Propositional logic (Either True or False, not Both)

(statement)

Knowledge representation by propositional logic.

Why?

For machines to interpret information properly.

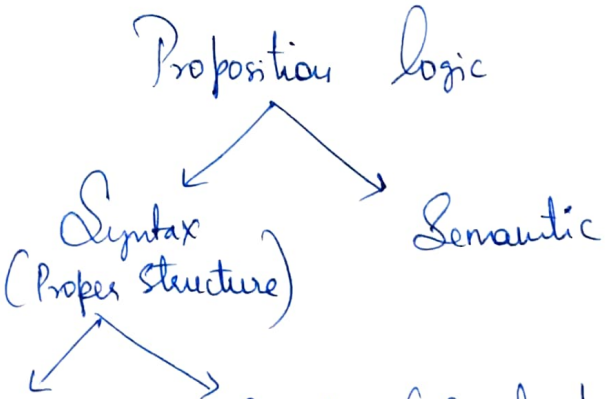
1+1=2 True proposition

2+1=4 False "

New delhi is Capital of India → True

Some students are Intelligent T/F.

*(Statements that don't Exhibit Either true or false are not a part of proposition logic).



Atomic

Single Proposition

1+1=2 T ✓

1+1=3 F ✗

Complex (Composite)

Two sentences together form a proposition using the following symbols.

¬ Negation (Today is Not Sunday)

∨ Disjunction (Please ~~Eat~~ or Watch TV at a time)

∧ Conjuction (Read and Write together).

→ if then (if there is rain then the roads get wet)

↔ iff (I will go to Mall iff I have to do Shopping)

Ex If there is rain then the roads are wet.

If then

T T T (if there is rain, roads are wet)

T F F (if there is rain, roads are not wet).

Iff I will go to Mall iff I have to do shopping)

T T T (I will go to Mall, iff I have to do shopping)

T F F (I will go to Mall, iff I dont have to do shopping).

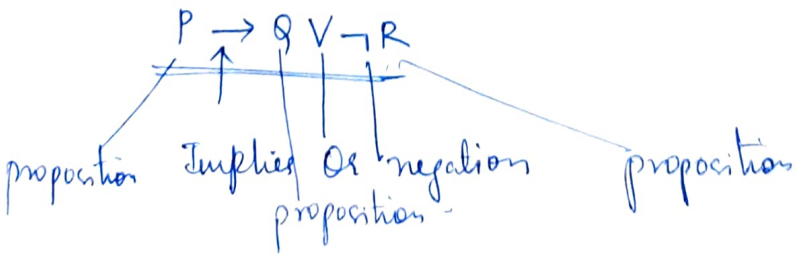
F T F (I will not go to Mall, iff I will do shopping)

F F F (I will not go to Mall, iff I will not do shopping)

Similarly other cases.

Ex: You can access the internet from Campus only if you are GIT student or you are not a freshman.

P Q R



Predicate logic.

→ Extention of proposition logic.
→ Known a first order Predicate logic or FOPL or FOL
→ Includes — ① Predicates
② Quantifiers

Predicates → Relation b/w 2 Objects

Eg: Simba likes Orange.

Likes (Simba, Orange).
relation objects

General form

Likes (x, y)

Quantifiers.

→ defines Scope of Object (range)

Two Types ① Universal Quantifier ∀
② Existential Quantifier ∃

① Universal Quantifier
∀x (we are talking about all x)
for Each x
for all x
for Every x

② Existential Quantifier
∃y (for some)
there Exists y.
for Some y
for atleast one y.

* Connection b/w ∀ and ∃
∀x likes (x, Orange) is Equivalent to
¬∃x¬likes(x, Orange) | It means that "there does not Exist atleast one x who does not like Orange which is ultimately Equivalent to "All x likes Orange".

(2) $\forall x \neg likes(x, Orange)$ | or $\neg(\neg A) = A$

$\downarrow$

$\neg \exists x\ likes(x, Orange)$

Range or Scope
1) Bound Variable → Ex: $\forall x\ (A(x) \rightarrow B(x))$
~~Range~~ $(A(x) \rightarrow B(x))$ (Entire thing).
Coz $\forall x$ is outside brackets so it will effect A as well as B.

2) Free Variable
↓
A Variable is said as free if its Occurence is free. → $\forall x \exists y\ (A(x, y, z))$

(Any change in x & y will not have effect on z (free variable).

How to Write Statements in Predicate logic.

1) Bread is a food
Variable relation: predicate

food (Bread)

2) Mango is a food.
food(mango)

3) Neha Eats burger
eats (Neha, burger)

4 Anything anyone Eats is called food
$\forall x \forall y\ eats(x, y) \rightarrow food(y)$

5. Mike likes all kind of food
$\forall y\ food(y) \rightarrow$ ~~likes (mike~~
likes (mike, y)

Predicate logic

① Every child loves every candy.

$\forall x, \forall y : child(x) \wedge candy(y) \rightarrow loves(x, y)$

(if x is a child and y is candy implies, x loves y.)

Always read ①, ② then ③.

② Anyone who loves Some candy is not a nutrition fanatic.

$\forall x, \exists y : candy(y) \wedge loves(x, y) \rightarrow \neg nutritionfanatic(x)$

③ Anyone who eats a pumpkin is a nutrition fanatic.

$\forall x, \exists y : pumpkin(y) \wedge eats(x, y) \rightarrow nutrition\text{-}finatic(x)$

④ Anyone who buys any pumpkin Either Craves it or Eats it

$\forall x, \forall y : pumpkin(y) \wedge buys(x, y) \rightarrow craves(x, y) \vee Eats(x, y)$

⑤ John buys a pumpkin

$\exists x : pumpkin(x) \rightarrow buys(John, x)$ (some pumpkin).

⑥ Life Saver is a Candy.

Candy (lifesaver)
name

⑦ John is a Child

Child (John)

* Limba likes Orange — Cannot be represented by ④ a proposition logic hence comes the predicate logic for such statements.

Problems - Predicate logic.

① Marcus was a man.

man (Marcus)

② ~~All fo~~ Marcus was a Pompeian.

Pompeian (Marcus)

③ All Pompeian were Romans.

$\forall x$: Pompeian(x) $\rightarrow$ Roman (x)

(for all x, If x is a Pompeian, Roman is a Pompeian.)

④ Caesar was a ruler

ruler (caesar)

⑤ All Romans were either loyal to Caesar or hated him.

(x is loyal to Caesar.)

$\forall x$: Roman (x) $\rightarrow$ loyal-to (x, caesar) $\vee$ hate (x, caesar)

② ① ③ ② ① ③

(If x is a Roman, he ~~was~~ is either loyal to Caesar or hated him)

first read ① then ② then ③.

(6). Everyone is loyal to someone.

forall → $\forall x$, for some → $\exists y$: loyalto(x, y) Read ① then ② & ③.

(x) Everyone (y) someone

(7). People only try to assassinate rulers they are not loyal to.

$\forall x, \forall y$: People$(x) \wedge$ Ruler$(y) \wedge$ tryassassinate$(x, y) \rightarrow \neg$ loyalto(x, y)

(Always read ①, ② then ③).

(8) Marcus tried to assassinate Caesar

tryassassinate (Marcus, Caesar)

Prove: marcus hated Caesar

hate (marcus, Caesar)

(Don't worry about tense).