# CSCI 206 Homework #3

Yifan Ge

## Exercise 4.1

### 4.1.1

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | RegWrite | MemRead | ALU Mux | MemWrite | ALU Op | Reg Mux | Branch |
| a | 1 | 0 | 0 (reg) | 0 | Add | 1 (ALU) | 0 |
| b | 0 | 1 | 1 (Imm) | 0 | Add | 0 (D-mem) | 0 |

### 4.1.2

a. PC, PC add, Instruction Memory, Registers, ALU

b. PC, PC add, Instruction Memory, Registers, ALU, Data Memory

### 4.1.3

a. Resources produce unused output: Branch add

Resources produce no output: Data Memory

b. Resources produce unused output: one of the Register output, Branch add

Resources produce no output: n/a

### 4.1.4

a. I-Mem, Regs, Mux, ALU, Mux

b. I-Mem, Regs, Mux, ALU, Mux

### 4.1.5

a. I-Mem, Regs, Mux, ALU, D-Men, Mux

b. I-Mem, Regs, Mux, ALU, D-Men, Mux

### 4.1.6

a. I-Mem, Regs, Mux, ALU, Mux

b. I-Mem, Regs, Mux, ALU, Mux

## Exercise 4.2

### 4.2.1

a. I-Mem, two read ports and one write port of Regs.

b. I-Mem, Regs, ALU mux, Regs Mux

### 4.2.2

a. Another read port in Regs, and another input port for ALU.

b. ALU can do shift

### 4.2.3

a. Another ALU Mux control bit

b. ALU shift control signal.

### 4.2.4

The critical path: I-Mem, Regs, Mux, ALU, D-Mem, Mux

without: 400+200+30+120+350+30 = 1130ps

a. with: 400+200+30+120+350+30 = 1130ps (add unit does not affect the critical path)

b. with: 400+(200+100)+30+120+350+30 = 1230ps

### 4.3.5

a. speedup = 1130/1130 = 1

b. speedup = 1130/(0.95\*1230) = 0.97

### 4.3.6

cost-without: 1000+30\*2+10\*3+100+200+2000+500 = 3890

a. cost-with: 100+50\*2+10\*3+100+200+2000+500 = 3930

Cost ratio = 3930/3890 = 1.01

Cost/performance = 1.01/1 = 1.01

b. cost-with: 3890+200 = 4090

cost ratio = 4090/3890 = 1.05

cost/performance = 1.05/0.97 = 1.08