EXPERT SYSTEMS

OVERVIEW OF ARTIFICIAL INTELLIGENCE

Intelligent Behaviour

- Learn from experience
- Apply knowledge acquired from experience
- Handle complex situations
- Solve problems when some information is missing
- React to a new situation
- Understand visual images
- Process and manipulate symbols
- Be creative and imaginative

Human beings have it all

OVERVIEW OF ARTIFICIAL INTELLIGENCE

Artificial Intelligent Computers

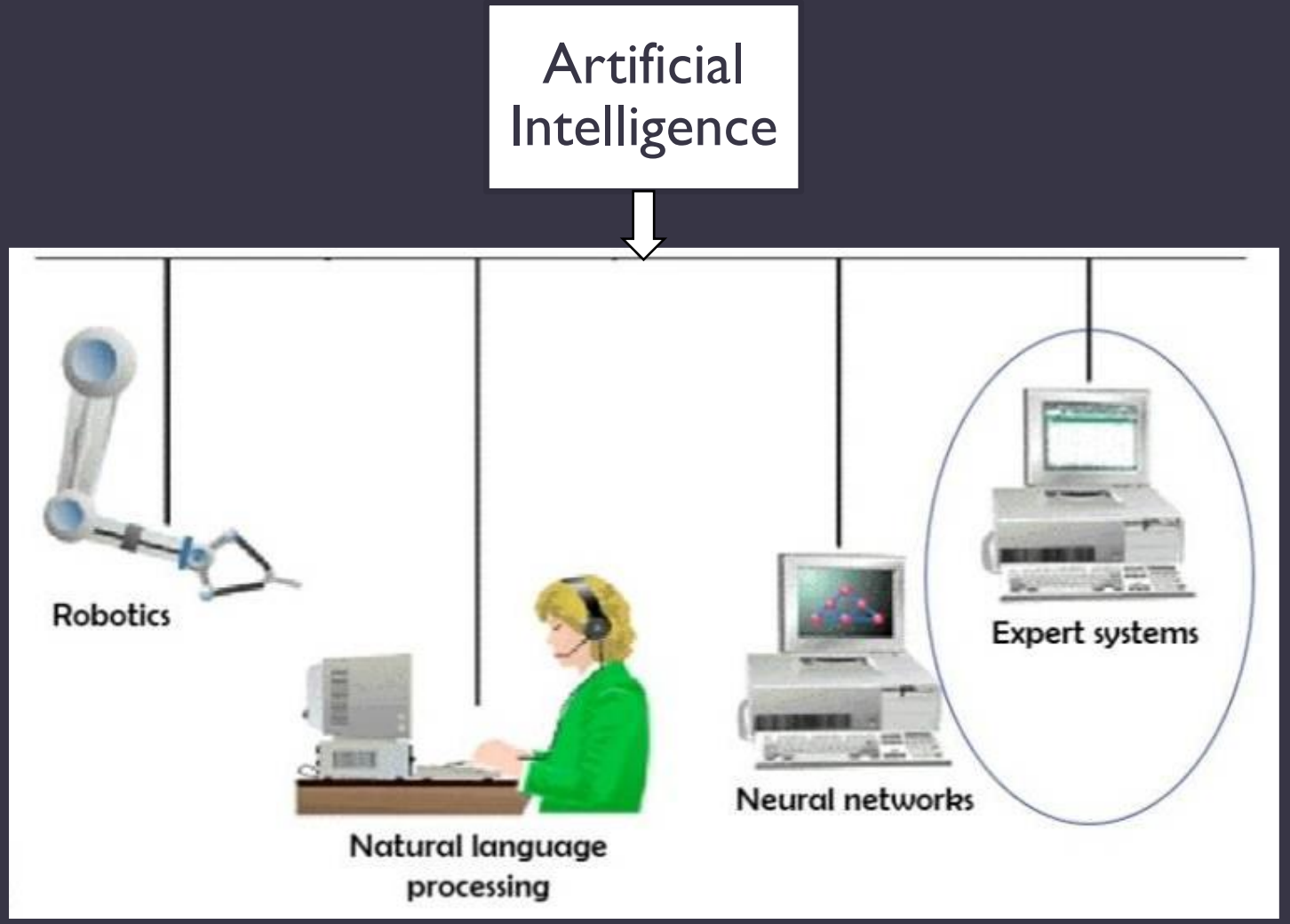
- Computers with the ability to mimic or duplicate
  - the intelligence of human beings
  - the functions of human brain

Artificial Intelligent Systems

- The systems and machines that demonstrate the characteristics of intelligence.

Artificial Intelligence is an area of Computer Science that deals with the Artificial Intelligent Systems.

APPLICATION AREAS OF AI



WHAT IS AN EXPERT SYSTEM ?

Experts :

- The people who are very familiar with solving specific types of problems.

Knowledge-based System:

- The fundamental function of the expert system depends upon it's knowledge.
- The expert system is sometimes called Knowledge-based System.

In short, an ES is an intelligent computer program that can perform special and difficult task(s) in some field(s) at the level of human experts.

OVERVIEW OF EXPERT SYSTEMS

- Expert systems can :
  - Explain their reasoning or suggested decisions,
  - Display intelligent behaviour,
  - Draw conclusions from complex relationships.

- Expert system shell : A collection of software packages and tools used to develop expert systems.

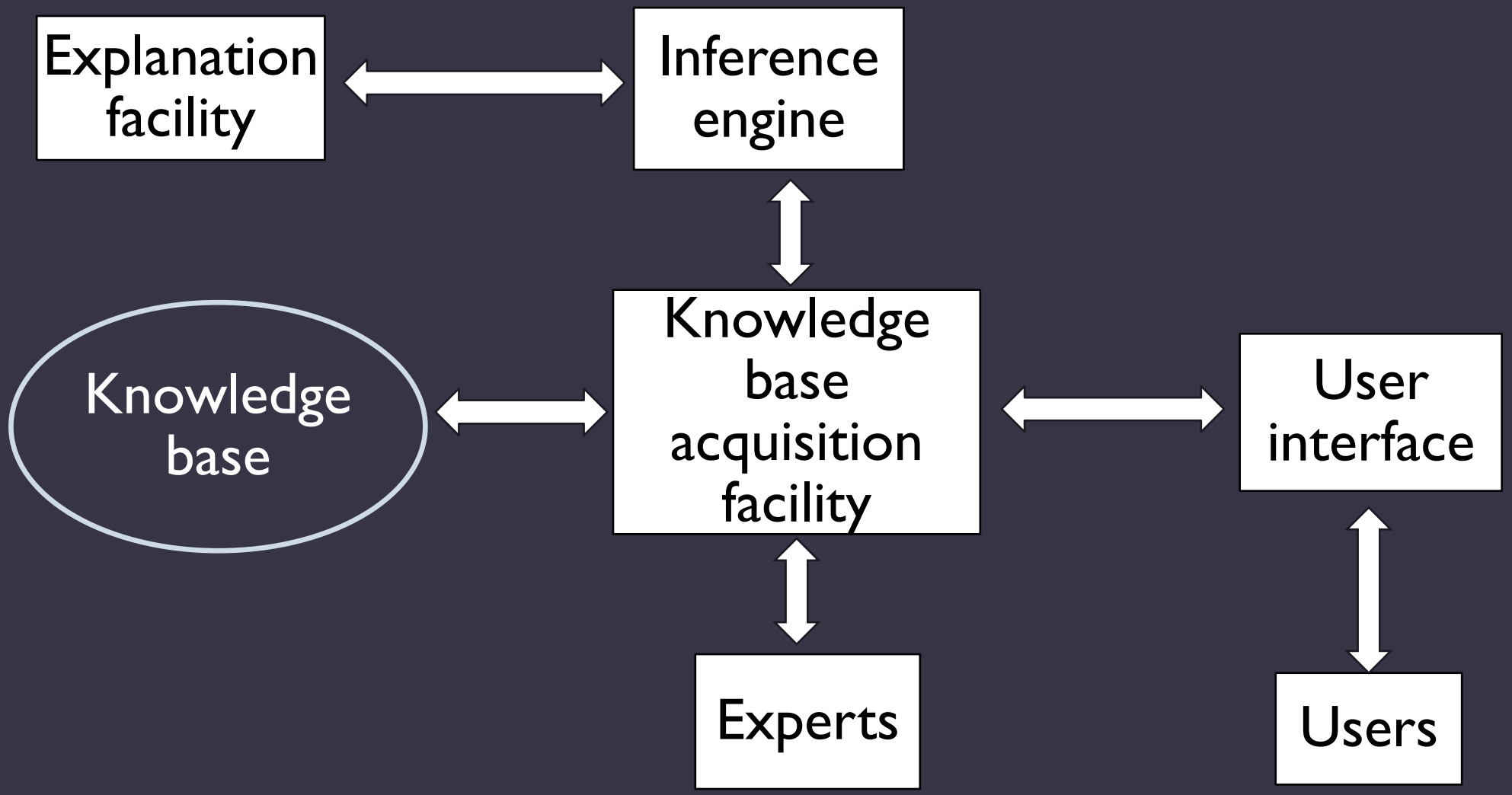
COMPONENTS OF AN EXPERT SYSTEM

- Knowledge Base
  - Stores all relevant information, data, rules, cases and relationships used by the expert system.
- Inference Engine
  - Seeks information and relationships from the knowledge base and provides answers, predictions and suggestions in the way a human expert would.
- Rule
  - A conditional statement that links given conditions to actions or outcomes.

COMPONENTS OF AN EXPERT SYSTEM

- Backward Chaining
  - A method of reasoning that starts with conclusions and works backward to the supporting facts.
- Forward Chaining
  - A method of reasoning that that starts with the facts and works forward to the conclusions.

COMPONENTS OF AN EXPERT SYSTEM



EXPLANATION AND KNOWLEDGE ACQUISITION FACILITY

- Explanation Facility : A part of the expert system that allows a user or decision maker to understand how the expert system arrived at certain conclusions or results.
- Knowledge Acquisition Facility : Provides a convenient and efficient means of capturing and storing all components of the knowledge base.

RULES FOR A CREDIT APPLICATION

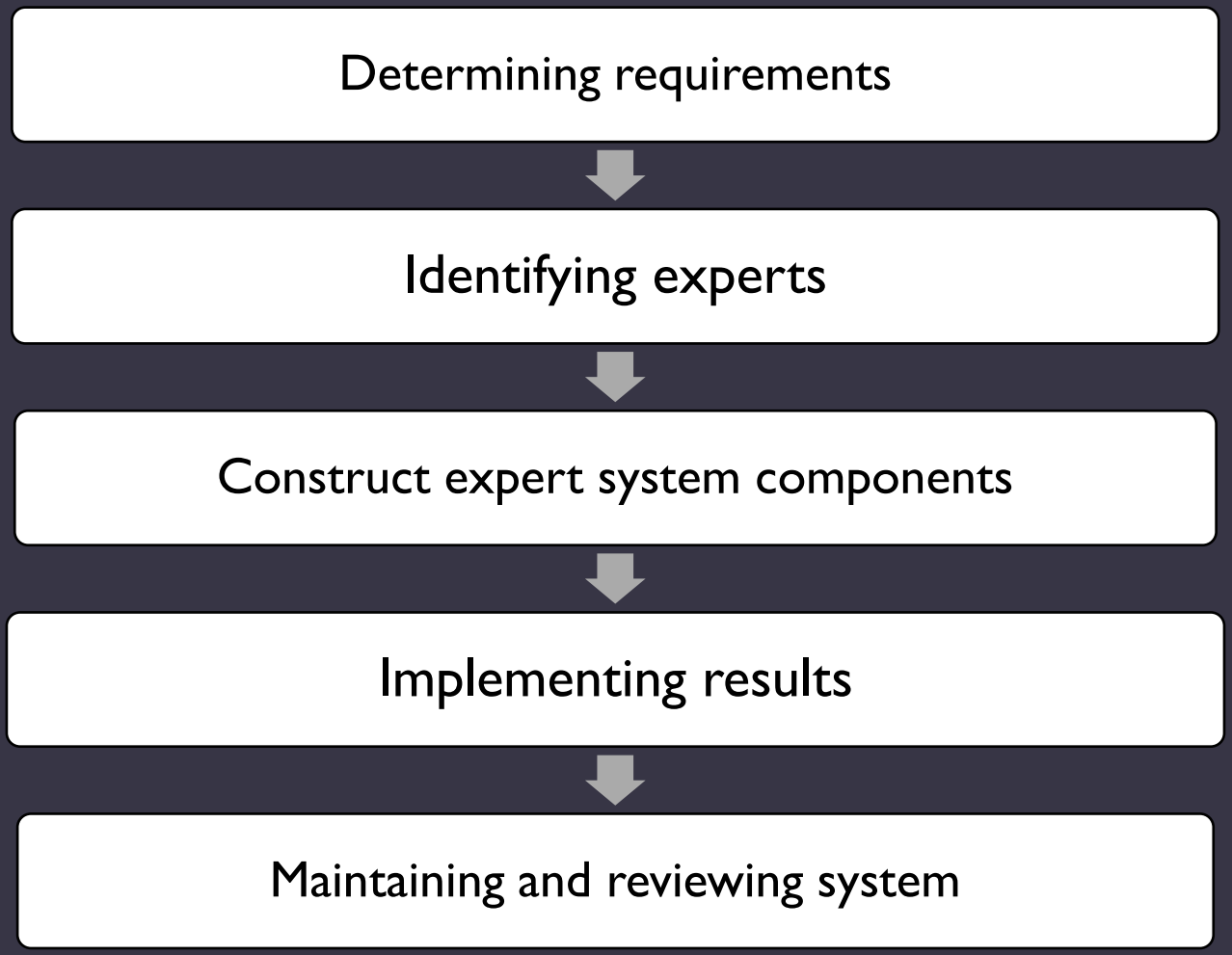
Application for a loan for Rs. 1,00,000 to Rs. 2,00,000.

- If there are no previous credits problems, and
- If month net income is greater than 4 x monthly loan payment, and
- If down payment is 15% of total value of property, and
- If net income of borrower is > Rs. 25,000, and
- If employment is >3 years at same company

Then accept the application.

Else, check other credit rules.

EXPERT SYSTEMS DEVELOPMENT

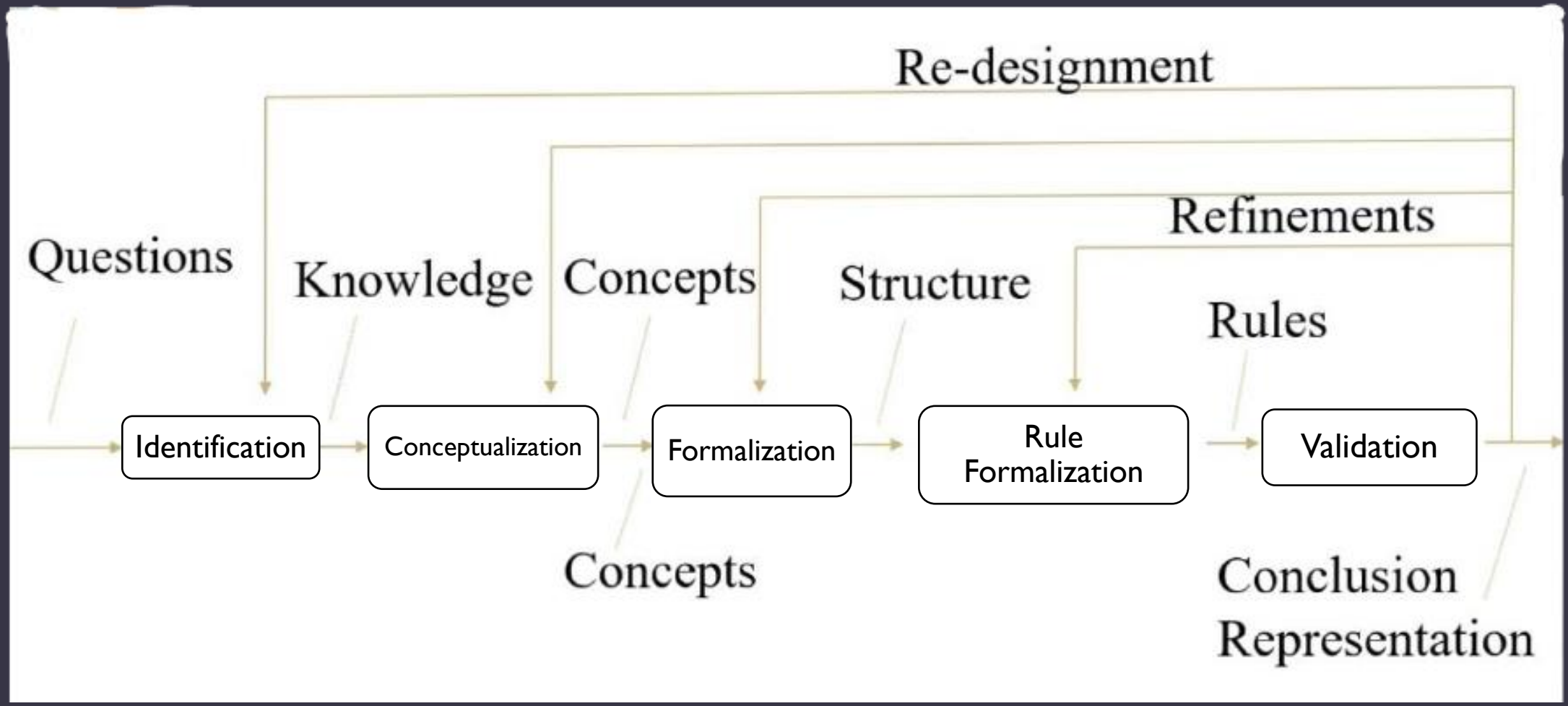


Domain : The area of knowledge addressed by the expert system.

PARTICIPANTS OF EXPERT SYSTEMS

- Domain Expert
  - The individual or group whose expertise and knowledge is captured for use in an expert system.
- Knowledge User
  - The individual or group who uses and get benefits from the expert system.
- Knowledge Engineer
  - The individual or group who are trained or have experience in design, development, implementation and maintenance of an expert system.

STAGES FOR DESIGNING KNOWLEDGE BASE



STAGES FOR DESIGNING KNOWLEDGE BASE

- Identification : Identify what the problem is, how to define it, can we divide it into sub problems.
- Conceptualization : Define key concepts of knowledge; for eg, type of data structure, conditions that have known, initial state, goal state and assumptions.
- Formalization : Use knowledge representation method to represent the gathered knowledge.
- Rule Formalization : Change the knowledge to programming language that can be identified by the computer.
- Validation : Check the correctness of rules or knowledge.

TYPES OF EXPERT SYSTEMS

Category	Problem Addressed
Interpretation	Inferring situation descriptions from sensor data
Prediction	Inferring likely consequences of given situation
Design	Configuring objects under constrains
Planning	Designing actions
Monitoring	Comparing observation to plan vulnerabilities

TYPES OF EXPERT SYSTEM

Category	Problem Addressed
Diagnosis	Inferring system malfunction from observation
Debugging	Prescribing remedies for malfunction
Instruction	Diagnosing , debugging and repairing system behaviour
Control	Interpreting, predicting, repairing and monitoring system behaviour

LIMITATIONS OF EXPERT SYSTEMS

- Not widely used or tested
- Limited to relatively narrow problems
- Cannot readily deal with ‘mixed’ knowledge
- Possibility of error
- Cannot define own knowledge base
- Difficult to maintain
- May have high development costs

EXPERT SYSTEM – MYCIN

- An expert system (rule-based) developed in early 1970s at Stanford University
- It was one of the first expert systems, and was designed to diagnose and treat infections in humans
- It provides advice through a consultative dialogue
- Mycin was able to make diagnoses by asking questions about a patient's symptoms, and then comparing the answers to a database of known infections
- If Mycin could not find a match in the database, it would ask additional questions in an attempt to narrow down the possibilities
- Mycin would then recommend a course of treatment, which could include antibiotics, surgery, or other medical procedures

EXPERT SYSTEM – MYCIN

Development of MYCIN owing to:

The problem:

- Only 13% of patients are treated rationally
- 66% are being given irrational treatment
- 21% are being given questionable treatment

Reason:

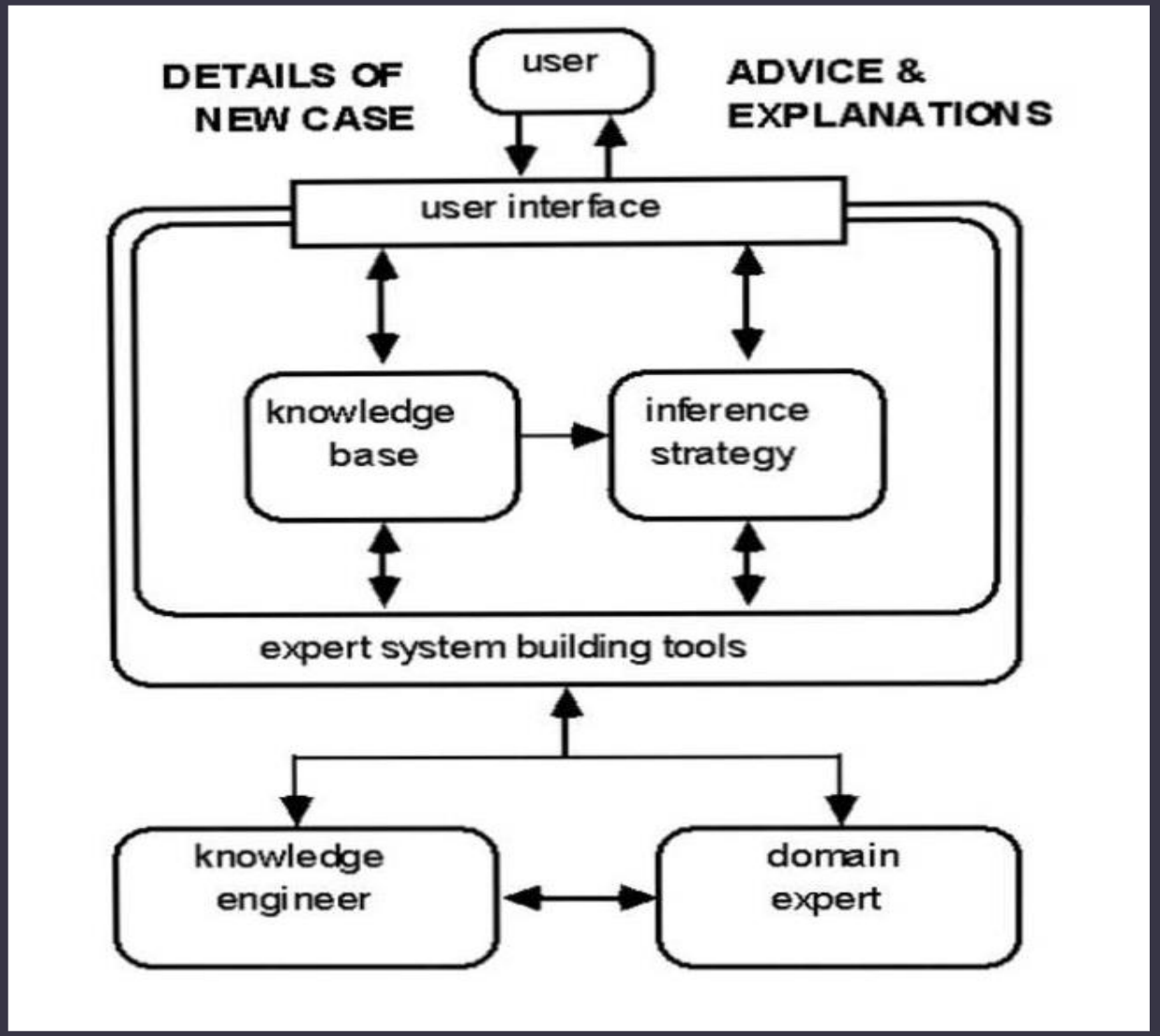
- Lack of time for proper diagnosis
- Lack of computer knowledge

DESIGN PARAMETERS

Expected design parameters : MYCIN

- Program must be competent and easy to use
- Must handle a large, changing body of knowledge
- Interact with human users
- Must take time into account
- Work with incomplete or uncertain information

HOW DOES IT WORK?



REASONING AND PROBLEM SOLVING STRATEGY

- MYCIN could use *backward chaining* to find out whether a possible bacteria was to blame.
- Performs assessment of the likelihood of a bacteria.
- The procedure is carried out in following style of dialogue:

MYCIN : Has the patient had neurosurgery ?

User : No

MYCIN : Is the patient a burn patient ?

User : No

…

MYCIN : It could be Diplococcus.

DIAGNOSTIC REASONING: INTERNIST

- Internist is a medical expert system for general disease diagnosis.
- Knowledge in system consists of disease profiles, giving symptoms associated with disease and relationship between them.

APPLICATIONS OF EXPERT SYSTEMS

- Credit granting
- Information management and retrieval
- Plant layout
- Hospitals and medical facilities
- Help desks and assistance
- Employee performance evaluation
- Virus detection
- Repair and maintenance
- Shipping
- Marketing
- Warehouse optimization

EXAMPLES OF EXPERT SYSTEMS

- MYCIN

  It was based on backward chaining and could identify various bacteria that could cause acute infections. It could also recommended drugs based on the patient's weight. It is one of the best expert system example.

- DENDRAL

  Expert system used for chemical analysis to predict molecular structure.

- PXDES

  An example of expert system used to predict the degree and type of lung cancer.

- CaDet

  One of the best expert system example that can identify cancer at early stages.