CS4223 Tutorial 1.1: ILP Solutions

Question 1:

Consider the following code fragment. Indicate all (a) data dependence, (b) anti-dependence, and (c) output dependence in this code fragment.

I1: R1 = R2 * R3
I2: R3 = R1 + R2
I3: R1 = R2 * R4
I4: R3 = R1 + R3

ANS:

True Data Dependence I1 -> I2 (R1), I3 -> I4 (R1), I2 -> I4 (R3)

Output dependence I1 -> I3 (R1) I2 -> I4 (R3)

Anti dependence I1 -> I2 (R3), I2 -> I3 (R1), I1 -> I4 (R3)

Question 2: Scoreboard/Tomasulo's Algorithm

Consider the following code fragment

MUL.D F0, F2, F4

SUB.D F8, F0, F6

ADD.D F6, F4, F6

SUB.D F0, F2, F4

The registers F* correspond to floating point registers and R* corresponds to integer registers. Assume that floating point add executes for 2 cycles, floating point multiply executes for 20 cycles. Further assume the presence of 4 floating-point add units and 1 floating-point multiply units.

(A) Step-by-step explain how the code will execute on an out-of-order processor employing Scoreboard.

(B) Assuming the presence of enough reservation stations, step-by-step explain how the code will execute on an out-of-order processor employing Tomasulo's algorithm.