Practice 01

problem 1 *English to logic*

Rewrite each of the following English sentences as an expression over propositions. Include both a mapping from symbols to propositions and the final expression (see the example). If there are ambiguities, explain where they arise, and give two non-equivalent interpretations.

1. (example) If I forget my keys I can't get into the house unless my roommate is home.

   K: I remember my keys

   H: I can enter my house

   R: My roommate is home

   $(\neg K \land \neg R) \to \neg H$

2. I prefer oranges to apples, although apples are less messy to eat

   P: I prefer oranges to apples
   M: apples are less messy than oranges

   $P \land M$

3. If you can prove $P \neq NP$ (or $P = NP$, though I hope you don't), you'll become famous and I'll give you an A in this class

   E: You can prove $P = NP$
   N: You can prove $P \neq NP$
   F: You'll be famous
   A: I'll give you an A
   H: I hope E

   $((E \lor N) \to (F \land A)) \land \neg H$
   note: the parenthetical is a separate claim, implicitly anded with others

4. Python programmers must be lazy because Python programs are so much shorter than the equivalent Java or C++ programs

   L: Python programmers are lazy
   J: Python programs are shorter than Java programs
   C: Python programs are shorter than C++ programs

   $(J \land C) \to L$
   note: the "or" linguistically means "and" logically in this case

PROBLEM 2 *If Statements*

Write an expression for when the following function returns the given return values. Use the variables `a` and `b` as your propositions.

```
def f(a,b):
    if a:
        return "left"
    elif b:
        return "right"
    else:
        return "up"
```

```
public static String f(boolean a, boolean b){
    if(a)
        return "left";
    else if(b)
        return "right";
    else
        return "up";
}
```

Returns "*right*" when $b \wedge \neg a$

Returns "*up*" when $\neg b \wedge \neg a$

PROBLEM 3 *Truth Tables*

Fill in the following truth tables

A	B	C	$(A \vee C)$	$\leftrightarrow$	$(B \wedge C)$
0	0	0	0	1	0
0	0	1	1	0	0
0	1	0	0	1	0
0	1	1	1	1	1
1	0	0	1	0	0
1	0	1	1	0	0
1	1	0	1	0	0
1	1	1	1	1	1

A	B	C	$((A \oplus B)$	$\vee$	$(A \oplus C))$	$\vee$	$(B \oplus C)$
0	0	0	0	0	0	**0**	0
0	0	1	0	1	1	**1**	1
0	1	0	1	1	0	**1**	1
0	1	1	1	1	1	**1**	0
1	0	0	1	1	1	**1**	0
1	0	1	1	1	0	**1**	1
1	1	0	0	1	1	**1**	1
1	1	1	0	0	0	**0**	0

In each of the blanks below, put 1st if the first truth table above is the given idea; 2nd if the second truth table is; leave it blank if neither is.

____ at least one of A, B, and C is 1

____ at least one of A, B, and C is 0

____ A, B, and C are all the same

2nd A, B, and C are not all the same

1st either A and C are both false or B and C are both true, but not both

1st either A and C are both false or B and C are both true, or both