

Expert Systems

Adnan Shahzada

What is an expert system?

- Human/AI-Oriented Approach

“An expert system is a computer system which uses a representation of human expertise in a specialist domain to perform functions similar to those normally performed by a human expert in that domain”

- Key concepts

- “Expert” performance
- Representation of “human” expertise as knowledge

What is an expert system?

- Technology-Oriented Approach

“An expert system is a computer system, which operates by applying an inference mechanism to a body of specialist expertise represented in the form of knowledge and which manipulates this knowledge to perform efficient and effective problem solving in a narrow problem domain.”

- Key concepts

- Use of an inference mechanism
- Efficiency and effectiveness
- Narrow domain

Why use expert systems?

◆ Human Expertise

- Perishable
 - people leave
 - people forget
- Difficult to transfer
 - requires training
- Difficult to document
 - hard to get at knowledge
 - time consuming

◆ Artificial Expertise

- Permanent
 - always there
 - once in, always in
- Easy to transfer
 - just copy it
- Easy to document
 - knowledge is in a form that is almost self-documenting

Why use expert systems?

◆ Human Expertise

- Unpredictable
 - emotional factors
 - stress
- Expensive
 - very scarce...
 - ...therefore very expensive

◆ Artificial Expertise

- Consistent
 - no change
 - unemotional
- Affordable
 - maybe costly to develop...
 - ...but inexpensive to operate

Why might humans be better?

◆ Human Expertise

● Creative

- can reorganise or synthesise knowledge
- can use imaginative approaches
- can draw analogies

● Adaptive

- can adjust approach
- continually learning

◆ Artificial Expertise

● Uninspired

- very routine
- no imagination
- little (if any) use of analogy

● Hard to make adaptive

- machine learning for ES very hard

Why might humans be better?

◆ Human Expertise

- Sensory experience
 - can use all senses: visual, tactile
 - “picture is worth 1000 words”
- Broad focus
 - can look at “big picture”
 - common sense knowledge

◆ Artificial Expertise

- Symbolic input
 - can only manipulate ideas and concepts
- Narrow focus
 - very focussed
 - acquiring knowledge expensive

Knowledge separated from methods

- Note the formal division between
 - the rule base (knowledge in machine-readable form)
 - the inference engine (the machinery for manipulating the knowledge, i.e. methods)
- The separation gives two big advantages:
 - the inference engine can be used for many projects, with saving of programming effort
 - the person developing the expert system can usually concentrate on the knowledge
 - "knowledge engineers" program with data

The conceptual model

- A framework of
 - language (technical terms etc.)
 - domain description
- To enable communication:
 - between the developer and the experts
 - between the developer and the users

What problems can be solved by expert systems ?

- Nature
 - can be solved naturally through symbol manipulation
 - is heuristic in nature
- Complexity
 - must not be too easy
 - area should require years of study to become expert
- Scope
 - should be narrow in technical scope yet have broad possibilities for application
 - must be of practical value

Types of problems solved by expert systems

Problem-solving activity	Description
Control	Governing system behaviour to meet specifications
Design	Configuring objects under constraints
Diagnosis	Inferring system malfunctions from observations
Instruction	Diagnosis, debugging, and repairing student behaviour
Interpretation	Inferring situation description from data
Monitoring	Comparing observations to expectations
Planning	Selecting and sequencing activities according to a set of constraints to achieve a goal
Prediction	Inferring likely consequences of given situations
Prescription	Recommending solution to system malfunction
Scheduling	Assigning resources and times to the set of activities in a plan
Selection	Identifying best choice from a list of possibilities
Simulation	Modelling the interaction between system components

What makes for a good expert system ?

- Genuine experts exist
- Experts must generally agree about choices
- Experts must be able to articulate and explain their method
- Problem must require cognitive not physical skills
- Task cannot be too difficult
- Problems should not require common sense