Computer Architecture
Fall 2022
Test 3
Show your work. Points will be deducted if you do not show your work.

1. (25 points) You are given the following program:

I0	LW X5, 8(X6)
I1	LW X4, 16(X3)
I2	ADD X6, X4, X5
I3	ADD X7, X6, X4
I4	SUB X8, X7, X6
I5	SW X8, 0(X9)

    a. (5 points) Draw the data dependency graph.
    b. (20 points) Plot the pipelined execution of the above program, making sure to avoid structural and data hazards.

2. (25 points) You are given several programs each consisting of 2000 instructions. The programs runs on two different computers, with the following configurations:

Computer A	Computer B
Cache hit rate = 0.95	Cache hit rate = 0.92
Cache miss penalty = 10 cycles	Cache miss penalty = 8 cycles
Everything else is identical to computer B.	Everything else is identical to computer A.

Assume that all cache hits take 2 cycles.
The instruction mix in the programs are as follows:
- Program 1: 20% of instructions are memory operations.
- Program 2: 40% of instructions are memory operations.
- Program 3: 60% of instructions are memory operations.
- Program 4: 80% of instructions are memory operations.

    a. (24 points) How many cycles will be needed by the programs to run on both the computers?
    b. (1 point) Which computer will finish executing which programs faster?