

# CS113/DISCRETE MATHEMATICS-SPRING 2024

## Worksheet 5

### Topic: Laws Of Inference

Today, we will explore the Laws of Inference, discovering how they help us draw logical and valid conclusions from various premises. Happy Learning!

Student's Name and ID: \_\_\_\_\_

Instructor's name: \_\_\_\_\_

## 1 Laws Of Inference:

Rule of Inference	Tautology	Name
$p$ $p \rightarrow q$ $\therefore q$	$(p \wedge (p \rightarrow q)) \rightarrow q$	Modus ponens
$\neg q$ $p \rightarrow q$ $\therefore \neg p$	$(\neg q \wedge (p \rightarrow q)) \rightarrow \neg p$	Modus tollens
$p \rightarrow q$ $q \rightarrow r$ $\therefore p \rightarrow r$	$((p \rightarrow q) \wedge (q \rightarrow r)) \rightarrow (p \rightarrow r)$	Hypothetical syllogism
$p \vee q$ $\neg p$ $\therefore q$	$((p \vee q) \wedge \neg p) \rightarrow q$	Disjunctive syllogism
$p$ $\therefore p \vee q$	$p \rightarrow (p \vee q)$	Addition
$p \wedge q$ $\therefore p$	$(p \wedge q) \rightarrow p$	Simplification
$p$ $q$ $\therefore p \wedge q$	$((p) \wedge (q)) \rightarrow (p \wedge q)$	Conjunction
$p \vee q$ $\neg p \vee r$ $\therefore q \vee r$	$((p \vee q) \wedge (\neg p \vee r)) \rightarrow (q \vee r)$	Resolution

1. Show that the premises “It is not sunny this afternoon and it is colder than yesterday,” “We will go swimming only if it is sunny,” “If we do not go swimming, then we will take a canoe trip,” and “If we take a canoe trip, then we will be home by sunset” lead to the conclusion “We will be home by sunset.”

2. Given the following premises:  $P \wedge Q$   
 $P \rightarrow \neg(Q \wedge R)$   
 $S \rightarrow R$

**Prove:**  $\neg S$ .

3. If Superman were able and willing to prevent evil, he would do so. If Superman were unable to prevent evil, he would be impotent; if he were unwilling to prevent evil, he would be malevolent. Superman does not prevent evil. If Superman exists, he is neither impotent nor malevolent. Determine whether the conclusion that Superman does not exist is valid or not. Start this question by identifying all the premises.