EEL 6764 Principles of Computer Architecture
Homework #5

1 Problems

Total points: 130

1. [80 pts] Consider the code below.

```
Loop:  fld    f0, 0(x1)
       fmul.d f4, f0, f2
       fsd    f4, 0(x1)
       fsub.d f4, f10, f14
       addi   x1, x1, 8
       bne    x1, x2, Loop // branches if x1x2
```

   Assume the following latencies:

   (a) `fld/fsd`: 1 cycle
   (b) `fsub.d`: 2 cycles
   (c) `addi/bne`: 1 cycle
   (d) `fmul.d`: 6 cycles

   Assume that branches are predicted as taken. Execute the above code for two iterations using

   1 Tomasulo's approach
   2 Hardware-based speculation

   Show the **step-by-step execution** using the tables in Figure 3.11 (Tomasulo) and 3.16 (HW-based speculation).

   What are the numbers of cycles to finish the first two iterations using the above three approached? Count the cycles from the first instruction being issued to the last instruction that finishes.

   I recommend using Excel sheets (a template is available on Canvas) to work on the above two problems.

2. [50 pts] Execute the code in Problem 1 using hardware-based speculation and multiple issue. Show the execution by reusing the table shown in Figure 3.24 in the book. Assume issue width of 2.

   (a) Show the status of associated reservation stations, reorder buffer, and registers after issuing the first two instructions in cycle 1.

2 Requirement

- All homeworks should be done and submitted individually.
- Show all steps to get full points.

- Writing and drawings if necessary must clear and readable. Otherwise, substantial loss of points may occur.
- You must submit your solutions electronically via Canvas.
- The file for your solutions must be in PDF or MS-Word DOCX format or EXcel xls.