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

   \( \neg K \land \neg R \rightarrow \neg H \)

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

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

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

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

Returns "right" when

Returns "up" when

**PROBLEM 3 Truth Tables**

Fill in the following truth tables

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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

___ \(A, B,\) and \(C\) are not all the same

___ either \(A\) and \(C\) are both false or \(B\) and \(C\) are both true, but not both

___ either \(A\) and \(C\) are both false or \(B\) and \(C\) are both true, or both