Artificial Intelligence

Lecture 29

Experts Systems in AI

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Goal of the study of EXPERT SYSTEMS

The goal of this study is to clarify

- Basic concepts behind expert systems
    - knowledge representation,
    - inference mechanisms,
    - problem solving.
- Techniques (knowledge engineering, rapid prototyping) used to construct expert systems,
- Tools used to construct expert systems.

OUTLINES of the lecture

- **What is an Expert System (ES)?**
- **Characteristics and Capabilities of ES**
- **Examples and Pioneer Works of ES**
- **Expert Systems vs Conventional Systems**

ES: Branch of AI

- Historically Expert Systems grew with AI, and can be regarded as a branch of AI.

- Expert systems are one of the prominent research domains of AI.

- It is introduced by the researchers at Stanford University, Computer Science Department.
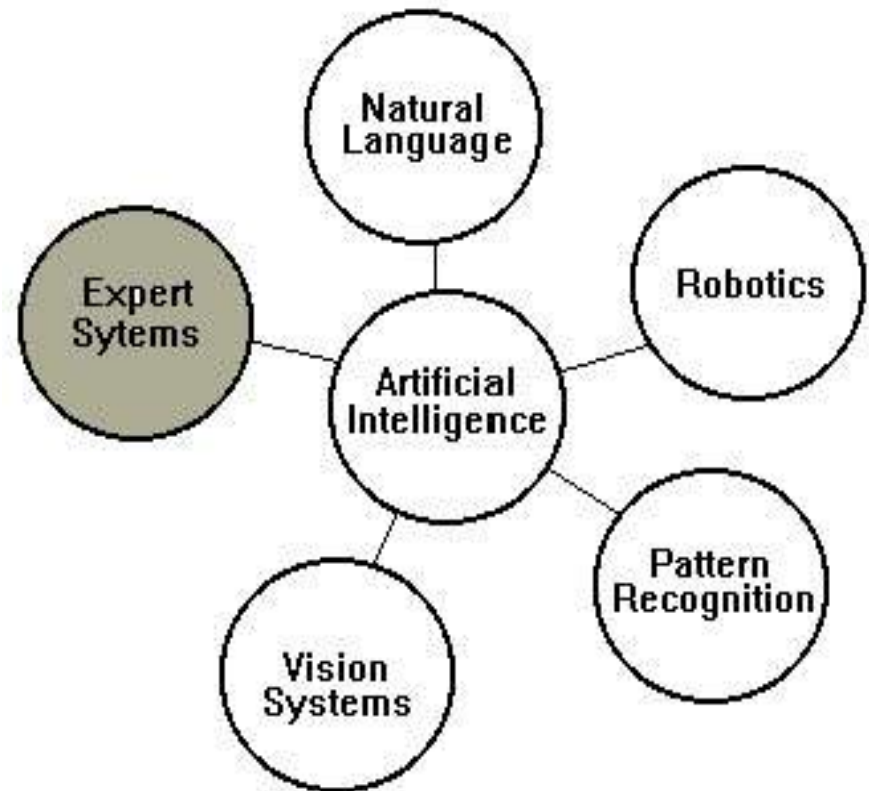
Expert Systems

What is an Expert System?

- An expert system (ES) is a computer program that is designed to solve complex problems and to provide decision-making ability like a human expert. It performs this by extracting knowledge from its knowledge base using the reasoning and inference rules according to the user queries.

- The expert system is a part of AI, and the first ES was developed in the year 1970, which was the first successful approach of artificial intelligence.

- It solves the most complex issue as an expert by extracting the knowledge stored in its knowledge base. The system helps in decision making for complex problems using **both facts and heuristics like a human expert**.

- It is called so because it contains the expert knowledge of a specific domain and can solve any complex problem of that particular domain. These systems are designed for a specific domain, such as **medicine, science,** etc.

ES: Definition

- ## According to Darlington:
  - "An expert system is a program that attempts to mimic human expertise by applying inference methods to a specific body of knowledge."

- ## According to Turban:
  - "An expert system is a system that employs human knowledge captured in a computer to solve problems that ordinarily require human expertise."

- ## According to Pigford & Braur :
  - A computer program that emulates the behaviour of human experts who are solving real-world problems associated with a particular domain of knowledge.

- ## According to Feigenbaum :
  - "An Expert System (ES) is a computer program that reasons using knowledge to solve complex problems."

Why use Expert Systems?

- Experts are not always available. An expert system can be used anywhere, any time.
- Human experts are not 100% reliable or consistent
- Experts may not be good at explaining decisions
- Cost effective

Characteristics of Expert System

- **High Performance:** The expert system provides high performance for solving any type of complex problem of a specific domain with high efficiency and accuracy.

- **Understandable:** It responds in a way that can be easily understandable by the user. It can take input in human language and provides the output in the same way.

- **Reliable:** It is much reliable for generating an efficient and accurate output.

- **Highly responsive:** ES provides the result for any complex query within a very short period of time.

Capabilities of Expert Systems

- **The expert systems are capable of -**
  - Advising
  - Instructing and assisting human in decision making
  - Demonstrating
  - Deriving a solution
  - Diagnosing
  - Explaining
  - Interpreting input
  - Predicting results
  - Justifying the conclusion
  - Suggesting alternative options to a problem

- **They are incapable of -**
  - Substituting human decision makers
  - Possessing human capabilities
  - Producing accurate output for inadequate knowledge base
  - Refining their own knowledge

Some Popular Examples of ES...
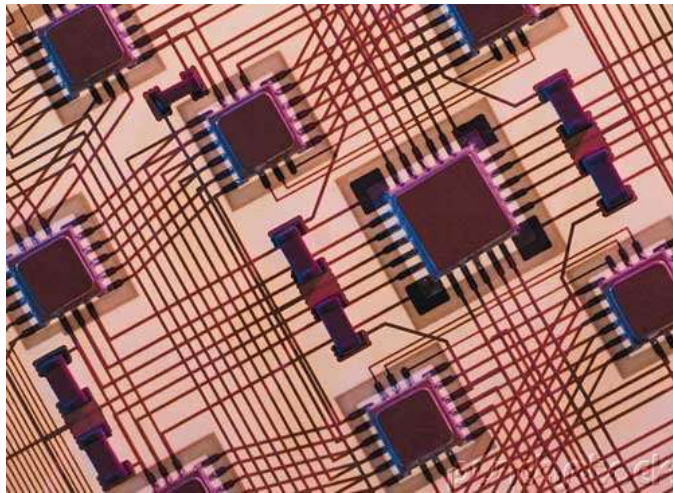
DESIGN ADVISOR
Gives advice to designers
of processor chips

MYCIN
Medical system for diagnosing
diagnosis of bacterial infections.
First used in 1979
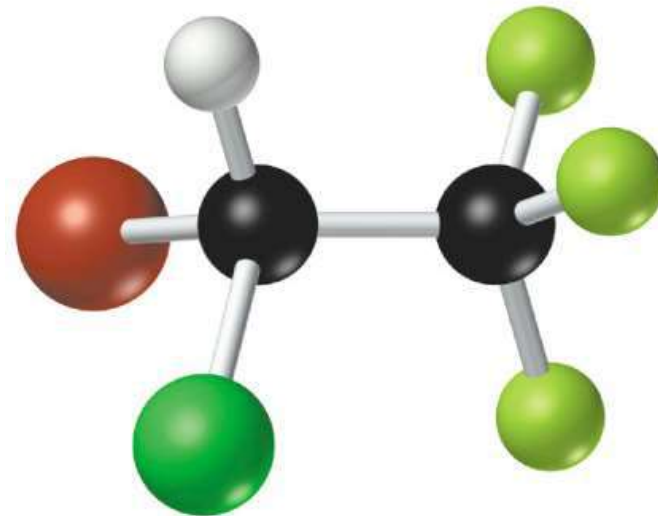

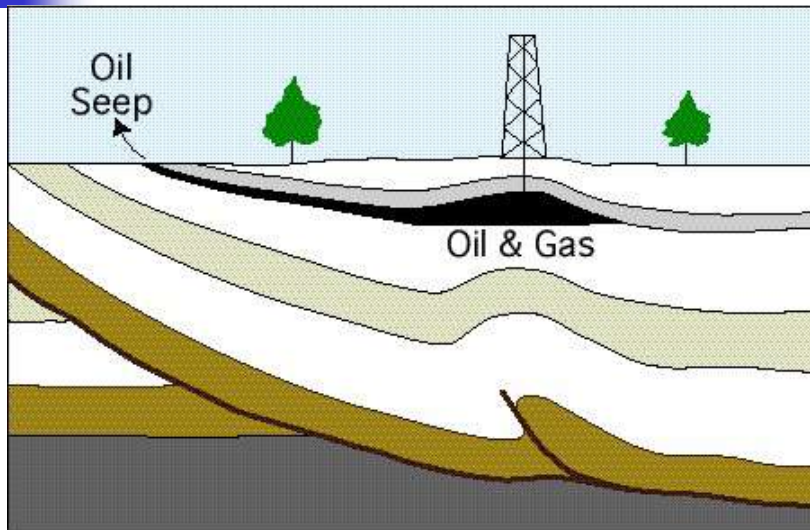Expert Systems

Some Popular Examples of ES...

LITHIAN
Gives advice to
archaeologists examining
stone tools

DENDRAL
Used to identify the structure
of chemical compounds.
First used in 1965

Expert Systems

Some Popular Examples of ES...

PUFF
Medical system
for diagnosis of respiratory
conditions

PROSPECTOR
Used by geologists to identify
sites for drilling or mining

Expert Systems

Some Popular Examples of ES...

PXDES

Pneumoconiosis X-Ray Diagnosis Expert System (PXDES) is an expert system which is used to diagnose Lung diseases. It takes our lunge picture from the upper side of the body which looks like the shadow. The shadow is used to determine the type and degree of lung cancer.
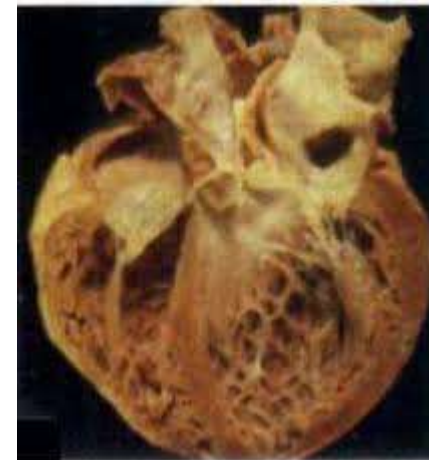
CaDeT

The CaDet (cancer detection) expert system is a computer-based clinical decision support system that can detect cancer at early stages.

Expert Systems

Some Pioneer Works of ES...

Pioneer work			
1955	Herbert Simon, Allen Newell	Carnegie Mellon	Logic Theorist: proved theorems using propositional logic
1960	Marvin Minsky John McCarthy Claude Shannon	MIT Dartmouth Bell Labs	LISP
1960	DENDRAL	Feigenbaum & Buchanan (Stanford)	Identify chemical constituents

Some Pioneer Works of ES

1970	MYCIN	Stanford	diagnosis of infectious diseases
1970	MACSYMA	MIT	Math expert system
1970	HEARSAY	Carnegie Mellon	Speach recognition
1977	PROSPECTOR	Stanford Research Inst Duda, Hart, Barnett	Mineral diagnosis
1978	XCON	McDermott	Computer configuration

Expert Systems

Expert Systems vs Conventional Systems...

- Expert systems are different from traditional application programs in that their capability to deal with challenging real world problems through the application process that reflect human judgment and intuition.

- Expert systems should not be confused with cognitive modeling programs, which attempt to simulate human mental architecture in detail. Expert systems are practical programs that use heuristic strategies developed to solve specific classes of problems.
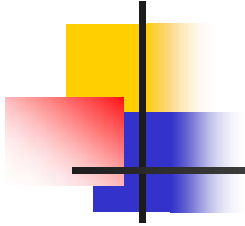
Expert Systems vs Conventional Systems Applications...

Expert Systems Applications	Conventional Systems Applications
Knowledge is fragmented and implicit, is difficult to communicate except in small "chunks", and is often distributed amongst individuals who may disagree.	Knowledge is complete and explicit, and is easily communicated with formulas and algorithms.
Rules are complex, conditional and often defined as imprecise "rules of thumb".	Rules are simple with few conditions.
The finished system captures, distributes and leverages expertise	The finished product automates manual procedures

Expert Systems
vs Conventional Systems Applications

Expert Systems Applications	Conventional Systems Applications
Problem-solving demands dynamic, context-driven application of facts, relationship and rules	Problem-solving requires predictable and repetetive sequences of actions.
System performance is measured in degrees of accuracy and completeness where explanations may be required to establish correctness.	Simple criteria are used to determine accuracy and completeness.

Expert Systems

TO BE CONTINUED…