COSC 6385
Computer Architecture
- Exercises

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Spring 2010
Exercise (I)

1. Given a code sequence
   1. LD R1, 50(R2)
   2. ADD R3, R1, R4
   3. LD R5, 100(R3)
   4. MUL R6, R5, R7
   5. S R6, 50(R2)
   6. ADD R1, R1, #100
   7. SUB R2, R2, #8
Exercises (II)

a) Find all dependencies in the code segment and list them by category (data dependence, output dependence, anti-dependence and control dependencies).

b) How many cycles does it take to execute this code segment without forwarding on the regular 5 stage MIPS pipeline, assuming that we have dual-ported memory? Indicate the number of stall cycles.

c) Instead of the 5 stage MIPS pipeline, assume that we have a 7 stage pipeline consisting of the following stages: IF ID ALU1 MEM1 MEM2 ALU2 WB ALU1 is used for effective address calculation for loads, stores and branches. ALU2 is used for other calculation and for branch resolution. Because we have a slow memory unit, access to memory is pipelined through two stages (MEM1 and MEM2)
Exercises (III)

I. How many cycles does it take to execute the code segment on this pipeline?
II. How large is the branch penalty for this pipeline?
Exercises (IV)

3. Given a code segment

```
DADD    R1, R0, R0
DADD    R2, R0, R0
DADD    R3, R0, R0
DADDI   R4, R0, #5
Loop:   BEQ    R3, R4, Done     /* Branch b1*/
        BNEZ   R1, I1f2         /* Branch b2  */
        DADDI  R2, R0, #1
        DADDI  R1, R0, #2
I1f2:   BNEZ   R2, End         /* Branch b3  */
        DADDI  R1, R0, #1
        DADDI  R2, R0, #2
End:    DADDI  R1, R1, #-1
        DADDI  R2, R2, #-1
        DADDI  R3, R3, #1
        J      Loop
Done:   ...
```
Exercises (V)

a) Use a 2-bit local predictor for branch b1. Show how the predictor state changes. Assume the initial state is 10.

b) Use a (1,1) correlating branch predictor for the branches b2 and b3. Show how the predictors state changes. Assume, that all initial states are NT.

c) Use a (1,2) correlating branch predictor for the branches b2 and b3. Assume, that all initial states are NT.

d) Use a (1,1) correlating branch predictor for the branches b1, b2 and b3. Show how the predictors state changes. Assume, that all initial states are NT.