ISA Design

Instructionformats

R-type

4 bits	4 bits	4 bits	4 bits
Opcode	rsd	rt	function

I-type

4 bits	4 bits	8 bits
Opcode	rsd	immediate

J-type

4 bits	12 bits
Opcode	address

LS-type

4 bits	4 bits	4 bits	4 bits
Opcode	rsd	rt	immediate

Our registers

Name	Number	Description
#PC	0	Program counter
#out0 , #out1	1-2	Function results
#temp0,#temp1, #temp2	3-5	Temporaries
#in0, #in1, #in2	6-8	Arguments
#zero	9	Constant value zero
#S0 , #S1 , #S2 , #S3	10-13	Saved temporaries
#ra	14	Return address

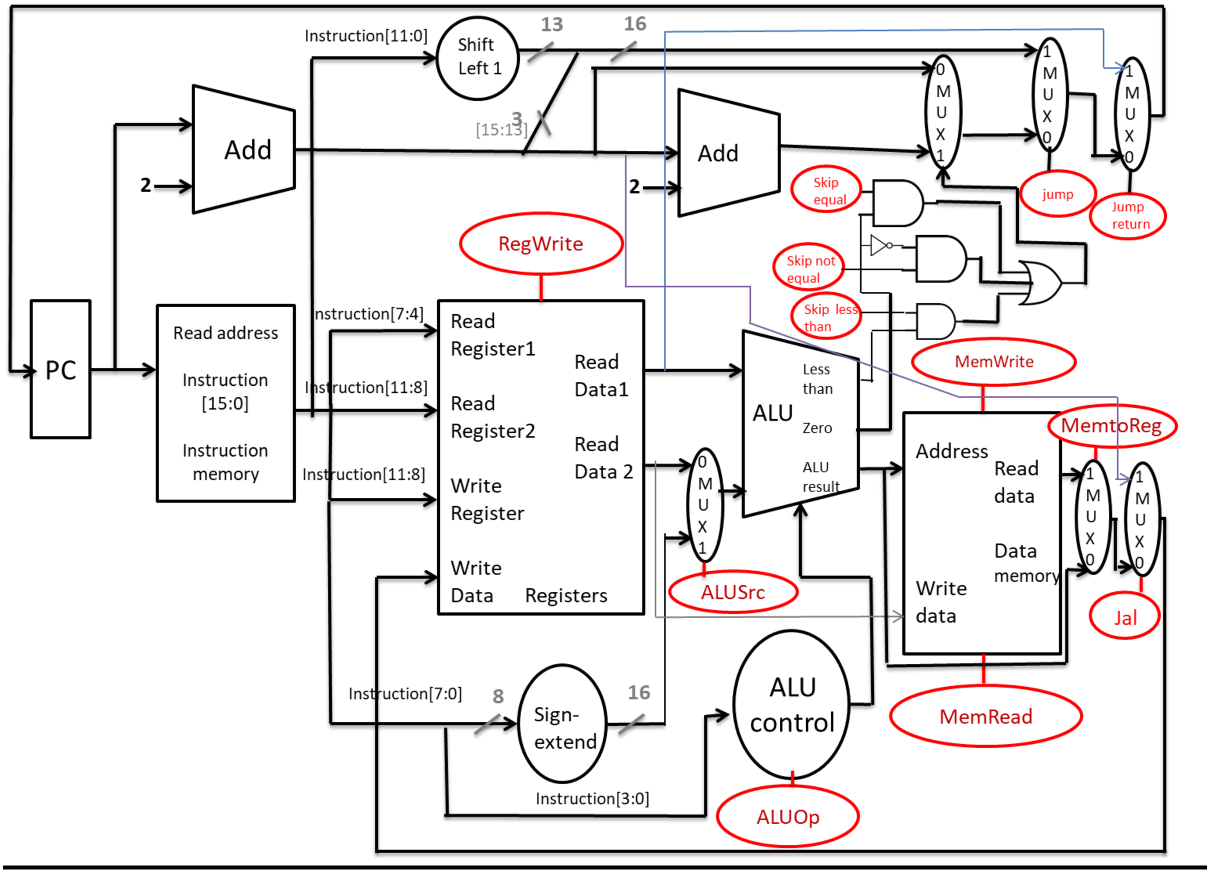
#Sp	15	Stack Pointer

Instructions

Instruction	Description	Action	Type	Opcode bitfield			
Seq	Skip next instruction if equal		R	0000	rsd	rt	0001
Jump		pc=pc_upper|(target<<2)	J	0001	Target		
Slt	Skip next instruction if less than		R	0000	rsd	rt	0010
LW	Load word	rt=*(int*)(offset+rsd)	LS	0100	rsd	rt	Immediate
SW	Store word	*(int*)(offset+rsd)=rt	LS	0101	rsd	rt	Immediate
add	Executes the add operation	rsd = rsd+ rt	R	0000	rsd	rt	0011
sub	Subtracts	rsd = rsd- rt	R	0000	rsd	rt	0100
and	And gate	rsd = rsd (and) rt	R	0000	rsd	rt	0101
or	Or gate	rsd = rsd (or) rt	R	0000	rsd	rt	0110
nor	Nor gate	rsd = rsd (nor) rt	R	0000	rsd	rt	0111
Jr	Jump to the adress in register		J	0010	Adress in register		
Mult	Performs multiplication on 2 registers	Rsd = rsd*rt	R	0000	rsd	rt	1000
Power	Performs Power operation	rsd=rsd^rt	R	0000	rsd	rt	1001

SNE	Skip if not equal		R	0000	rsd	rt	1010
Addi	Add immediate		I	0111	rsd	Immediate	
Jal	Jump and link		J	0011	Target		

Datapath



PC
Add
2
Read address
Instruction
[15:0]
Instruction
memory
Instruction[11:0]
Shift
Left 1
13
16
3
[15:13]
Add
2
Instruction[7:4]
Instruction[11:8]
Instruction[11:8]
RegWrite
Read
Register1
Read
Register2
Write
Register
Write
Data
Read
Data1
Read
Data 2
Registers
0
M
U
X
1
ALUSrc
ALU
Less
than
Zero
ALU
result
Instruction[7:0]
8
Sign-
extend
16
Instruction[3:0]
ALU
control
ALUOp
0
M
U
X
1
1
M
U
X
0
1
M
U
X
0
Skip
equal
Skip not
equal
Skip less
than
jump
Jump
return
MemWrite
MemtoReg
Address
Read
data
Data
memory
Write
data
MemRead
1
M
U
X
0
1
M
U
X
0
Jal