Expert Q&A

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Direction: You can consult any resources such as books, online references, and videos for this assignment, however, you have to properly cite and paraphrase your answers when it is necessary. There will be points for partial attempts. You should submit a handwritten answer or printed answer to class Sunday, 20th November, 2022.

Note: You are allowed to use only instructions implemented by the actual MIPS hardware provided in the Canvas references. Use assembly language format from the references or the book. Note, base ten numbers are listed as normal (e.g. 23), binary numbers are prefixed with 0b and hexadecimal numbers are prefixed with 0x.

1. **(30 points, 5 each)** What is the single MIPS instruction, or if not possible, the shortest sequence of MIPS instructions that performs:

    1. Move content of register r11 into register r23.
    2. Load register r15 with the value 265,140.
    3. Store the value 55,259 into a word at memory location 40000.
    4. The equation a = b + c,assuming a, b and c are integer variables at memory location 0b10000000, 0b1001000 and 0b100010011100, respectively.
    5. The equation y[5] = y[10] + x, assuming x corresponds to register r2, and y[1] is an integer at the memory location 524,292 is the first element of vector y.
    6. The statement: if (a <= b) goto lab1, assuming that variable a corresponds to the word at memory address 400, and variable b corresponds to register r10. The instruction with lab1 is before the branch instruction and there are 20 (machine) instructions between those two instructions.

2. (20 points) For the following MIPS program determine the bit pattern for each instruction.

```
lap:  lw    r16, 0(13)
      addi  r8, r2, -513
      nop
      sw    r8, -18(r4)
      bne   r3, r0, lap
```

3. **(50 points)** Write a C program and corresponding assembly program based on MIPS ISA that reads three edges for a triangle and computes the perimeter if the input is valid. Otherwise, display that the input is invalid. The input is valid if the sum of every pair of two edges is greater than the remaining edge.

Step-by-step

1st step
All steps
Answer only
Step 1/2

(1) What is the single MIPS instruction, or if not possible, the shortest sequence of MIPS instructions that performs:

1. Move content of register r11 into register r23.

add r23, r0, r11

2.Load register r15 with the value 265,140.

Here, $265{,}140 = 2^{18} + 2{,}996 = 0b1000000101110110100 > 2^{16}$

lui r15, 4

addi r15, r15, 2996

3. Store the value 55,259 into a word at memory location 40000.

here, $55{,}259 > 2^{15}$

ori r15, r0, 0b1101011111011011

sw r15, 40000(r0)

4.The equation a=b+c, assuming a,b and c are integer variables at memory location 0b10000000, 0b1001000 and 0b100010011100, respectively.

lw r1 0b1001000(r0) ; r1←b

lw r2 0b100010011100(r0) ; r2←c

add r1, r2

mflow r1

sw r1, 0b10000000(r0)

5. The equation y[5]=y[10]+x, assuming x corresponds to register r2, and y[1] is an integer at the memory location 524,292 is the first element of vector y

lui r1, 8 ; r1 ←&y[0], not &y[1]

lw r8, 40(r1)

add r8, r8, r2

sw r8, 20(r1)

6. The statement: if (a <= b) go to lab1, assuming that variable a corresponds to the word at memory address 400, and variable b corresponds to register r10. The instruction withlab1 is before the branch instruction and there are 20 (machine) instructions between those two instructions.

lw r20, 400(0)

slt r1, r10, r20

beq r1, r0, -22

Explanation for step 1

These are the single MISP instruction.

Step 2/2

(2) For the following MIPS program determine the bit pattern for each instruction.

(1) lw r16, 0(13) **100011 01101 10000 0000000000000000**

(2) addi r8, r2, -513

001000 00010 01000 1111110111111111

(3) nop **00000000000000000000000000000000**

(4) sw r8, -18(r4)

101011 00100 01000 1111111111101110

(5) bne r3, r0, lap

bne

r3, r0, lap

000101 00011 00000 1111111111111011

Explanation for step 2

These are bit pattern for MISP program.

Final answer
It is all about MISP instruction. if you face any problem, then please let me know in comment section rather than downvote.