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CS 4100 Computer Architecture
Quiz 2
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1. (60 points) Consider the following RISC-V assembly code and assume that STRCPY is at memory location 5000_{10}.

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```
5000 STRCPY: addi   x2, x2, -8      # adjust stack for 1 doubleword
5004         sd     x19, 0(x2)      # push x19
8            add    x19, x0, x0     # i=0
L1:  12      add    x5, x19, x11    # x5 = addr of y[i]
     16      lbu    x6, 0(x5)       # x6 = y[i]
     20      add    x7, x19, x10    # x7 = addr of x[i]
     24      sb     x6, 0(x7)       # x[i] = y[i]
     28      beq    x6, x0, L2      # if y[i] == 0 then exit
     32      addi   x19, x19, 1     # i = i + 1
     36      jal    x0, L1          # next iteration of loop
L2:  60      ld     x19, 0(x2)      # restore saved x19
            addi   x2, x2, 8       # pop 1 doubleword from stack
            jalr   x0, 0(x1)       # and return
```

What are the machine instructions respectively for the following four assembly instructions?
"lbu x6, 0(x5)", "sb x6, 0(x7)", "beq x6, x0, L2", "jal x0, L1"

Ans:

lbu x6, 0(x5)

imm[11:0]	rs1	funct3	rd	opcode
000000000000	00101	100	00110	0000011

sb x6, 0(x7)

imm[11:5]	rs2	rs1	funct3	imm[4:0]	opcode
0000000	00110	00111	000	00000	0100011

beq x6, x0, L2

imm[12]	imm[10:5]	rs2	rs1	funct3	imm[4:1]	imm[11]	opcode
0	000000	00000	00110	000	00110	0	1100011

jal x0, L1

imm[20]	Imm[10:1]	Imm[11]	Imm[19:12]	rd	opcode
1	1111101100	1	11111111	00000	1101111

(背面尚有題目)

2. (25 points) Match the region of a running program's memory with what to store there. Some regions may have zero, one, or multiple answers.

What to store:

(a) The instructions for the program

(b) Values for registers that need to be preserved across a procedure call

(c) Return address of a procedure call

(d) A constant

(e) A binary tree that may have elements inserted while the program is running

Ans:

Regions: Stack: b. c Heap: e Static data: d Text: a

3. (15 points) Assume that registers x11 and x12 hold the values of two integer variable x and y. Write **a RISC-V assembly instruction** to perform the following operation:

branch to IndexOutOfBound if ($0 \le x$ and $x < y$) is NOT true $y > 0$ $x \ge y$

Ans:

bgeu x11, x12, IndexOutOfBound

unsigned 會被當成很大的數

[0 y)

means unsigned $x \ge y$ is out of bound