

Expert System Project

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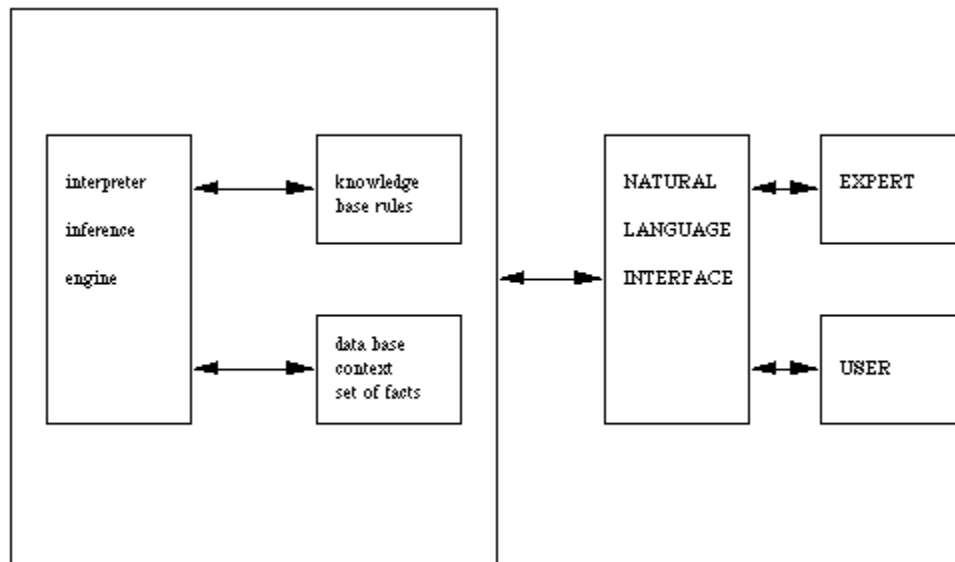
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What is an Expert System?

An expert system is a computer system that emulates the decision making ability of a human expert. Expert systems are designed to reason through a body of knowledge (Knowledge Base) and produce solutions by following a series of if-then-else statements. Expert systems are typically implemented using Procedural Code in languages such as LISP or Prolog.

The internal structure of an Expert System can be considered to be made out of three parts.

1. Knowledge Base;
2. Database
3. Rule Interpreter



Firstly, the Knowledge Base holds the set of rules that are used in reasoning. The rules follow the IF-ELSE format, and a typical knowledge base can hold anywhere from several hundred to several thousand rules.

Secondly, the Database holds the useful facts and acts as the domain of context for our problem. These are the facts that satisfy the conditions from our Knowledge Base.

Lastly, the Rule Interpreter (or Inference Engine) controls the knowledge base using the given facts to produce more facts.

The Expert System has three modes of operation. Firstly, a knowledge acquisition mode in which the designers interact with field specialists in order to extract knowledge and meaningful rules. The knowledge engineers responsible for constructing the knowledge base must act as an intermediary between the expert and the expert system. Secondly, there is a consultation mode in which the user interacts with the system by entering data in the form of facts to which the expert

system responds with an answer by querying it's knowledge base. Lastly, there is an explanation mode in which the system must explain to the user the reasoning behind it's answer.

What is COVID-19?

COVID-19 is a virus that is a member of the Coronavirus family. Coronaviruses (CoV) are a large family of illnesses that cause diseases that range from mild (common cold) to severe (MERS-CoV and SARS-CoV).

COVID-19 first appeared in the Wuhan, China in December, 2019. The virus was first diagnoses as severe pneumonia. COVID-19 has since proceeded to spread globally and was recently classified as a pandemic. The disease's main method of infection is person to person, however it is also able to live on surfaces and travel via air droplets due to coughs or sneezes.

The most common symptoms of COVID-19 are fever, dry coughing, and tiredness. However, it can also manifest symptoms such as aches and pains, nasal congestion, runny nose, sore throat, and diarrhea.

Currently, the best methods of prevention are isolation, social distancing, and quarantine. As of 4/20/2020, the disease has infected over 2.3 million people worldwide, caused over 200 thousand deaths, and has neither a vaccine nor any viable treatments.

System Goal

The goal of our COVID-19 Expert System is to provide recommendations and a course of action to patients with the ultimate hopes of reducing the load on the healthcare system. Ideally, our expert system will be used by potential patients who are curious as to their infection status.

The users fall into 3 categories:

1. Infected
2. High risk
3. Low risk

An infected patient is a patient who presents with any of the primary symptoms; fever, dry cough, and difficulty breathing. A patient who is labeled as "infected" will be advised to immediately head to the nearest hospital.

A high risk patient is a patient whose history indicates a high likelihood of exposure to COVID-19. These are patients who have travelled to high risk countries or areas (United States, Europe, China, etc), who have directly interacted with an individual diagnosed with COVID-19, or are medical professionals with a high chance of exposure. These patients are advised to isolate themselves from others and to head to the hospital if any other symptoms appear.

Lastly, a low risk patient is a patient with either no symptoms and no high risk activities, or with a few secondary symptoms like a sore throat or a runny nose. This type of patient is advised to continue being proactive at avoiding infections.

Rules

- Fever
 - Chills + Headache + Muscle Pain + Sore Eyes + Aches
 - High temperature
- Dry cough
- Difficulty breathing
- Flu Symptoms
 - Runny nose
 - Sneezing
 - Headache
 - Sore throat
- Diarrhea
- New loss of taste or smell
- Infectious Situations
 - Travel to highly infected location
 - Interacted with someone who has travelled to a highly infectious location
 - Interacted with someone who was diagnosed with COVID-19
 - Work in a field that places the patient at risk of infection

Outcomes:

- Seek medical attention.

- Self isolate and await more symptoms.
- Unlikely to have Coronavirus.

Prolog Code:

```
go:-
    /*hypothesis(disease),*/
    recommend(Action),
    write('I believe that you should '),
    (   write(Action), !);
    write('You are fine. Stay safe.'),!.
/*Hypothesis that should be tested*/

recommend("seek medical attention") :- major_symptom.
recommend("self-isolate and await more symptoms") :- minor_symptoms.

hypothesis(covid) :- major_symptom;minor_symptoms.
hypothesis("flu like symptoms") :- fls.
hypothesis( fever) :- fever.
hypothesis(infectious_situation) :- infectious_situation.

major_symptom:-
    verify("dry cough");
    hypothesis( fever);
    verify("difficulty breathing").
minor_symptoms:-
    hypothesis("flu like symptoms");
    hypothesis(infectious_situation),
    verify('diarrhea'),
    verify('loss of taste of smell').
fls :-
    verify(headache);
    verify(runny_nose);
    verify(sneezing);
    verify(sore_throat).
fever :-
    verify('high tempreture');
    (   verify(chills),
        verify(aches),
        verify('sore eyes'), verify('muscle pain'), verify(headache)).
infectious_situation :-
    (   verify_action("travel to highly infected location recently (within
the last 2 weeks)"));
    (   verify_action("Interacted with someone who has travelled to a
highly infected location"));
    verify_action("Interacted with someone while that person was sick");
    verify_action("Work in a field that puts you at risk of infection").

/* how to ask questions */
ask(Question) :-
```

```

write('Do you have:'),
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))).

ask_action(Question) :-
  write('Did you: '),
  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_action(S) :-
  (yes(S)
  ->
    true ;
    (no(S)
    ->
      fail ;
      ask_action(S))).
/* undo all yes/no assertions*/
undo :- retract(yes(_)),fail.
undo :- retract(no(_)),fail.
undo.

```