IC220: HW 8

Due: 15 Apr 2019

Full Name: _____ **Alpha:** _____

Circle Your Section: Aviv/1001 Aviv/2001 Aviv/4001 Choi/5001 Missler/5002

Total Points: 32

Preliminary: Carefully do the assigned reading for Chapter 4 (4.5-4.8)

1. [**10 points**] Draw a pipeline stage diagram for the following sequence of instruction. You dont need fancy pictures — just text for each stage: ID, MM, etc. Label the cycle number for each column, starting with cycle #1.

```
lw  $v0, 0($a0)
lw  $v1, 0($v0)
add $a0, $a0, $v1
sub $t0, $t0, $a0
```

2. Assume the previous sequence of instructions is repeated 100 times (so the processor does a load, another load, an add, a sub, then back to load, another load, an add, ...). There are no branches, just these 4 instructions repeated 100 times. **Do NOT reorder the code to improve efficiency**. *HINT: this question takes a bit more thought and care then you may realize at first.*

   (a) [**5 points**] What is the total number of cycles needed to execute those 400 instructions?

   (b) [**2 points**] What is the CPI?

   (c) [**2 points**] What is the CPI if we ran this same sequence on a non-pipeline cycle CPU, where it still takes 1 cycle per staging area.

   (d) [**2 points**] What is the CPI if we rant this sequence on a **single cycle** CPU?

   (e) [**4 points**] Using the various CPI calculations, argue why the CPI alone may or may not provide a good estimate for the performance gained from the different CPU styles? For example, why would a single-cycle CPU not actually be faster than a pipeline CPU even if its CPI is lower.?

3. Draw a pipeline stage diagram for the same sequence of instructions as before, **but this time there is no FORWARDING available**. Again, you must show the number of cycles

```
lw $v0, 0($a0)
lw $v1, 0($v0)
add $a0, $a0, $v1
sub $t0, $t0, $a0
```

4. Again, assume the previous sequence of instructions is repeated 100 times with no forwarding! There are no branches and you cannot reorder.

   (a) [**5 points**] What is the total number of cycles needed to execute those 400 instructions?

   (b) [**2 points**] What is the CPI?