



SNS COLLEGE OF TECHNOLOGY

(An Autonomous Institution)

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COIMBATORE-641 035, TAMIL NADU



Expert Systems, Neural Networks, and Fuzzy Logic

1. Expert Systems

Definition:

An **Expert System** is a computer program that simulates the decision-making ability of a human expert.

Components:

Knowledge Base

Contains domain-specific facts and rules.

Inference Engine

Applies logical rules to the knowledge base to derive new facts or reach conclusions.

User Interface

Allows interaction between the user and the system.

Features:

Rule-based reasoning (IF-THEN rules)

Can explain its reasoning process

Operates in a specific domain (e.g., medical diagnosis, legal advice)

Examples:

MYCIN (medical diagnosis)

DENDRAL (chemical analysis)

CLIPS (tool for building expert systems)

✓ **Advantages:**

Consistency in decision-making

Can store and reuse expert knowledge

Accessible 24/7

Limitations:

Limited to the knowledge it is given

Cannot learn on its own

Difficult to update rules for complex systems

2. Neural Networks

Definition:

Artificial Neural Networks (ANNs) are computing systems inspired by the biological neural networks of the brain. They consist of layers of interconnected nodes (neurons).

Structure:

Input Layer – Receives data

Hidden Layers – Perform computations (can be multiple)

Output Layer – Produces the final result

Types:

Feedforward Neural Network

Convolutional Neural Network (CNN) – for image processing

Recurrent Neural Network (RNN) – for sequential data (e.g., text, time series)

Applications:

Image and speech recognition

Natural language processing

Fraud detection

Autonomous vehicles

✓ **Advantages:**

Can learn and adapt from data

Handles noisy and incomplete data

Good at pattern recognition

Limitations:

Requires large datasets

Computationally expensive

Acts like a "black box" (hard to interpret)

3. Fuzzy Logic

Definition:

Fuzzy Logic is a form of many-valued logic that deals with reasoning that is **approximate** rather than fixed and exact.

Concept:

Instead of binary (true/false), fuzzy logic allows values between 0 and 1, representing degrees of truth.

Key Terms:

Fuzzy Sets: Elements have degrees of membership

Membership Function: Defines how each input is mapped to a membership value

Rules: IF-THEN statements with fuzzy values

Applications:

Washing machines (fuzzy control)

Air conditioning systems

Automatic gearboxes

Medical diagnosis

Advantages:

Mimics human reasoning

Tolerant to imprecise input

Easy to implement in control systems

Limitations:

Rule formulation can be complex

Not suitable for dynamic or learning-based systems on its own

Summary Table

Concept	Key Feature	Used In
Expert Systems	Rule-based decision-making	Medical, Legal, Troubleshooting
Neural Networks	Data-driven learning	AI, ML, Image/Speech Recognition
Fuzzy Logic	Handling uncertainty/fuzziness	Consumer electronics, Control Systems