

**Pop Quiz #1. CSE 141      Spring 2004**

**ISA design**

NAME: (2 points)

Student ID number: (2 points)

No calculators are allowed. There is a cheat-sheet giving powers-of-two on the back of the test if you need it.

This is a closed book, closed notes, closed neighbor test. If you crack a book, touch a calculator, consult any written material (other than the test) or consult your neighbor's test, you will be blocked from withdrawing from the class and you will receive an F. Your name will be forwarded to the Dean for academic review and possible further sanctions.

This is a "silent" test. No questions allowed once the test starts. If a question is unclear, make a reasonable assumption and state that assumption clearly in writing. If your assumption is reasonable and clearly stated you may still receive full credit.

Some questions may be *intentionally* incomplete in order to test your ability to make reasonable assumptions.

Do not start the test until the signal is given.

Consider an ISA made up of only the following similar-to-MIPS instructions.

**ADD \$R1, \$R2, \$R3**      # add contents of \$R3 to \$R2 and put in \$R1

**LW \$R1, M(\$R2)**      # load contents of memory addressed by \$R2  
# put in \$R1

**MUL \$R1, \$R2, \$R3**      # multiply contents of \$R3 with \$R2 and put in \$R1

**BNE \$R1, \$R2, B-Label**    # if contents of \$R1 does not equal \$R2, goto Label

**JUMP J-Label**            # goto Label

a) How many bits are needed to encode opcodes for 5 instructions? (2 points)

If we have 4 general-purpose registers (\$R1 thru \$R4) that can appear in any of the register argument positions in the above instructions and we are using 8-bit instruction words (like lab) then consider the following opcode assignments

**ADD 00**  
**LW 01**  
**MUL 10**  
**BNE 11**  
**JUMP 100**

b) How far can you branch? State any assumptions as to direction (forward or backward). (8 points).

c) How far can you jump? (10 points)

d) Is the resulting ISA ambiguous or not? In other words, is it possible to interpret some 8-bit instructions in more than one way? Only 1/8<sup>th</sup> of one point available for guessing! If it is ambiguous then exhibit an ambiguous sequence of 8 bits. If it is not, say why. (10 points).

e) EXTRA CREDIT. These same questions, or ones very similar, will re-appear on the midterm. Also, on the midterm, you will be asked something like the following:

If the above ISA is ambiguous show a new coding scheme to fix it. If it isn't ambiguous suggest a coding scheme to break it so it is ambiguous ☺ (if these change your answers to b) and C) say how). If you want to use implicit registers to enable changes that is fine. But just say how you are using them. Document if any instructions have changed as to arguments, branch distances etc. Describe all the fields of your changed ISA. (20 points).

## Powers of 2 cheat-sheet

1.00

2.00

4.00

8.00

16.00

32.00

64.00

128.00

256.00

512.00

1024.00

2048.00

4096.00