Lab 5: Pipeline CPU II

Due: 2018/06/18 11:59pm

1. Goal:

Modifying the CPU designed in CPU lab4 and implementing an advanced version pipelined CPU.

2. HW requirement:

a. Please use Modelsim as simulation platform.

b. Group member same as Lab1. Just hand in one assignment for one group.

3. Requirement description:

a. Code (100%):

Basic instruction set (60%): ADD, ADDI, SUB, AND, OR, SLT, SLTI, LW, SW, and MULT.

- Must implement **Hazard Detection** and **Forwarding Unit**.
- Need to forward data if instructions have data dependency.
- Need to stall pipelined CPU if it detects load-use.

Advanced instruction set (40%): BEQ, BNE, BGE, BGT

Modify **Hazard Detection Unit** to flush useless pipelined registers (IF/ID, ID/EX, EX/MEM) if a branch launch.

Instruction	Op
BEQ	000 100
BNE	000 101
BGE	000 001
BGT	000 111

b. Testbench:

Try to solve the date hazards in I1 / I2, I5 / I6, I8 / I9, I9 / I10 by using forwarding unit and Hazard Detection Unit.

CO_P5_test_1.txt

```
I1:  addi   $1, $0, 16
I2:  mult   $2, $1, $1
I3:  addi   $3, $0, 8
I4:  sw     $1, 4($0)
I5:  lw     $4, 4($0)
I6:  sub    $5, $4, $3
I7:  add    $6, $3, $1
I8:  addi   $7, $1, 10
I9:  and    $8, $7, $3
I10: slt    $9, $8, $7
```

Result：r1 = 16; r2 = 256; r3 = 8; r4 = 16; r5 = 8; r6 = 24; r7 = 26; r8 = 8; r9 = 1; data_mem[1] = 16;

c. Report (20%):

The context must include:

1. Source code and the note
2. Your architecture
3. Hardware module analysis
4. Finished part
5. Problems you met and solutions
6. Division of this work (If you are two members as a team.)
7. Summary

4. Grade

a. Total score: 120% COPY WILL GET 0!

b. Basic score: 60%

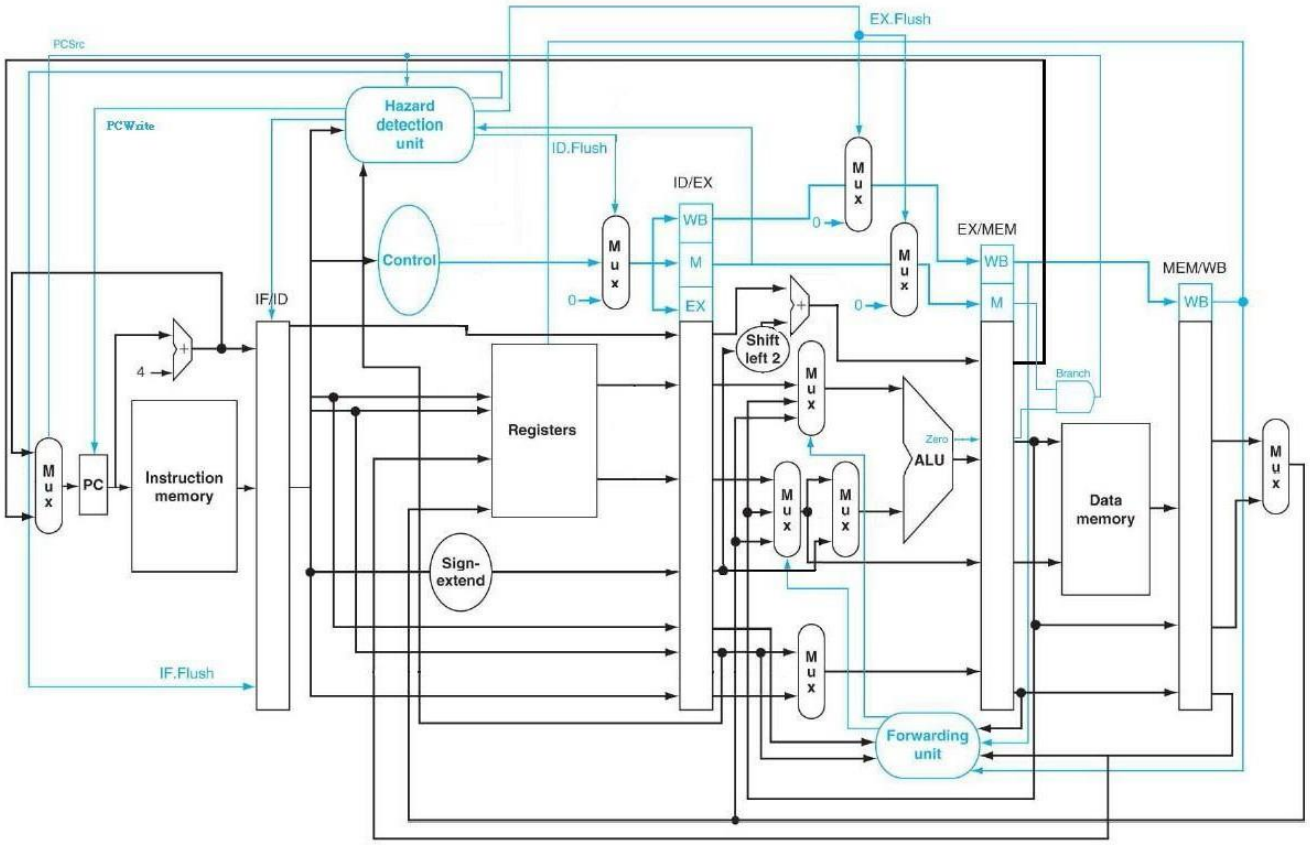
c. Advance score: 40%

d. Report: 20%

e. Delay: Late submission: Score*0.8 before 6/25. After 6/25,you will get 0 point.

f. Put .v source files and report into a compressed file.The compressed file you upload on E3 must have the form of "student ID.zip " , otherwise deduct 20 points.

5. Architecture:



6. Hand in your Assignment

Please upload the assignment to the E3.

Only hand in one assignment for one group.

Put all of .v source files and report into same compressed file in zip format. (Use your student ID to be the name of your compressed file and must have the form of "student ID.zip". (Ex. 0216310_0216077.zip or 0216310.zip)

7. Q&A

If you have any question, use E3 discussion or just send email to TAs.