Expert Systems

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Topics Covered

• What is an Expert System?
• Why should we use Expert Systems?
• History of Expert Systems.
• Latest Developments in Expert Systems.
• Components of an Expert System.
• Rule Based Reasoning in Expert Systems.
• Limitations of Expert Systems.
What is an Expert System?

• Human experts have
  – a considerable knowledge about their areas of expertise
  – Can learn from their experience
  – Can do reasoning
  – Can explain the solution
  – Can restructure knowledge
  – Can determine relevance
What is an Expert System? (2)

• An Expert System (ES) is software that attempts to reproduce the performance of one or more human experts, typically in a specific problem domain.

• ES employs human knowledge represented in a computer to solve problems that ordinarily require human expertise.

• ES imitate the expert’s reasoning processes to solve specific problems.
Why should we Use Expert System?

• Expert Systems:
  – Capture and preserve irreplaceable human expertise
  – Provide expertise needed at a number of locations at the same time or in a hostile environment that is dangerous to human health
  – Provide unemotional objective solutions faster than human experts
  – Provide expertise that is expensive or rare
  – Share human expertise with a large number of people
History of Expert Systems

• In 1959 Newell and Simon described General Problem Solver (GPS).

• GPS:
  – Intended to solve general problems across domains. Example: theorem proof, geometric problem and chess playing.
  – First computer program to separate knowledge from strategy (generic solver engine).
  – Predecessor to ES.
History of Expert Systems (2)

• ES introduced by Stanford Heuristic Programming Project led by Feigenbaum.

• Mid-1960s: Early ES programs:
  – MYCIN:
    • Diagnose infectious diseases such as bacteremia and meningitis.
    • Recommend antibiotics.
    • Dosage adjusted for patient’s body weight.
    • Name derived from antibiotics (suffix – “mycin”).
History of Expert Systems (3)

• Mid-1970s:
  – Recognition of the role of knowledge
    • Power of an ES comes from the specific knowledge it possesses, not from the inference schemes it employs.
    • Development of knowledge representation theories.
    • Development of decision making procedures and inferences.
History of Expert Systems (4)

• Early 1980s:
  – Expert systems proliferated. Example: XCON, XSEL.
    • XCON (eXpert CONfigurator):
      – Used to assist in the ordering of DEC’s VAX computer system
      – Automatically selected the computer system components based on the customer’s requirements
      – Saved DEC $25M a year by speeding the assembly process and increasing customer satisfaction
    • XSEL:
      – A newer version of XCON
      – Intended to be used by DEC’s salesforce
History of Expert Systems (5)

– Universities offered expert system courses.
– ES technology became commercial.
– Programming tools and shells appeared. Example: EMYCIN, EXPERT.
Latest Developments in ES

• Improvements in knowledge acquisition.
• Software and expertise also available on internet.
• Use of multiple knowledge bases.
• Many tools to expedite the construction of ES at a reduced cost.
  – eXpertise2Go provides a free expert system shell that provides the inference engine, acquisition and explanation interface.
• Increased use of expert systems in many tasks like medical diagnosis, car diagnosis and financial advice.
Components of an Expert System

- **User**
  - Provides expertise
  - Inputs facts

- **User Interface**
  - Facilitates communication between user and expert system

- **Knowledge Base**
  - Stores knowledge (facts and rules)

- **Inference Engine**
  - Derives new knowledge from existing knowledge

- **Expert System**
  - Processes information from user and expertise
  - Integrates knowledge base and inference engine
Rule Based Reasoning in Expert System

Simple Rules Regarding Vegetation

Rule 1: IF mango plant is diseased
  THEN spray fungicide on the plant

Rule 2: IF mango plant is not diseased
  THEN water the plant sufficiently

Rule 3: IF there are leaf spots
  AND there are fruit rots
  THEN mango plant is diseased
Rule Based Reasoning in Expert System

Take Action X

Rule 1: spray fungicide on the plant
Rule 2: water the plant sufficiently

Question 1: mango plant is diseased
Question 2: mango plant is not diseased

Rule 3: mango plant is diseased

there are leaf spots
there are fruit rots

Conclusion: spray fungicide on the plant
Explanation in Reasoning

• ES answers two questions:
  – WHY? means “why are you asking for a particular information”.
    • ES returns the current rule that is being fired.
  – HOW? means “how did you reach the conclusion”.
    • ES returns the sequence of rules that are fired to reach a conclusion.
Limitations of Expert Systems

- Limited to relatively narrow problems
- Cannot readily deal with “mixed” knowledge
- Errors may occur in the knowledge base
- Cannot refine own knowledge base or learn from experience
- Lack common sense
- Cannot make creative responses as human expert
- Domain experts not always able to explain their logic and reasoning
Thank You