CS220 Quiz#4

General instructions: Please write brief explanation for your answers. If you submit multiple times, your last submission will be used for grading. Please provide an email address below where your responses can be sent.

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Q1. Suppose a processor uses the I-format of MIPS to encode conditional branch instructions. The only difference is that the immediate field has a length of 20 bits. What is the maximum size of a loop in terms of the number of instructions that can be run on this processor if a backward conditional branch instruction is used to check loop termination? Assume that each instruction is of four bytes size. [1 point]

The largest magnitude negative number representable using 20 bits is -524288. So, if the PC of the backward branch instruction is x, the PC of the first instruction in the loop is at least x-(524288*4). Therefore, the maximum number of instructions in the loop is 524289 including the backward branch instruction.

Q2. What are the byte addresses accessed by the lh instruction in the following sequence of instructions separated by semi-colons on a 32-bit MIPS processor? Note that the immediate field is 16 bits long. {lui $1, 0x8000; addi $1, $1, 0x8888; lh $2, 0xe888($1)} [2 point]

lui $1, 0x8000   // $1 <-- 0x80000000
addi $1, $1, 0x8888 // $1 <-- 0x80000000 + 0xffff8888 = 0x7fff8888
lh $2, 0xe888($1) // Address = 0xffffe888 + 0x7fff8888 = 0x7fff7110

Byte addresses accessed = 0x7fff7110, 0x7fff7111

Q3. Suppose a function f starts at address 0xfcdefcde. Write a sequence of 32-bit MIPS instructions that would call f. Your instruction sequence must work irrespective of where in memory this sequence is placed. [1 points]

addi $sp, $sp, -4
sw $ra, 0($sp)
lui $at, 0xfcde
ori $at, $at, 0xfcde
jalr $at

Q4. Suppose two variables x and y of type float are allocated in registers $f8 and $f9. Write a sequence of 32-bit MIPS instructions to translate the C statement x = y + 1.625. The sequence cannot use any load/store instructions. Assume that y has already been loaded in $f9. [2 points]

First 1.625 (which is 1.101 in binary) needs to be represented in single-precision IEEE 754 format and copied into a floating-point register (say, $f10). Now, 1.101 binary is represented as 0_01111111_10100000000000000000000. The instruction sequence is shown below.

lui $at, 0x3fd0
mtc1 $at, $f10
add.s $f8, $f9, $f10

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