ROOM 5-6 LESSONS

A **subset** is a part of a given set (another set or the same set). The set notation to represent a set A as a subset of set B is written as A ⊆ B.

If all elements of set 1 are present in set 2 then we say that set 1 is a subset of set 2. We know that a set is a well-defined collection of numbers, alphabets, objects, or any items. If set 1 = {A,B,C} and set 2 = {A,B,C,D,E,F} we can say that set 1 is a subset of set 2 since all the elements in set 1 are present in set 2.

**Subset Meaning**

If all elements of set A are in another set B, then set A is said to be a subset of set B. In this case, we say

* A is a subset of B (or)
* B is a [superset](https://www.cuemath.com/algebra/superset/) of A

For example, A is the set of [natural numbers](https://www.cuemath.com/numbers/natural-numbers/), and B is the set of all [whole numbers,](https://www.cuemath.com/numbers/whole-numbers/) then A is a subset of B because all natural numbers are present in the set of whole numbers). We can understand it this way:

* A = Set of natural numbers = {1, 2, 3, ....}
* B = Set of whole numbers = {0, 1, 2, 3, ...}
* Since every element of A is in B, A ⊆ B.

ROOM 7-8 LESSONS

## **Inference rules:**

Inference rules are the templates for generating valid arguments. Inference rules are applied to derive proofs in artificial intelligence, and the proof is a sequence of the conclusion that leads to the desired goal.

In inference rules, the implication among all the connectives plays an important role. Following are some terminologies related to inference rules:

* **Implication:** It is one of the logical connectives which can be represented as P → Q. It is a Boolean expression.
* **Converse:** The converse of implication, which means the right-hand side proposition goes to the left-hand side and vice-versa. It can be written as Q → P.
* **Contrapositive:** The negation of converse is termed as contrapositive, and it can be represented as ¬ Q → ¬ P.
* **Inverse:** The negation of implication is called inverse. It can be represented as ¬ P → ¬ Q.

## **Types of Inference rules:**

### 1. Modus Ponens:

The Modus Ponens rule is one of the most important rules of inference, and it states that if P and P → Q is true, then we can infer that Q will be true.

**Example:**

Statement-1: "If I am sleepy then I go to bed" ==> P→ Q  
Statement-2: "I am sleepy" ==> P  
Conclusion: "I go to bed." ==> Q.  
Hence, we can say that, if P→ Q is true and P is true then Q will be true.

### 2. Modus Tollens:

The Modus Tollens rule state that if P→ Q is true and **¬ Q is true, then ¬ P** will also true.

**Statement-1:** "If I am sleepy then I go to bed" ==> P→ Q  
**Statement-2:** "I do not go to the bed."==> ~Q  
**Statement-3:** Which infers that "**I am not sleepy**" => ~P

### 3. Hypothetical Syllogism:

The Hypothetical Syllogism rule state that if P→R is true whenever P→Q is true, and Q→R is true.

**Example:**

**Statement-1:** If you have my home key then you can unlock my home. **P→Q**  
**Statement-2:** If you can unlock my home then you can take my money. **Q→R**  
**Conclusion:** If you have my home key then you can take my money. **P→R**

### 4. Disjunctive Syllogism:

The Disjunctive syllogism rule state that if P∨Q is true, and ¬P is true, then Q will be true.

**Example:**

**Statement-1:** Today is Sunday or Monday. ==>P∨Q  
**Statement-2:** Today is not Sunday. ==> ¬P  
**Conclusion:** Today is Monday. ==> Q

### 5. Addition:

The Addition rule is one the common inference rule, and it states that If P is true, then P∨Q will be true.

**Example:**

**Statement:** I have a vanilla ice-cream. ==> P  
**Statement-2:** I have Chocolate ice-cream.  
**Conclusion:** I have vanilla or chocolate ice-cream. ==> (P∨Q)

### 6. Simplification:

The simplification rule state that if **P∧ Q** is true, then **Q or P** will also be true.

### 7. Resolution:

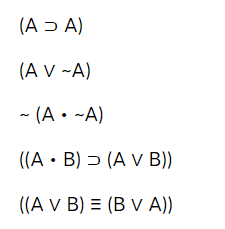
The Resolution rule state that if P∨Q and ¬ P∧R is true, then Q∨R will also be true.

ROOM 9-10 LESSONS

## **A tautology**

It is also known as a tautologous proposition, which is a logical form that cannot be proven wrong (no matter what truth values are assigned to the sentence letters).

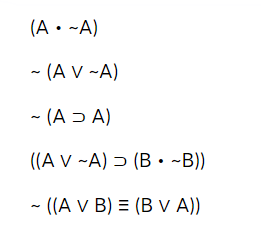
The following statements are all tautologies:



## **A contradiction**

## **It is also known as a self-contradictory proposition, and has a logical form that can’t be true (no matter what truth values are assigned to the sentence letters).**

The following statements are incompatible:



## **A contingent proposition**

Contingency has a logical form that can be true or untrue (depending on what truth values are assigned to the sentence letters).

Contingencies include the following propositions:

