Problem 1: HCL

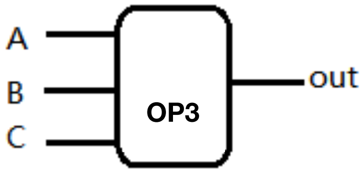
Please write down the HCL expressions for the following signals (HINT: you can refer to the Section 4.2.2 in the CSAPP book).
EXAMPLE: Show if the two input signals a and b are equal

```
bool eq = (a&&b) || (!a && !b);
```

1. The HCL expression for a signal **NAND**, which is equal to **NAND** of inputs **a** and **b**, the truth table is given, and you should **only** use **NOT** (**!**) and **OR** (**||**) operators.

NAND	0	1
0	1	1
1	1	0

2. A HCL expression called OP3: If and only if all the inputs are the same, output will be true (1). Each input and output is one-bit wise. (Hints: You can use boolean expressions or case expressions.)



Problem 2: SEQ

Suppose we are going to implement **cirmovxx V, rB**, which conditionally moves value V to register rB, in our SEQ Y86_64 processor.

1. Try to fill the table.

Stage	`cirmovxx V, rB`
Fetch	
Decode	
Execute	
Memory	
Write back	
PC update	

2. Which of following logics should be modified, please give the HCL code. { aluA, aluB, new_pc, dstE }

Problem 3: Y86-64

In Section 3.6.8, we saw a common way to implement switch statements is to create a set of code blocks and then index those blocks using a jump table. Consider the C code shown below for a function switchv.

```
long switchv(long idx)
{
   long result = 0;
   switch(idx) {
   case 0:
      result = 0xaaa;
      break;
   case 2:
   case 5:
      result = 0xbbb;
      break;
   case 3:
      result = 0xccc;
      break;
   default:
      result = 0xddd;
   }
   return result;
}
```

Alice wants to implement switchv in Y86-64 using jump table. Since Y86-64 instruction set does not include indirect jump instruction, she decides to get the same effect by combining several of them. Here is part of her solution.

```
jtable:
    .quad LD
    .quad L0
    .quad L1
    .quad L2
    .quad L3
    .quad L4
    .quad L5

switchv:
    irmovq [1], %r8
    irmovq [2], %r10
    irmovq [3], %r11

    irmovq $0, %rax
    irmovq jtable, %rcx
    rrmovq %rdi, %rdx
    subq %r8, %rdx
    jg dflt
    subq %r10, %rdi
    jl dflt
mul:
    irmovq $0x8, %r8
    subq %r10, %rdi
    je addr
    addq %r8, %rcx
    subq %r11, %rdi
    jmp mul
```

```
addr:
    addq %r8, %rcx
    mrmovq (%rcx), %rdi
    # “Question 2”
dflt:
    irmovq jtable, %rcx
    mrmovq (%rcx), %rdi
    # “Question 2”
L0:
    [4]
    ret
L1:
    [5]
L2:
    jmp L5
L3:
    irmovq $0xccc, %rax
    [6]
L4:
    jmp LD
L5:
    irmovq $0xbbb, %rax
    ret
LD:
    irmovq $0xddd, %rax
    ret
```

1. Please fill in the blanks.

2. The marks “`Question 2`” stands for indirect jump to `*%rdi`, please write down a combination of Y86-64 instructions to make that effect. (Hint: use two Y86-64 instructions).