In [1]:

```
```

Expert systems

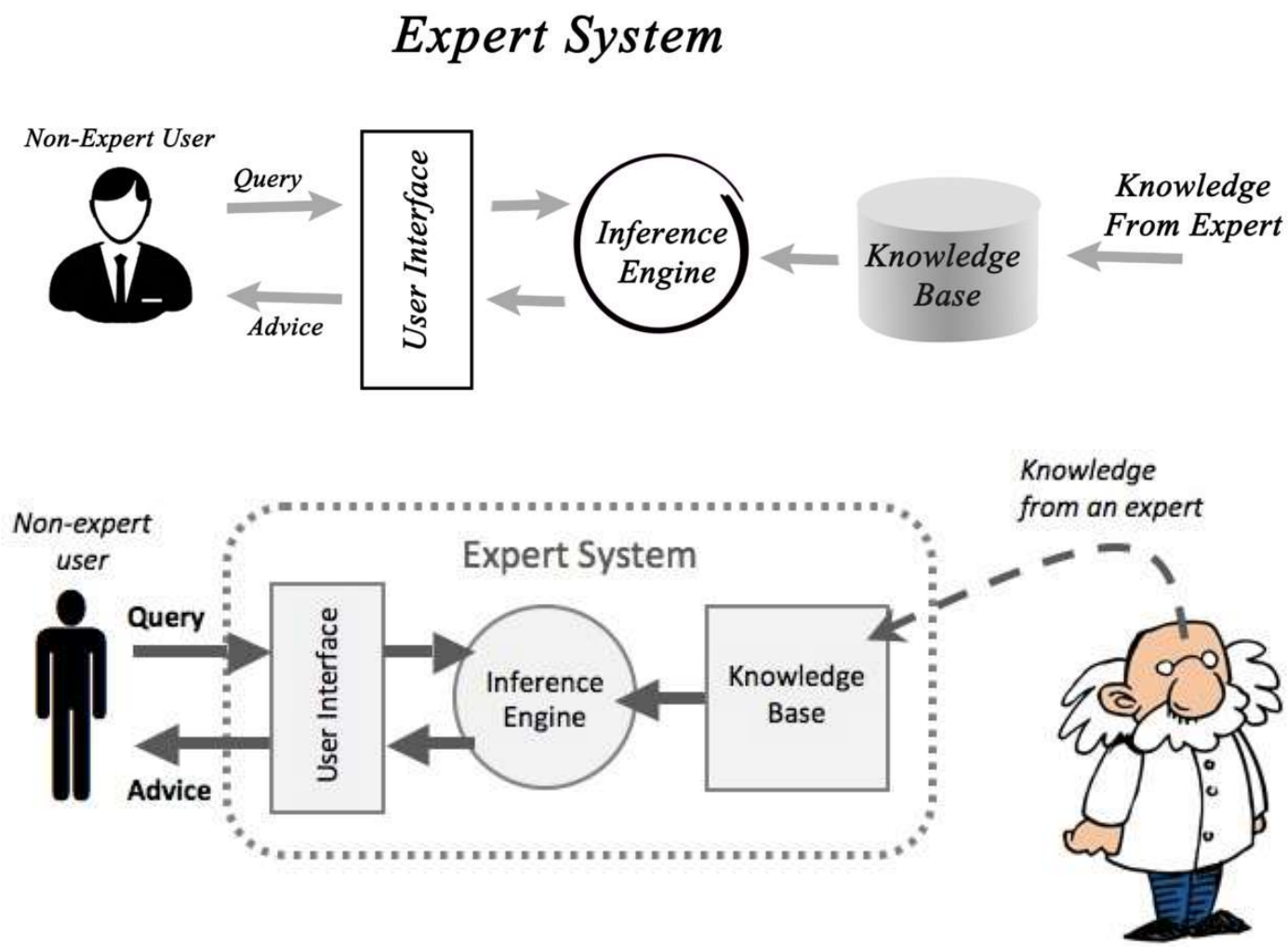
Expert system is a computer program that uses artificial intelligence methods to solve problems within a specialized domain that ordinarily requires human expertise.

The main objective of knowledge based expert systems is to replicate the judgmental tasks and decision-making processes of human experts with the ability to provide advices in a certain domain of knowledge

Components/ Architecture of Expert Systems

There are 5 Components of expert systems:

- **Knowledge base**: The knowledge base in an expert system represents facts and rules. It contains knowledge in specific domains along with rules in order to solve problems and form procedures that are relevant to the domain.
- **Inference engine**: The most basic function of the inference engine is to acquire relevant data from the knowledge base, interpret it, and find a solution to the user's problem. Inference engines also have explanatory and debugging abilities.
- **Knowledge acquisition and learning module**: This component functions to allow the expert systems to acquire more data from various sources and store it in the knowledge base.
- **User interface**: This component is essential for a non-expert user to interact with the expert system and find solutions.
- **Explanation module**: As the name suggests, this module helps in providing the user with an explanation of the achieved conclusion.



Characteristics of Expert Systems

They have high-performance levels
They are easy to understand
They are completely reliable
They are highly responsive

Capabilities of Expert Systems

The expert systems are capable of a number of actions, including:

- Advising
- Assistance in human decision making
- Demonstrations and instructions
- Deriving solutions
- Diagnosis
- Interpreting inputs and providing relevant outputs
- Predicting results

- Justification of conclusions
- Suggestions for alternative solutions to a problem

Incapabilities of Expert Systems

- Substituting human decision akers
- Possessing human capabilities
- Producing accurate output for inadequate Knowledge base
- Refining their own knowledge

Expert Systems Examples

There are numerous examples of expert systems. Some of them are:

- **MYCIN**: This was one of the earliest expert systems that were based on backward chaining. It has the ability to identify various bacteria that cause severe infections. It is also capable of recommending drugs based on a person's weight.
- **DENDRAL**: This was an AI-based expert system used essentially for chemical analysis. It uses a substance's spectrographic data in order to predict its molecular structure.
- **R1/XCON**: This ES had the ability to select specific software to generate a computer system as per user preference.
- **PXDES**: This system could easily determine the type and the degree of lung cancer in patients based on limited data.
- **CaDet**: This clinical support system identifies cancer in its early stages.
- **DXplain**: This is also a clinical support system that is capable of suggesting a variety of diseases based on just the findings of the doctor.

Human System Vs. Expert System

Human System	Expert System
Perishable and unpredictable in nature	Permanent and consistent in nature
Difficult to transfer and document data	Easy to transfer and document data
Human expert resources are expensive	Expert Systems are cost-effective Systems

An expert system shell is a set of programs which allow the building of an expert system through the creation of knowledge and rules.

Even Better Than Human Experts - IBM Deep Blue supercomputer -1997

- Despite all that computer technology had achieved, many authorities thought that Expert System chess programs would never reach a high enough level to match the top levels of human play.
- Those doubts were put to rest forever in 1997, when IBM's chess program "Deep Blue" won a 6-game match against the reigning world champion, Garry Kasparov.

IBM Watson supercomputer and Jeopardy! - 2006

- Watson a supercomputer designed to answer questions in natural language by IBM had a much larger area of knowledge than previous limited expert systems.
- Watson stored over 4 terabytes of data, consisting of over 200 million pages of information.
- In 2011 Watson competed against two humans in the US TV show Jeopardy! Watson won the contest by a significant margin.

For example, suppose a new pet, Fritz, is delivered in an opaque box along with two facts about Fritz:

Fritz croaks
Fritz eats flies

1) If X croaks and eats flies – Then X is a frog
2) If X chirps and sings – Then X is a canary
3) If X is a frog – Then X is green
4) If X is a canary – Then X is yellow

You are looking for what color your pet is there are two options.

1) If X croaks and eats flies – Then X is a frog
2) If X chirps and sings – Then X is a canary
3) If X is a frog – Then X is green
4) If X is a canary – Then X is yellow

Try the first option.

1) If X croaks and eats flies – Then X is a frog
2) If X chirps and sings – Then X is a canary
3) If X is a frog – Then X is green
4) If X is a canary – Then X is yellow

Iterate through the list and see if you can find if X is a frog.

1) If X croaks and eats flies – Then X is a frog
2) If X chirps and sings – Then X is a canary
3) If X is a frog – Then X is green
4) If X is a canary – Then X is yellow

Repeat with step 1. X croaks and eats flies is given as true. Since X croaks and eats flies, X is a frog. Since X is a frog, X is green.