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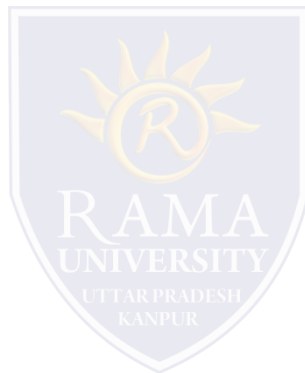
## **FACULTY OF ENGINEERING AND TECHNOLOGY**

### **Soft Computing LECTURE -14**

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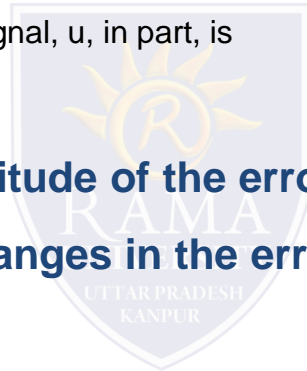
# OUTLINE

- **Fuzzy Control Methods**
- **Proportional to the error**
- **Conventional Control**
- **Fuzzy Controller**
- **Reference**



## Fuzzy Control Methods

- ❑ The term control is generally defined as a mechanism used to guide or regulate the operation of a machine, apparatus or constellations of machines and apparatus.
- ❑ Feedback control' is thus a mechanism for guiding or regulating the operation of a system or subsystems by returning to the input of the (sub)system a fraction of the output.
- ❑ One can intuitively argue that the control signal,  $u$ , in part, is
  - **Proportional to the error;**
  - **Proportional to both the magnitude of the error and the duration of the error**
  - **Proportional to the relative changes in the error values over time**



# FUZZY CONTROLLING METHODS

## Conventional Control

In the case of classical operations of process control one has to solve the non-linear function  $u$ . Furthermore, it is very important that one also finds the proportionality constants  $K_I$ ,  $K_D$ , and  $K_P$ .

$$u(t) = K_P e(t) + K_I \int_0^t e(\tau) d\tau + K_D \frac{de}{dt}$$

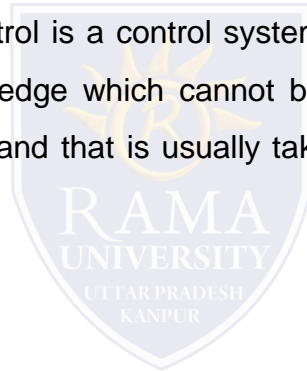
In the case of fuzzy controller, the non-linear function is represented by a fuzzy mapping, typically acquired from human beings



Value	determines reaction to the
Proportional ( $K_P$ )	current error
Integral ( $K_I$ )	sum of recent errors
Derivative ( $K_D$ )	rate at which the error has been changing

## Fuzzy Controller

- ❑ A Fuzzy Controller is a device that is intended to modelize some vaguely known or vaguely described process.
- ❑ Logical rules with vague predicates can be used to derive inference from vague formulated data. The idea of linguistic control algorithms was a brilliant generalization of the human experience to use linguistic rules with vague predicates in order to formulate control actions.
- ❑ A knowledge-based system for closed-loop control is a control system which enhances the performance, reliability, and robustness of control by incorporating knowledge which cannot be accommodated in the analytic model upon which the design of a control algorithm is based, and that is usually taken care of manual modes of operation, or by other safety and ancillary logic mechanisms.



# KNOWLEDGE REPRESENTATION

**There are two types of fuzzy controllers:**

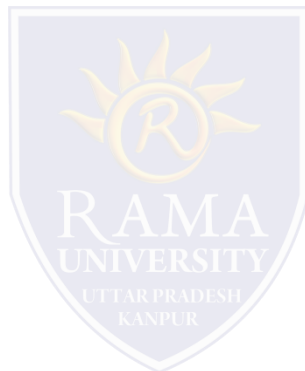
- Mamdani (linguistic) Controller
- Takagi-Sugeno-Kang Controller

**Mamdani (linguistic) Controller**

- Direct closed-loop controller

**Takagi-Sugeno-Kang Controller**

- Supervisory controller



# MULTIPLE CHOICE QUESTION

1. Which combines inductive methods with the power of first-order representations?

- a) Inductive programming
- b) Logic programming
- c) Inductive logic programming
- d) Lisp programming

2. How many reasons are available for the popularity of ILP?

- a) 1
- b) 2
- c) 3
- d) 4

3. Which cannot be represented by a set of attributes?

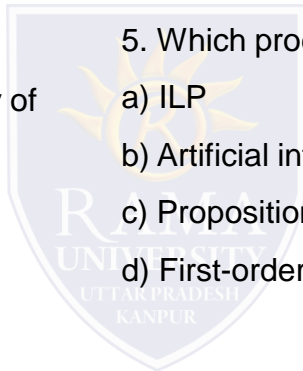
- a) Program
- b) Three-dimensional configuration of a protein molecule
- c) Agents
- d) None of the mentioned

4. Which is an appropriate language for describing the relationships?

- a) First-order logic
- b) Propositional logic
- c) ILP
- d) None of the mentioned

5. Which produces hypotheses that are easy to read for humans?

- a) ILP
- b) Artificial intelligence
- c) Propositional logic
- d) First-order logic



# REFERENCES

- ❑ <https://www.maths.tcd.ie/~ormondca/notes/Fuzzy%20Logic%20Notes.pdf>

