#### Commudation

#### Distributive

$$A * (B + C) = AB + AC$$

$$\begin{matrix}
oR & AND \\
\uparrow & \uparrow \\
p & (q & \uparrow \gamma)
\end{matrix} = (p \cdot q) \cdot (p \cdot \gamma)$$

$$p \cdot (q \vee \gamma) = (p \cdot q) \vee (p \cdot \gamma)$$

#### Asso clative

$$A + (B+C) = (A+B)+C$$

$$P \vee (Q, V \wedge Y) = (P \vee Q) \vee Y$$

$$P \wedge (Q, N \wedge Y) = (P \wedge Q) \wedge Y$$

## <u>De Morganis</u>

$$\neg (p \lor q) \equiv \neg p \lor \neg q$$

$$\neg (p \land q) \equiv \neg p \lor \neg q$$

$$p \rightarrow q$$
  $\neq$   $p \land q$ 

Predicate
$$P(x) : x \rightarrow \text{variable}$$

$$P(x) : x - 5 = 40$$

$$P \Rightarrow \text{predicate}$$

$$P(35) \rightarrow \text{false}$$

$$P(45) \rightarrow \text{true}$$

$$P(x) : 5x = 15$$

$$P(x,y,z): x+y>z$$

$$P(1,1,1) \Rightarrow true \qquad P(1,2,10) \Rightarrow false$$

## Consider p(x): x+3=6if x is an element from the set of real numbers then p(x) is a proposition?

 $p \rightarrow q$ 

tre

#### Given Predicates:

• 
$$r(x): x > 0$$

3. 
$$p(-1) \land q(1) \rightarrow faller$$

3. 
$$p(-1) \land q(1) \rightarrow \text{falle}$$
4.  $p(0) \rightarrow q(0) \rightarrow \text{the}$ 

$$p(4) \rightarrow 4 < = 3 \rightarrow \text{folie}$$
 $q(1) \rightarrow 1+1 \text{ is odd} \rightarrow \text{folie}$ 
 $\sigma(2) \rightarrow 2 > 0 \rightarrow \text{true}$ 

folie  $\vee$  (folie  $\wedge$  true)

 $\Rightarrow$  folie

 $\Rightarrow$  folie

 $\Rightarrow$  folie

 $\Rightarrow$  folie

## Quantifiers

1. All squeres are rectangle. True

2. Each prime number is odd. False

3. There exists attent one integer whose square is egnal to itself. True  $1^2 = 1$ 

Universal (\forall )

AU, each, for every, for each

for all natural numbers x>0

There exists attent one

Domain

 $\forall x P(x) > 0$ 

x ∈ N (natural number)

Negation of Quantified expression.

#### Find the negation of the following statements:

- 1. All citizens vote during election.
- 2. Someone in the class has a height greater than 5ft.
- 1. Attent one citizen does not vote during elections.
- 2. Everyone in the class has a height less than or equal to 5ft.

$$\neg \quad \left( \forall x P(x) \right) \equiv \exists x \neg P(x)$$

Negation of Existential

$$\neg \left( \exists x P(x) \right) \equiv \forall x \neg P(x)$$

Rules of Inference using proposotion >

Modus Ponens → method of affirming

If p is true and p → g, is true then q must be touch

p→q: If it is sunny, then I will wear a hat.

p: It is sunny

i. q → I will wear a hat

Modus Tellens > method of denying

$$\begin{array}{ccc}
 & \neg & q \\
 & p \rightarrow & q \\
 & \ddots & \neg & p
\end{array}$$

7 q → toue

¬p → true

## Hypothetical Syllogism

$$\begin{array}{cccc}
\rho & q & \Rightarrow & \text{Towe} \\
q & & & \Rightarrow & \text{Towe} \\
\hline
\vdots & & & & \Rightarrow & \Rightarrow & \text{Towe}
\end{array}$$

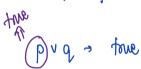
 $p \rightarrow q \rightarrow$  If John goes to school, then Harry goes to school  $q \rightarrow r \rightarrow$  If Harry goes to school, then Seema goes to school  $p \rightarrow r \rightarrow$  If John goes to school, then Seema goes to school

## Disjunctive Syllogism

## Addition

## Conjunction

## Revolution





## Rules of inference using predicate and Quantifies.

### Universal Instantiation

# $\forall x P(x)$ $\therefore P(c)$ where c is a member of the domain

Examples P(x): All squares are reclargle

n: any square

RE set of squares

 $\forall x P(x)$ 

P(x): x is studying discrete mathe

x ∈ Group1 c: Smidhi

P(c) => true

Universal Generalisation

# P(c) for an arbitrary c in domain $\therefore \forall x P(x)$

Existential Instantiation

$$\exists x P(x)$$

 $\therefore P(c)$  for some element c in the domain

$$P(x): x + 10 > 50$$
  $x \in N$ 

Existential Generalisation

P(c) for some element c in the domain  $\therefore \exists x P(x)$ 

### Problems

<u>g</u>ı.

If it mows, the school will be closed

If the school is closed, the classes will be cancelled.

Therefore, if it snows, then the classes will be cancelled.

## thypothetical Syllogism

Given the hypotheses "I play outside or I study well," "I don't study well or I pass the exam," and "I don't play outside or I pass the exam," is the conclusion, "Therefore, I passed the exam" valid?

p: I play outside
q: I study well
r: I pan the exam

Premise 1: pvq

Premise d: 79, vr

Premise 3: 7pvr

.. r

If p = True

J q = True
PVr

P V V P V V P V V P V V V P V V V P V V V P V V V P V V P V V V P V V P V V P V V P V V P V V P V V P V V P V V P V V P V V P V V P V

9 Vr P Vr Remise 1: pvq

Premise d: 7qvr

Premise 3: 7pvr

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q => false

pvq ⇒ true Not possible