Branches and Jumps

#1. True/False

[ ] Jump commands (in the MIPS architecture) are always conditional.

[ ] Branch commands (in the MIPS architecture) are always conditional.

[ ] Jump commands (in the MIPS architecture) are always to an absolute address.

[ ] Branch commands (in the MIPS architecture) are always to an absolute address.

[ ] Jumps are always to an absolute address.

[ ] Branches are always to a relative address.

[ ] Jumps are always non-conditional.

[ ] Branches are always conditional.

#2. Our MIPS architecture has only "Branch on Equal" (BEQ) and "Branch on Not Equal" (BNE) commands. Show how to use the "Set on Less Than" (SLT) and BEQ or BNE to make the equivalent of BLT.

Example: blt $10, $8, label ->

#3. MIPS being a Reduced Instruction Set Computer (RISC) has only BEQ and BNE commands, requiring the use of only two op codes for Branch instructions, and two for SLT and SETI.

a. How many 6-bit op codes are available? _____

b. How many would be needed if MIP instruction set had register and immediate versions of all the BEQ, BNE, BLT, BLE, BGT, and BGE commands? _____

#4. What is the range of a BNE or BEQ instruction?
Minimum word address: 0x _____ , Minimum word address: 0x _____
Relative to what value? _____

#5. What is the range of a "j" immediate jump instruction (if PC = 0x84894534)?
Minimum byte address (hex is easier): 0x _____
Maximum byte address (hex is easier): 0x _____

#6. What is the range of a "jr" register jump instruction?
Minimum byte address (hex is easier): 0x _____
Maximum byte address (hex is easier): 0x _____

#7 What would be the relative address encoded in the following bne instruction (decimal addresses are used rather than hex as in slides- your answer can be decimal)?

Answer: _____

```
Memory    Assembly
Address   Instruction

1204  labelx:     add $5, $5, $6
 . . .
1264  bne $7, labelx
```

#8 What would be the word address encoded in the following "j" instruction (decimal addresses are used rather than hex as in slides)?

Answer: _____

```
Memory    Assembly
Address   Instruction

1204  labelx:     add $5, $5, $6
 . . .
1264  j labelx
```

#9 What would be the address needed in $11 for the following "jr" instruction to work properly (decimal addresses are used rather than hex as in slides)?

```
Memory    Assembly
Address   Instruction

1204  labelx:     add $5, $5, $6
 . . .
1264  jr $11, labelx
```

#10. What is the difference between the "jal" and the "j" command?

#11. What command is used at the end of a subroutine or procedure?

#12. Write in R4000 assembly language the commands to do the following:
Compare two variables, X and Y. If X > Y then do an absolute jump to the instruction whose address is in register $5. Use the SLT instruction.

X is in memory address 0x00001200. Y is in memory address 0x00002400.