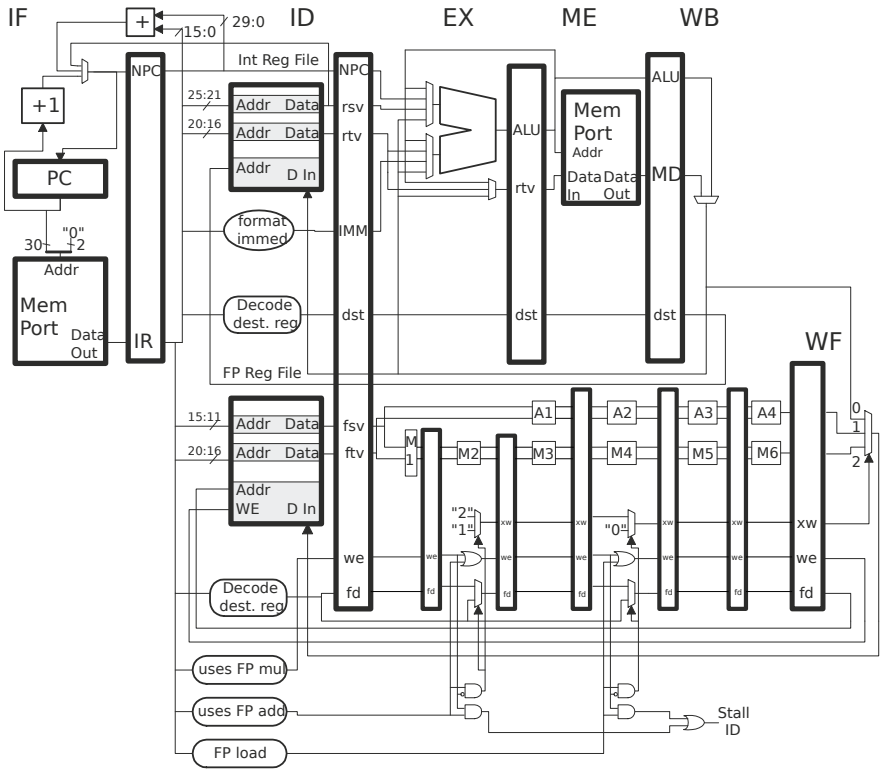
LSU EE 4720 **Homework 4** **Due: 24 March 2014**

Problem 1: The following code fragments execute incorrectly on the following pipeline. For each fragment describe the problem and correct the problem.



(*a*) Describe problem and fix problem.

```
lwc1  f2, 0(r1)   IF ID EX ME WF
add.s f1, f2, f3     IF ID A1 A2 A3 A4 WF
```

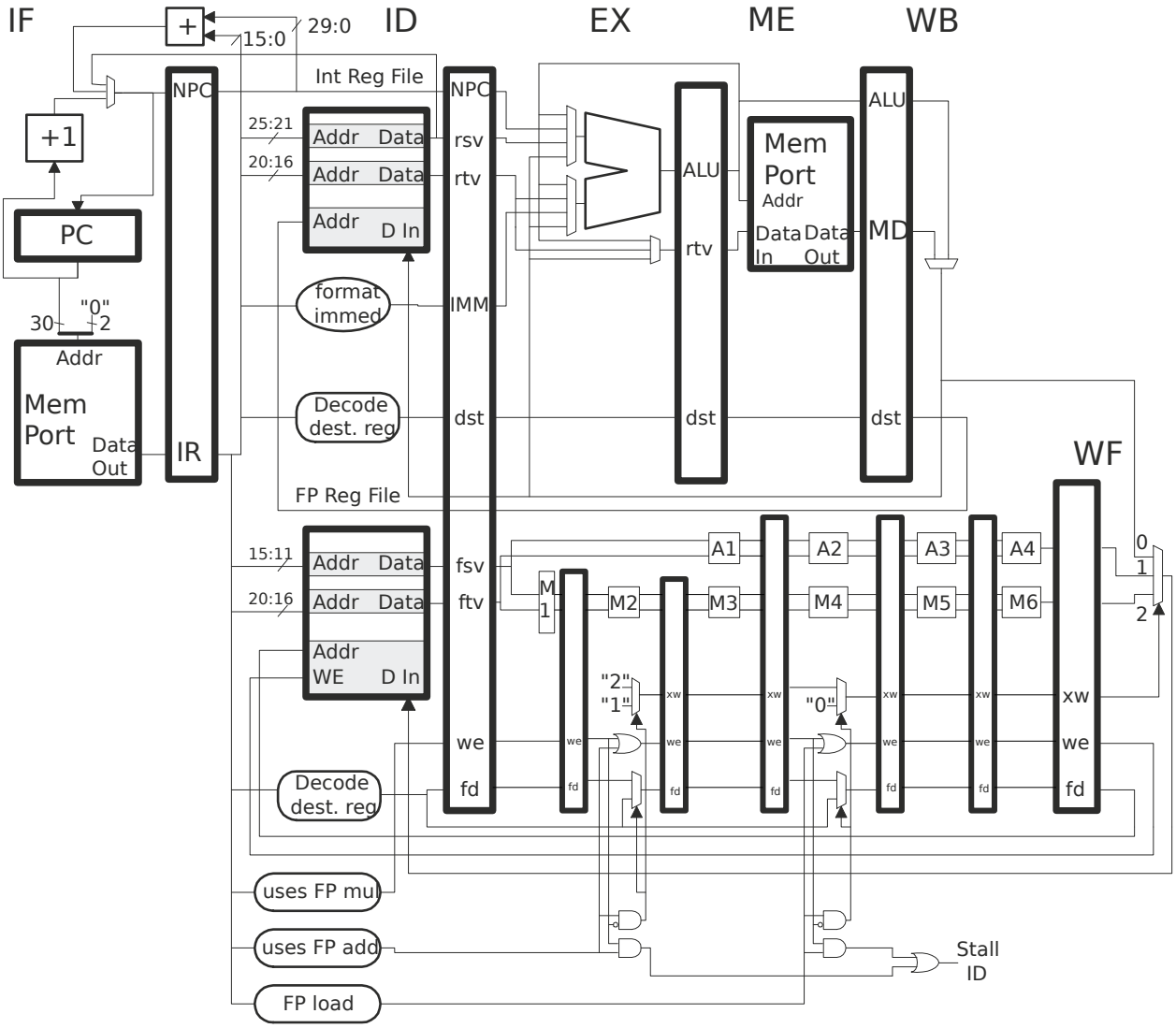
(*b*) Describe problem and fix problem.

```
add.s f1, f2, f3     IF ID A1 A2 A3 A4 WF
addi r1, r1, 4          IF ID EX ME WB
lwc1  f2, 0(r1)            IF ID EX ME WF
```

(*c*) Describe problem and fix problem.

```
add.d  f1, f2, f3     IF ID A1 A2 A3 A4 WF
```

Problem 2: The code fragment below contains a MIPS floating-point comparison instruction and branch. The pipeline illustrated below does not have a comparison unit, in this problem we will add one. The comparison unit to be used has two stages, named `C1` and `C2`. The output of `C2` is one bit, indicating if the comparison was true.




```
c.gt.d f2, f4
bc1t TARG
add.d  f2, f2, f10
...
TARG: xor r1, r2, r3
```

(*a*) Add the comparison unit to the pipeline above. Also add a new register `FCC` (floating point condition code) that is written by the comparison instruction and is used by the control logic to determine if a floating-point branch is taken.

The `FCC` register should have a data and write-enable input, show the control logic generating the write-enable signal. Show a cloud labeled "branch control logic" and connect it to appropriate datapath components.

(*b*) Show the execution of the code sample above on your modified hardware, but without any bypass paths for the added hardware.

(*c*) Add whatever bypass paths are needed so that the code executes with as few stalls as possible **but** without having a major impact on clock frequency. Assume that `C2` produces a result in about 80% of the clock period.

Source files for the diagram are at:
`http://www.ece.lsu.edu/ee4720/2014/mpipeifp.eps`,
`http://www.ece.lsu.edu/ee4720/2014/mpipeifp.svg`. The `svg` file can be edited using Inkscape.