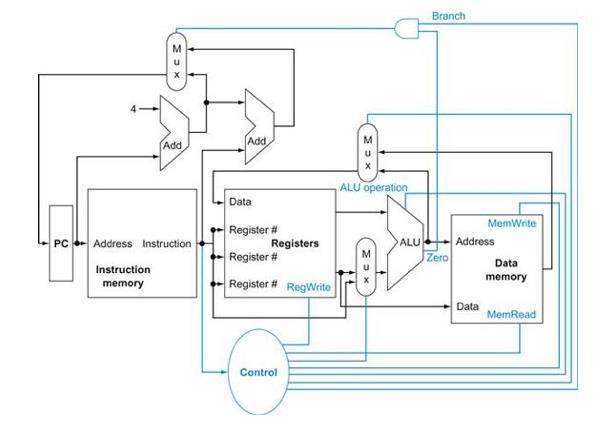
CPSC 3300 – Homework 3

Due 11:59PM Tuesday, March 9

Submit your answers to Canvas



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1. Consider the MIPS “load word” instruction as implemented on the datapath above (Figure 4. from textbook):

lw R2, 8(R1) // Reg[2] <- memory[ Reg[1] + 8 ]

Circle the correct value 0 or 1 for the control signals (a-d) and circle whether each of the three muxes (e-g) selects its upper input, lower input, or don't care. For the ALU operation (h) circle one of the function names. (The Zero condition signal will be assumed to be 0.) (20 pts.)

* 1. Branch = **0** 1 (e) Mux1 (upper left; output to PC) = upper, **lower**, don't care
  2. MemRead = 0 **1** (f) Mux2 (upper middle; output to Data port of Regs) = **upper**, lower, don't care
  3. MemWrite = **0** 1 (g) Mux3 (lower middle; output to bottom leg of ALU) = upper, **lower**, don't care
  4. RegWrite = 0 **1** (h) ALU operation = and, or, **add**, subtract, set-on-less-than, nor

1. Consider the MIPS “store word” instruction as implemented on the datapath above (Figure 4.2 from textbook):

sw R4, -12(R3) // Memory[ Reg[3] + signextended(-12) ] <- Reg[4]

Circle the correct value 0 or 1 for the control signals (a-d) and circle whether each of the three muxes (e-g) selects its upper input, lower input, or don't care. For the ALU operation (h) circle one of the function names. (The Zero condition signal will be assumed to be 0.) (20 pts.)

* 1. Branch = **0** 1 (e) Mux1 (upper left; output to PC) = upper, **lower**, don't care
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  4. RegWrite = **0** 1 (h) ALU operation = and, or, add, **subtract**, set-on-less-than, nor

1. For the MIPS instruction sequence below, complete the data dependency diagram. (Destination register is listed first except for sw instruction; sw writes into memory rather than a register.) (15 pts.)

i1: lw r4, 0( r1 ) // reg[4] ← memory[ reg[1] + 0 ] i2: lw r5, 4( r1 ) // reg[5] ← memory[ reg[1] + 4 ] i3: mul r6, r4, r5 // reg[6] ← reg[4] \* reg[5]

i4: sub r8, r6, r7 // reg[8] ← reg[6] - reg[7]

i5: sw r8, 8( r1 ) // memory[ reg[1] + 8 ] ← reg[8] i6: add r1, r1, r2 // reg[1] ← reg[1] + reg[2]

r1 r1



i1: lw

i2: lw

r4/RAW

r5/RAW

i3: mul

r1/WAR

i6: add

r2

r1/RAW

r8/RAW

i5: sw

i4: sub

r7

r6/RAW

1. Draw the dependency diagram for the following MIPS code (15 pts.)

i1: add r3, r1, r2 // reg[3] ← reg[1] + reg[2]

i2: lw r5, 0(r3) // reg[5] ← memory[ reg[3] + 0 ]

i3: add r3, r3, r6 // reg[3] ← reg[3] + reg[6]

i4: addi r5, r5, 1 // reg[5] ← reg[5] + 1

i5: sw r5, 0( r3 ) // memory[ reg[3] + 0 ] ← reg[5]

Graphical user interface, application

Description automatically generated

1. For the following MIPS instruction sequence, complete the pipeline cycle diagram for the standard 5- stage pipeline without forwarding. Assume register file writes occur in the first half cycle and reads in the second half cycle. (15 pts.)

i1: lw r1, 0( r5 ) // reg[1] ← memory[ reg[5] + 0 ]

i2: add r3, r1, r2 // reg[3] ← reg[1] + reg[2]

i3: addi r4, r3, 1 // reg[4] ← reg[3] + 1

i1:lw IF ID EX MEM WB

i2:add IF STALL STALL ID EX MEM WB

i3:addi IF STALL STALL ID EX MEM WB

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i1: lw r1, 0( r5 ) // reg[1] ← memory[ reg[5] + 0 ]

i2: add r3, r1, r2 // reg[3] ← reg[1] + reg[2]

i3: addi r4, r3, 1 // reg[4] ← reg[3] + 1

i1:lw IF ID EX MEM WB

i2:add IF STALL ID EX MEM WB

i3:addi IF STALL ID EX MEM WB