CSE 191 Recitation

2/27/23 - 3/3/23 - Logical Reasoning and Proofs

Arguments

An **argument** is a list of propositions called *hypotheses* and a single proposition called the *conclusion*

An argument is **valid** if $(p_1 \land p_2 \land p_n) \rightarrow c$ is a tautology

Recall the truth table for implication

- The only time an implication is F is if the premise is T, and the conclusion is F
- So an argument is **invalid** if it is possible for all the hypotheses to be T, and the conclusion be F

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

Invalid Arguments

For the following arguments, come up with counterexamples to show they are invalid

$$\begin{array}{l} a \\ b \rightarrow a \\ \hline \therefore b \end{array}$$

$$\begin{array}{l} p \wedge q \\ q \vee \neg r \\ r \rightarrow \neg p \\ \hline \therefore r \wedge q \end{array}$$

$$\begin{array}{l} x \vee y \vee z \\ x \wedge z \\ \hline \therefore \neg y \end{array}$$

Logical Reasoning Proofs

Translate the following statements to a formal argument, then prove validity via truth table, and with a proof.

If I am with friends, I am playing a game

If I am playing a game, I am happy

I am with friends

∴ I am happy

Mathematical Proof Examples

Proof by Cases: Prove that if n is an integer, then $n^2 \geq n$

What are your exhaustive cases? Prove each case? **Note:** you can assume we've proven that $n^2 \geq 0$

Proof by Contraposition: Prove that for any integers x and y, if both $x + y$ and xy are even, then both x and y are even.

What implication are you trying to prove? What is its contrapositive? What is the starting assumption of your proof?