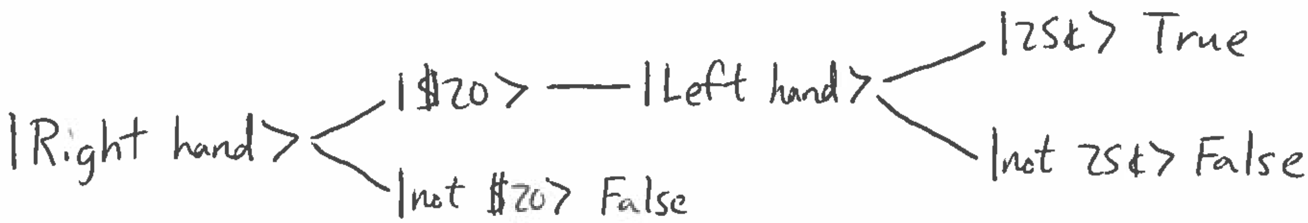
Solutions

1.1: Formal Logic
Truth Tables

Question 1. Westley, standing with his hands behind his back, claims that he is holding a quarter in his left hand and a $20 in his right hand. You believe he is lying. What would have to show to demonstrate that he is lying? Invent a diagram, chart or symbols to illustrate the possible scenarios.



Question 2. Buttercup knows whether or not Westley is lying. She promises that if Westley is lying, she will give you a cookie. Buttercup always keeps her promises. Suppose she does not give you a cookie; what can you conclude? Suppose that she gives you a cookie; what can you conclude?

If you do not receive a cookie, then Westley is telling the truth (or you don't know Buttercup well enough).

If you do receive a cookie, then ~~Westley is lying~~ you cannot conclude anything. (I hope to convince you of this.)

Question 3. Camp Halcyon and Camp Placid are two summer camps with the following daily policies on pool use and cleanup duties.

Camp Halcyon's Policy: If you used the pool in the afternoon and you didn't clean up after lunch, then you must clean up after dinner.

Camp Placid's Policy: You must do at least one of the following: (a) Stay out of the pool in the afternoon, (b) clean up after lunch, or (c) clean up after dinner.

How do these policies differ? Explain your reasoning.

They are the same.

Definition 1. A statement (also known as a proposition) is a declarative statement that is either true or false, but not both.

Examples.

Statements

- 7 is odd
- $1+1=4$
- If it is raining, then the ground is wet.

Not Statements

- x is even (depends on x)
  this is a predicate (Sect. 1.3)
- This sentence is false (Liar's paradox)

Often, a complicated statement consists of several simple statements joined together. There are five logical connectives.

Name	Symbol
and	$\wedge$
or	$\vee$
not	$\neg$
implies (if ... then)	$\rightarrow$
if and only if	$\leftrightarrow$

Truth Tables.

Truth tables are a tool we can use to establish the validity (truthness?) of a complicated statement. Each logical connective has a truth table associated to it. This allows us to say precisely what each symbol means without ambiguity.

p	$\neg p$
T	F
F	T

p	q	$p \wedge q$
T	T	T
T	F	F
F	T	F
F	F	F

p	q	$p \vee q$
T	T	T
T	F	T
F	T	T
F	F	F

p	q	$p \leftrightarrow q$
T	T	T
T	F	F
F	T	F
F	F	T

p	q	$p \rightarrow q$ *
T	T	T
T	F	F
F	T	T
F	F	T

Homework. **(Due Sept 3, 2018)** Section 1.1: 2

Practice Problems. Section 1.1: 1

* Implication is the most unintuitive. Here is a ~~element~~ situation to think about: Suppose a presidential candidate says "If I get elected, then I will lower taxes." If she does not get elected, then was she lying?