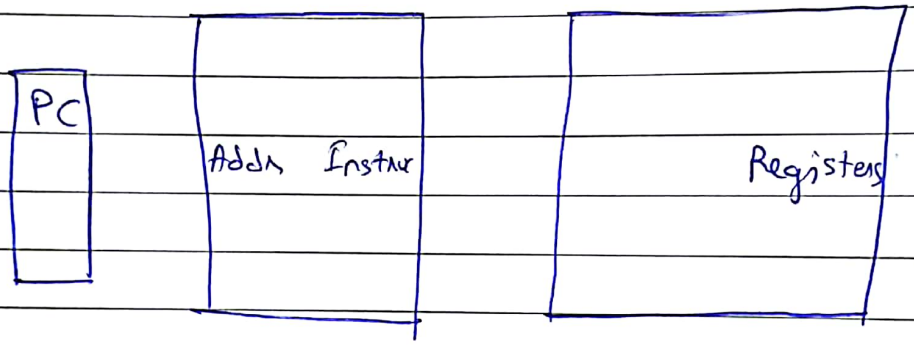
Assignment 5

4.1.1 What are the values of control signals generated by the control in Figure 4.2 for the above instruction.

Instruction = AND Rd, Rs, Rt

Fig 4.2 from text book



Solution :

AND is ALU operation so:
BSrc will look to register
OpSel will tell ALU to AND
MemW is false, memory is not touched.
RegW is true is true, register Rd is written.
WBSrc is will set to use output from ALU as data RegDst is Rd

PCSrc is PC + 4 since no jumps occurs.

opcode	ExtSel	BSrc	OpSel	MemW	RegW	WSrc	RegDst	PCSrc
ALU	*	Reg	Func	no	yes	ALU	rd	pc+4

4.1.2 Which resources (blocks) perform a useful function for this instruction.

Solution:

Ans) PC, instruction mem, ALU, registers

We are not using memory or jumping.

4.1.3 Which resources (blocks) produce outputs, but their outputs are not used for this instruction. Which resources produce no outputs for this instruction?

Ans) From my observation

1) Branch Add
2) Data memory

produce outputs but are redundant.

4.3.1 Consider the addition of a multiplier to ALU This addition will add 300 ps to the latency of the ALU and will add a cost of 600 to the ALU. The result will be 5% fewer instruction executed since we will no longer need to emulate the MUL instruction.

4.3.1 What is the clock cycle time with & without this improvement?

	Imem	Add	Mux	ALU	Regs	Dmem	Control
Latency	400	100	30	120	200	350	100
Cost	1000	30	10	100	200	2000	500

clock cycle time = 1 / clock cycle rate

clock cycle time = 1330 ps (without)

clock cycle time = 1330 + 300 = 1630 ps (with)

Explaination: Critical path for Iw instruction

Imem → Regs → Mux → ALU → Dmem → Mux → Regs

= 400 + 200 + 30 + 120 + 350 + 30 + 200

= 1330

4.3.2] What is the speed up achieved by adding this improvement?

Solution.

$$\text{speed} = \frac{\text{cpu time old}}{\text{cpu time new}} = \frac{1 \times 1330}{0.95 \times 1630}$$

$$= 0.85889$$

This means that the new speed is slower than the original speed.

4.3.3] Compare cost/performance ratio with & without this improvement.

Original cost

	Imem	Reg File	control	ALU, Dmem,	2 Adder,	3 mux
Σ	1000	200	500	100 2000	2×30	3×10

Σ = 3890 ... (1) Original cost

New cost

3890 + 600 = 4490

Relative cost = $\frac{4490}{3890}$ = 1.15

$$\text{Cost/perf} = \frac{1.15}{0.85} = 1.3390$$

so this suggests that we are paying more for poor performance.