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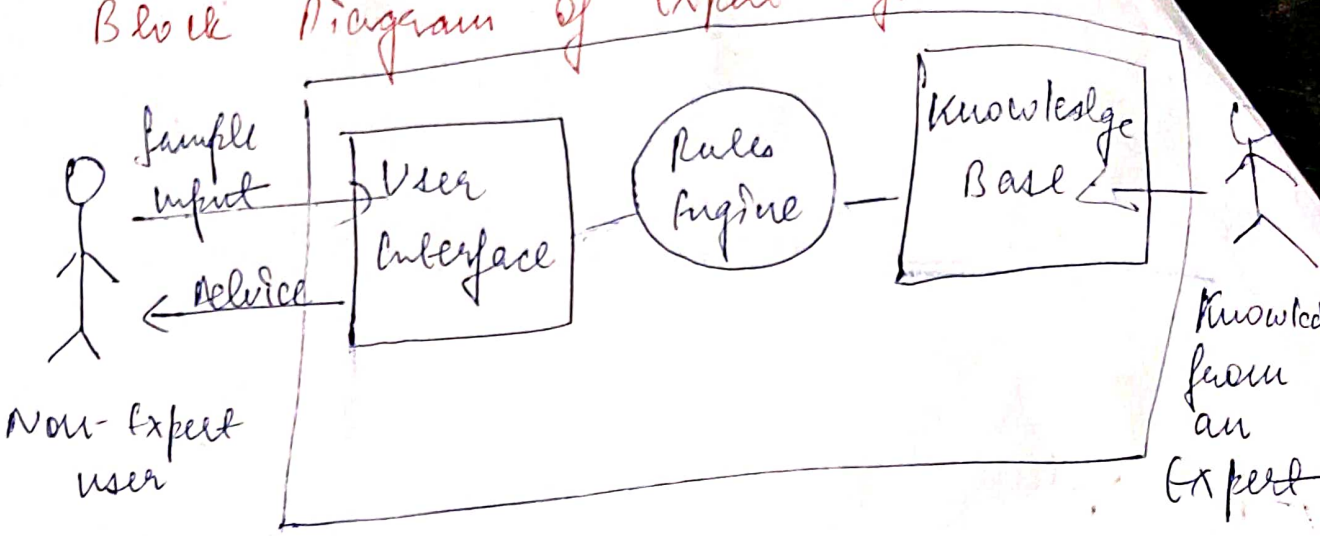
Name of Faculty: .....
Class/Section: .....
Name of Subject: .....
Date: .....
Code: .....

Expert System

- 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.
- First ES was developed in 1970.
- Performance of ES is based on the expert knowledge stored in its knowledge base. The more knowledge stored in the KB, the more the system improves its performance.

Block Diagram of Expert System



Note: Remember that an Expert System is not used to Replace the Human Experts; instead it is used to assist the Human in making a complex decisions. These systems do not have Human capabilities of thinking & work on the Basis of Knowledge Base of the particular domain.

Popular Examples of Expert System.

1) DENDRAL: It was an AI Project that was made as a Chemical Analysis ES.
- used in Organic Chemistry to detect unknown Organic molecules with help of their mass Spectra & KB of Chemistry

2) MYCIN — later Explained in detail.

3) PXDES 4) CADET.

Characteristics of Expert System

1) High Performance 2) Understandable
3) Reliable 4) Highly Responsive.

Components of Expert System

1) User Interface: With the Help of User Interface, ES interacts with the user, takes queries as an input in a readable format and passes it to the inference Engine. After getting the Response from the inference Engine, it displays the output to the user. In other words, it is an interface that helps a non-expert user to communicate with the Expert System to find a soln.

2) Inference Engine (Rules of Engine).

- Known as Brain of ES as it is main processing unit of the System.
- Applied Inference rules to the Knowledge Base to derive a Conclusion or deduce New Information It helps in deriving an error - free soln of queries asked by the user.
- With the help of an Inference engine, the System extracts the Knowledge from the KB.

Types of Inference Engine

Deterministic Inference Engine

- Conclusions drawn from this type of Inference Engine are assumed to be true.
- Based on facts and Rules.

Probabilistic Inference Engine

- Contains uncertainity in conclusions, and based on the Probability.

It also used modes as :

1) Forward Chaining / Reasoning 2) Backward

3) Knowledge Base : It is a type of storage that stores knowledge acquired from the different experts of the particular domain.

- considered as big storage of knowledge.
- similar to a DB that contains information and rules of a particular domain or subject.
- one can also view the Knowledge Base as collection of objects eg. their Attributes.

Components of Knowledge Base

Factual Knowledge

- Knowledge which is based on facts eg accepted by knowledge engineers comes under Factual Knowledge

Heuristic Knowledge

It is based on practice, the ability to guess, evaluation eg experiences.

→ Knowledge Representation: It is used to formalize the knowledge stored in the Knowledge Base using the if-else Rules.

→ Knowledge Acquisition: It is the process of Extracting, Organizing and structuring the domain knowledge, specifying the Rules to acquire the Knowledge ~~Base~~ from various experts, and store that knowledge into knowledge Base.

Development of Expert System: Imp

→ working of ES by taking example of MYCIN ES.

- Firstly, it should be fed with expert knowledge. In the case of MYCIN, human experts ~~there~~ specialized in the Medical field of Bacterial Infection, provide information about the causes, symptoms and and other knowledge in the Domain.
- The KB of the MYCIN is updated successfully. In order to test it, the Doctor provides a new problem to it. The problem is ~~the~~ to identify the presence of bacteria by inputting

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Campus: ..... Course: ..... Class/Section: ..... Date: .....
Name of Faculty: ..... Name of Subject: ..... Code: .....

the details of a patient, including the symptoms, current condition, and medical history.

- The is will need a questionaire to be filled by the patient to know the general information about the patient such as gender, age, etc.
- Now the system has collected all the information so it will find the solu for the problem by applying if-then Rules using the inference engine and using the facts stored within the KB.
- In the end, it will provide a Response to the patient by using the User interface.

Participants in Expert System

1) Expert : Specialized in specific Domain.

[illegible] is much difficult

2) Knowledge Engineer: Gathers knowledge from domain experts

3) End-user: Not experts but needs the solu or advice for the queries, which are complex.

Why Expert System?

→ No emotions
→ High efficiency
→ Expertise in domain
→ No Memory limitation
→ Regular updates improves the performance
→ High security.
→ Considers all the facts.

Capabilities of ES:

1) Advising
2) Provide Decision making capabilities
3) Demonstrate a Device
4) Problem Solving
5) Explaining a problem
6) Interpreting the input.
7) Predicting Results
8) Diagnosis

Advantages of ES:

1) Highly Reproducible
2) can be used in Risky Places where the human presence is not safe.
3) Error possibilities are less if the KB contains correct knowledge
4) Performance of these systems remains steady as it is not affected by emotions, tension or fatigue
5) Provide a high speed to Respond a particular query.

Limitations of ES:

1) Response of ES may get wrong if the KB contains the wrong information
2) like human Being, it cannot produce a creative output for different scenarios.
3) Maintainance & Development costs are very high.
4) Knowledge Acquisition for designing is much difficult

7) For each domain, we require a specific ES, which is one of the Big limitations.

8) It cannot learn from itself & hence requires manual updates.

Applications of ES:

1) Designing and Manufacturing domain.
2) In Knowledge Domain.
3) Finance domain.
4) Diagnosis & troubleshooting of devices.
5) Planning & Scheduling.