University of Chittagong

A Rule Based System for Anticipating Chronic and Inflammatory Ailments Based on Symptoms

CSE 714 Artificial Intelligence Lab

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1. Problem Statement

Medicine and healthcare are some of the most crucial parts of the economy and human life. There is a tremendous amount of change in the world we are living in now and the world that existed a few weeks back. Everything has turned gruesome and divergent. In this situation, where everything has turned virtual, the doctors and nurses are putting up maximum efforts to save people's lives even if they have to danger their own. There are also some remote villages which lack medical facilities. Virtual doctors are board-certified doctors who choose to practice online via video and phone appointments, rather than in-person appointments but this is not possible in the case of emergency. Machines are always considered better than humans as, without any human error, they can perform tasks more efficiently and with a consistent level of accuracy. A disease predictor can be called a virtual doctor, which can predict the disease of any Patient without any human error. In this report, we are focusing on some automated system for chronic and inflammatory disease prediction. A disease or condition that usually lasts for 3 months or longer and may get worse over time. Chronic diseases tend to occur in older adults and can usually be controlled but not cured. The most common types of chronic disease are cancer, heart disease, stroke, diabetes, and arthritis. Moreover, Inflammation is a process by which your body's white blood cells and the things they make protect you from infection from outside invaders, such as bacteria and viruses. But in some diseases, like arthritis, your body's defense system -- your immune system -- triggers inflammation when there are no invaders to fight off. In these autoimmune diseases, your immune system acts as if regular tissues are infected or somehow unusual, causing damage.
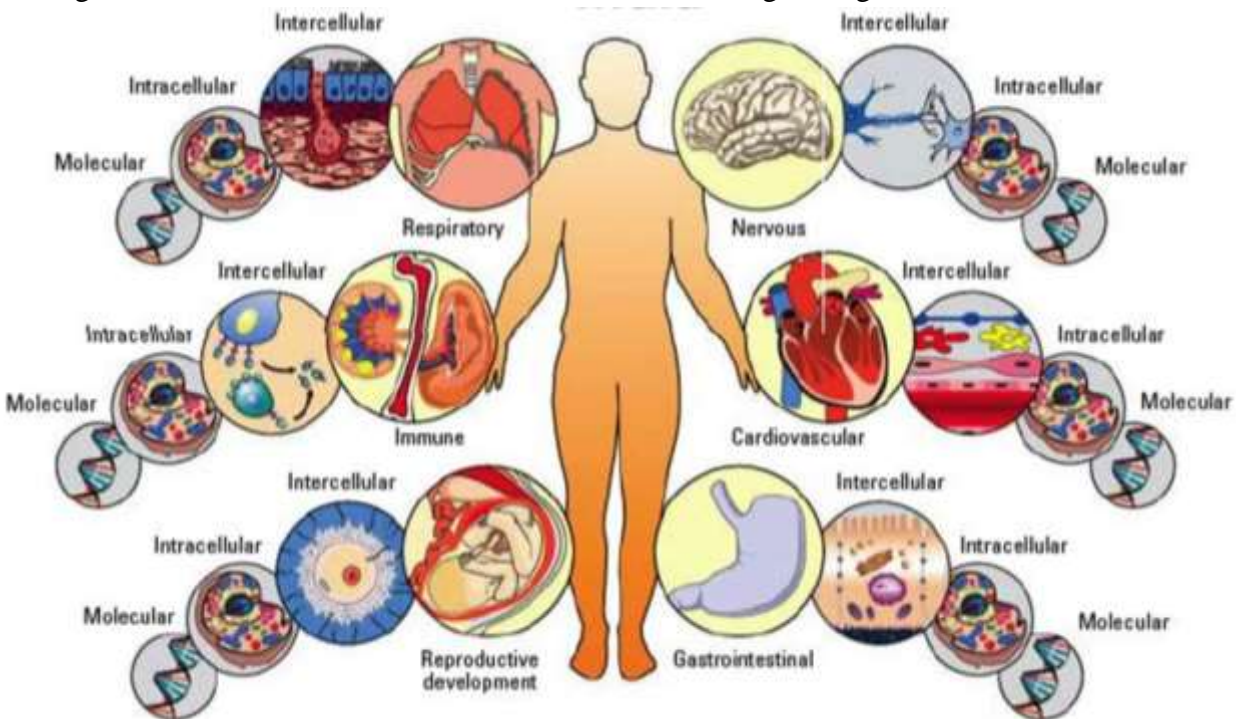

Figure 1: A condition of Human body

The kind of chronic and inflammatory illness can be determined by an expert system built into prolog. The kind of chronic and inflammatory illness may be identified, which will benefit both the medical system and the Patient.

2. Rule Based System

The most basic type of artificial intelligence is rule-based systems, commonly referred to as production systems or expert systems. In a rule-based system, the knowledge that has been programmed into the system is represented by rules. Expert systems, which are a system that replicates the thinking of a human expert in addressing a knowledge-intensive problem, are the foundation upon which the definitions of the rule-based system are founded. A rule-based system conveys knowledge in terms of a collection of rules that specify what to do or what to conclude in various scenarios, as opposed to describing information declaratively and statically as a set of true objects.

An automated system may be programmed using the knowledge of a human specialist in a relatively small field using a rule-based framework. By combining a set of assertions with a set of rules that define how to respond to the assertion set, one may easily build a rule-based system. A collection of if-then statements are used to represent rules; these are known as IF-THEN rules or production rules. For example, the phrase IF P THEN Q is identical to the statement P⇒Q. The components of a rule-based system are a collection of IF-THEN rules, a set of facts, and some interpreters who regulate how the rules are applied in light of the facts.

Using knowledge from an intelligent system and encoding it into a set of regulations is the notion behind an expert system. The expert system will operate (or is anticipated to act) similarly to the expert when presented with the same facts. Rule-based systems are incredibly flexible models that may be used to solve a wide variety of issues. The knowledge about the issue area must be able to be stated as a set of if-then rules. Additionally, the region shouldn't be too big because an expert system's ability to handle problems might be hindered by a huge number of rules.

3. Aims and Objectives

The goals of my project are to:

- Assist users in determining whether they have chronic and inflammatory conditions while they are at home.
- Sharing knowledge with a large population of individuals, whether or not the users have a sickness that is comparable to theirs.
- Promoting knowledge of the inflammatory and chronic illness.
- Developing an approachable rule-based framework.

4. Architecture

"Rule Based Architecture" is the foundation of the system. It detects input from the surrounding world and communicates with the user via a user interface. It utilizes knowledge base rules and information from the database to deduce an answer. The user is then presented with the response.
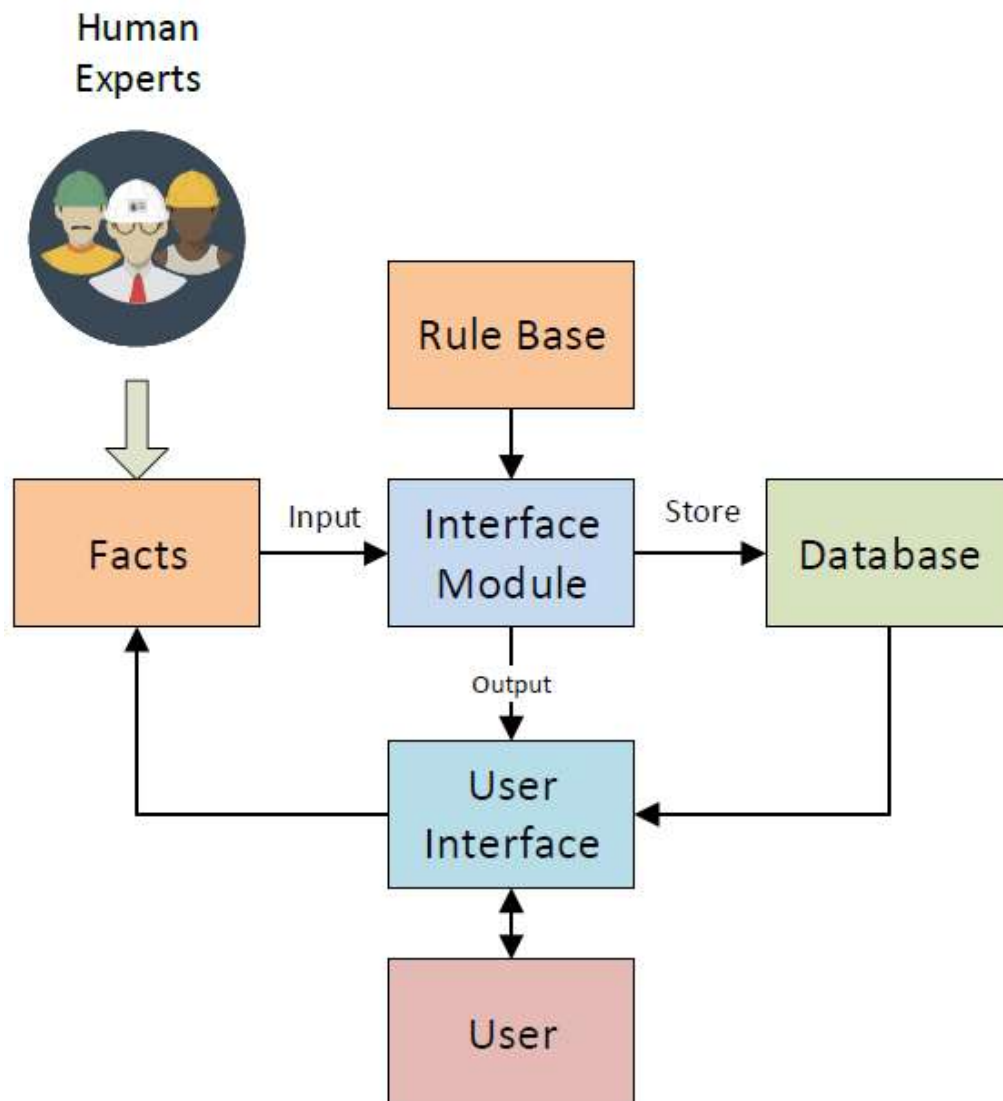

Figure 3: Architecture of the system.

5. Problem Space

Symptoms	Disease
Itching	
Skin rash	Fungal infection
Nodal skin eruptions	

Continuous sneezing	Allergy
Shivering	
chills	
Stomach pain	GERD
Acidity	
Ulcers on tongue	
vomitting	
Stomach pain	Drug Reaction
Burning micturition	
Spotting urination	
Vomiting	Peptic ulcer disease
Indigestion	
Loss of appetite	
Passage of gase	
Internal itching	
Muscle wasting	AIDS
Patches in throat	
High fever	
Extra marital contacts	
Fatigue	Diabetics
Weight loss	
Restlessness	
Lethargy	
Irregular sugar level	
Blurred and distorted vision	
Obesity	
Excessive hunger	
Polyuria	
Increased appetite	
Vomiting	Gastroenteritis
Sunken eyes	
Dehydration	
Diarrhea	
Fatigue	Bronchial Asthma
Cough	
High fever	
Breathlessness	
Family history	
Mucoid sputum	

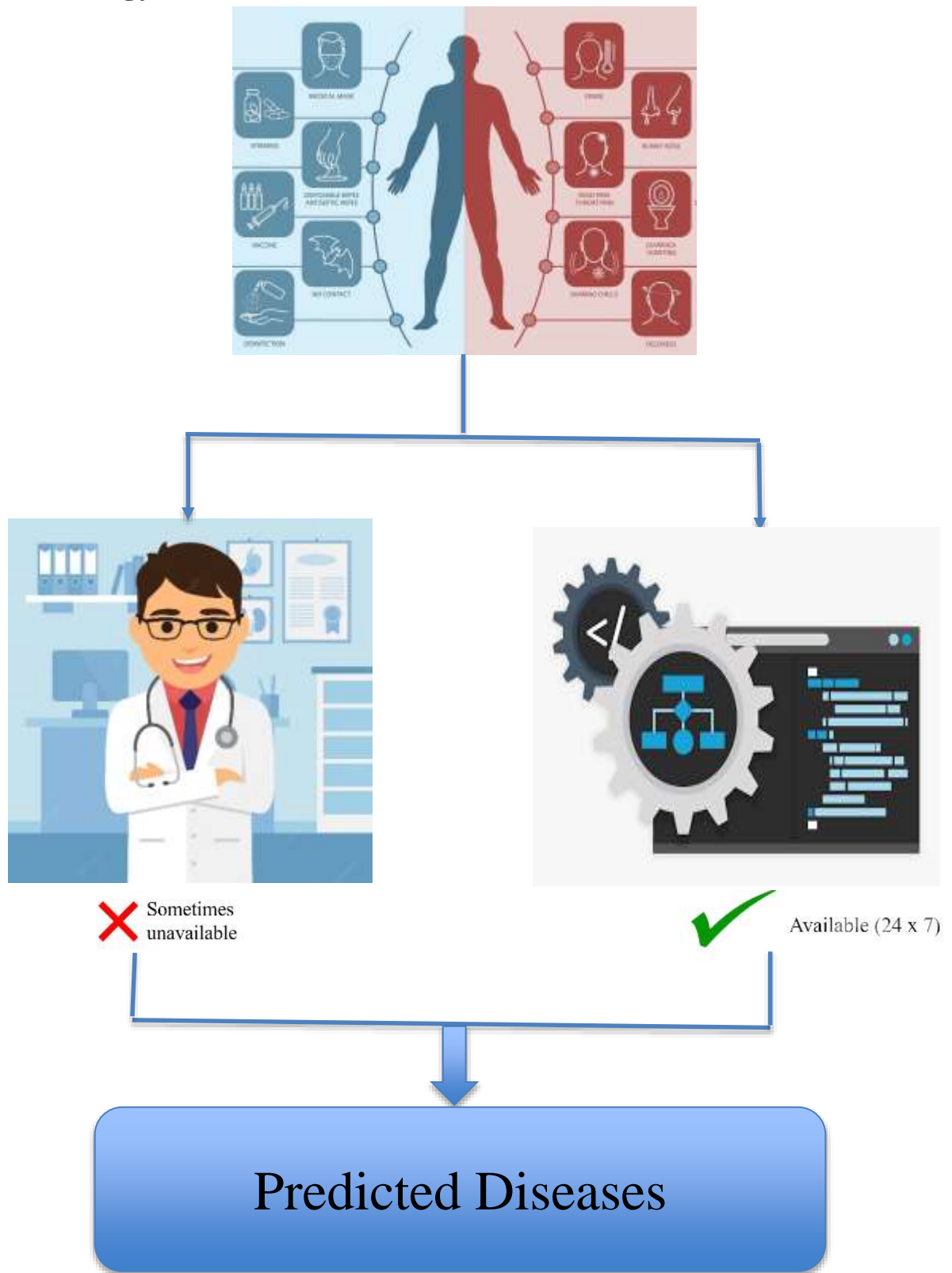| Symptoms	Disease
Indigestion	Hypertension
Chest pain	
Dizziness	
Loss of balance	
Loss of concentration	
Acidity	Migraine
Indigestion	
Headache	
Blurred and distorted vision	
Excessive hunger	
Stiff neck	
Irritability	
Depression	
Visual disturbances	
Back pain	Cervical spondylosis
Weakness in limbs	
Dizziness	
Neck pain	
Loss of balance	
Vomiting	Paralysis(Brain hemorrhage)
Headache	
Weakness on one body side	
Altered sensorium	
Itching	Jaundice
Vomiting	
Fatigue	
Weight loss	
High fever	
Dark urine	
Yellowish skin	
Abdominal pain	
Chills	Malaria
Vomiting	
High fever	
Sweating	
Headache	
Nausea	
Diarrhea	
Muscle pain	

6. Methodology

Figure 2: Proposed system for disease prediction.

7. Implementation

Domains

disease, indication = symbol

Patient, name = string

Predicates

hypothesis(string,disease)

symptom(name,indication)

response(char)

go

Clauses

```
go:-
    write("What is the Patient name? "),
    readln(Patient),
    hypothesis(Patient,disease),
    write(Patient," probably has ",disease,"."),nl,!.


go:-
    write("Sorry, I do not seem to be able to"),nl,
    write("diagnosis the disease."),nl.


symptom(Patient, itching):-
    write("Does ",Patient," have a itching(y/n)?"),
    response(Reply),
    Reply='y'.


symptom(Patient, skin_rash):-
    write("Does ",Patient," have a skin_rash(y/n)?"),
    response(Reply),
    Reply='y'.


symptom(Patient, nodal_skin_eruptions):-
    write("Does ",Patient," have a nodal_skin_eruptions(y/n)?"),
    response(Reply),
    Reply='y'.


symptom(Patient, continuous_sneezing):-
    write("Does ",Patient," have a continuous_sneezing(y/n)?"),
    response(Reply),
    Reply='y'.
```

```prolog
symptom(Patient, shivering):-
    write("Does ",Patient," have a shivering(y/n)?"),
    response(Reply),
    Reply='y'.

symptom(Patient, chills):-
    write("Does ",Patient," have a chills(y/n)?"),
    response(Reply),
    Reply='y'.

symptom(Patient, stomach_pain):-
    write("Does ",Patient," have a stomach_pain(y/n)?"),
    response(Reply),
    Reply='y'.

 symptom(Patient, acidity):-
    write("Does ",Patient," have a acidity(y/n)?"),
    response(Reply),
    Reply='y'.

symptom(Patient, ulcers_on_tongue):-
    write("Does ",Patient," have a ulcers_on_tongue(y/n)?"),
    response(Reply),
    Reply='y'.

symptom(Patient, vomitting):-
    write("Does ",Patient," have a vomitting(y/n)?"),
    response(Reply),
    Reply='y'.

symptom(Patient, fever):-
    write("Does ",Patient," have a fever(y/n)?"),
    response(Reply),
    Reply='y'.

symptom(Patient, rash):-
    write("Does ",Patient," have a rash(y/n)?"),
    response(Reply),
    Reply='y'.
```

```prolog
symptom(Patient, runny_nose):-
     write("Does ",Patient," have a runny_nose(y/n)?"),
     response(Reply),
     Reply='y'.

symptom(Patient, headache):-
     write("Does ",Patient," have a headache(y/n)?"),
     response(Reply),
     Reply='y'.

symptom(Patient,conjuctivitis):-
     write("Does ",Patient," have a conjuctivits(y/n)?"),
     response(Reply),
     Reply='y'.

symptom(Patient,cough):-
     write("Does ",Patient," have a cough(y/n)?"),
     response(Reply),
     Reply='y'.

symptom(Patient,sneezing):-
     write("Does ",Patient," have a sneezing(y/n)?"),
     response(Reply),
     Reply='y'.


symptom(Patient,sore_throat):-
     write("Does ",Patient," have a sore_throat(y/n)?"),
     response(Reply),
     Reply='y'.

symptom(Patient,swollen_gland) :-
     write("Does ",Patient," have a swollen_gland(y/n)?"),
     response(Reply),
     Reply='y'.

symptom(Patient, body_ache):-
     write("Does ",Patient," have a sore_throat(y/n)?"),
     response(Reply),
     Reply='y'.
```

```prolog
symptom(Patient, yellowish_skin):-
     write("Does ",Patient," have a yellowish_skin(y/n)?"),
     response(Reply),
     Reply='y'.

symptom(Patient, nausea):-
     write("Does ",Patient," have a nausea(y/n)?"),
     response(Reply),
     Reply='y'.

symptom(Patient, loss_of_appetite):-
     write("Does ",Patient," have a loss_of_appetite(y/n)?"),
     response(Reply),
     Reply='y'.

symptom(Patient, abdominal_pain):-
     write("Does ",Patient," have a abdominal_pain(y/n)?"),
     response(Reply),
     Reply='y'.

symptom(Patient, burning_micturition):-
     write("Does ",Patient," have a burning_micturition(y/n)?"),
     response(Reply),
     Reply='y'.

symptom(Patient, spotting_urination):-
     write("Does ",Patient," have a spotting_urination(y/n)?"),
     response(Reply),
     Reply='y'.

symptom(Patient, indigestion):-
     write("Does ",Patient," have a indigestion(y/n)?"),
     response(Reply),
     Reply='y'.

symptom(Patient, passage_of_gase):-
     write("Does ",Patient," have a passage_of_gase(y/n)?"),
     response(Reply),
     Reply='y'.
```

```prolog
symptom(Patient, internal_itching):-
     write("Does ",Patient," have a internal_itching(y/n)?"),
     response(Reply),
     Reply='y'.


symptom(Patient, muscle_wasting):-
     write("Does ",Patient," have a muscle_wasting(y/n)?"),
     response(Reply),
     Reply='y'.


symptom(Patient, patches_in_throat):-
     write("Does ",Patient," have a patches_in_throat(y/n)?"),
     response(Reply),
     Reply='y'.


symptom(Patient, high_fever):-
     write("Does ",Patient," have a high_fever(y/n)?"),
     response(Reply),
     Reply='y'.


symptom(Patient, extra_marital_contacts):-
     write("Does ",Patient," have a patches_in_throat(y/n)?"),
     response(Reply),
     Reply='y'.


symptom(Patient, fatigue):-
     write("Does ",Patient," have a fatigue(y/n)?"),
     response(Reply),
     Reply='y'.


symptom(Patient, weight_loss):-
     write("Does ",Patient," have a weight_loss(y/n)?"),
     response(Reply),
     Reply='y'.


symptom(Patient, restlessness):-
     write("Does ",Patient," have a restlessness(y/n)?"),
     response(Reply),
     Reply='y'.
```

```prolog
symptom(Patient, lethargy):-
    write("Does ",Patient," have a lethargy(y/n)?"),
    response(Reply),
    Reply='y'.

symptom(Patient, irregular_sugarlevel):-
    write("Does ",Patient," have a irregular_sugarlevel(y/n)?"),
    response(Reply),
    Reply='y'.

symptom(Patient, blurred_and_distorted_vision):-
    write("Does ",Patient," have a blurred_and_distorted_vision(y/n)?"),
    response(Reply),
    Reply='y'.

symptom(Patient, obesity):-
    write("Does ",Patient," have a obesity(y/n)?"),
    response(Reply),
    Reply='y'.

symptom(Patient, excessive_hunger):-
    write("Does ",Patient," have a excessive_hunger(y/n)?"),
    response(Reply),
    Reply='y'.

symptom(Patient, polyuria):-
    write("Does ",Patient," have a polyuria(y/n)?"),
    response(Reply),
    Reply='y'.

symptom(Patient, increased_appetite):-
    write("Does ",Patient," have a increased_appetite(y/n)?"),
    response(Reply),
    Reply='y'.

symptom(Patient, sunken_eyes):-
    write("Does ",Patient," have a sunken_eyes(y/n)?"),
    response(Reply),
    Reply='y'.
```

```prolog
symptom(Patient, dehydration):-
    write("Does ",Patient," have a dehydration(y/n)?"),
    response(Reply),
    Reply='y'.

symptom(Patient, diarrhoea):-
    write("Does ",Patient," have a diarrhoea(y/n)?"),
    response(Reply),
    Reply='y'.

symptom(Patient, family_history):-
    write("Does ",Patient," have a family_history(y/n)?"),
    response(Reply),
    Reply='y'.

symptom(Patient, mucoid_sputum):-
    write("Does ",Patient," have a mucoid_sputum(y/n)?"),
    response(Reply),
    Reply='y'.

symptom(Patient, breathlessness):-
    write("Does ",Patient," have a breathlessness(y/n)?"),
    response(Reply),
    Reply='y'.

symptom(Patient, chest_pain):-
    write("Does ",Patient," have a chest pain(y/n)?"),
    response(Reply),
    Reply='y'.

symptom(Patient, stiff_neck):-
    write("Does ",Patient," have a stiff neck(y/n)?"),
    response(Reply),
    Reply='y'.

symptom(Patient, irritability):-
```

```prolog
        write("Does ",Patient," have a irritability(y/n)?"),
        response(Reply),
        Reply='y'.


symptom(Patient, deepression):-
        write("Does ",Patient," have a deepression(y/n)?"),
        response(Reply),
        Reply='y'.


symptom(Patient, visual_disturbances):-
        write("Does ",Patient," have a visual_disturbances(y/n)?"),
        response(Reply),
        Reply='y'.


symptom(Patient, dizziness):-
        write("Does ",Patient," have a dizziness(y/n)?"),
        response(Reply),
        Reply='y'.


symptom(Patient, loss_of_balance):-
        write("Does ",Patient," have a loss_of_balance(y/n)?"),
        response(Reply),
        Reply='y'.


symptom(Patient, lack_of_concentration):-
        write("Does ",Patient," have a lack_of_concentration(y/n)?"),
        response(Reply),
        Reply='y'.


symptom(Patient, back_pain):-
        write("Does ",Patient," have a back pain(y/n)?"),
        response(Reply),
        Reply='y'.
```

```prolog
symptom(Patient, weakness_of_limbs):-
    write("Does ",Patient," have a weakness_of_limbs(y/n)?"),
    response(Reply),
    Reply='y'.


symptom(Patient, neck_pain):-
    write("Does ",Patient," have a neck_pain(y/n)?"),
    response(Reply),
    Reply='y'.


symptom(Patient, weakness_of_one_body_side):-
    write("Does ",Patient," have a weakness_of_one_body_side(y/n)?"),
    response(Reply),
    Reply='y'.


symptom(Patient, altered_sensorium):-
    write("Does ",Patient," have a altered_sensorium(y/n)?"),
    response(Reply),
    Reply='y'.


symptom(Patient, dark_urine):-
    write("Does ",Patient," have a dark_urine(y/n)?"),
    response(Reply),
    Reply='y'.


symptom(Patient, abdominal_pain):-
    write("Does ",Patient," have a abdominal_pain(y/n)?"),
    response(Reply),
    Reply='y'.

symptom(Patient, sweating):-
    write("Does ",Patient," have a sweating(y/n)?"),
    response(Reply),
```

```prolog
        Reply='y'.

symptom(Patient, muscle_pain):-
        write("Does ",Patient," have a abdominal_pain(y/n)?"),
        response(Reply),
        Reply='y'.

hypothesis(Patient,malaria):-
            symptom(Patient,chills),
            symptom(Patient,vomitting),
            symptom(Patient,high_fever),
            symptom(Patient,sweating),
            symptom(Patient,headache),
            symptom(Patient,nausea),
            symptom(Patient,diarrhoea),
            symptom(Patient,muscle_pain).

hypothesis(Patient,jaundice):-
            symptom(Patient,itching),
            symptom(Patient,vomitting),
            symptom(Patient,fatigue),
            symptom(Patient,weight_loss),
            symptom(Patient,stiff_neck),
            symptom(Patient,high_fever),
            symptom(Patient,dark_urine),
            symptom(Patient,yellowish_skin),
            symptom(Patient,abdominal_pain).

hypothesis(Patient,paralysis_brain_hemorrhage):-
            symptom(Patient,vomitting),
            symptom(Patient,headache),
            symptom(Patient,weakness_of_one_body_side),
            symptom(Patient,altered_sensorium).


hypothesis(Patient,cervical_spondylosis):-
            symptom(Patient,back_pain),
            symptom(Patient,weakness_of_limbs),
            symptom(Patient,dizziness),
            symptom(Patient,neck_pain),
            symptom(Patient,loss_of_balance).

hypothesis(Patient,migraine):-
            symptom(Patient,acidity),
            symptom(Patient,indigestion),
```

```
        symptom(Patient,headache),
        symptom(Patient,blurred_and_distorted_vision),
        symptom(Patient,stiff_neck),
        symptom(Patient,irritability),
        symptom(Patient,deepression),
        symptom(Patient,visual_disturbances),
        symptom(Patient,excessive_hunger).


hypothesis(Patient,hypertension):-
        symptom(Patient,indigestion),
        symptom(Patient,chest_pain),
        symptom(Patient,dizziness),
        symptom(Patient,loss_of_balance),
        symptom(Patient,lack_of_concentration).


hypothesis(Patient,bronchial_asthma):-
        symptom(Patient,fatigue),
        symptom(Patient,cough),
        symptom(Patient,high_fever),
        symptom(Patient,breathlessness),
        symptom(Patient,family_history),
        symptom(Patient,mucoid_sputum).

hypothesis(Patient,gastroenteritis):-
        symptom(Patient,vomitting),
        symptom(Patient,sunken_eyes),
        symptom(Patient,dehydration),
        symptom(Patient,diarrhoea).

hypothesis(Patient,diabetics):-
        symptom(Patient,fatigue),
        symptom(Patient,weight_loss),
        symptom(Patient,restlessness),
        symptom(Patient,irregular_sugarlevel),
        symptom(Patient,blurred_and_distorted_vision),
        symptom(Patient,obesity),
        symptom(Patient,excessive_hunger),
        symptom(Patient,polyuria),
        symptom(Patient,increased_appetite).


hypothesis(Patient,aIDS):-
        symptom(Patient,muscle_wasting),
        symptom(Patient,patches_in_throat),
```

```
        symptom(Patient,high_fever),
        symptom(Patient,extra_marital_contacts).

hypothesis(Patient,peptic_ulcer_disease):-
        symptom(Patient,vomitting),
        symptom(Patient,indigestion),
        symptom(Patient,loss_of_appetite),
        symptom(Patient,passage_of_gase),
        symptom(Patient,internal_itching).

hypothesis(Patient,drug_Reaction):-
        symptom(Patient,stomach_pain),
        symptom(Patient,burning_micturition),
        symptom(Patient,spotting_urination).

hypothesis(Patient,chronic_cholestasis):-
        symptom(Patient,yellowish_skin),
        symptom(Patient,nausea),
        symptom(Patient,loss_of_appetite),
        symptom(Patient,abdominal_pain).

hypothesis(Patient,fungal_infection):-
        symptom(Patient,itching),
        symptom(Patient,skin_rash),
        symptom(Patient,nodal_skin_eruptions).

hypothesis(Patient,allergy):-
        symptom(Patient,continuous_sneezing),
        symptom(Patient,shivering),
        symptom(Patient,chills).

hypothesis(Patient,gERD):-
        symptom(Patient,stomach_pain),
        symptom(Patient,acidity),
        symptom(Patient,ulcers_on_tongue),
        symptom(Patient,vomitting).

hypothesis(Patient,german_measels):-
        symptom(Patient,fever),
        symptom(Patient,rash),
        symptom(Patient,runny_nose),
        symptom(Patient,headache).

hypothesis(Patient,measels):-
        symptom(Patient,fever),
        symptom(Patient,rash),
```

```
        symptom(Patient,runny_nose),
        symptom(Patient,cough),
        symptom(Patient,conjuctivitis).

hypothesis(Patient,common_cold):-
        symptom(Patient,headache),
        symptom(Patient,sneezing),
        symptom(Patient,runny_nose),
        symptom(Patient,chills),
        symptom(Patient,sore_throat).

hypothesis(Patient,chicken_pox):-
        symptom(Patient,fever),
        symptom(Patient,rash),
        symptom(Patient,body_ache),
        symptom(Patient,chills).

response(Reply) :-
        readchar(Reply),
        write(Reply),nl.
```

8. Dialog Modules

Table 1 below illustrates a few of the turbo prolog goal procedures. A series of yes/no questions will be asked of the user in this manner; if the user responds positively to the questions, then the user exhibits those symptoms. The user input to the system is yes/no.

User	Dialog
System	Do you have a skin rash(y/n)?
User	y/n
System	Do you have ulcers on tongue(y/n)?
User	y/n
System	Do you have a yellowish skin(y/n)?
User	y/n
System	Do you have irregular sugar level(y/n)?
User	y/n
System	Do you have a blurred and distorted vision(y/n)?
User	y/n

Table 1: Some examples of symptoms.

9. Snapshots

The system was developed on prolog using DOSBOX. Some snapshots of the whole process is given below:

Figure 3: Snapshot of the implemented system.

Figure 4: Snapshot of the implemented system.

Figure 5: Snapshot of the implemented system.

Figure 6: Snapshot of the implemented system.

10. Conclusion

The prolog application I created is incredibly user-friendly and effective. It's also fairly accurate. Typically, an expert system is created to do tasks with abilities resembling those of a human expert. The user is prompted with a few yes/no questions by the application to record the symptoms they are experiencing. The expert system then searches its knowledge base for the most likely response, which in this case is the types of chronic and inflammatory diseases, after learning about all the symptoms the user is experiencing. It should be noted that an interference base is included with the knowledge base. As a result, the expert system is enhanced and gradually gains knowledge through experience. This work may be improved by:

- Including recommendations for diets and medications.
- Adding more precise rules and information.
- Including recommendations for doctors.
- And changing the user interface into a graphical one.