

Homework 4 (not graded)

Due date: Feb 4, 2020, 9:30am

Objective

- Apply the laws of logic, inference rules, and proof techniques in a formal proof.
- Apply the laws of logic and inference rules to simplify conditional expressions in a program segment.

Exercises

1. Prove that the following argument is valid.

Given:

- (1) $p \rightarrow t$
- (2) $s \rightarrow u$
- (3) $t \vee u \rightarrow w$
- (4) $\neg w$

Show: $\neg p \wedge \neg s$

2. An island contains two types of people: knight who always tell the truth and knaves who always lie.
 - a) Two natives A and B address you as follows:
A says: Both of us are knights.
B says: A is a knave.

What are A and B?
 - b) Another two natives C and D approach you but only C speaks.
Both of us are knaves.

What are C and D?
 - c) You then encounter natives E and F.
E says: F is a knave.
F says: E is a knave.

How many knaves are there?

d) You meet a group of six natives, U, V, W, X, Y, and Z.

U says: None of us is a knight

V says: At least three of us are knights.

W says: At most three of us are knights.

X says: Exactly five of us are knights.

Y says: Exactly two of us are knights.

Z says: Exactly one of us is a knight.

Which are knights and which are knaves?

3. Simplify the following code. Do not change the outcome of the code fragments, even if they seem to be flawed semantically.

```
a) if (tree.size() =< 5){  
    description = "sapling";  
}  
else if (tree.size() =< 1){  
    description = "seedling";  
}  
else if (tree.size() > 5){  
    description = "mature";  
}
```

```
b) if (treeA.size() <= 5 || treeB.size() <= 5){  
    description = "at least one sapling";  
}  
else if (treeA.size() > 5 && treeB.size() <= 5){  
    description = "exactly one mature tree";  
}  
else if (treeA.size() <= 5 && treeB.size() > 5){  
    description = "exactly one mature tree";  
}  
else if (treeA.size() > 5 && treeB.size() > 5){  
    description = "two mature trees";  
}
```

Submission

You do not need to submit your solutions.