Assignment No:

Title of the Assignment: Expert System

Problem statement: Implement any one of the following Expert System for Hospitals and medical facilities

Objective:

- To understand the concept of expert systems and AI.
- To implement an expert system for disease diagnosis.

Theory:

An expert system, also known as a knowledge based system, is a computer program that contains the knowledge and analytical skills of one or more human experts, related to a specific subject. Thus an expert system asks you questions until it can identify an object that makes your answers. More generally an expert system attempts to advice its user its subject of expertise. This system is used to diagnose a disease and also give preliminary medical prescription to the patient. It accepts symptoms from the user and generates the diagnosis.

Typically, an expert system incorporates a knowledge base containing accumulated experience and an inference or rules engine -- a set of rules for applying the knowledge base to each particular situation that is described to the program. The system's capabilities can be enhanced with additions to the knowledge base or to the set of rules. Current systems may include machine learning capabilities that allow them to improve their performance based on experience, just as humans do.

The concept of expert systems was first developed in the 1970s by Edward Feigenbaum, professor and founder of the Knowledge Systems Laboratory at Stanford University. Feigenbaum explained that the world was moving from data processing to "knowledge processing," a transition which was being enabled by new processor technology and computer architectures.

Expert systems have played a large role in many industries including in financial services, telecommunications, healthcare, customer service, transportation, video games, manufacturing, aviation and written communication. Two early expert systems broke ground in the healthcare space for medical diagnoses: Dendral, which helped chemists identify organic molecules, and

MYCIN, which helped to identify bacteria such as bacteremia and meningitis, and to recommend antibiotics and dosages.

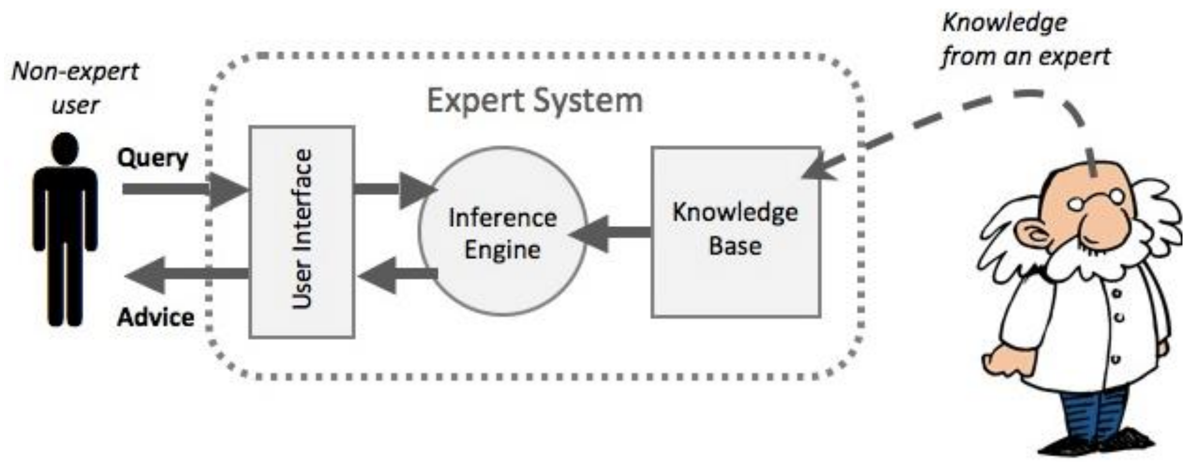


Figure: Components of Expert System

Components of Expert Systems:

1. User Interface (UI)

With the assistance of a UI, the master framework communicates with the client, accepts inquiries as a contribution to a clear arrangement, and passes it to the deduction motor.

In the wake of getting the reaction from the deduction motor, it shows the yield to the client. As it were, it is an interface that helps a non-master client to speak with the master framework to discover an answer.

It takes the client's inquiry in a coherent structure and forwards it to the inference engine. From that point onward, it shows the outcomes to the client, as such, it's an interface that enables the client to speak with the master framework.

The (UI) is the space that encourages correspondence between the framework and its clients. It's synonymous with your PC work area or cell phone home screen.

2. Inference Engine

Inference Engine is the mind behind the UI. It contains a predefined set of rules to tackle a particular issue and alludes to the information from the Knowledge Base.

It chooses realities and rules to apply when attempting to answer the client's inquiry. Inference Engine gives thinking about the data in the information base.

It likewise helps in deducting the issue to discover the arrangement. This part is additionally useful for detailing ends.

The two basic strategies used in inference engines are:

a. **Forward Chaining**

   This strategy used to determine the probable outcome in the future. With the given inputs and conditions, this strategy utilizes expert systems to find out the probable outcome. This helps to extract data till a particular goal is reached.

b. **Backward Chaining**

   This strategy used to determine why a particular event take would happen with the current circumstances provided. It is utilized in automated theorem provers, inference engines, proof assistants, and other AI applications.

3. Knowledge Base

It is where data contributed by specialists from the required domains is put away. Think about an information base as a book or an article. To make entries from a book sound, you need to refer to data from specialists to make it more credible. It contains both factual and heuristic knowledge.

Characteristics of Expert Systems in AI:

1. High performance
The first and foremost characteristic of an expert system is to deliver high performance 24×7

2. Understandable
The expert system should be easy to comprehend for all the people using it.

3. Reliable
An expert system has to be reliable in the sense that it is error-free so that it is trustable.

4. Highly Responsive
An expert system has to be proactive and provide responses for each and every detail of the problem.

Advantages:

- Provides consistent answers for repetitive decisions, processes and tasks

- Holds and maintains significant levels of information
- Encourages organizations to clarify the logic of their decision-making
- Never "forgets" to ask a question, as a human might

Limitations:

- Lacks common sense needed in some decision making
- Cannot make creative responses as human expert would in unusual circumstances
- Domain experts not always able to explain their logic and reasoning
- Errors may occur in the knowledge base, and lead to wrong decisions
- Cannot adapt to changing environments, unless knowledge base is changed

Applications of Expert Systems:

- Expert systems are being used in designing and manufacturing domain for the production of vehicles and gadgets like cameras.
- In the knowledge domain, Expert Systems are used for delivering the required knowledge to the client. The knowledge can be legal advice, tax advice, or something other than that.
- In the banking and finance sector, expert systems are widely used for the detection of frauds.
- Expert Systems can also use in the diagnosis and troubleshooting of medical equipment.
- Apart from this, Expert Systems can also have use cases in Planning and Scheduling tasks.

Languages and technologies:

Expert systems have been constructed using various general-purpose programming languages as well as specific tools. LISP and PROLOG have been used widely.

SWI-Prolog offers a comprehensive free Prolog environment. Since its start in 1987, SWI-Prolog development has been driven by the needs of real world applications. SWI-Prolog is widely used in research and education as well as commercial applications.
Python and Java programming languages are also used along with ML.

Sample program: The animal identification game (simple expert system)

```
go :- hypothesize(Animal),
      write('I guess that the animal is: '),
      write(Animal),
      nl,
      undo.

/* hypotheses to be tested */
hypothesize(cheetah)   :- cheetah, !.
hypothesize(tiger)     :- tiger, !.
```

```
hypothesize(giraffe)   :- giraffe, !.
hypothesize(zebra)     :- zebra, !.
hypothesize(ostrich)   :- ostrich, !.
hypothesize(penguin)   :- penguin, !.
hypothesize(albatross) :- albatross, !.
hypothesize(unknown).             /* no diagnosis */

/* animal identification rules */
cheetah :- mammal,
           carnivore,
           verify(has_tawny_color),
           verify(has_dark_spots).
tiger :- mammal,
         carnivore,
         verify(has_tawny_color),
         verify(has_black_stripes).
giraffe :- ungulate,
           verify(has_long_neck),
           verify(has_long_legs).
zebra :- ungulate,
         verify(has_black_stripes).

ostrich :- bird,
           verify(does_not_fly),
           verify(has_long_neck).
penguin :- bird,
           verify(does_not_fly),
           verify(swims),
           verify(is_black_and_white).
albatross :- bird,
             verify(appears_in_story_Ancient_Mariner),
             verify(flys_well).

/* classification rules */
mammal    :- verify(has_hair), !.
mammal    :- verify(gives_milk).
bird      :- verify(has_feathers), !.
bird      :- verify(flys),
             verify(lays_eggs).
carnivore :- verify(eats_meat), !.
carnivore :- verify(has_pointed_teeth),
             verify(has_claws),
             verify(has_forward_eyes).
ungulate :- mammal,
            verify(has_hooves), !.
ungulate :- mammal,
            verify(chews_cud).

/* how to ask questions */
ask(Question) :-
    write('Does the animal have the following attribute: '),
    write(Question),
    write('? '),
    read(Response),
```

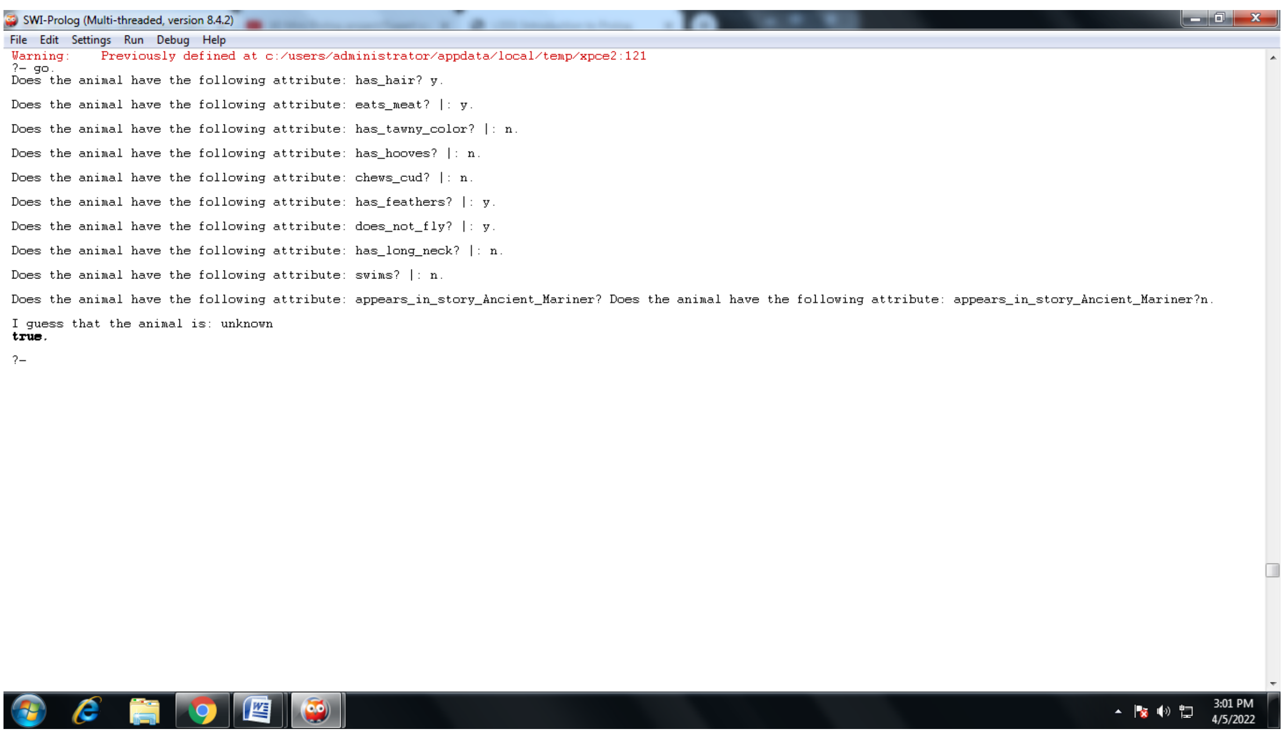
```
    nl,
    ( (Response == yes ; Response == y)
      ->
       assert(yes(Question)) ;
       assert(no(Question)), fail).

:- dynamic yes/1,no/1.

/* How to verify something */
verify(S) :-
   (yes(S)
    ->
    true ;
    (no(S)
     ->
     fail ;
     ask(S))).

/* undo all yes/no assertions */
undo :- retract(yes(_)),fail.
undo :- retract(no(_)),fail.
undo.
```

Output:



```
?- go.
Does the animal have the following attribute: has_hair? y.
Does the animal have the following attribute: eats_meat? |: y.
Does the animal have the following attribute: has_tawny_color? |: n.
Does the animal have the following attribute: has_hooves? |: n.
Does the animal have the following attribute: chews_cud? |: n.
Does the animal have the following attribute: has_feathers? |: y.
Does the animal have the following attribute: does_not_fly? |: y.
Does the animal have the following attribute: has_long_neck? |: n.
Does the animal have the following attribute: swims? |: n.
Does the animal have the following attribute: appears_in_story_Ancient_Mariner? Does the animal have the following attribute: appears_in_story_Ancient_Mariner?n.
I guess that the animal is: unknown
true.
?- 
```

Conclusion:

We have understood the concept of Expert system and implemented an expert system for Hospitals and medical facilities.

Oral questions:

1. What is an expert system?
2. What are the different stages/components/blocks of expert system?
3. What is meant by a knowledge base?
4. How a knowledge base is different from a database?
5. What is an inference engine?
6. Whether an expert system can replace human experts? Yes/No
7. What is an expert shell?
8. What are the desirable properties of a good expert system?
9. What is MYCIN?
10. What is Prolog?
11. What Are The Features Of Prolog Language?

Reference:
https://www.swi-prolog.org/
https://www.cpp.edu/~jrfisher/www/prolog_tutorial/pt_framer.html