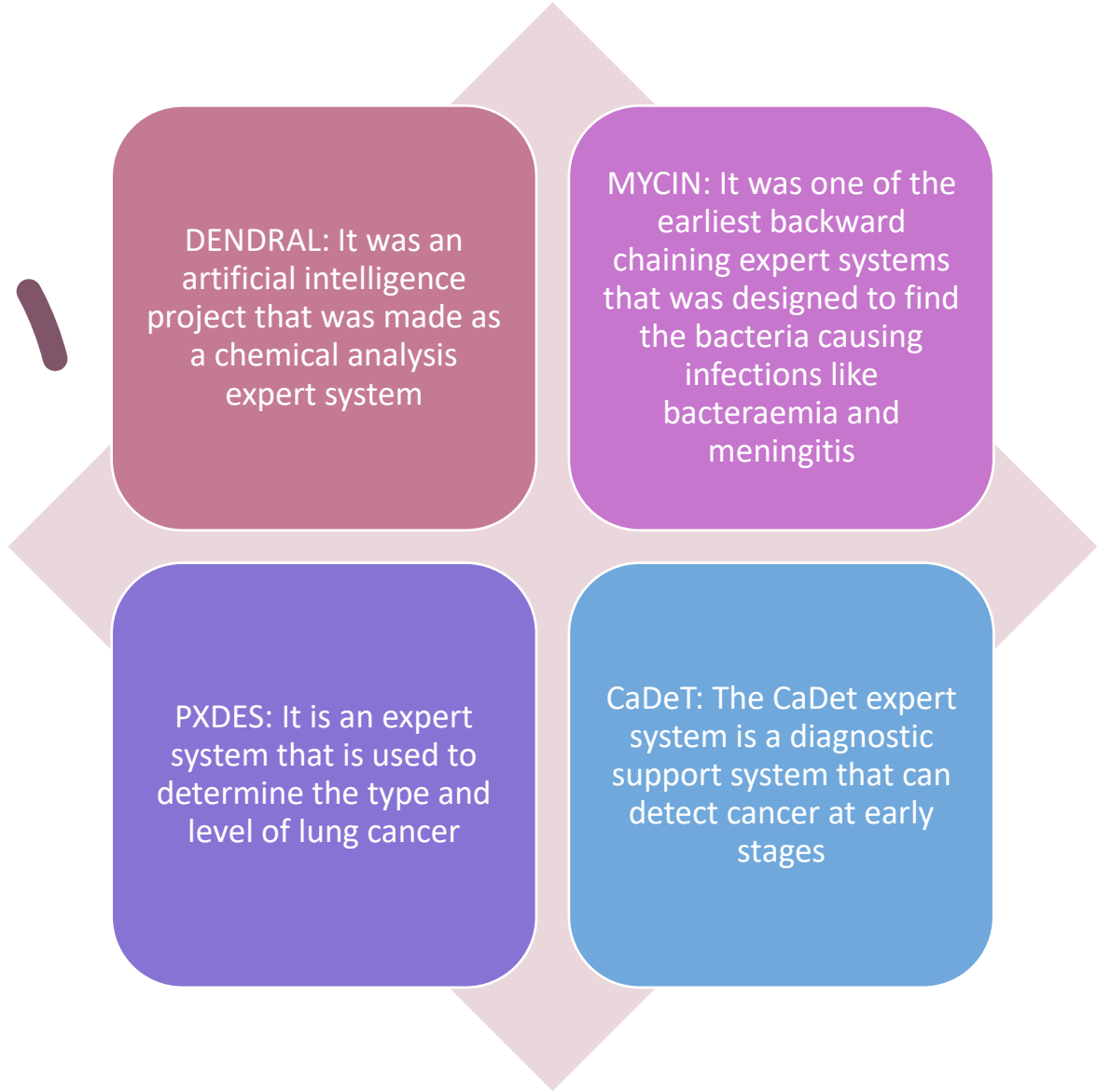
What is an Expert System?


DENDRAL: It was an artificial intelligence project that was made as a chemical analysis expert system
MYCIN: It was one of the earliest backward chaining expert systems that was designed to find the bacteria causing infections like bacteraemia and meningitis
PXDES: It is an expert system that is used to determine the type and level of lung cancer
CaDeT: The CaDet expert system is a diagnostic support system that can detect cancer at early stages

Characteristics of Expert System

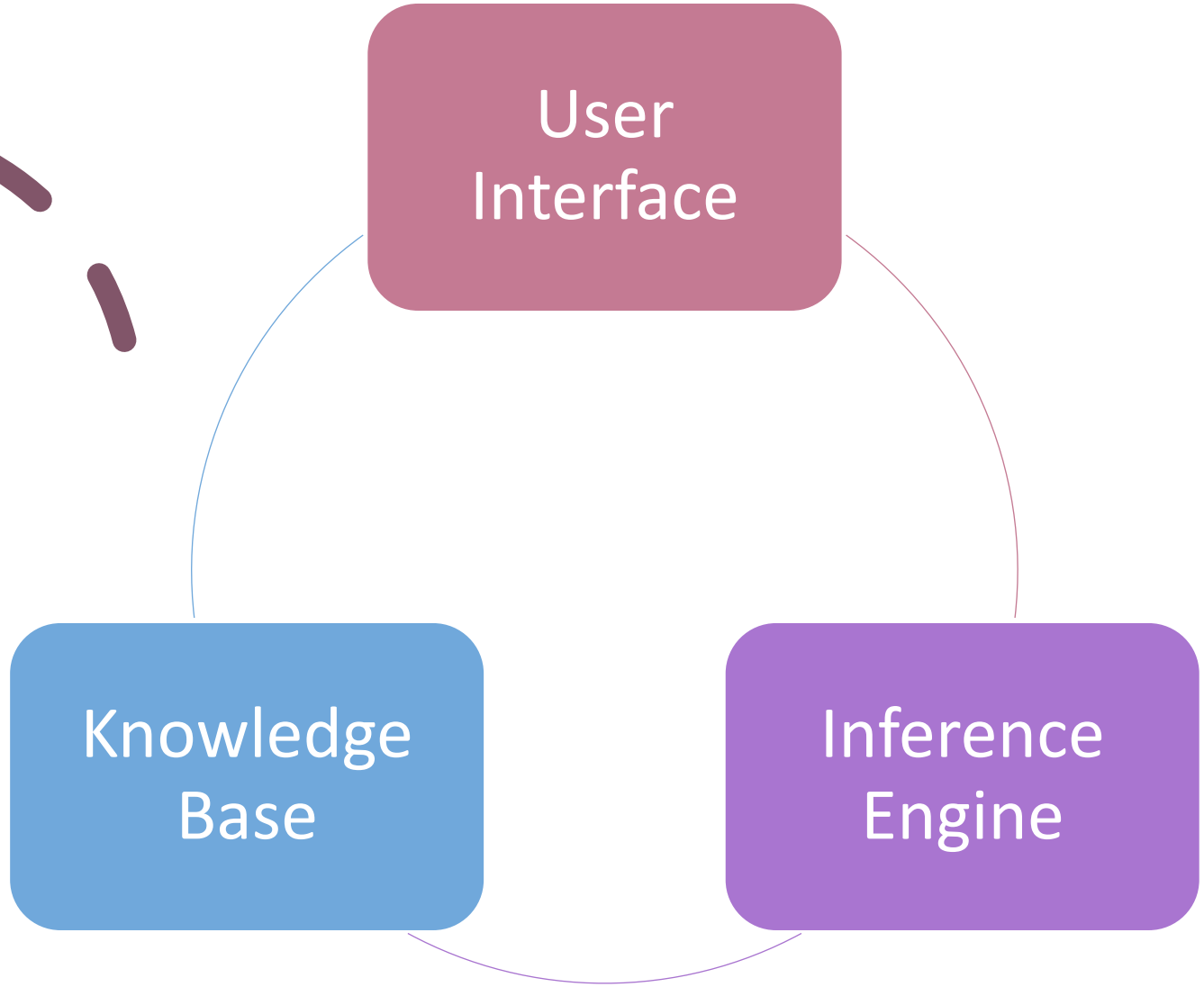
High Performance: The expert system provides high performance for solving any type of complex problem of a specific domain with high efficiency and accuracy

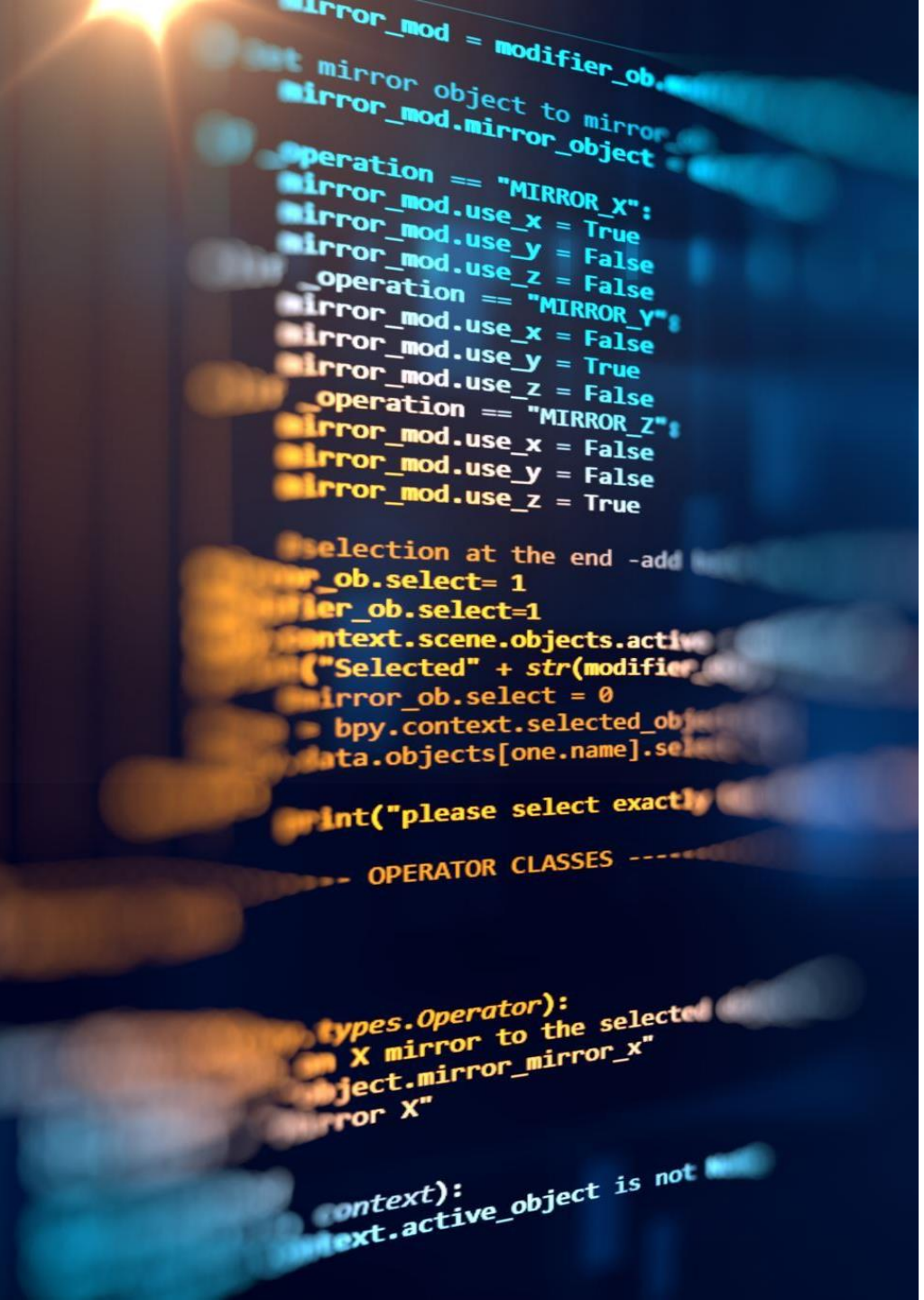
Understandable: It responds in a way that can be easily understandable by the user

Reliable: It is much reliable for generating an efficient and accurate output

Highly responsive: ES provides the result for any complex query within a very short period of time

Components of Expert System





1. User Interface

- With the help of a user interface, the expert system 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 solution

2. Inference Engine

- The inference engine is known as the brain of the expert system as it is the main processing unit of the system
- With the help of an inference engine, the system extracts the knowledge from the knowledge base
- There are two types of inference engine
- Deterministic Inference engine: The conclusions drawn from this type of inference engine are assumed to be true
- Probabilistic Inference engine: This type of inference engine contains uncertainty in conclusions, and based on the probability
- Forward Chaining: It starts from the known facts and rules, and applies the inference rules to add their conclusion to the known facts
- Backward Chaining: It is a backward reasoning method that starts from the goal and works backward to prove the known facts

3. Knowledge Base

The knowledgebase is a type of storage that stores knowledge acquired from the different experts of the particular domain

It is similar to a database that contains information and rules of a particular domain or subject

One can also view the knowledge base as collections of objects and their attributes

Components of Knowledge Base

Factual Knowledge: The knowledge which is based on facts and accepted by knowledge engineers comes under factual knowledge

Heuristic Knowledge: This knowledge is based on practice, the ability to guess, evaluation, and experiences

Components of Knowledge Base

Knowledge Representation: It is used to formalize the knowledge stored in the knowledge base using the If-else rules

Knowledge Acquisitions: It is the process of extracting, organizing, and structuring the domain knowledge, specifying the rules to acquire the knowledge from various experts, and store that knowledge into the knowledge base

Development of Expert System

- Firstly, ES should be fed with expert knowledge
- The KB of the MYCIN is updated successfully
- The ES will need a questionnaire 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 solution 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 the development of Expert System

Expert: The success of an ES much depends on the knowledge provided by human experts

Knowledge Engineer: Knowledge engineer is the person who gathers the knowledge from the domain experts and then codifies that knowledge to the system according to the formalism

End-User: This is a particular person or a group of people who may not be experts, and working on the expert system needs the solution or advice for his queries, which are complex

Why Expert System?

- No memory Limitations: It can store as much data as required and can memorize it at the time of its application
- High Efficiency: If the knowledge base is updated with the correct knowledge, then it provides a highly efficient output, which may not be possible for a human
- Expertise in a domain: There are lots of human experts in each domain, and they all have different skills, different experiences, and different skills, so it is not easy to get a final output for the query
- Not affected by emotions: These systems are not affected by human emotions such as fatigue, anger, depression, anxiety, etc
- High security: These systems provide high security to resolve any query

Why Expert System?

Considers all the facts: To respond to any query, it checks and considers all the available facts and provides the result accordingly

Regular updates improve the performance: If there is an issue in the result provided by the expert systems, we can improve the performance of the system by updating the knowledge base

Capabilities of the Expert System

Advising: It is capable of advising the human being for the query of any domain from the particular ES

Provide decision-making capabilities: It provides the capability of decision making in any domain, such as for making any financial decision, decisions in medical science, etc

Demonstrate a device: It is capable of demonstrating any new products such as its features, specifications, how to use that product, etc

Problem-solving: It has problem-solving capabilities

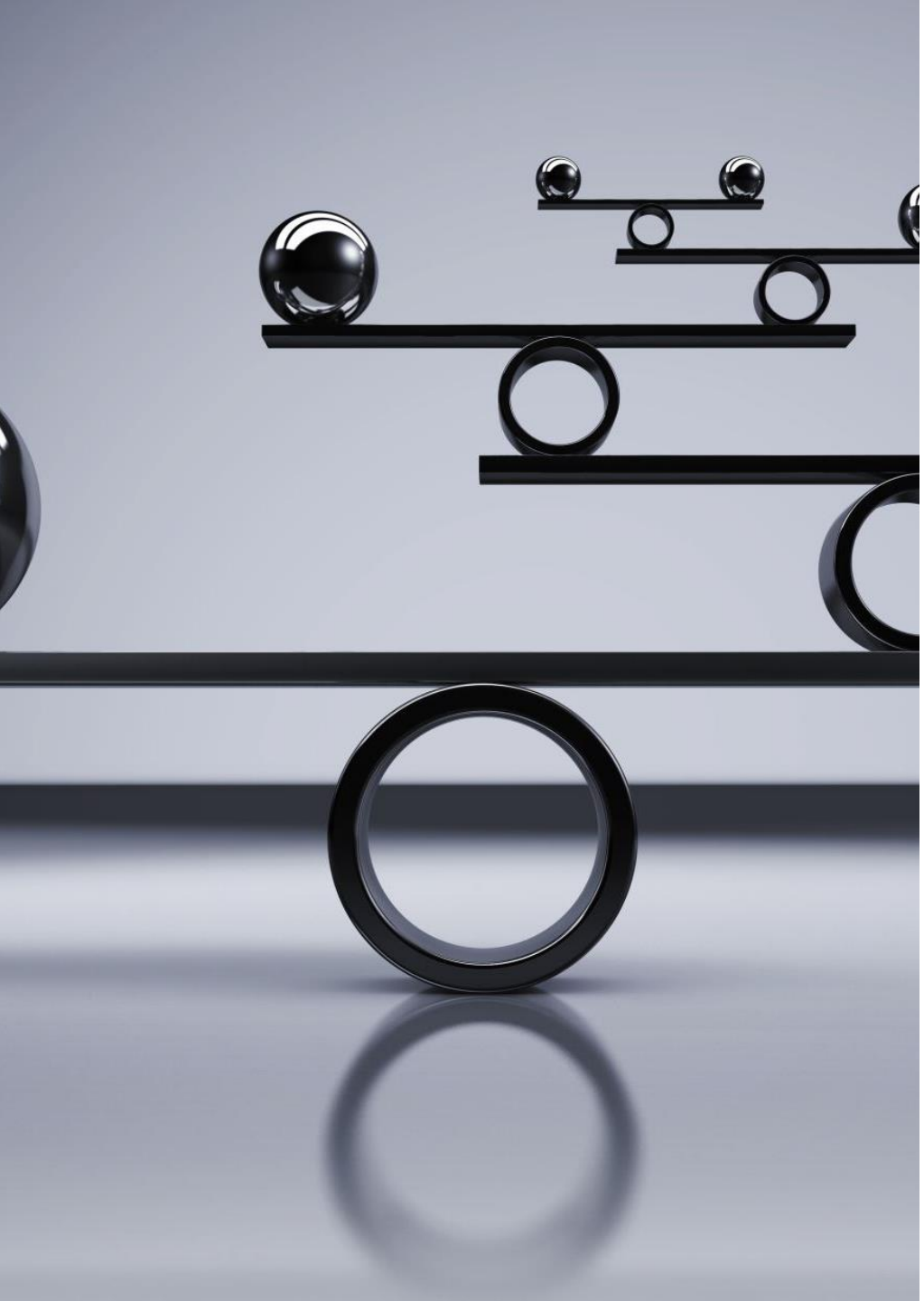
Explaining a problem: It is also capable of providing a detailed description of an input problem

Interpreting the input: It is capable of interpreting the input given by the user

Predicting results: It can be used for the prediction of a result

Capabilities of the Expert System

- Diagnosis: An ES designed for the medical field is capable of diagnosing a disease without using multiple components as it already contains various inbuilt medical tools



Advantages of Expert System

- These systems are highly reproducible
- They can be used for risky places where the human presence is not safe
- Error possibilities are less if the KB contains correct knowledge
- The performance of these systems remains steady as it is not affected by emotions, tension, or fatigue
- They provide a very high speed to respond to a particular query

Limitations of Expert System

- The response of the expert system may get wrong if the knowledge base contains the wrong information
- Like a human being, it cannot produce a creative output for different scenarios
- Its maintenance and development costs are very high
- Knowledge acquisition for designing is much difficult
- For each domain, we require a specific ES, which is one of the big limitations
- It cannot learn from itself and hence requires manual updates

Applications of Expert System

- In designing and manufacturing domainIt can be broadly used for designing and manufacturing physical devices such as camera lenses and automobiles
- In the knowledge domainThese systems are primarily used for publishing the relevant knowledge to the users
- In the finance domainIn the finance industries, it is used to detect any type of possible fraud, suspicious activity, and advise bankers that if they should provide loans for business or not
- In the diagnosis and troubleshooting of devicesIn medical diagnosis, the ES system is used, and it was the first area where these systems were used
- Planning and SchedulingThe expert systems can also be used for planning and scheduling some particular tasks for achieving the goal of that task