Assignment-03

1

$(\sim P \vee Q) \wedge R \rightarrow S \vee (\sim R \wedge Q)$

I_1: P is true, Q is true, R is false, S is true.

Here,

Rule 2 gives $\sim P$ as False.

Rule 5 gives $(\sim P \vee Q)$ as True.

Rule 4 gives $(\sim P \vee Q) \wedge R$ as False.

Rule 2 gives $\sim R$ as True.

Rule 3 gives $\sim R \wedge Q$ as True.

Rule 4 gives $S \vee (\sim R \wedge Q)$ as True.

Rule 7 gives $(\sim P \vee Q) \wedge R \rightarrow S \vee (\sim R \wedge Q)$ as True.

So, the statement I_1 is True.

I_2: P is true, Q is false, R is true, S is true.

Here, Rule 2 gives $\sim P$ as false.

Rule 5 gives $\sim P \vee Q$ as False.

Rule 3 gives $(\sim P \vee Q) \wedge R$ as False.

Rule 2 gives $\sim R$ as False.

Rule 3 gives $\sim R \wedge Q$ as False.

Rule 4 gives $S \vee (\sim R \wedge Q)$ as True.

Rule 7 gives $(\sim P \vee Q) \wedge R \rightarrow S \vee (\sim R \wedge Q)$ as True.

So, the statement I_2 is True.

$S1: (P \land Q) \lor \sim(P \land Q)$

P	Q	$(P \land Q)$	$\sim(P \land Q)$	$(P \land Q) \lor \sim(P \land Q)$
F	F	F	T	T
F	T	F	T	T
T	F	F	T	T
T	T	T	F	T

So, S1 is valid because it is true for every interpretation

$S2: (P \lor Q) \rightarrow (P \land Q)$

P	Q	$P \lor Q$	$P \land Q$	$\sim(P \lor Q)$	$(P \lor Q) \rightarrow (P \land Q)$
F	F	F	F	T	T
F	T	T	F	F	F
T	F	T	F	F	F
T	T	T	T	F	T

So, S2 is satisfiable because there is some interpretation for which it is true.

$S_3 : (P \wedge Q) \rightarrow R \vee \sim Q$

P	Q	R	$P \wedge Q$ (X)	$\sim Q$	$R \vee \sim Q$ (Y)	$\sim X$	$X \rightarrow Y$
F	F	F	F	T	T	T	T
F	F	T	F	T	T	T	T
F	T	F	F	F	F	T	T
F	T	T	F	F	T	T	T
T	F	F	F	T	T	T	T
T	F	T	F	T	T	T	T
T	T	F	T	F	F	F	F
T	T	T	T	F	T	F	T

Let's assume,

$P \wedge Q = X$

$R \vee \sim Q = Y$

Here, S_3 is satisfiable because there is some interpretation for which it is true.

$S_4 : (P \vee Q) \wedge (P \vee \sim Q) \vee P$

P	Q	$P \vee Q$ (X_1)	$\sim Q$	$P \vee \sim Q$ (X_2)	$X = X_1 \wedge X_2$	$X \vee P$
F	F	F	T	T	F	F
F	T	T	F	F	F	F
T	F	T	T	T	T	T
T	T	T	F	T	T	T

So, S.

Let's assume,

$P \vee Q = X_1$

$P \vee \sim Q = X_2$

So, S4 is satisfiable because there is some interpretation for which it is true.

$S_5 : P \rightarrow Q \rightarrow \sim P$

P	Q	$\sim P$	$\sim Q$	$Q \rightarrow \sim P$	$P \rightarrow Q \rightarrow \sim P$
F	F	T	T	T	T
F	T	T	F	T	T
T	F	F	T	T	T
T	T	F	F	F	F

So, S5 is satisfiable because there is some interpretation for which it is true.

S6: $P \vee Q \wedge \sim P \vee \sim Q \wedge P$

P	Q	$\sim P$	$\sim Q$	$P \vee Q$ (X_1)	$\sim P \vee \sim Q$ (X_2)	$X = X_1 \wedge X_2$	$X \wedge P$
F	F	T	T	F	T	F	F
F	T	T	F	T	T	T	F
T	F	F	T	T	T	T	T
T	T	F	F	T	F	F	F

Let's assume,

$P \vee Q = X_1$

$\sim P \vee \sim Q = X_2$

So, S_6 is satisfiable because there is some interpretation for which it is true.

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Meaning of Statements

13. If the earth moves round the sun or the sun moves round the earth, then Copernicus might be a mathematician but wasn't an astronomer.

⇒ Let's assume,

P = The earth moves round the sun.

Q = The sun moves round the earth.

R = Copernicus is a mathematician.

S = Copernicus was an astronomer.

So, the sentence will be: $P \vee Q \rightarrow R \wedge \sim S$

14. Inspite of having French nationality, B. Russel was a critic of imperialism, then either he was not a bachelor or he was a universal lover.

⇒ Let's assume,

P = have french nationality.

Q = B. Russel was a critic of imperialism.

R = He was a bachelor.

S = He was a universal lover.

So, the sentence will be: $P \rightarrow Q \rightarrow (\sim R \vee S)$.

Examples of Predicate Logic (Page-12)

* $\forall x \exists y (LOVES(x,y))$

  $\Rightarrow$ Everyone loves someone.

* $\forall x (HANDSOME(x) \Rightarrow \exists y (LOVES(y,x)))$

  $\Rightarrow$ Every handsome people are loved by some people.

* All men are mortal.

  $\Rightarrow \forall x (Man(x) \Rightarrow Mortal(x))$

* Noone likes hartal.

  $\Rightarrow \forall x (\sim LIKES(X, HARTAL))$

* Everyone taking AI will pass their exam.

  $\Rightarrow \forall x (TAKING(x, AI) \rightarrow PASS(X))$

* Every race has a winner.

  $\Rightarrow \forall x (RACE(X) \rightarrow \exists y (WINNER(Y, X))$

* Sajjad likes everyone who is tall.

  $\Rightarrow \forall x (TALL(x) \rightarrow LIKES(Sajjad, x))$

* Rita doesn't like anyone who prefers arguments.

  $\Rightarrow \forall x (PREFERSARGUMENT(X) \rightarrow \sim LIKES(Rita, X))$

* There is something small and slimy on the table.

$\Rightarrow \exists x (SMALL(X) \land SLIMY(X) \land ON(x, table))$