



Next Chapter:

# Mathematical Logic

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Next Chapter:

# Mathematical Logic



# Mathematical Logic:

Language for Mathematics

Language for Mathematicians

Language for Computers/AI/Automated Reasoning



# Mathematical Logic:

Language for Mathematics:

Mathematical Logic gives Precise, Unambiguous  
meaning to Mathematical Statements/Theorems etc.



Q:

Why do we need a NEW Languages/Logic for  
Mathematics/Computers??

Why can't we use a Natural Language, Like  
English??



Q:

Why can't we use a Natural Language, Like

English, for Computers, Mathematics??

Ans: Because All the Natural Languages are  
Ambiguous.



## English is an Ambiguous Language:

Consider the statement:

Let  $a, b$  be two integers;

If  $a * b$  is Even then " $a$ " is even Or " $b$ " is even.

$$a * b = \text{even}$$

$a$  is even or  $b$  is even.



## English is an Ambiguous Language:

Consider a **Missile System.** ✓

You give a command in English Language:

Attack city A OR city B.

P

q

CLASSES

Disaster ✓

But P, q X

# English is an Ambiguous Language:

1. “a” is even Or “b” is even
  2. Attack city A OR city B.

Same structure

**Mathematical Logic Resolves this Ambiguity:**

1. “a” is even Or “b” is even  
 $\frac{\text{P}}{\text{Q}}$
  2. Attack city A OR city B.

$$\rightarrow \boxed{P \vee Q}$$

M+N

# Math Topics

statement

## Missile System



## English is an Ambiguous Language:

Example: Suppose a friend says:

‘The sun is shining and I feel happy’.



## English is an Ambiguous Language:

Example: Suppose a friend says:

‘The sun is shining and I feel happy’.

At first sight, the meaning is obvious, but when you think about the sentence more carefully, it isn’t so clear.

## English is an Ambiguous Language:

Example: Suppose a friend says:

'The sun is shining and I feel happy'. ✓

What does this statement mean??

1. Does it mean that your friend is happy BECAUSE the sun is shining??

OR

2. Sun shining & his happiness are completely independent things??



English is an Ambiguous Language:

2. 'Cats are furry and elephants are heavy'.

## English is an Ambiguous Language:

1. ‘The sun is shining and I feel happy’.

2. ‘Cats are furry and elephants are heavy’.

same  
structure

These two statements have exactly the same structure, but nobody would assume that elephants are heavy because of the furriness of cats.



## English is an Ambiguous Language:

1. ‘The sun is shining and I feel happy’.
2. ‘Cats are furry and elephants are heavy’.

So, two statements, that have same structure, BUT still bring  
ambiguity of interpretation in English Language...



## English is an Ambiguous Language:

1. ‘The sun is shining and I feel happy’.
2. ‘Cats are furry and elephants are heavy’.

So, two statements, that have same structure, BUT still bring ambiguity of interpretation in English Language... The Mathematical Logic Solves this problem..



# Mathematical Logic Resolves the Ambiguity of

## Natural Languages:

English

1. ‘The sun is shining A and I feel happy’.

*math.  
logic expression*

$A \wedge B$

2. ‘Cats are furry C and elephants are heavy’.

$C \wedge D$



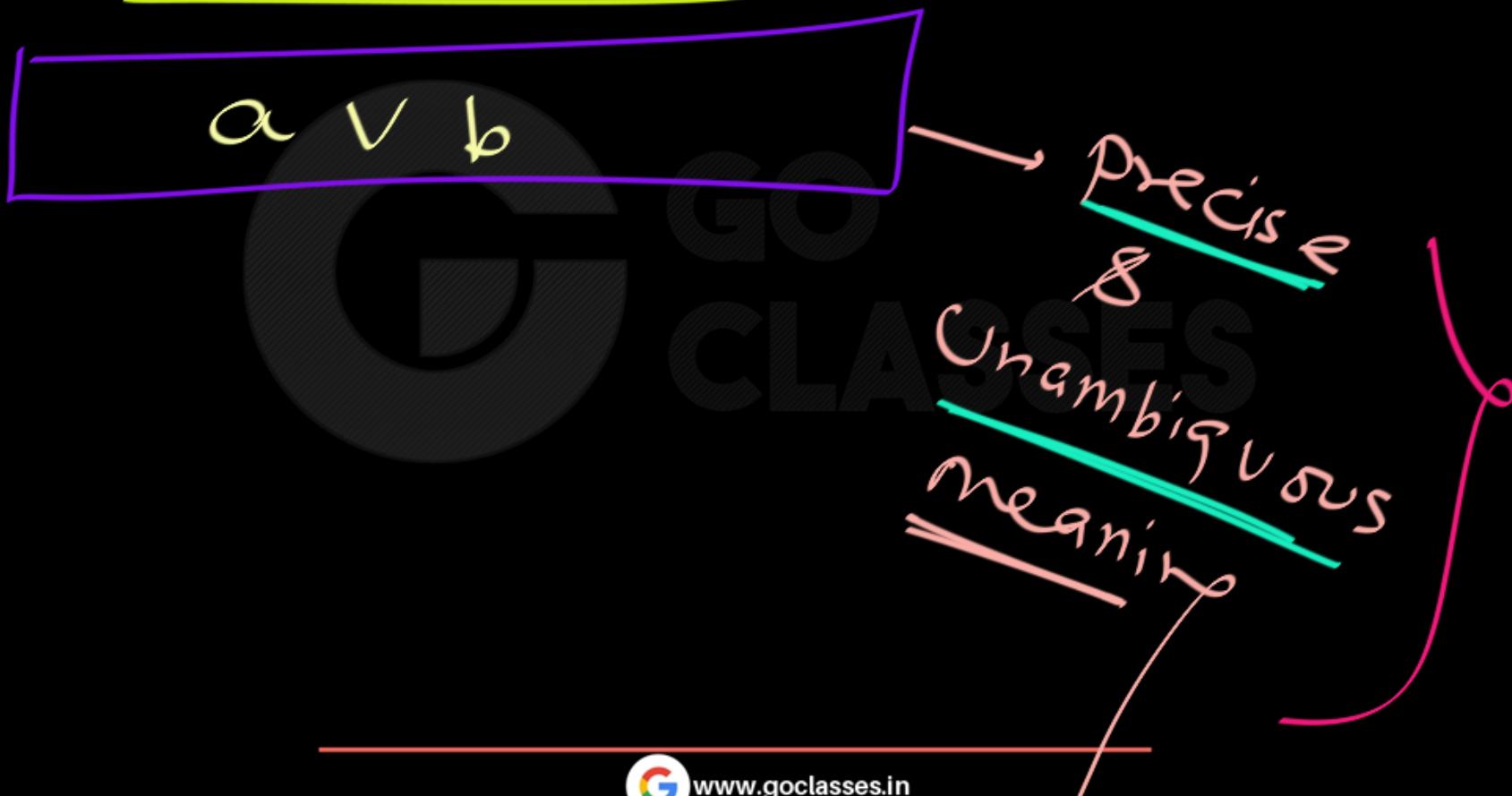
So,

Mathematical Logic Resolves the Ambiguity of  
Natural Languages.

The rules of logic specify the Precise & Unambiguous  
meaning of mathematical statements.



## mathematic logic





## Mathematical Logic :

2

Logic is the basis of all mathematical reasoning, and of all automated reasoning.



Consider the following two Reasoning/Arguments:

1. All men are mortal. Socrates is a man.  
Hence, Socrates is mortal.

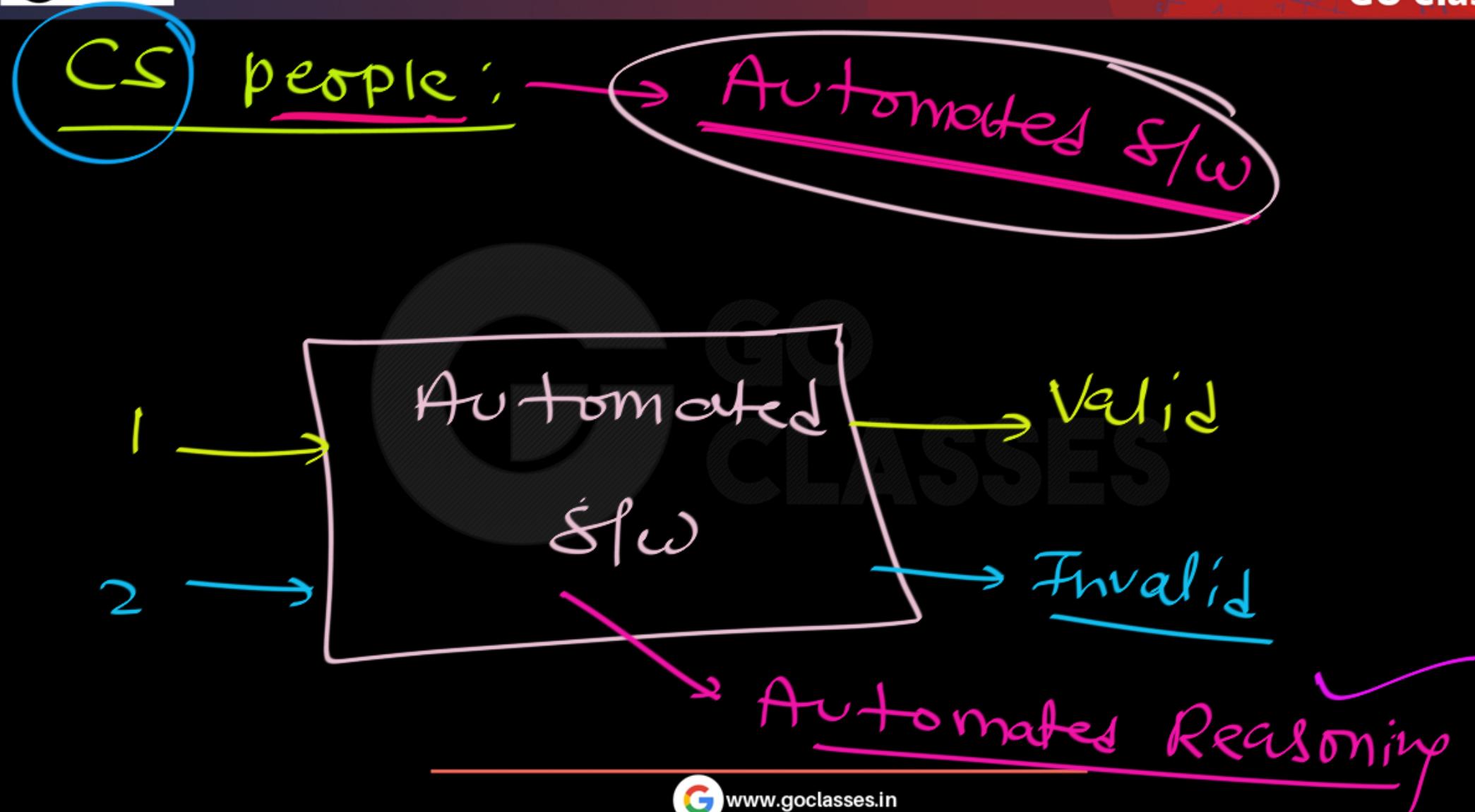
Valid Reasoning

2. All cats like fish. Silvy isn't a cat.  
Hence, Silvy doesn't like fish.

Invalid Argument

Cat → like  
fish

WRONG Conclusion





## Mathematical Logic :

Natural languages are Ambiguous, but computer should not have ambiguity.

### Why Mathematical Logic is Important??

- The rules of logic specify the meaning of mathematical statements.
- Logic is the basis of all mathematical reasoning, and of all automated reasoning.

AI Course :

AI Book :



Chapter I :  
Mathematical Logic  
Basis for all  
Automated Reasoning



## Mathematical Logic :

When most people say 'logic', they mean either propositional logic or first-order predicate logic.

However, the precise definition is quite broad, and literally **hundreds of logics have been studied** by philosophers, computer scientists and mathematicians.

mathematical logic

① Propositional logic

② first order logic

③ Second order logic

GATE Syllabus

fuzzy logic



Next Lecture:

Propositional Logic