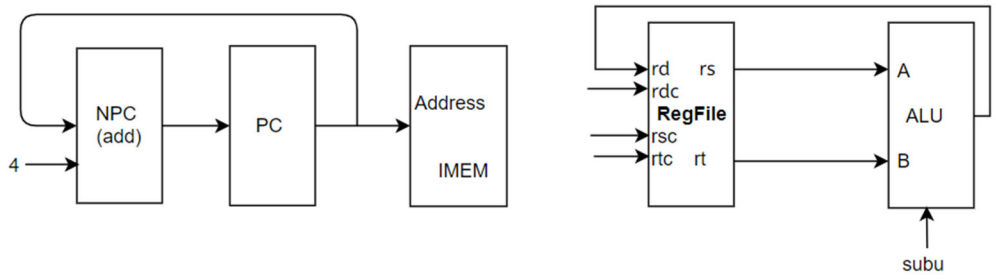
Format：subu rd, rs, rt

Operation：fetch，rd←rs-rt, PC←NPC(PC+4)

digital part：PC, NPC, IMEM, Regfile, ALU

input & output relation：

	PC	NPC	IMEM	Rgefile	ALU	
				rd	A	B
subu	NPC	PC	PC	ALU	rs	rt



5 and

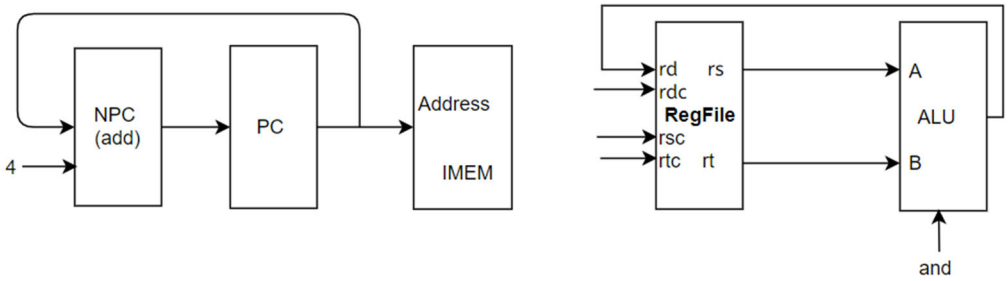
Format：and rd, rs, rt

Operation：fetch，rd←rs&rt, PC←NPC(PC+4)

digital part：PC, NPC, IMEM, Regfile, ALU

input & output relation：

	PC	NPC	IMEM	Rgefile	ALU	
				rd	A	B
and	NPC	PC	PC	ALU	rs	rt

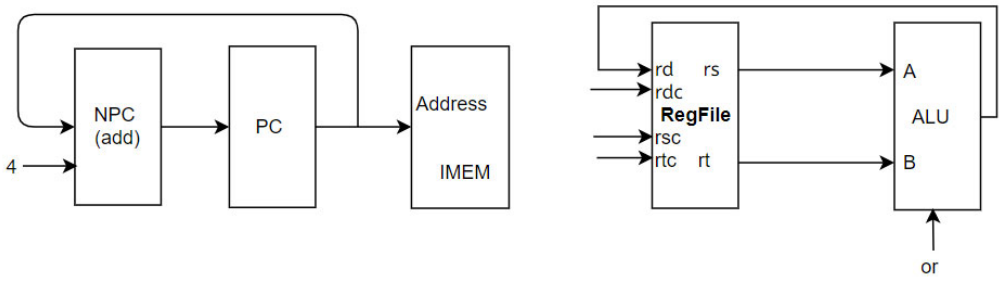


6 or

Format：or rd, rs, rt

Operation：fetch，rd←rs|rt, PC←NPC(PC+4)
digital part：PC, NPC, IMEM, Regfile, ALU
input & output relation：

	PC	NPC	IMEM	Rgefile	ALU	
				rd	A	B
or	NPC	PC	PC	ALU	rs	rt

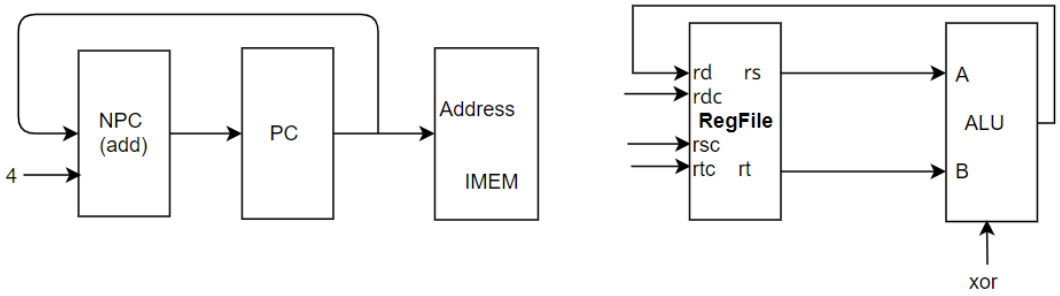


7 xor
Format：xor rd, rs, rt

Operation：fetch，rd←rs^rt, PC←NPC(PC+4)

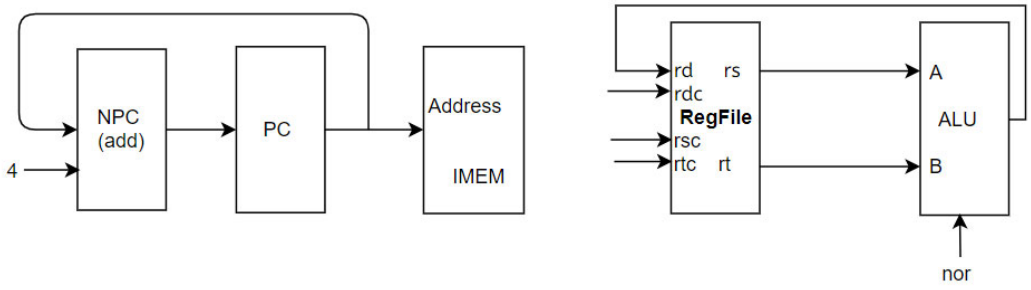
digital part：PC, NPC, IMEM, Regfile, ALU
input & output relation：

	PC	NPC	IMEM	Rgefile	ALU	
				rd	A	B
xor	NPC	PC	PC	ALU	rs	rt



8 nor
Format：nor rd, rs, rt
Operation：fetch，rd←~(rs|rt), PC←NPC(PC+4)
digital part：PC, NPC, IMEM, Regfile, ALU
input & output relation：

	PC	NPC	IMEM	Rgefile	ALU	
				rd	A	B
nor	NPC	PC	PC	ALU	rs	rt



9 slt

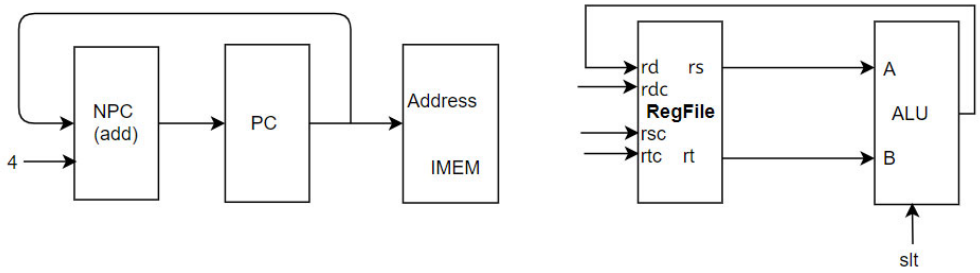
Format：slt rd, rs, rt

Operation：fetch，rd←rs<rt, PC←NPC(PC+4)

digital part：PC, NPC, IMEM, Regfile, ALU

input & output relation：

	PC	NPC	IMEM	Rgefile	ALU	
				rd	A	B
slt	NPC	PC	PC	ALU	rs	rt



10 sltu

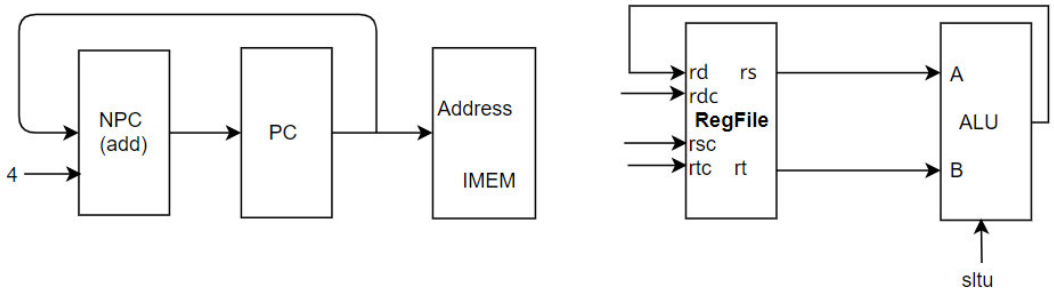
Format：sltu rd, rs, rt

Operation：fetch，rd←rs<rt, PC←NPC(PC+4)

digital part：PC, NPC, IMEM, Regfile, ALU

input & output relation：

	PC	NPC	IMEM	Rgefile	ALU	
				rd	A	B
sltu	NPC	PC	PC	ALU	rs	rt



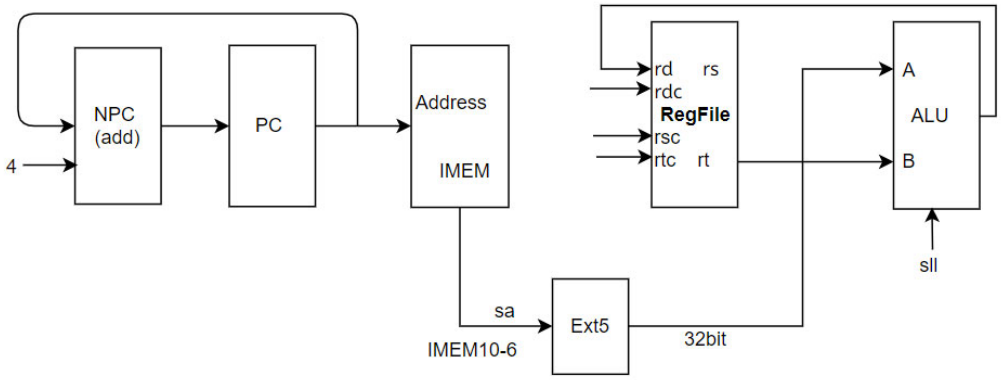
11 sll

Format：sll rd, rt, sa

Operation：fetch，rd←rt<<sa, PC←NPC(PC+4)

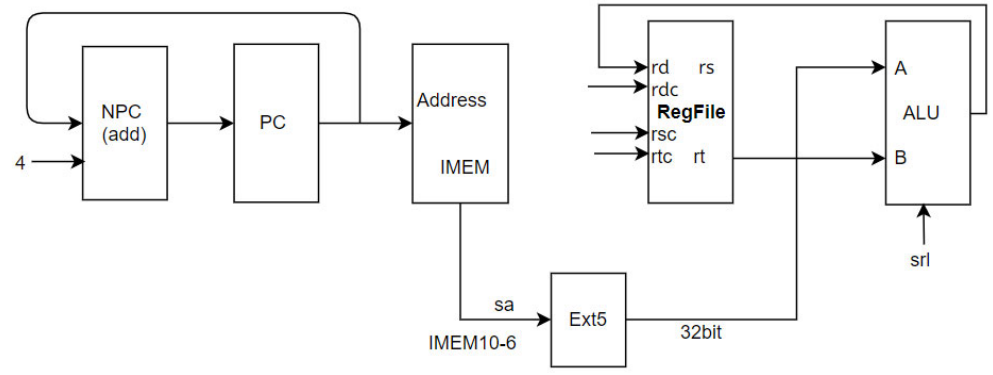
digital part：PC, NPC, IMEM, Regfile, ALU,Ext5
input & output relation：

	PC	NPC	IMEM	Rgefile	ALU		Ext5
				rd	A	B	
sll	NPC	PC	PC	ALU	Ext5	rt	sa(IM[10:6])



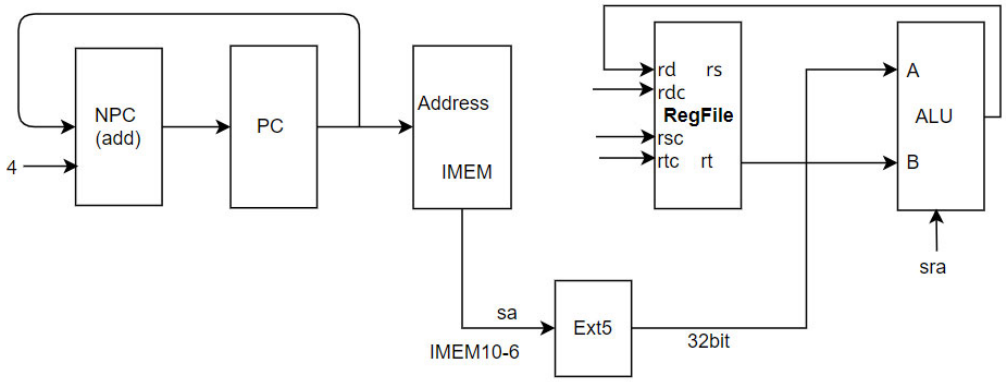
12 srl
Format：srl rd, rt, sa
Operation：fetch，rd←rt>>sa(逻辑), PC←NPC(PC+4)
digital part：PC, NPC, IMEM, Regfile, ALU,Ext5
input & output relation：

	PC	NPC	IMEM	Rgefile	ALU		Ext5
				rd	A	B	
srl	NPC	PC	PC	ALU	Ext5	rt	sa(IM[10:6])



13 sra
Format：sra rd, rt, sa
Operation：fetch，rd←rt>>sa(算数), PC←NPC(PC+4)
digital part：PC, NPC, IMEM, Regfile, ALU,Ext5
input & output relation：

	PC	NPC	IMEM	Rgefile	ALU		Ext5
				rd	A	B	
srl	NPC	PC	PC	ALU	Ext5	rt	sa(IM[10:6])



14 sllv

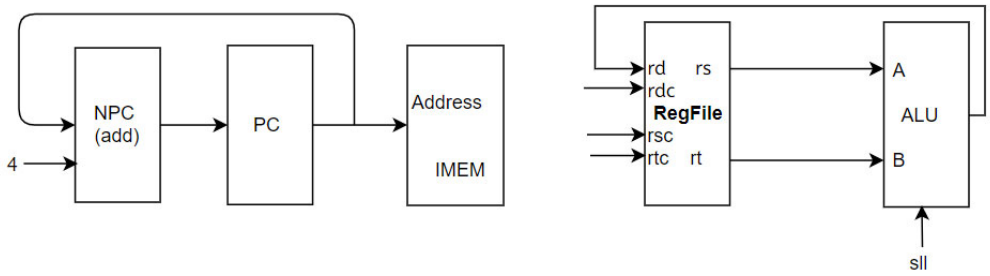
Format：sllv rd, rs, rt

Operation：fetch，rd←rs<<rt, PC←NPC(PC+4)

digital part：PC, NPC, IMEM, Regfile, ALU

input & output relation：

	PC	NPC	IMEM	Rgefile	ALU	
				rd	A	B
sllv	NPC	PC	PC	ALU	rs	rt



15 srlv

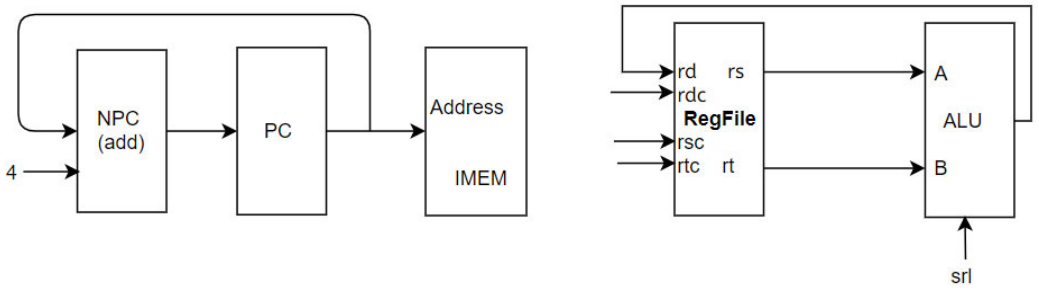
Format：srlv rd, rs, rt

Operation：fetch，rd←rs>>rt(逻辑), PC←NPC(PC+4)

digital part：PC, NPC, IMEM, Regfile, ALU

input & output relation：

	PC	NPC	IMEM	Rgefile	ALU	
				rd	A	B
srlv	NPC	PC	PC	ALU	rs	rt



16 srav

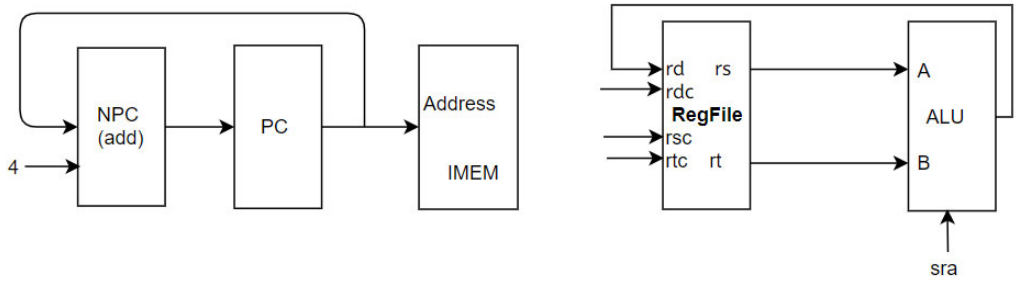
Format：srav rd, rs, rt

Operation：fetch，rd←rs>>rt(算数), PC←NPC(PC+4)

digital part：PC, NPC, IMEM, Regfile, ALU

input & output relation：

	PC	NPC	IMEM	Rgefile	ALU	
				rd	A	B
srav	NPC	PC	PC	ALU	rs	rt



17 jr

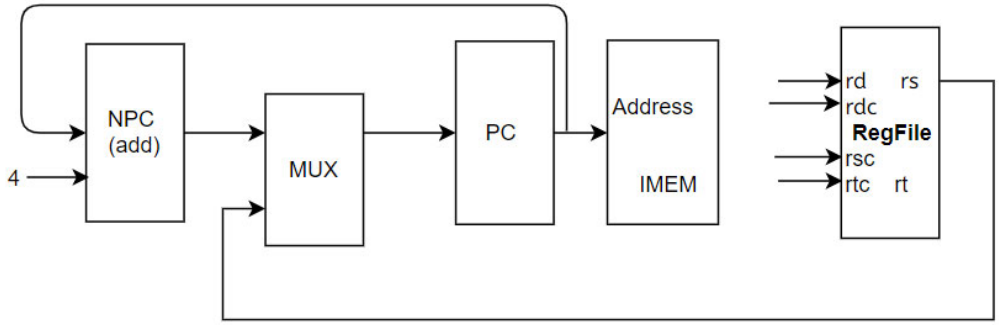
Format：jr rs

Operation：fetch，PC←rs, PC←NPC(PC+4)

digital part：PC, NPC, IMEM, Regfile,MUX

input & output relation：

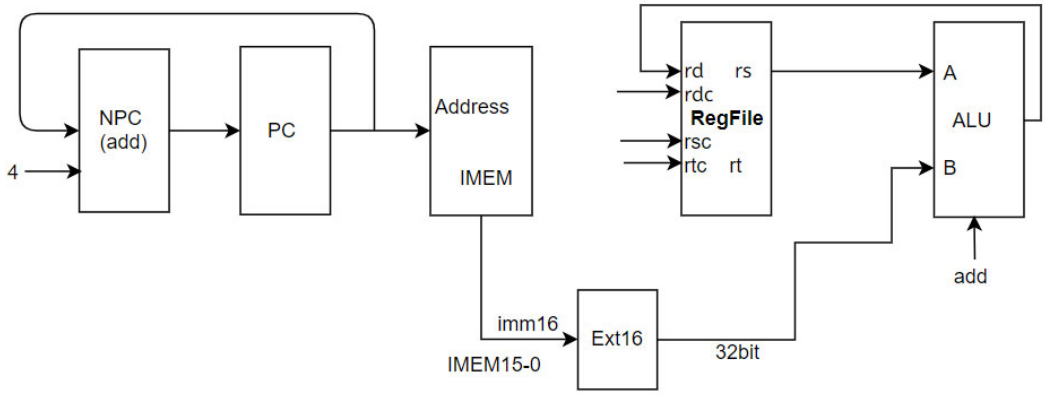
	PC	NPC	IMEM	Rgefile
				Rd
jr	rs	PC	PC	



18 addi

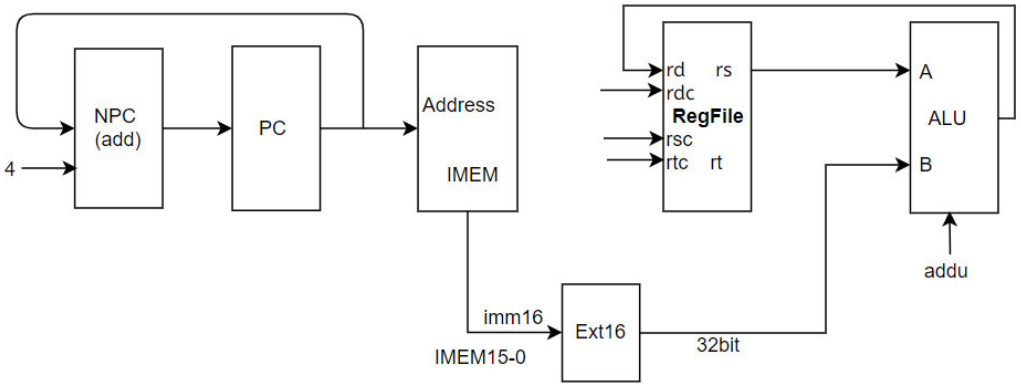
Format：addi rt, rs, imm16
Operation：fetch、rt←rs+imm16(sign_extend) 、PC←NPC(PC+4)
digital part：PC、NPC、IMEM、Regfile、ALU、Ext16
input & output relation：

	PC	NPC	IMEM	Rgefile	ALU		Ext16
				Rd	A	B	
addi	NPC	PC	PC	ALU	rs	Ext16	imm16



19 addiu
Format：addiu rt, rs, imm16
Operation：fetch、rt←rs+imm16(sign_extend) 、PC←NPC(PC+4)
digital part：PC、NPC、IMEM、Regfile、ALU、Ext16
input & output relation：

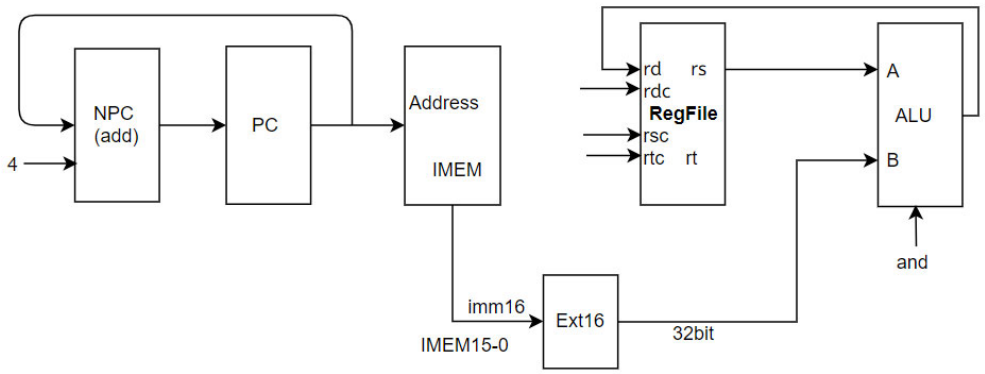
	PC	NPC	IMEM	Rgefile	ALU		Ext16
				Rd	A	B	
addiu	NPC	PC	PC	ALU	rs	Ext16	imm16



20 andi
Format：andi rt, rs, imm16
Operation：fetch、rt←rs&imm16(zero_extend) 、PC←NPC(PC+4)
digital part：PC、NPC、IMEM、Regfile、ALU、Ext16
input & output relation：

	PC	NPC	IMEM	Rgefile	ALU	Ext16

				Rd	A	B	
andi	NPC	PC	PC	ALU	rs	Ext16	imm16



21 ori

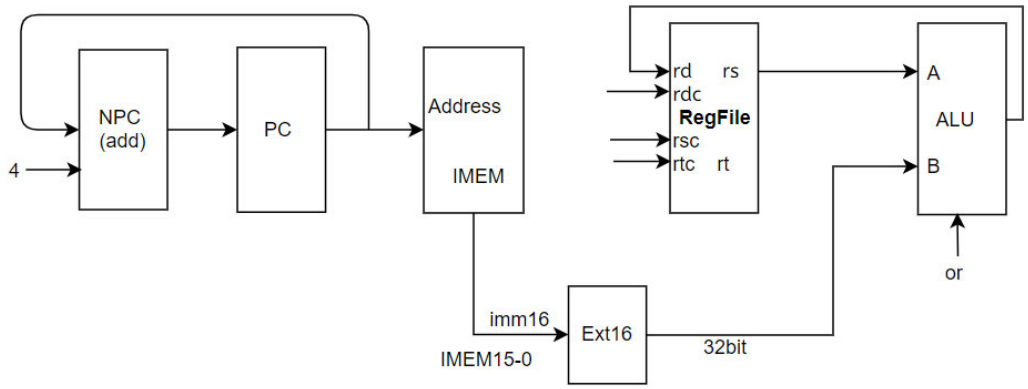
Format：ori rt, rs, imm16

Operation：fetch、rt←rs|imm16(zero_extend) 、PC←NPC(PC+4)

digital part：PC、NPC、IMEM、Regfile、ALU、Ext16

input & output relation：

	PC	NPC	IMEM	Rgefile	ALU		Ext16
				Rd	A	B	
ori	NPC	PC	PC	ALU	rs	Ext16	imm16



22 xori

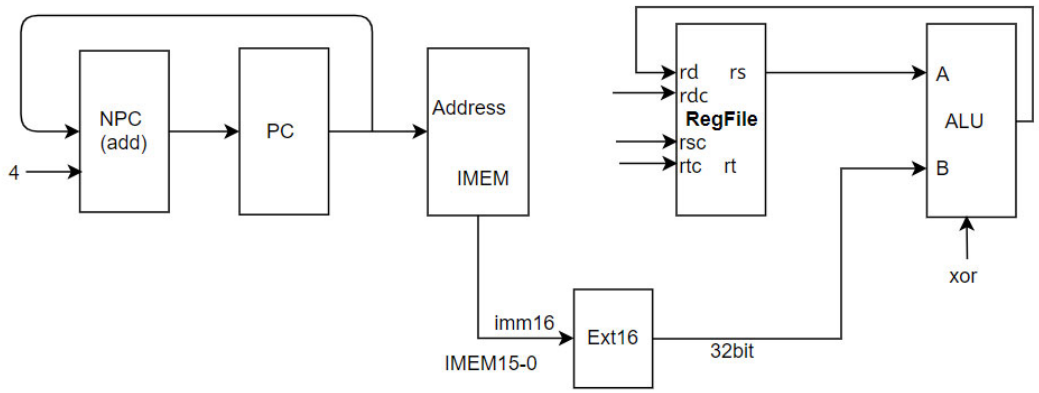
Format：xori rt, rs, imm16

Operation：fetch、rt←rs^imm16(zero_extend) 、PC←NPC(PC+4)

digital part：PC、NPC、IMEM、Regfile、ALU、Ext16

input & output relation：

	PC	NPC	IMEM	Rgefile	ALU		Ext16
				Rd	A	B	
xori	NPC	PC	PC	ALU	rs	Ext16	imm16



23 lw

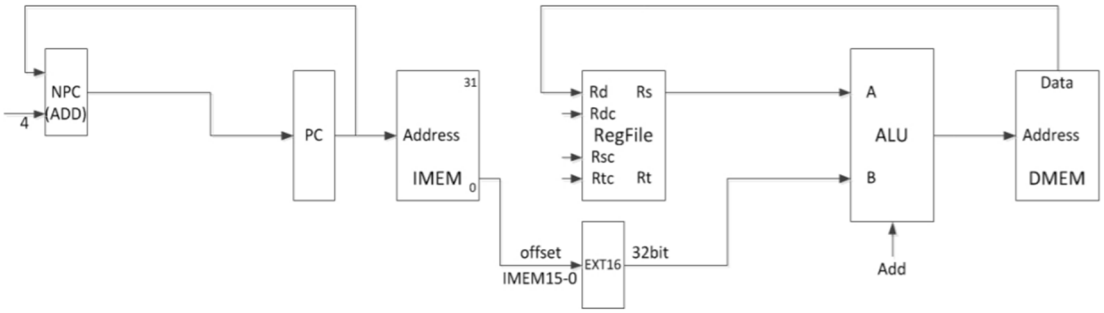
Format：lw rt, offset(base)

Operation：fetch、rt←[rs+Sign_ext_offset] 、PC←NPC(PC+4)

digital part：PC、NPC、IMEM、Regfile、ALU、Ext16、DMEM

input & output relation：

	PC	NPC	IMEM	Rgefile	ALU		Ext16	DMEM	
				Rd	A	B		Addr	Data
lw	NPC	PC	PC	DMEM(Data)	rs	Ext16	offset	ALU	



24 sw

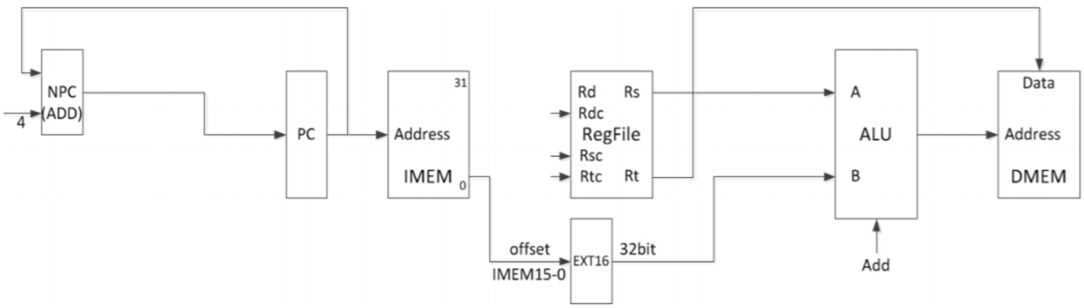
Format：sw rt, offset(base)

Operation：fetch、[base+Sign_ext_offset]←rt, PC←NPC(PC+4)

digital part：PC、NPC、IMEM、Regfile、ALU、Ext16、DMEM

input & output relation：

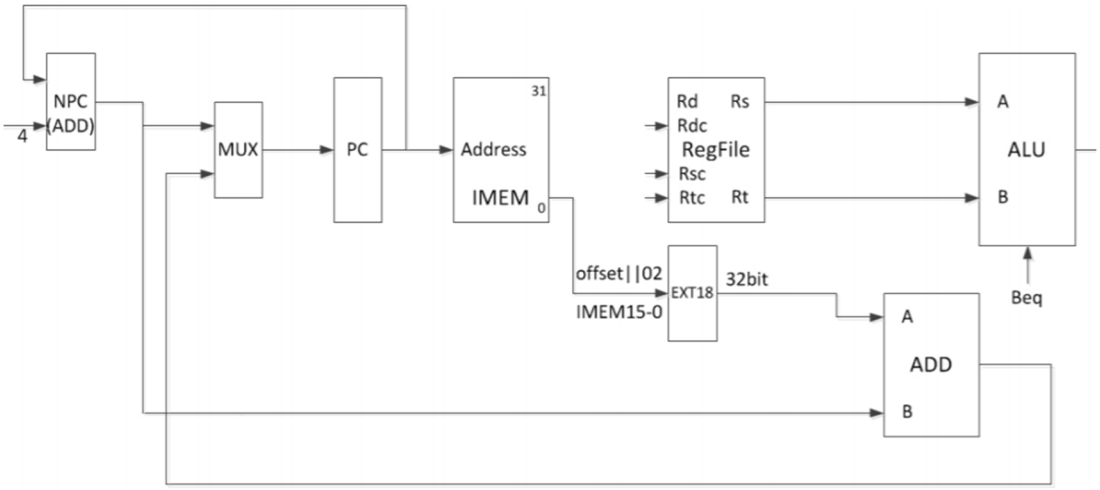
	PC	NPC	IMEM	Rgefile	ALU		Ext16	DMEM	
				Rd	A	B		Addr	Data
sw	NPC	PC	PC		rs	Ext16	offset	ALU	rt



25 beq

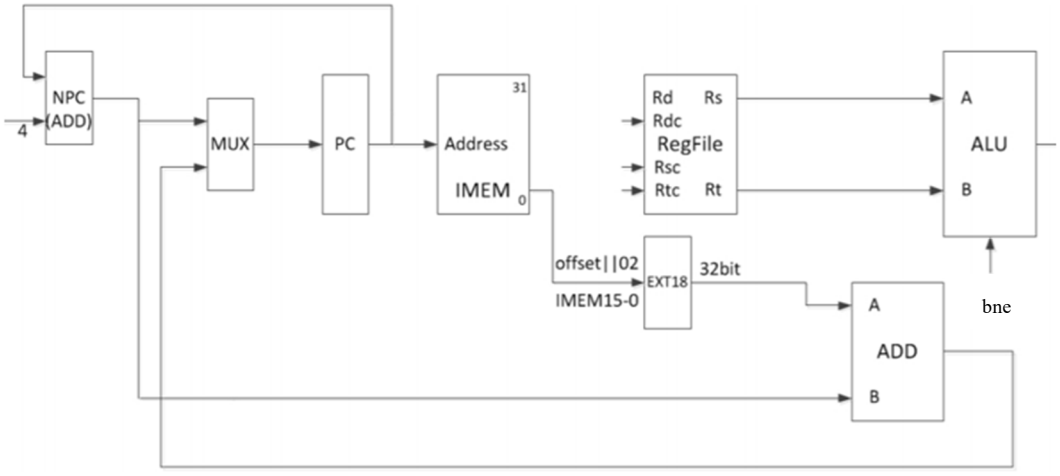
Format：beq rs,rt,offset
Operation：fetch、rs=rt,PC←NPC+Sign_ext(offset||0^2) 否则 PC←NPC(PC+4)
digital part：PC、NPC、IMEM、Regfile、ALU、Ext18、ADD
input & output relation：

	PC	NPC	IMEM	Rgefile	ALU		Ext18	ADD	
				Rd	A	B		A	B
beq	ADD	PC	PC		rs	rt	offset	NPC	Ext18



26 bne
Format：bne rs,rt,offset
Operation：fetch、rs≠rt,PC←NPC+Sign_ext(offset||0^2) 否则 PC←NPC(PC+4)
digital part：PC、NPC、IMEM、Regfile、ALU、Ext18、ADD
input & output relation：

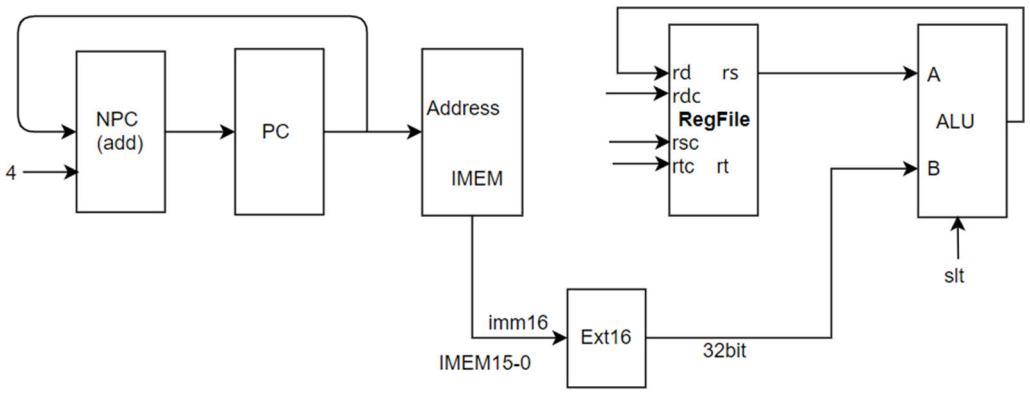
	PC	NPC	IMEM	Rgefile	ALU		Ext18	ADD	
				Rd	A	B		A	B
bne	ADD	PC	PC		rs	rt	offset	NPC	Ext18



27 slti
Format：slti rt, rs, imm16
Operation：fetch、rt←rs<imm16(sign_extend) 、PC←NPC(PC+4)

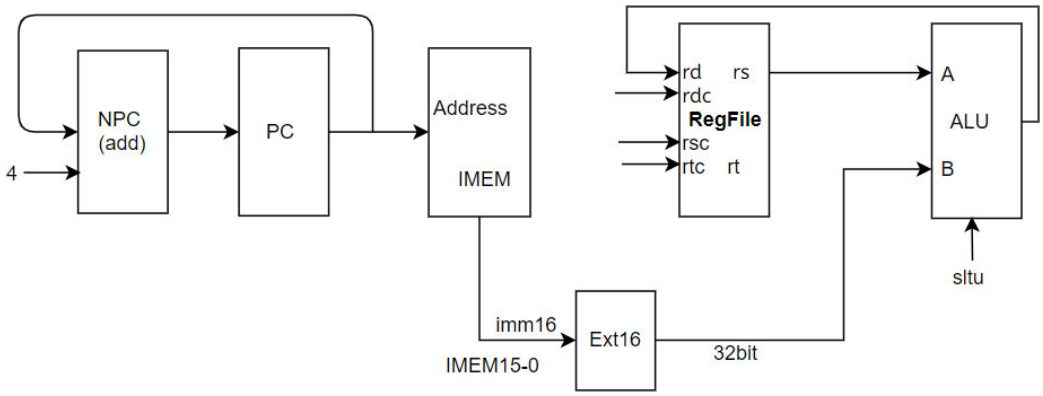
digital part：PC、NPC、IMEM、Regfile、ALU、Ext16
input & output relation：

	PC	NPC	IMEM	Rgefile	ALU		Ext16
				Rd	A	B	
slti	NPC	PC	PC	ALU	rs	Ext16	imm16



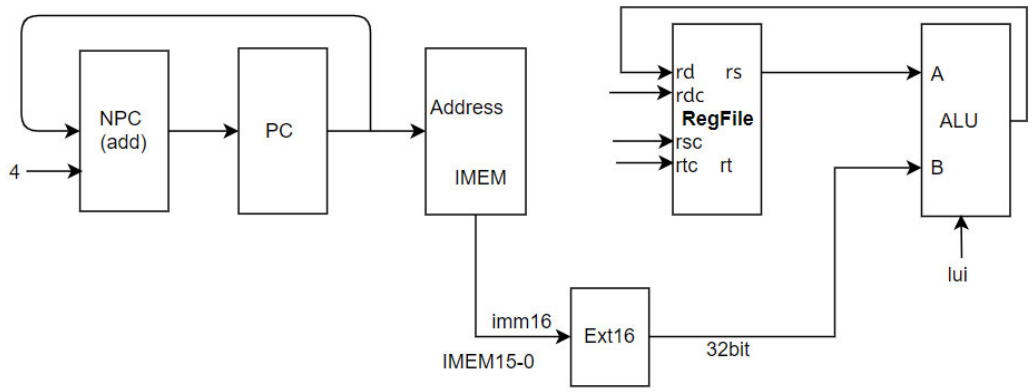
28 sltiu
Format：sltiu rt, rs, imm16
Operation：fetch、rt←rs<imm16(sign_extend) 、PC←NPC(PC+4)
digital part：PC、NPC、IMEM、Regfile、ALU、Ext16
input & output relation：

	PC	NPC	IMEM	Rgefile	ALU		Ext16
				Rd	A	B	
sltiu	NPC	PC	PC	ALU	rs	Ext16	imm16



29 lui
Format：lui rt, rs, imm16
Operation：fetch、rt←imm16||0^{16} 、PC←NPC(PC+4)
digital part：PC、NPC、IMEM、Regfile、ALU、Ext16
input & output relation：

	PC	NPC	IMEM	Rgefile	ALU		Ext16
				Rd	A	B	
lui	NPC	PC	PC	ALU	rs	Ext16	imm16



30 j

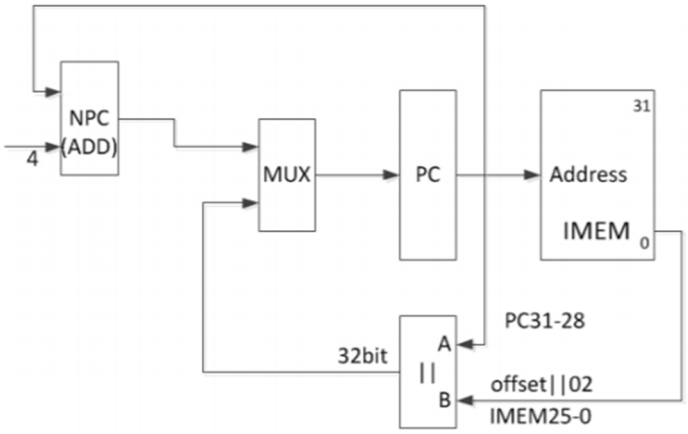
Format：j target

Operation：fetch、PC←PC_{31-28}||instr_index||0^2 ， PC←NPC(PC+4)

digital part：PC、NPC、IMEM、||

input & output relation：

	PC	NPC	IMEM	||
				A	B
j	||	PC	PC	PC31-28	IMEM 25-0||0^2



31 jal

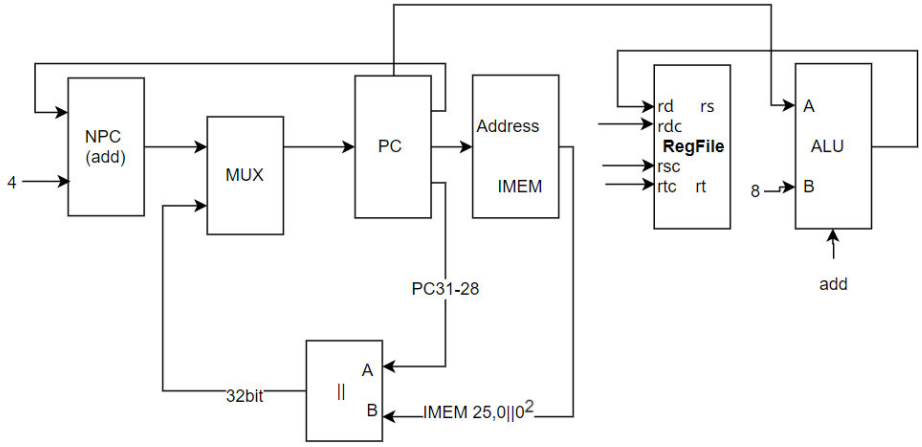
Format：jal target

Operation：fetch、PC←PC_{31-28}||instr_index||0^2 ， PC←NPC(PC+4)，rd←PC+8

digital part：PC、NPC、IMEM、||、ALU、

input & output relation：

	PC	NPC	IMEM	||	ALU	
				A	B	A	B
jal	||	PC	PC	PC31-28	IMEM 25-0||0^2	PC	8



32 clz

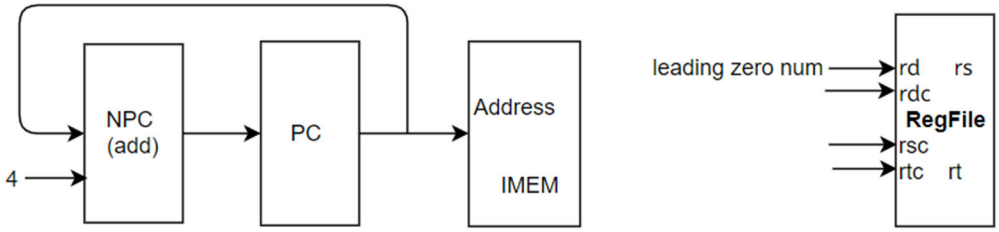
Format：clz rd, rs

Operation：fetch、rd ←count_leading_zeros (rs), PC←NPC(PC+4)

digital part：PC、NPC、ALU、IMEM、Regfile

input & output relation：

	PC	NPC	IMEM	Rgefile
				Rd
clz	NPC	PC	PC	count_leading_zeros (rs)



33 divu

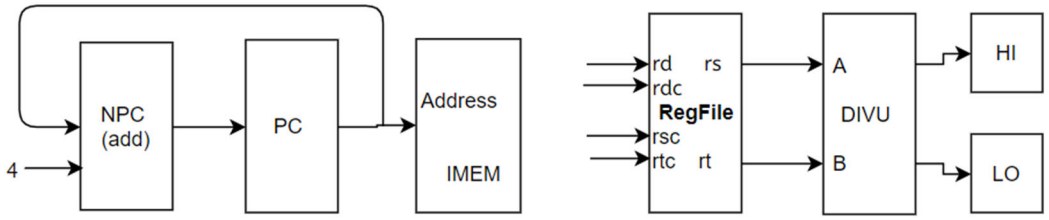
Format：divu rs, rt

Operation：fetch、(HI，LO)←(unsign)rs/rt, PC←NPC(PC+4)

digital part：PC、NPC、DIVU、IMEM、Regfile、HI、LO

input & output relation：

	PC	NPC	IMEM	DIVU		HI	LO
				dividend	divisor		
divu	NPC	PC	PC	rs	rt	r	q



34 eret

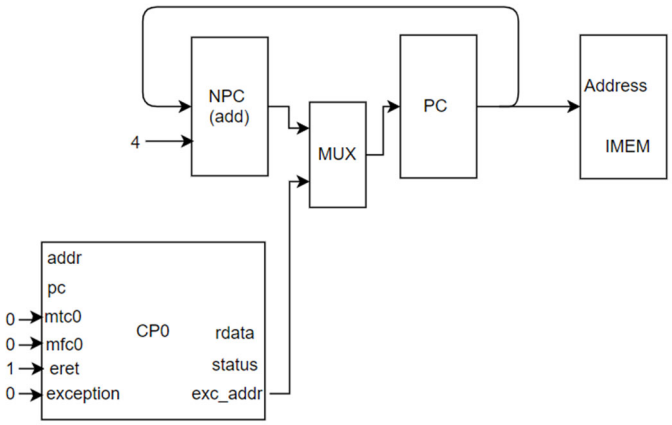
Format：eret

Operation：fetch、PC←EPC，PC←NPC(PC+4)

digital part：PC、NPC、CP0、IMEM

input & output relation：

	PC	NPC	IMEM	CP0
				eret
eret	EPC	PC	PC	1



35 jalr

Format：jalr rd rs

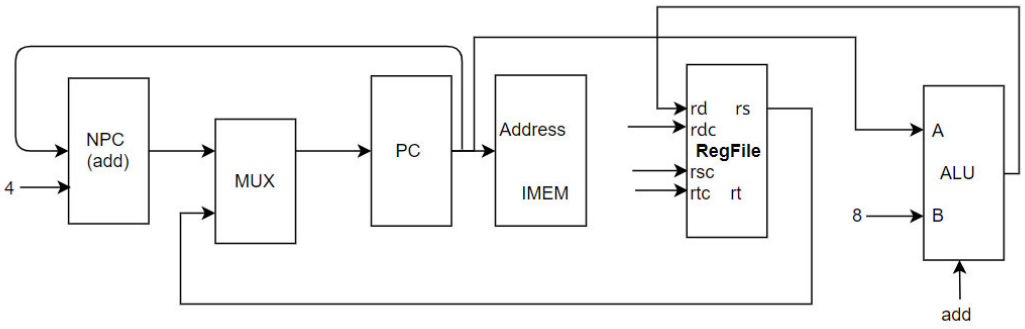
jalr rs (rd = 31 implied)

Operation：fetch、rd ← PC+8 , PC ← rs，PC←NPC(PC+4)

digital part：PC、NPC、IMEM、Regfile

input & output relation：

	PC	NPC	IMEM	Regfile	ALU	
				rd	A	B
jalr	NPC	PC	PC	ALU.r	PC	8



36 lb

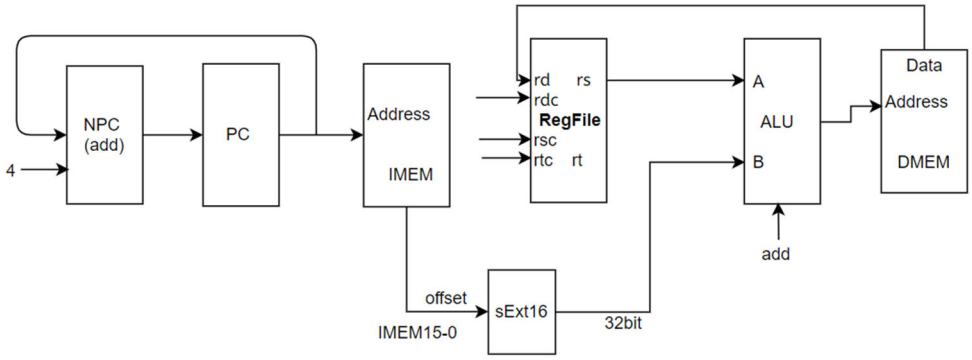
Format：lb rt,offset(base)

Operation：fetch、rt←memory[base+offset]，PC←NPC(PC+4)

digital part：PC、NPC、IMEM、Regfile、ALU、sExt16、DMEM

input & output relation：

	PC	NPC	IMEM	Regfile	ALU		DMEM	Ext16
				rd	A	B	Addr	
lb	NPC	PC	PC	DMEM.data	rs(base)	sExt16	ALU.r	offset (IMEM15-0)



37 lbu

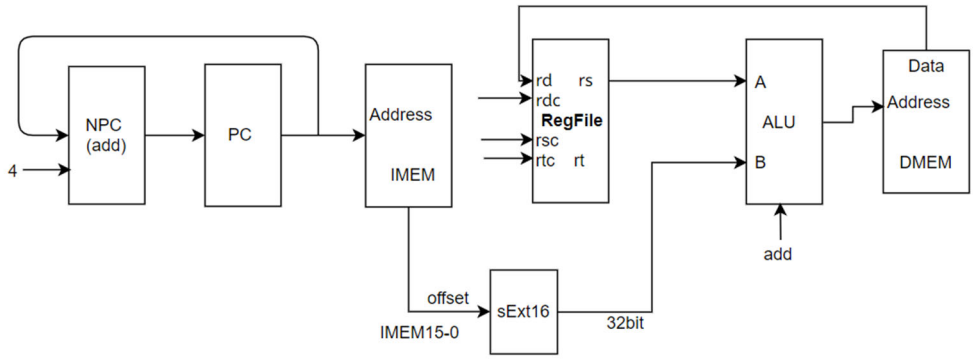
Format：lbu rt,offset(base)

Operation：fetch、rt←memory[base+offset]，PC←NPC(PC+4)

digital part：PC、NPC、IMEM、Regfile、ALU、sExt16、DMEM

input & output relation：

	PC	NPC	IMEM	Regfile	ALU		DMEM	Ext16
				rd	A	B	Addr	
lbu	NPC	PC	PC	DMEM.data	rs(base)	sExt16	ALU.r	offset (IMEM15-0)



38 lhu

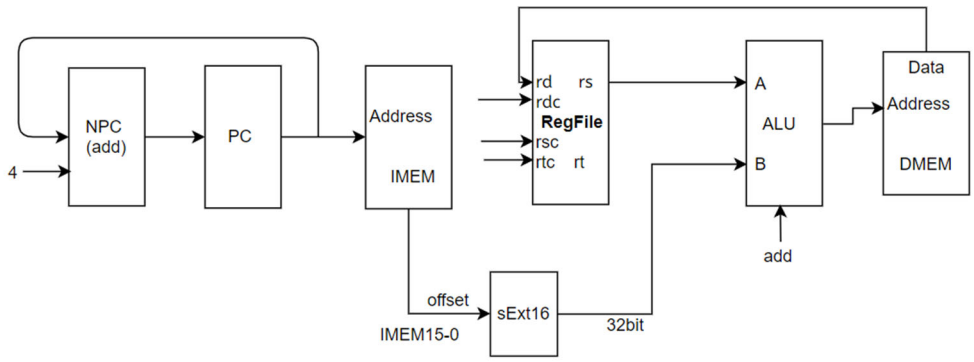
Format：lhu rt,offset(base)

Operation：fetch、rt←memory[base+offset]，PC←NPC(PC+4)

digital part：PC、NPC、IMEM、Regfile、ALU、sExt16、DMEM

input & output relation：

	PC	NPC	IMEM	Regfile	ALU		DMEM	Ext16
				rd	A	B	Addr	
lhu	NPC	PC	PC	DMEM.data	rs(base)	sExt16	ALU.r	offset (IMEM15-0)



39 sb

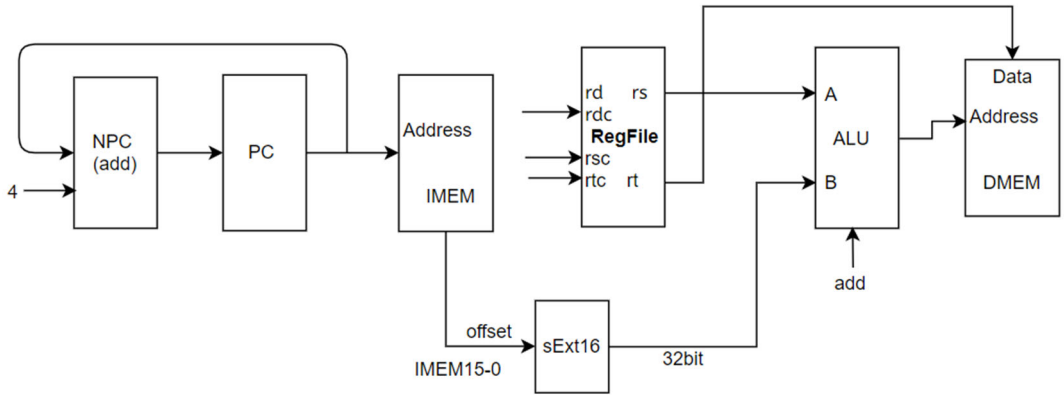
Format：sb rt,offset(base)

Operation：fetch、memory[base+offset]←rt，PC←NPC(PC+4)

digital part：PC、NPC、IMEM、Regfile、ALU、sExt16、DMEM

input & output relation：

	PC	NPC	IMEM	Regfile	ALU		DMEM		Ext16
				rt	A	B	Addr	data	
sb	NPC	PC	PC	DMEM.data	rs(base)	sExt16	ALU.r	RF.rt	offset (IMEM15-0)



40 sh

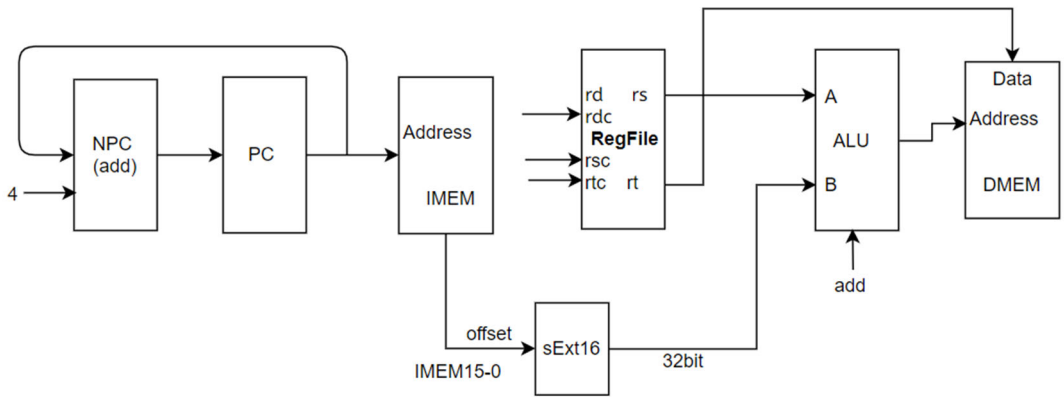
Format：sh rt,offset(base)

Operation：fetch、memory[base+offset]←rt，PC←NPC(PC+4)

digital part：PC、NPC、IMEM、Regfile、ALU、sExt16、DMEM

input & output relation：

	PC	NPC	IMEM	Regfile	ALU		DMEM		Ext16
				rt	A	B	Addr	data	
sh	NPC	PC	PC	DMEM.data	rs(base)	sExt16	ALU.r	RF.rt	offset (IMEM15-0)



41 lh

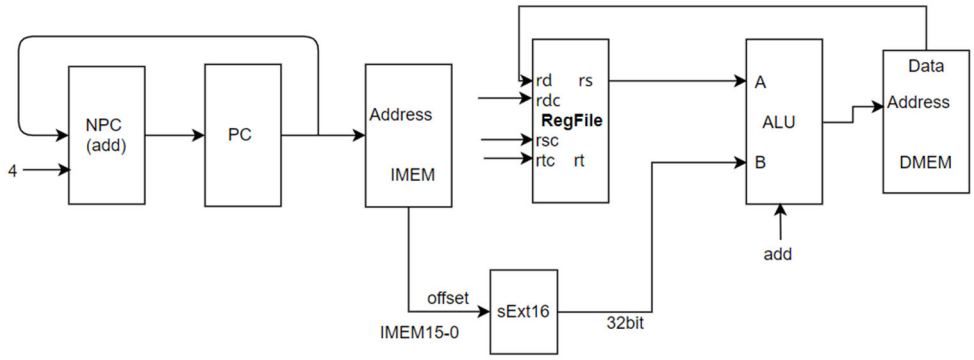
Format：lh rt,offset(base)

Operation：fetch、rt←memory[base+offset]，PC←NPC(PC+4)

digital part：PC、NPC、IMEM、Regfile、ALU、uExt16、DMEM

input & output relation：

	PC	NPC	IMEM	Regfile	ALU		DMEM	Ext16
				rd	A	B	Addr	
lh	NPC	PC	PC	DMEM.data	rs(base)	uExt16	ALU.r	offset (IMEM15-0)



42 mfc0

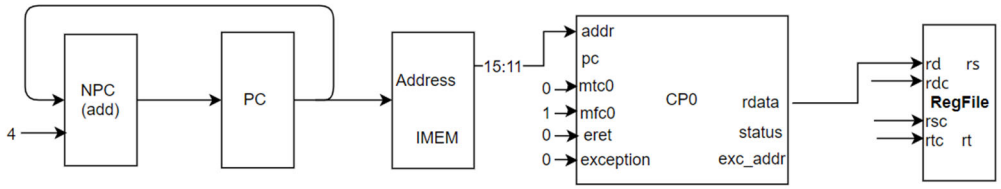
Format：mfc0 rt, rd

Operation：fetch、rt←CP0 rd，PC←NPC(PC+4)

digital part：PC、NPC、CP0、IMEM、Regfile

input & output relation：

	PC	NPC	IMEM	CP0		Regfile
				mfc0	addr(Rd)	rd
mfc0	NPC	PC	PC	1	IMEM 15-11	CP0.rdata



43 mfhi

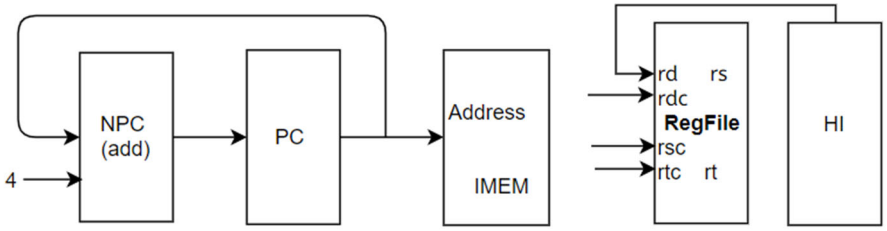
Format：mfhi rd

Operation：fetch、rd← HI，PC←NPC(PC+4)

digital part：PC、NPC、HI、IMEM、Regfile

input & output relation：

	PC	NPC	IMEM	Regfile
				rd
mfhi	NPC	PC	PC	HI



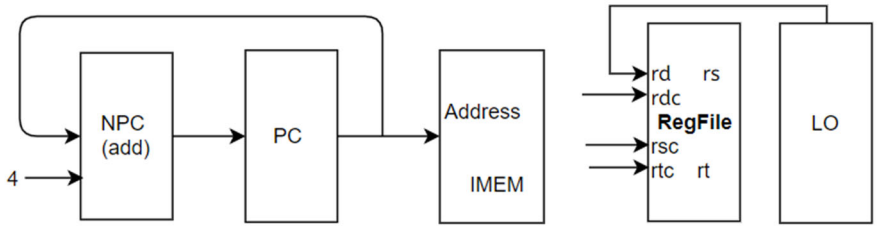
44 mflo

Format：mflo rd

Operation：fetch、rd← LO，PC←NPC(PC+4)

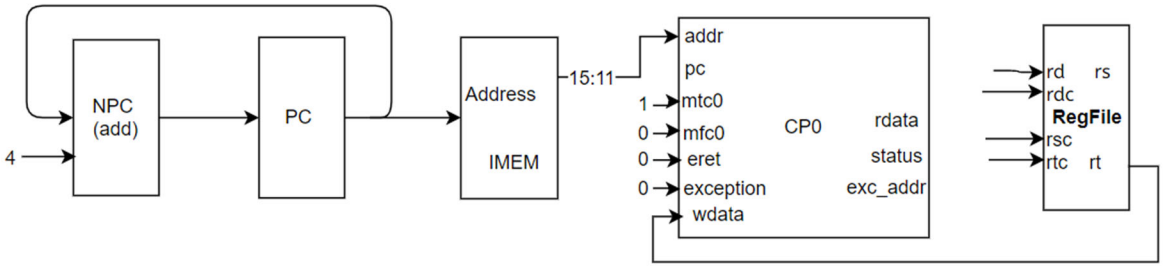
digital part：PC、NPC、LO、IMEM、Regfile
input & output relation：

	PC	NPC	IMEM	Regfile
				rd
mflo	NPC	PC	PC	LO



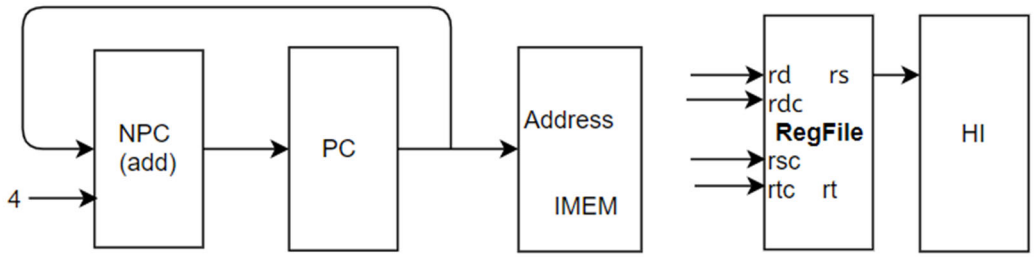
45 mtc0
Format：mtc0 rt, rd
Operation：fetch、CP0 rd←rt，PC←NPC(PC+4)
digital part：PC、NPC、CP0、IMEM、Regfile
input & output relation：

	PC	NPC	IMEM	CP0		
				mtc0	addr(Rd)	wdata
mtc0	NPC	PC	PC	1	IMEM 15-11	RF.rt



46 mthi
Format：mthi rd
Operation：fetch、HI←rs，PC←NPC(PC+4)
digital part：PC、NPC、HI、IMEM、Regfile
input & output relation：

	PC	NPC	IMEM	HI
mthi	NPC	PC	PC	RF.rs



47 mtlo

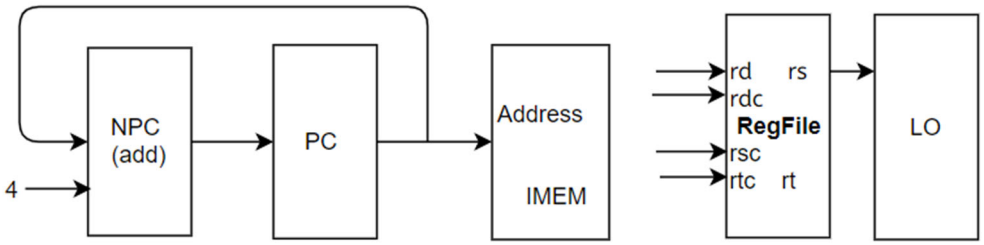
Format：mtlo rd

Operation：fetch、LO←rs，PC←NPC(PC+4)

digital part：PC、NPC、LO、IMEM、Regfile

input & output relation：

	PC	NPC	IMEM	LO
mtlo	NPC	PC	PC	RF.rs



48 mul

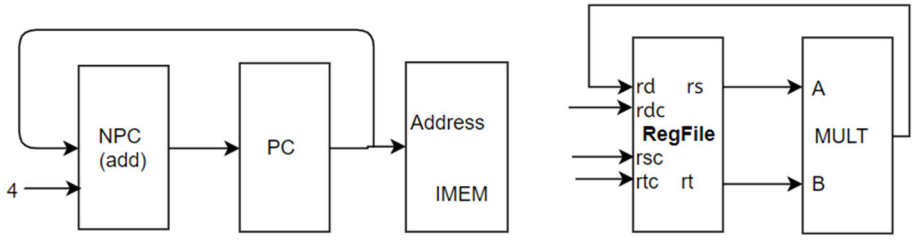
Format：mul rd, rs, rt

Operation：fetch、rd←(sign)rs*rt, PC←NPC(PC+4)

digital part：PC、NPC、MULT、IMEM、Regfile

input & output relation：

	PC	NPC	IMEM	MULT		Regfile
				a	b	rd
div	NPC	PC	PC	rs	rt	z(lo)

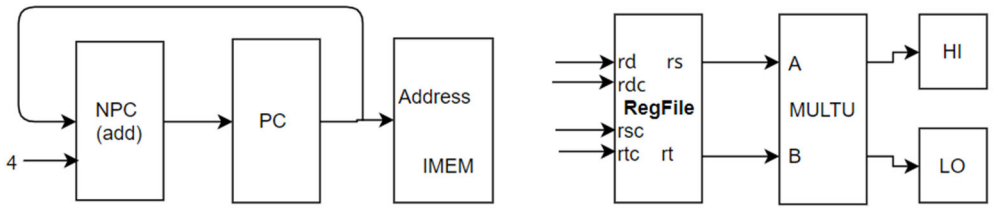


49 multu

Format：multu rs, rt

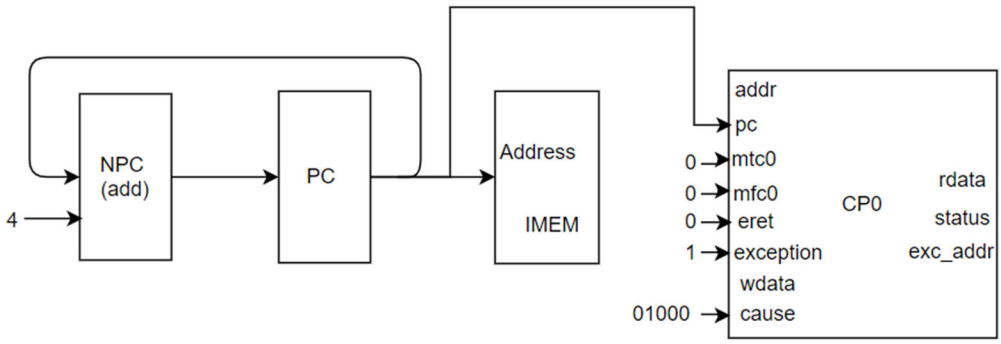
Operation：fetch、(HI，LO)←(unsign)rs*rt, PC←NPC(PC+4)
digital part：PC、NPC、MULTU、IMEM、Regfile、HI、LO
input & output relation：

	PC	NPC	IMEM	MULTU		HI	LO
				a	b		
multu	NPC	PC	PC	rs	rt	z(hi)	z(lo)



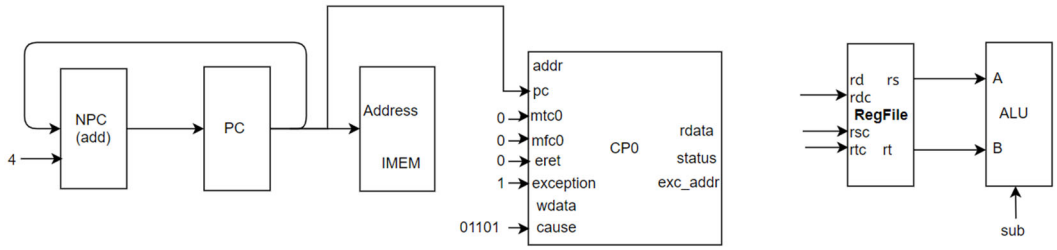
50 syscall
Format：syscall
Operation：fetch、EPC←PC，cause← 01000，status<<5，PC←NPC(PC+4)
digital part：PC、NPC、CP0、IMEM
input & output relation：

	PC	NPC	IMEM	CP0		
				exception	cause	EPC
syscall	NPC	PC	PC	1	01000	PC



51 teq
Format：teq rs, rt
Operation：fetch、rs-rt，EPC←PC , cause← 01101，status<<5，PC←NPC(PC+4)
digital part：PC、NPC、CP0、IMEM、Regfile、ALU
input & output relation：

	PC	NPC	IMEM	CP0			ALU	
				exception	cause	EPC	A	B
teq	NPC	PC	PC	1	01101	PC	rs	rt



52 bgez

Format：bgez rs,offset

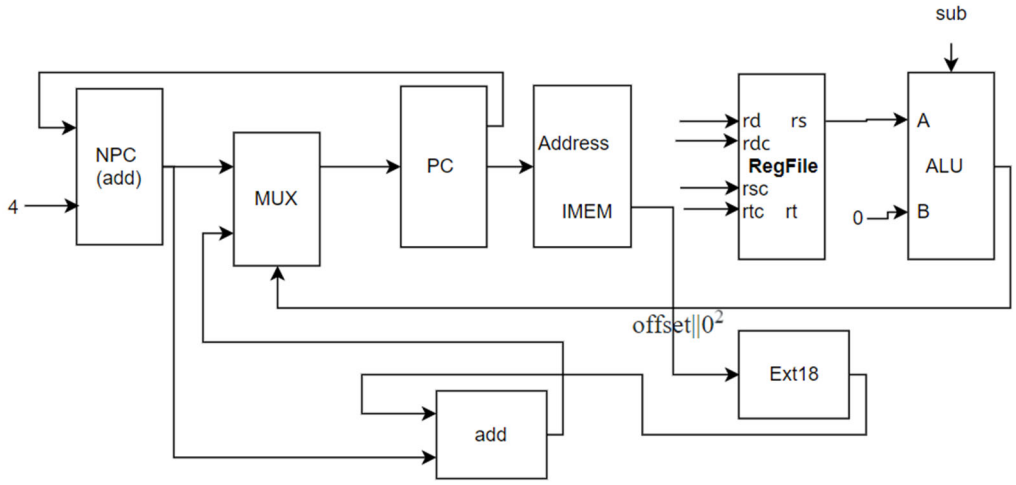
Operation：fetch、if(rs>=0)PC←PC+Sign_ext(offset||0^2)

else PC←NPC(PC+4)

digital part：PC、NPC、IMEM、sExt18

input & output relation：

	PC	NPC	IMEM	sExt18	ALU	
					A	B
bgez	ALU.r	PC	PC	offset||0^2	rs	0



53 break

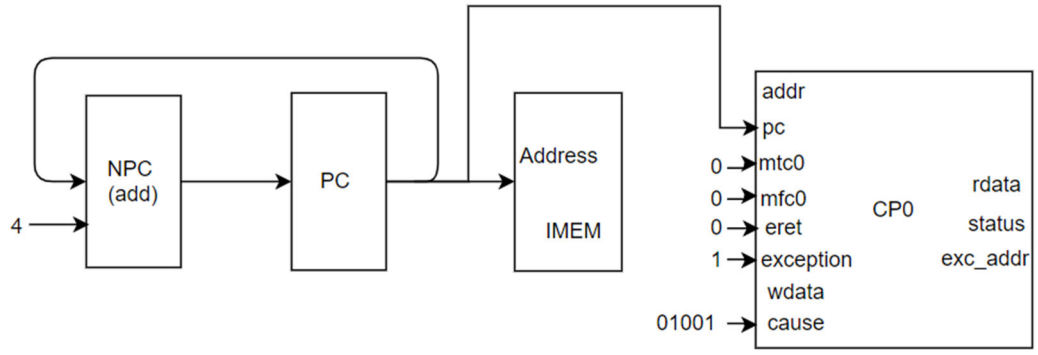
Format：break

Operation：fetch、EPC←PC , cause← 01001，status<<5，PC←NPC(PC+4)

digital part：PC、NPC、CP0、IMEM

input & output relation：

	PC	NPC	IMEM	CP0		
				exception	cause	EPC
break	NPC	PC	PC	1	01001	PC



54 div

Format：div rs, rt

Operation：fetch、(HI，LO)←(sign)rs/rt, PC←NPC(PC+4)

digital part：PC、NPC、DIV、IMEM、Regfile、HI、LO

input & output relation：

	PC	NPC	IMEM	DIV		HI	LO
				dividend	divisor		
div	NPC	PC	PC	rs	rt	r	q