

Homework #2, 10 points

Due Wednesday, 8 October at the beginning of class or by e-mail before the beginning of class. (Los Alamos students: having the proctor fax them to me or send them via courier is also okay as long as they're stamped as having been turned in Wednesday). Half credit if turned in before the test on Friday, 10 October. There will be no extension this time.

You can always stop by my office or e-mail if you have any questions or need help, but you can also e-mail me your answers and I'll reply with which ones are right and which ones are wrong.

1. Multiple choice, circle all answers that apply (*i.e.*, your answer could be more than one of the choices, or none). As the following sequence of instructions makes its way through a MIPS pipeline as described in the book, and assuming no exceptions occur and all branch delay slots are appropriately filled (*i.e.*, branches require no bubbles), which of these things *might* happen (depending on if a branch is taken):

```
addi $t0, $t1, 5
subu $t2, $t0, $t5
beq  $t5, $zero, Label
```

- a. A bubble will be inserted by the hazard detection unit
- b. Forwarding between EX/MEM and ID/EX will occur
- c. Forwarding between MEM/WB and ID/EX will occur
- d. The pipeline will be flushed

2. Multiple choice, circle all answers that apply (*i.e.*, your answer could be more than one of the choices, or none). As the following sequence of instructions makes its way through a MIPS pipeline as described in the book, and assuming no exceptions occur and all branch delay slots are appropriately filled (*i.e.*, branches require no bubbles), which of these things *might* happen (depending on if a branch is taken):

```
lw   $t0, 24($t1)
subu $t2, $t1, $t5
addi $s2, $s2, -1
sll  $s3, $s3, 3
add  $t3, $t0, $s4
```

- a. A bubble will be inserted by the hazard detection unit
- b. Forwarding between EX/MEM and ID/EX will occur
- c. Forwarding between MEM/WB and ID/EX will occur
- d. The pipeline will be flushed

3. Multiple choice, circle all answers that apply (*i.e.*, your answer could be more than one of the choices, or none). As the following sequence of instructions makes its way through a MIPS pipeline as described in the book, and assuming no exceptions occur and all branch delay slots are appropriately filled (*i.e.*, branches require no bubbles), which of these things *might* happen (depending on if a branch is taken):

```
lw    $t0, 24($t1)
subu  $t2, $t1, $t5
addi  $s2, $t0, -1
sll   $s3, $s3, 3
add   $t3, $t0, $s4
```

- a. A bubble will be inserted by the hazard detection unit
- b. Forwarding between EX/MEM and ID/EX will occur
- c. Forwarding between MEM/WB and ID/EX will occur
- d. The pipeline will be flushed

4. Multiple choice, circle all answers that apply (*i.e.*, your answer could be more than one of the choices, or none). As the following sequence of instructions makes its way through a MIPS pipeline as described in the book, and assuming no exceptions occur and all branch delay slots are appropriately filled (*i.e.*, branches require no bubbles), which of these things *might* happen (depending on if a branch is taken):

```
lw    $t0, 24($t1)
subu  $t2, $t1, $t0
addi  $s2, $t2, -1
sll   $s3, $s3, 3
add   $t3, $t0, $s4
```

- a. A bubble will be inserted by the hazard detection unit
- b. Forwarding between EX/MEM and ID/EX will occur
- c. Forwarding between MEM/WB and ID/EX will occur
- d. The pipeline will be flushed

5) Suppose you develop a pipelining technique that can continue to fetch and execute other instructions while divides and multiplies are completing. What this means is that you spend half as many cycles waiting for divides and multiplies, or, in other words, they are effectively twice as fast. What fraction of your execution time for a given benchmark would need to have been being spent on multiplies and divides in order for you to expect to see an overall speedup of 1.25 for that benchmark?

$$O.S. = 1/((1 - f) + (f/s))$$