COSC 6385
Computer Architecture
- Exercises

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Spring 2014

Reading Assignment for 2\textsuperscript{nd} quiz

• Date:
  - March 25 2014, 1.00pm-2.30pm
• Topics:
  - discussed on the next pages
• You can have 6 sheets (US letter or A4) of handwritten notes
  - you can write on both sides of each sheet
  - any pages containing non-handwritten items will be removed during the quiz and student will get 0\% for that quiz
  - you have to write it yourself, not copy/xerox it from somebody else. Pages that have been xeroxed from somebody else will be treated as non-handwritten.
• Pipelining I-II
  - C.1 - C.2, C4 - C5, C7
• Instruction Level Parallelism I - III
  - Sections 3.1 - 3.9

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? Give the number of stall cycles.

Exercises (IV)

3. Given a code segment

```assembly
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, Ilf2       /* Branch b2 */
    DADDI  R2, R0, #1
    DADDI  R1, R0, #2

Ilf2:
    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.

For part a)

[Diagram showing branch predictors' states and transitions]
### For part b)

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<th>R3</th>
<th>R4</th>
<th>b1 act.</th>
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### For part c)

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Given the status when executing Tomasulo's algorithm for clock cycle $x$:

RegisterStat[F2].Qi = 0
RegisterStat[F6].Qi = Load1
RegisterStat[F8].Qi = Load2

In clock cycle $(x+1)$, the instruction MUL.D F6, F2, F8 will be issued to the MULT1 unit (i.e. $r = \text{MULT1}$). Give the following fields for the corresponding reservation station and Register status result table.

$RS[r].Qj =$
$RS[r].Vj =$
$RS[r].Qk =$
$RS[r].Vk =$
RegisterStat[F6].Qi =