AUTOMATA, FORMAL LANGUAGES AND LOGIC

Dr Pooja Agarwal

Professor,

Department of Computer Science & Engineering

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MODULE 5

Propositional Logic & First-Order Logic

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Department of Computer Science & Engineering

Syntax

- **Syntax** defines the sentences in the language.

- Can be thought of as a “grammar” of representation.
- Consider a stmt: Buffalo is Black.
- It can be represented as:

  1) p= Buffalo is black, or
  2) Black(Buffalo)
  3) for all x, Buffalo(x)→black(x)

  means for all x, if x is buffalo, x is black

Different syntax

Logic In general

- Logics are formal languages for representing information such that conclusions can be drawn.

- Let

  A= Postman delivers post from Monday to Friday

  B= Today is Sunday.

  C (conclusion)=Post is not delivered today.

Semantics

- **Semantics** OR "meaning" of sentences;
  - i.e., define truth of a sentence in a *possible world*.
  - Eg 2xy=3 is true for whenever x=3, y=1/2 in a world but would be false for x=3, y=2 in a world
- **X + Y = 4** is **true** in a word where X is 2 and Y is 2. But **false** in a word where X is 1 and Y is 1.

Model

- The word "**Model" is also used for " possible world"**

Models are mathematical abstraction.

Think of a possible world having

x men and y women sitting at a table playing chess

The sentence **x+y = 4** is true, **when** there are **4** people in total.

Model

If,

a sentence **α is true in model M**,

we say, that M satisfies α **OR**

sometimes M is a model of α.

We use the notation **M(α)** to represent the set of all models of α.

Entailment

- Entailment means that one thing follows from another:

$$p \models q$$

means p entails the sentence q .

- In every model, in which p is true, q is also true.
- The truth of q is contained in p

eg, $a + b=9 \models 9=a + b$

Sentence x = 0 entails the sentence xy = 0.

Model

M is a model of a sentence α

If α is true in *M* *and M(α)* is the set of all models of α

$\alpha \models \beta$ means α **entails** the sentence β

i.e $\alpha \models \beta$

iff M(α) is a subset of M(β).

THANK YOU

Dr Pooja Agarwal
Department of Computer Science & Engineering

poojaagarwal@pes.edu