Propositional Logic

Homework 3

5 Types of Questions in Propositional Logic

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GATE CSE AIR 53; AIR 67; AIR 206; AIR 256;

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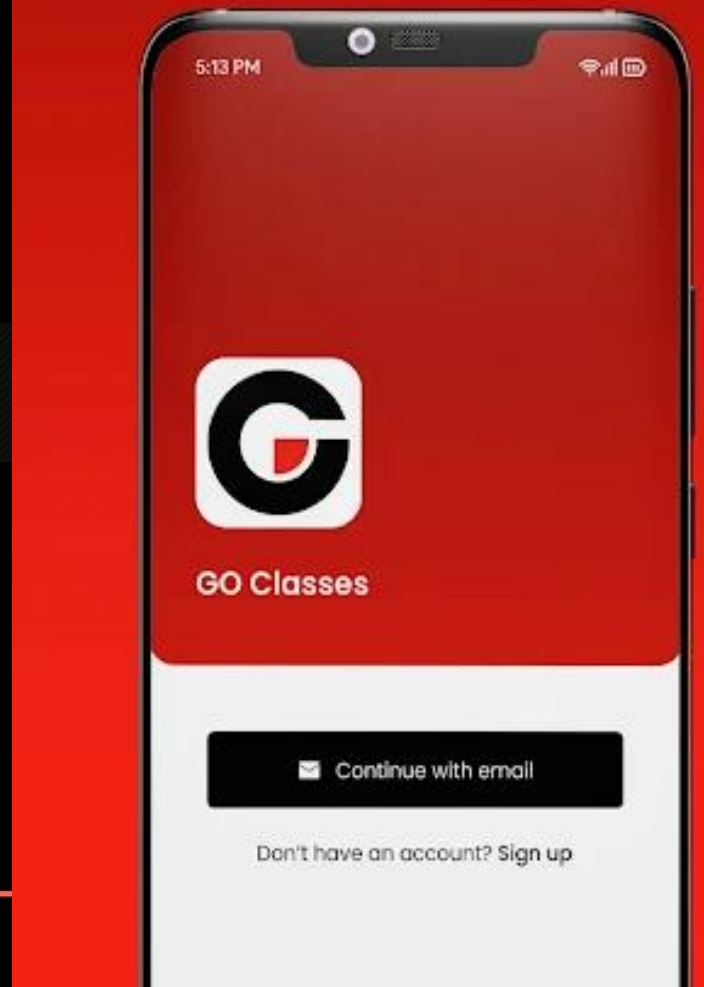

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5 Types of Questions in Propositional Logic

- By Deepak Poonia (IISc Bangalore)

Detailed Solutions of this Homework

is discussed in the "Live Doubts Session-3" of

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1.11 Propositional Logic Questions

1. Suppose that the statement $p \rightarrow \neg q$ is false. Find all combinations of truth values of r and s for which $(\neg q \rightarrow r) \wedge (\neg p \vee s)$ is true.

Detailed Solutions of this Homework is discussed in the

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2. Find all combinations of truth values for p, q and r for which the statement $\neg p \leftrightarrow (q \wedge \neg(p \rightarrow r))$ is true.

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9. You have discovered an old paper on graph theory that discusses the *viscosity* of a graph (which for all you know, is something completely made up by the author). A theorem in the paper claims that "if a graph satisfies *condition (V)*, then the graph is *viscous*." Which of the following are equivalent ways of stating this claim?

(a) A graph is viscous only if it satisfies condition (V).

(b) A graph is viscous if it satisfies condition (V).

(c) For a graph to be viscous, it is necessary that it satisfies condition (V).

(d) For a graph to be viscous, it is sufficient for it to satisfy condition (V).

(e) Satisfying condition (V) is a sufficient condition for a graph to be viscous.

(f) Satisfying condition (V) is a necessary condition for a graph to be viscous.

(g) Every viscous graph satisfies condition (V).

(h) Only viscous graphs satisfy condition (V).

Detailed Solutions of this Homework is discussed in the

"Live Doubts Session-3" of Goclasses Discrete Mathematics Course-2024"

EXAMPLE 7 Extra Examples

In [Sm78] Smullyan posed many puzzles about an island that has two kinds of inhabitants, knights, who always tell the truth, and their opposites, knaves, who always lie. You encounter two people A and B. What are A and B if A says "B is a knight" and B says "The two of us are opposite types?"

Source: Discrete Mathematics and Its Applications 7th Edition Kenneth H. Rosen

Detailed Solutions of this Homework is discussed in the

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EXAMPLE 7

Extra Examples

In [Sm78] Smullyan posed many puzzles about an island that has two kinds of inhabitants, knights, who always tell the truth, and their opposites, knaves, who always lie. You encounter two people A and B. What are A and B if A says "B is a knight" and B says "The two of us are opposite types?"

Solution: Let p and q be the statements that A is a knight and B is a knight, respectively, so that $\neg p$ and $\neg q$ are the statements that A is a knave and B is a knave, respectively.

We first consider the possibility that A is a knight; this is the statement that p is true. If A is a knight, then he is telling the truth when he says that B is a knight, so that q is true, and A and B are the same type. However, if B is a knight, then B's statement that A and B are of opposite types, the statement $(p \wedge \neg q) \vee (\neg p \wedge q)$, would have to be true, which it is not, because A and B are both knights. Consequently, we can conclude that A is not a knight, that is, that p is false.

If A is a knave, then because everything a knave says is false, A's statement that B is a knight, that is, that q is true, is a lie. This means that q is false and B is also a knave. Furthermore, if B is a knave, then B's statement that A and B are opposite types is a lie, which is consistent with both A and B being knaves. We can conclude that both A and B are knaves.

Knights and knaves

- On a mystical island, there are two kinds of people: knights and knaves. Knights always tell the truth. Knaves always lie.

- Puzzle 1: You meet two people on the island, Arnold and Bob. Arnold says “Either I am a knave, or Bob is a knight”. Is Arnold a knight or a knave? What about Bob?