Unit:9 Expert System

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- **Outline:**

  – Introduction

  – Characteristics of expert systems

  – Knowledge engineering

  – Classic expert system

    - DENDRAL

    - MYCIN

    - EMYCIN

  – Case based reasoning

Introduction

- An expert system is a computer system whose performance is guided by specific, expert knowledge in solving problems.

  – simulates the decision- making process of a human expert in a specific domain.

  – solves problems in a narrow problem area by using high-quality, specific knowledge rather than an algorithm.

  – used by most of the large or medium sized organization as a major tool for improving productivity and quality.

Expert systems architecture

- The principal components of most expert systems are as shown in fig:
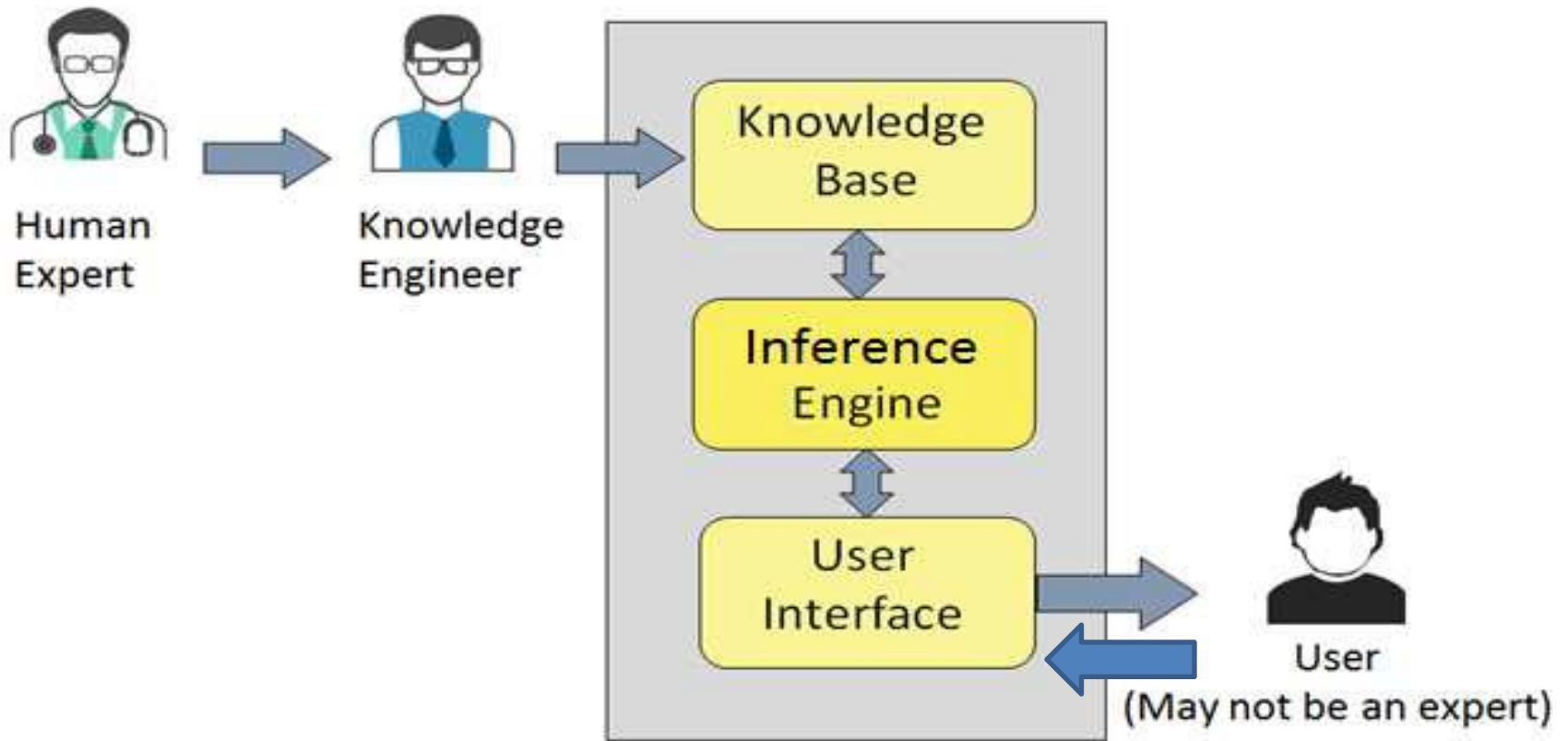
# Fundamental characteristics of an expert system

- Useful

- Usable

- Educational when appropriate

- Explain its advice

- Respond to simple questions also

- Learn new knowledge

- Easily modifiable

The main players in the expert system development team

- An expert system is defined as " a computer program capable of performing at the level of a human expert in a narrow problem area."

- For the development of such program requires a team involving the following members:
    - the domain expert,
    - the knowledge engineer,
    - the programmer,
    - the project manager and
    - the end-user.

- The success of their expert system entirely depends on how well the members work together.

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- The basic relations in the development team are summarized in figure:
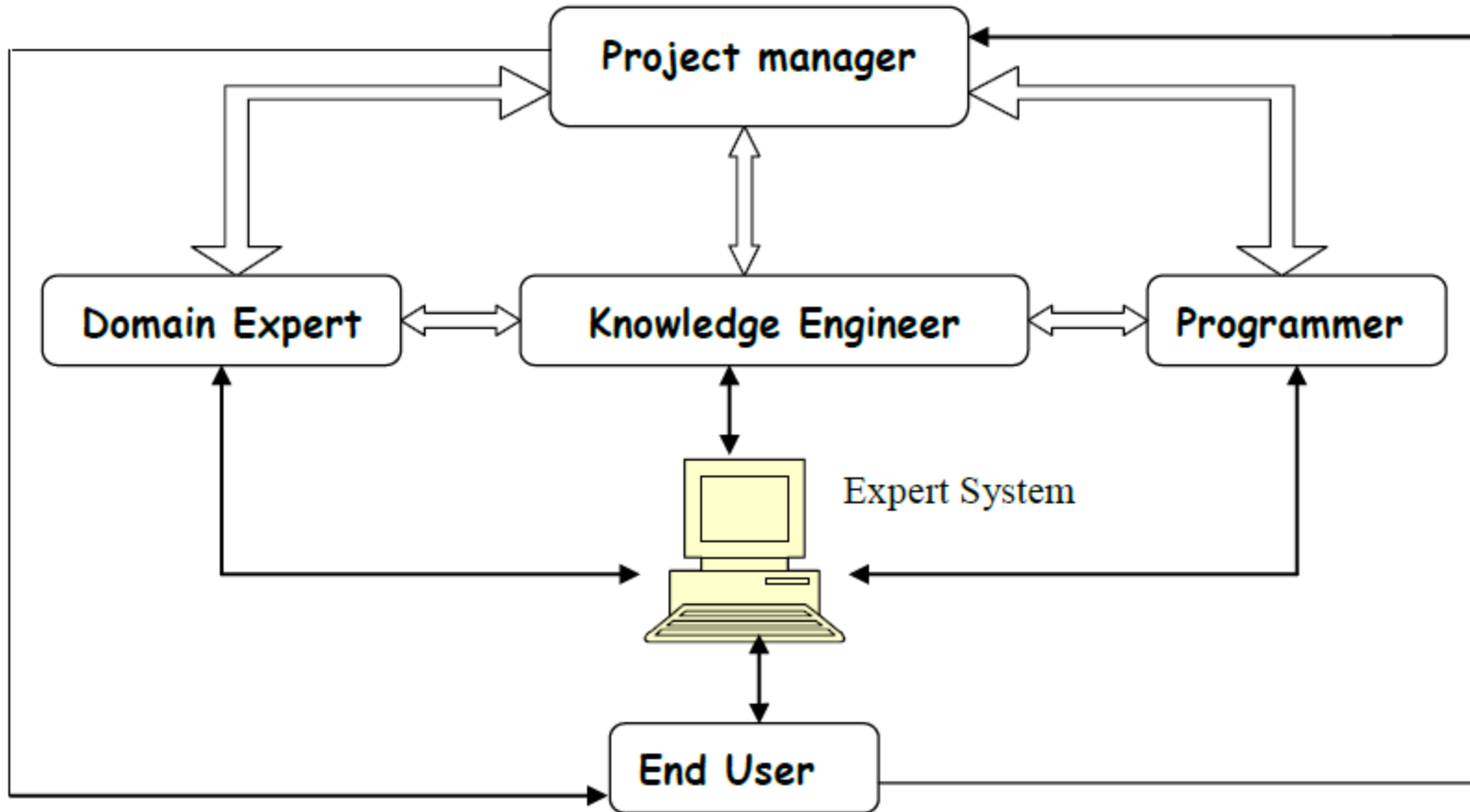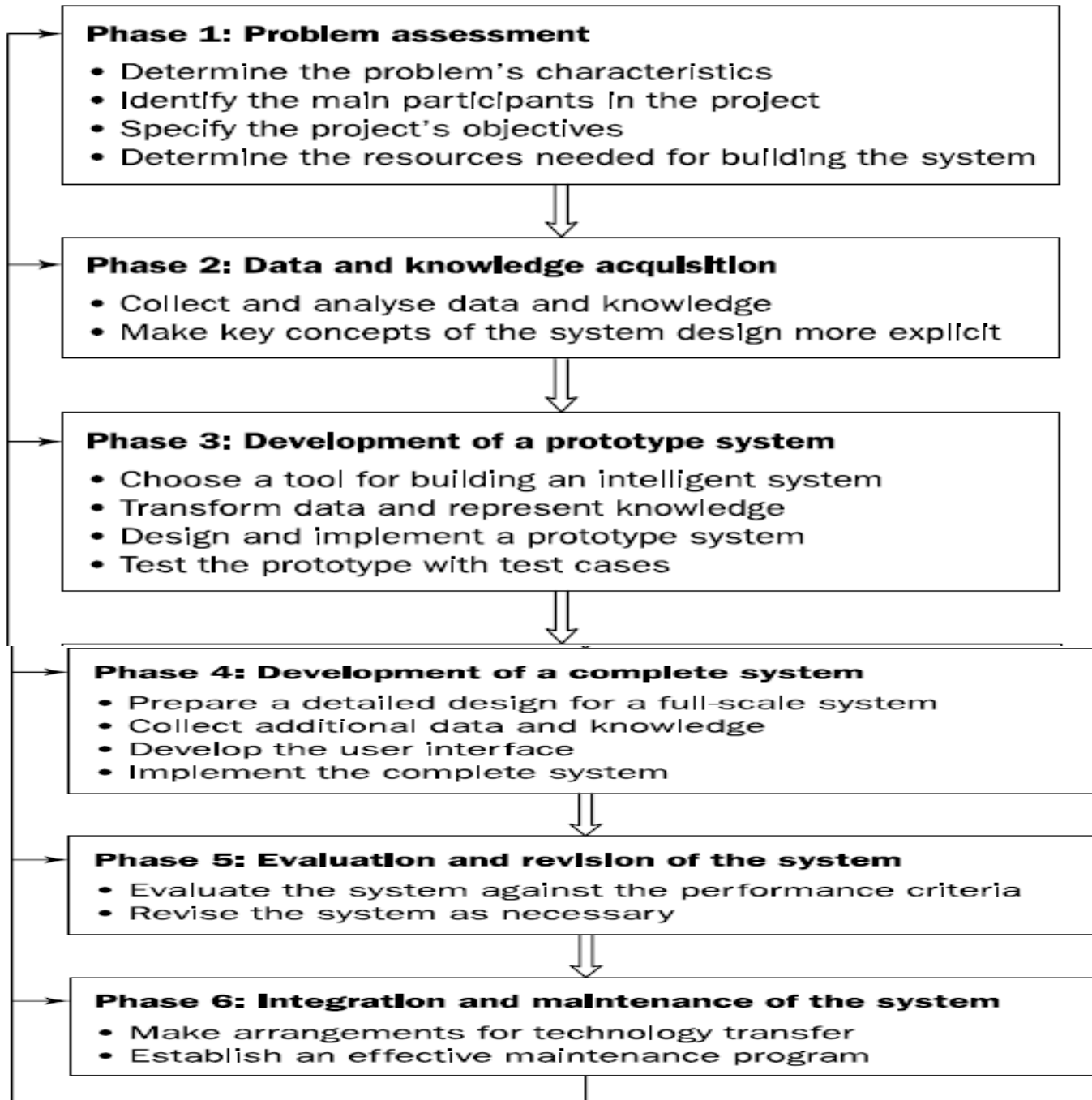
knowledge engineering

- The process of building intelligent knowledge-based systems is called knowledge engineering. It has six basic phases:

    1. Problem assessment

    2. Data and knowledge acquisition

    3. Development of a prototype system

    4. Development of a complete system

    5. Evaluation and revision of the system

    6. Integration and maintenance of the system

Contd…

Phase 1: Problem assessment

- Determine the problem's characteristics
- Identify the main participants in the project
- Specify the project's objectives
- Determine the resources needed for building the system

Phase 2: Data and knowledge acquisition

- Collect and analyse data and knowledge
- Make key concepts of the system design more explicit

Phase 3: Development of a prototype system

- Choose a tool for building an intelligent system
- Transform data and represent knowledge
- Design and implement a prototype system
- Test the prototype with test cases

Phase 4: Development of a complete system

- Prepare a detailed design for a full-scale system
- Collect additional data and knowledge
- Develop the user interface
- Implement the complete system

Phase 5: Evaluation and revision of the system

- Evaluate the system against the performance criteria
- Revise the system as necessary

Phase 6: Integration and maintenance of the system

- Make arrangements for technology transfer
- Establish an effective maintenance program

Classic Expert Systems

- **DENDRAL**

  – First ES developed in late 1960

  – Designed to analyze mass spectra

  – Based on the mass of fragments seen in the spectra, it would be possible to make inference as the nature of molecule tested, identifying functional groups or even the entire molecule.

  – Used Heuristic knowledge obtained from experienced chemists.

  – Use forward chaining for reasoning

Classic Expert Systems

- **MYCIN**

  – Expert system for treating blood infections

  – Diagnose patients based on reported symptoms and medical test results

  – Could ask some more information and lab test results for diagnosis

  – Recommend a course of treatment, if requested, MYCIN would explain the reasoning that lead to its diagnosis and recommendation.

  – Use about 500 production rules, MYCIN operated roughly the same level of competence as human specialists in blood infections.

  – Use backward chaining for reasoning.

Classic Expert Systems

- **EMYCIN**

  - **EMYCIN** is an expert system shell, a framework for building programs that record the knowledge of domain experts and use that knowledge to help non-expert users solve problems.

  - It provides an interface that helps experts define data types and rules, a backwards-chaining reasoning algorithm, a mechanism for dealing with uncertainty, and facilities for introspection that permit users to learn what the system knows and what it is doing.

Advantages and Disadvantages of Expert Systems

- Advantages of Expert System

  – It provides consistent answer for repetitive decisions, processes and tasks.

  – Hold and maintained significant level of information.

  – Encourage organization to clarify the logic of their decision making.

  – Ask question like human expertise.

- Disadvantages of Expert System

  – Lack of common sense needed in some decision making.

  – Cannot make creative response as human expert would in unusual circumstances.

  – Error may occur in the knowledge base and lead to wrong decision.

  – Cannot adopt changing environment, unless knowledgebase is changed.

Based Reasoning

- **Case-based reasoning** (**CBR**) is the process of solving new problems based on the solutions of similar past problems.

    - For Example: An auto mechanic who fixes an engine by recalling another car that exhibited similar symptoms is using case-based reasoning.

- Case-based reasoning is liked by many people because they feel happier with examples rather than conclusions separated from their context.
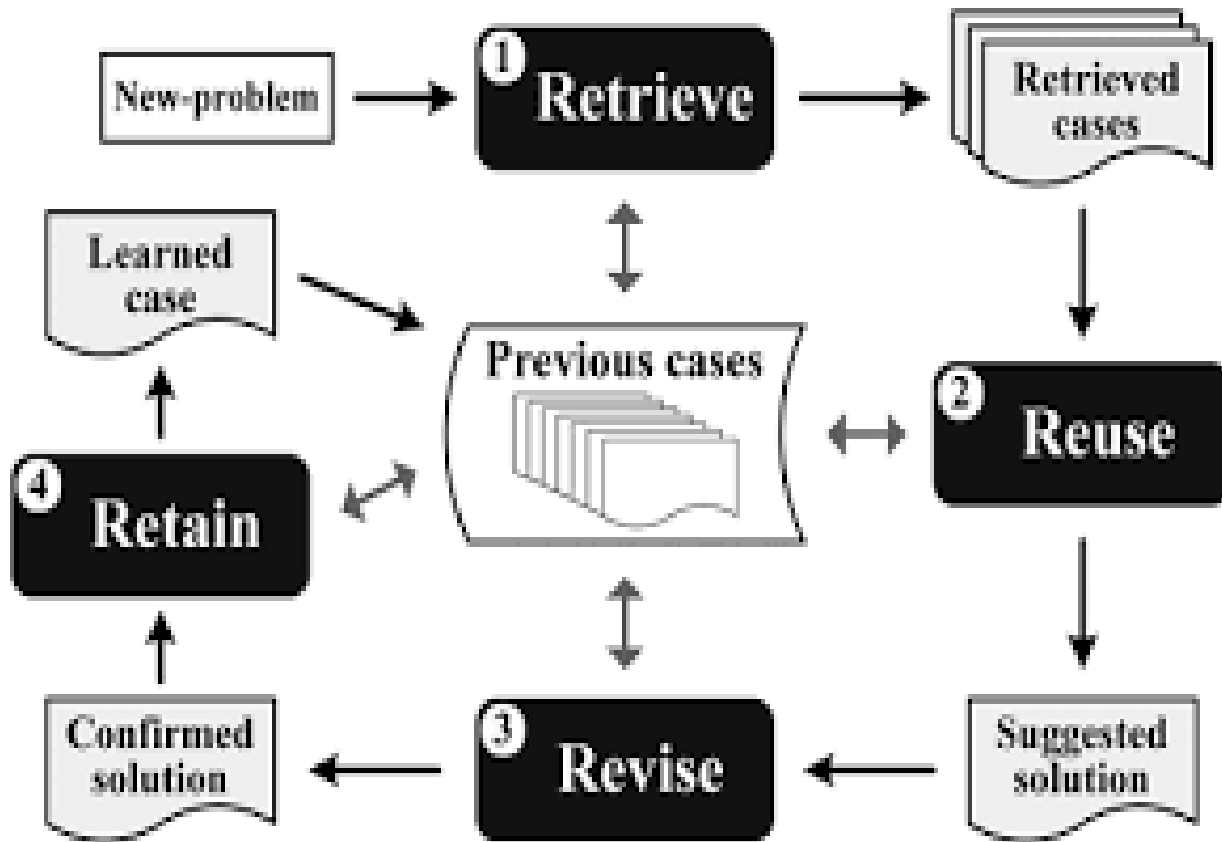
Case Based Reasoning process

Fig: case- based reasoning process

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- In case-based reasoning (CBR) systems expertise is embodied in a library of past cases, rather than being encoded in classical rules.

- Each case typically contains a description of the problem, plus a solution and/or the outcome.

- The knowledge and reasoning process used by an expert to solve the problem is not recorded, but is implicit in the solution.

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- To solve a current problem:

  - The problem is matched against the cases in the case base, and similar cases are retrieved.

  - The retrieved cases are used to suggest a solution which is reused and tested for success.

  - If necessary, the solution is then revised.

  - Finally the current problem and the final solution are retained as part of a new case.

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- When to use Case Based Reasoning?

  – records of previously solved problems exist

  – historical cases are viewed as an asset which ought to be preserved

  – remembering previous experiences is useful;

  – specialists talk about their domain by giving examples;

  – experience is at least as valuable as textbook knowledge.

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- Advantages and disadvantages of CBR:
  - Advantages
    - Solutions are quickly proposed
      - Derivation form scratch is avoided
    - Domains do not need to be completely understood
    - Cases useful for ill-defined concepts
    - Highlights important features
  - Disadvantages
    - Old cases may be poor
    - Library may be biased
    - Most appropriate cases may not be retrieved
    - Retrieval/ adaptation knowledge still needed

Thank You !