Propositional Logic

Next Chapter:

The Inference Symbol |= or |-

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

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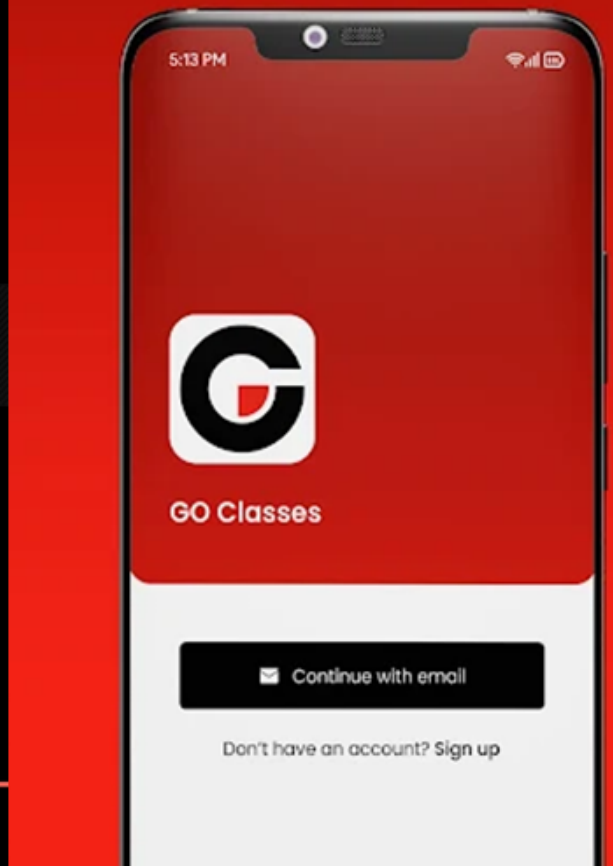

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Next Topic:

The Inference Symbol

|- or |=

KB : knowledge Base
(set of premises)

$KB \models \gamma$ means KB infers γ

means

($\models$: logically) infers

KB
$\therefore \gamma$
} Valid Arg.

P_1

P_2

P_3

$\therefore C$

Valid Arg iff $P_1 \wedge P_2 \wedge P_3 \rightarrow C$ is a Tautology.

iff

$P_1, P_2, P_3 \models C$

Way 1

P_1
P_2
P_3
$\therefore C$

Valid Arg

iff

Way 2

$P_1 \wedge P_2 \wedge P_3 \rightarrow C$ is a Tautology.

iff

$P_1, P_2, P_3 \models C$

Way 3

Way 1 $\equiv$ Way 2 $\equiv$ Way 3

$P_1, P_2, P_3 \models Y$

means

P_1
P_2
P_3
$\therefore Y$

} valid

means

$P_1 \wedge P_2 \wedge P_3 \rightarrow C$ is a Tautology.

$P_1, P_2, P_3 \not\models y$

means

P_1
P_2
P_3
$\therefore y$

Invalid

means

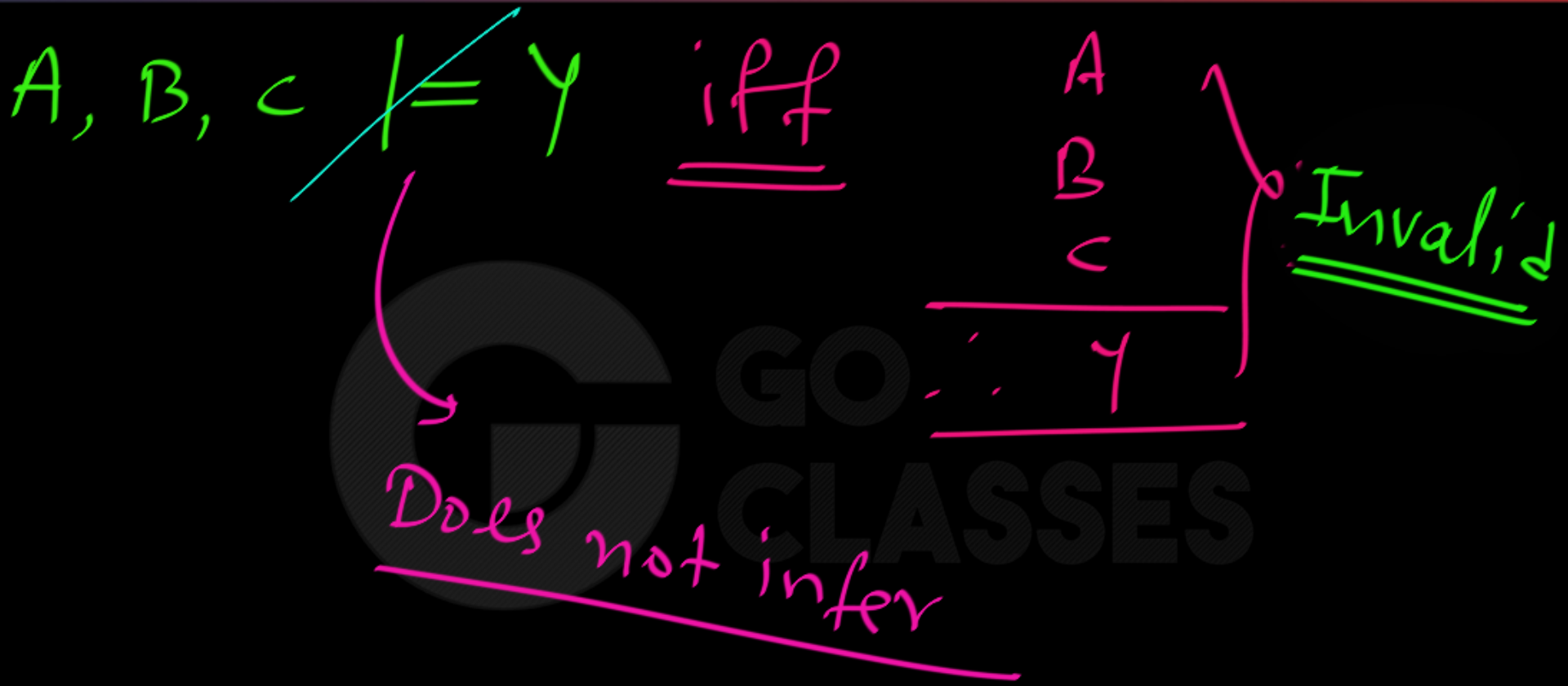
$P_1 \wedge P_2 \wedge P_3 \rightarrow c$ is a Tautology.

NOT

$A, B, C \models Y$ iff

A
B
C
$\therefore Y$

valid


A, B, C ⊭ Y
iff
A
B
C
∴ Y
Invalid
Does not infer

$KB \models Y$

KB 'infers' Y

KB entails Y

KB implies Y

Y is a Consequence of KB.

$$\frac{\begin{array}{l}A_1\\A_2\\\vdots\\A_n\end{array}}{B}$$

Valid

Read this as "from $A_1, \ldots, A_n$, infer B."

– Sometimes written "$A_1, \ldots, A_n \vdash B$"

- **Entailment: KB |= Q**
  - Q is entailed by KB (a set of premises or assumptions) if and only if there is no logically possible world in which Q is false while all the premises in KB are true.
  - Or, stated positively, Q is entailed by KB if and only if the conclusion is true in every logically possible world in which all the premises in KB are true.

Logical inference:

X (logically)infers Y, iff "X → Y" is a tautology.

$X \models Y$ iff $X \rightarrow Y$ is a Tautology.

Logical Consequence

Logical inference

Logical implication

Logical Entailment

} Same

Logical consequence:

Y is a (logical) consequence of X, iff "X → Y" is a tautology.

$X \models Y$

Logical inference:

X (logically)infers Y, iff "X → Y" is a tautology.

$X \models Y$

Logical implication:

X (logically)implies Y, iff "X → Y" is a tautology.

$X \models Y$

Q:

KB = {p → q, p, s → r}

Which of p, q, r, s are inferred by(entailed by) KB?

- p → q, p, s → r |= p
- p → q, p, s → r |= q
- p → q, p, s → r |= r
- p → q, p, s → r |= s

Q:

KB = {p → q, p, s → r}

Which of p, q, r, s are inferred by(entailed by) KB?

- p → q, p, s → r |= p
- p → q, p, s → r |= q
- p → q, p, s → r |= r
- p → q, p, s → r |= s

(a) $P \rightarrow Q, P, S \rightarrow r \models P$

True / false ?

$P \rightarrow Q$

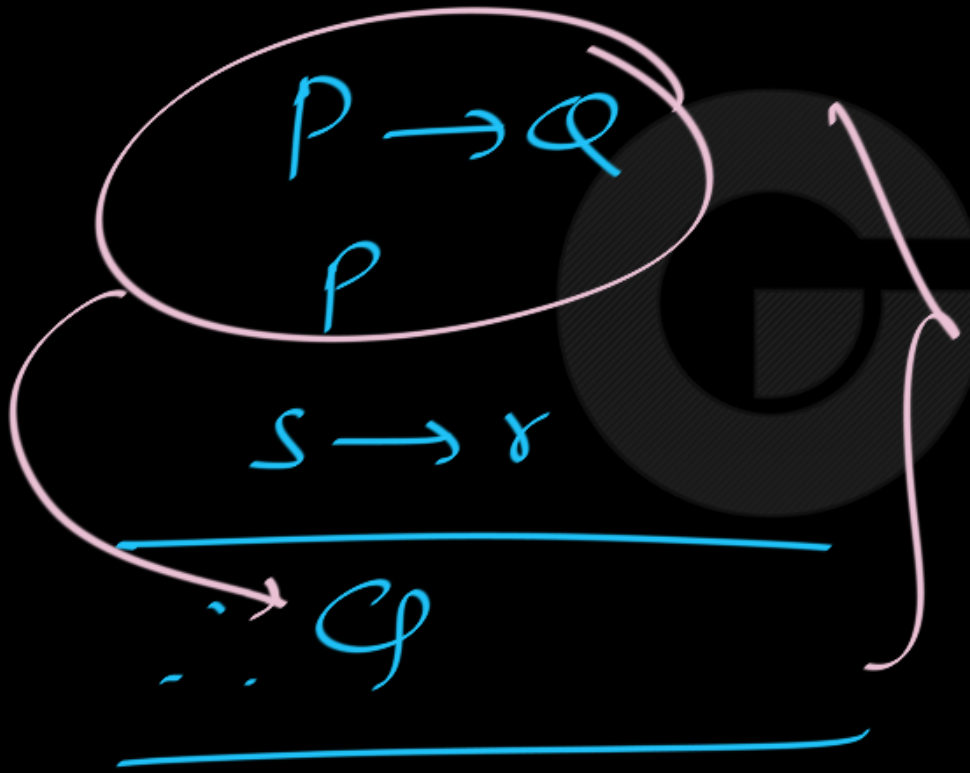
P

$S \rightarrow r$

$\therefore P$

Valid Arg

(a) $p \rightarrow q,\ p,\ s \rightarrow r \models q$



Valid Arg

(a) $P \to Q, P, S \to r \models S$

$\models$ → false

(1) $P \to Q$ = True (T, True)

(2) P = True

(3) $S \to r \equiv$ True (F)

$\therefore$ (S) false

Invalid Arg.

(a) $P \to Q,\ P,\ S \to r \models r$

false

(1) $P^{T} \to Q^{T} \equiv$ True

(2) $P =$ True

(3) $S^{F} \to r^{F} \equiv$ True

Invalid

$\therefore$ (r) false