Rule Based Expert System for Rose Plant

Ch.Viswanadha Sarma

Department of CSE,

Vignan Institute of Information Technology,

Duvvada, Visakhapatnam, Andhrapradesh, India

Abstract

Expert systems are especially important to organizations that rely on people who possess specialized knowledge of some problem domain, especially if this knowledge and experience cannot be easily transferred. Artificial intelligence methods and techniques have been applied to a broad range of problems and disciplines, some of which are esoteric and others which are extremely practical

In this Rose crop Rule Based System the System takes the Symptoms as Input and produces the Exact Disease with all the facts and Rules that matches with in the Knowledge base.

Keywords: **Artificial Intelligence, Expert System, Rule based System, Disease, rules.**

1. Introduction

The need of expert systems for technical information transfer in agriculture can be identified by recognizing the problems in using the traditional system for technical information transfer, and by proving that expert systems can help to overcome the problems addressed, and are feasible to be developed. Knowledge-based expert system technology has been applied to a variety of agricultural problems. In this paper we present an inference engine which operates by the method of forward chaining.

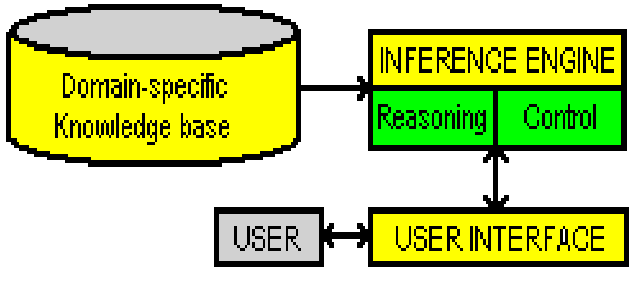
2. Expert System:

An expert system is an intelligent computer program that uses knowledge and interface procedures to solve out complex problems that requires significant human

expertise for their solution. Expert system is a computer that emulates the decision-making capacity of human experts.

In the Rose crop Rule Based System the System takes the Symptoms as Input and produce the Exact Disease with all the facts and Rules that matches with in the Knowledge base.

This Rule Based System Consists of Knowledge Base, Inference Engine, User Interface, Expert and the User.



Architecture of Expert System

- **A problem-domain specific knowledge base**: It stores the encoded knowledge to support one problem domain. In a rule-based expert system, the knowledge base includes the if-then rules. Where if the *conditions* are true then the *actions* are executed..

- **An interface engine**: It implements the reasoning mechanism and controls the interview process. When rules are examined by the inference engine, actions are executed if the information supplied by the user satisfies the conditions in the rules. Two methods of inference often are used, *forward* and *backward chaining*.

  - **Forward chaining** is a top-down method which takes facts as they become available and attempts to draw conclusions (from satisfied conditions in rules) which lead to actions being executed.
  - **Backward chaining** is the reverse. It is a bottom-up procedure which starts with *goals* (or actions) and queries the user about information which may satisfy the conditions contained in the rules. It is a verification process rather than an exploration process.

- **The user interface**: It requests information from the user and outputs intermediate and final results. In some expert systems input is acquired from additional sources such as data bases and sensors.

3. System Overview

This rule based system is developed based on the information collected from the various experts from agricultural side. The knowledge representation language is a high-level language which allows a user to construct a knowledge base. It is based upon production rules of the form:

if <*conditions*> then <*action list*>

Conditions are expressions involving attribute and the logical connective and. Attributes are of course like programming language variables and have *types* which must be *numerical* or *string*. (A string type variable can possess a value from a set of strings, for example: {true, false} or {red, yellow, green}).

An *action list* consists of one or more of the actions

In our project we have developed 150 rules for the rose crop expert system based on the information gathered from the experts.

For example

RULE: 1

If
[Infected to] = "Leaves and stems" and
[Occurs when weather is] = "cool" and
[Occurs when temperature is] <25 and
[Defoliated the plant] = "completely" and
[Causes infections when environment change] = "yes"
Then
[DISEASE] = "BLACK SPOT"

RULE:2

If
[Infected to] = "Leaves" and
[Leaves infected by color] = "brown" and
[Occurs when weather is] = "cool" and
[Occurs when temperature is] <25 and
[Defoliated the plant] = "partially" and
[Causes infections when environment change] = "yes"
Then
[DISEASE] = "BOTRYTIS BLIGHT"

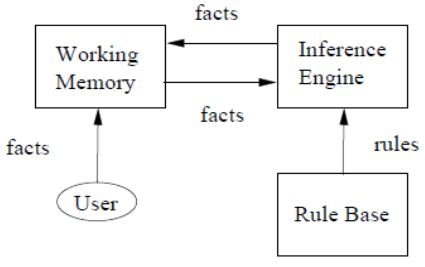
3.1. The Inference Engine:

In order to execute a rule-based expert system we use the method of ***forward chaining*** to *fire* (or execute) actions whenever they appear on the action list of a rule whose conditions are true. This involves assigning values to attributes, evaluating conditions, and checking to see if all of the conditions in a rule are satisfied.

3.2. Forward chaining:

In a forward chaining system:

1) Facts are held in a *working memory*.
2) Condition-action rules represent actions to take when specified facts occur in working memory.
3) Typically the actions involve adding or deleting facts from working memory.



Algorithm:

- Repeat
  - o Collect the *rules* whose conditions match facts in WM(Working Memory)
  - o If more than one rule matches
  - o Use *conflict resolution strategy* to eliminate all but one
  - o Do actions indicated by the rules
  - o (add facts to WM or delete facts from WM)
- Until problem is solved or no condition match

Some points about this algorithm.

First, some *conflict resolution strategy* needs to be employed in order to decide which rules are fired first.

Our method is to fire the rule which the system designer defined first. Also, we wish to cut down on computational time. To do this we must not do anything which does not absolutely need to be done. This means that conditions are only evaluated at the time they might change and that rules are checked (to see if all of their conditions are satisfied) only when they might be ready to be fired, not before. We shall do this as attributes are assigned values and shall only consider rules and conditions affected by the new attribute assignment.

Let us develop an inference engine for a rule-based system whose basic components are:

Attributes : X1, X2 , ... , Xn

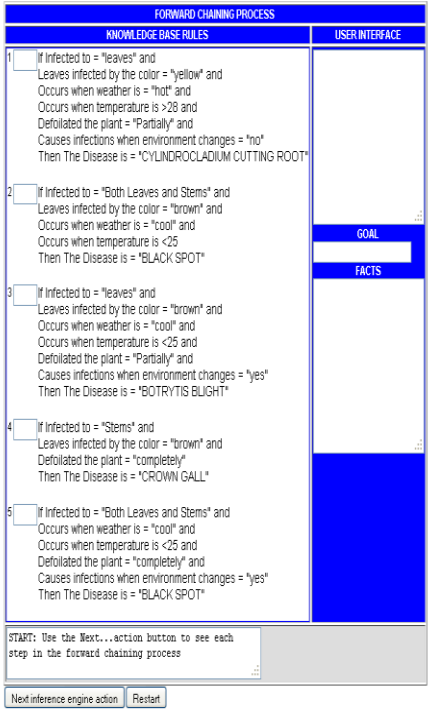
Conditions : C1, C2 , ... , Cn

Rules : R1, R2 , ... , Rn

Actions : A1, A2 , ... , An

Forward chaining process for our knowledge base:

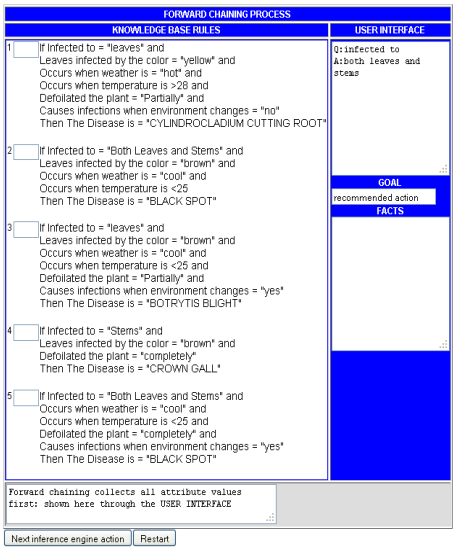
1. Here the knowledge base contains five rules.



2. Forward chaining collects all attribute values first: shown here through the USER INTERFACE

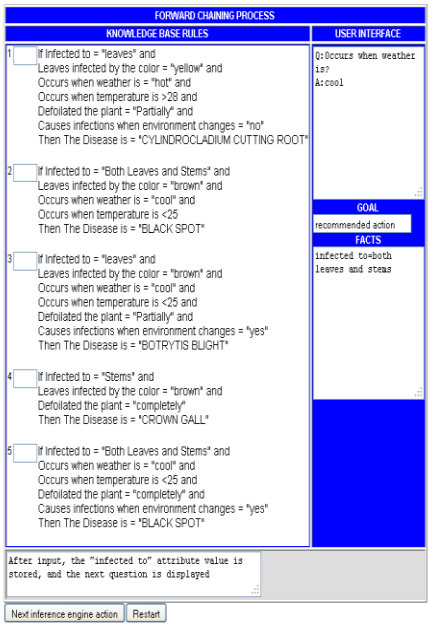
QI: Infected to:

A: both leaves and stems



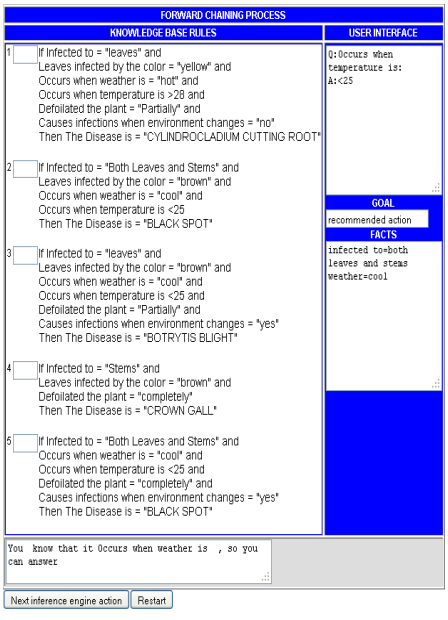
3. After input, the "infected to" attribute value is stored in FACTS, and the next question is displayed in USER INTERFACE

Q2: Occurs when the weather is:

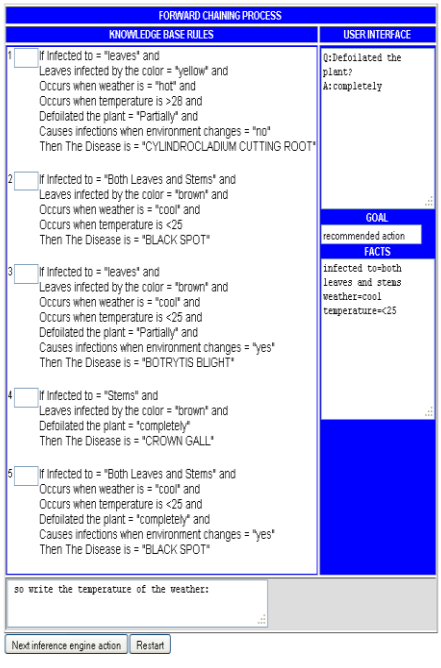


4. You know that it Occurs when weather is , so you can answer

A: cool

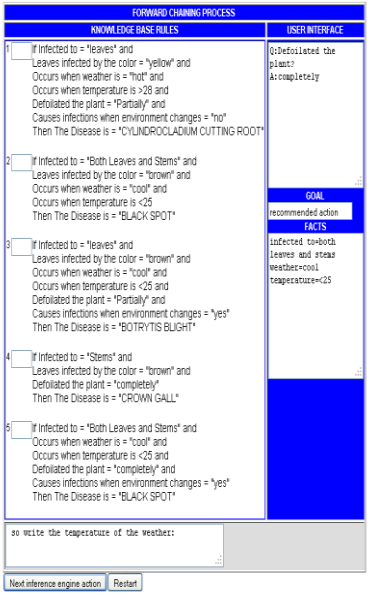


5. The weather is cool now enter the temperature is < 25

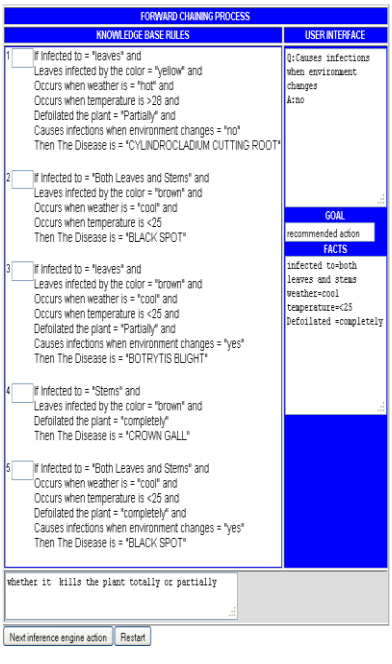


6. Now the next question is displayed in the USER INTERFACE is

Q: Defoliated the plant

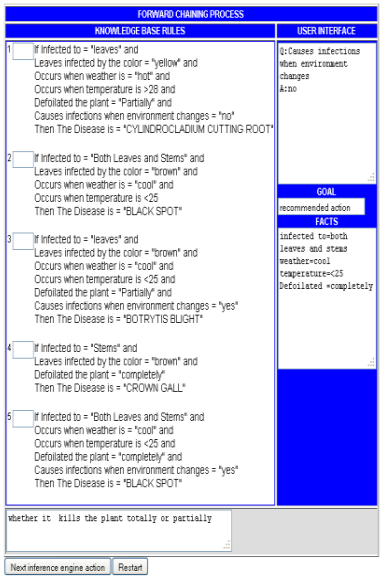


7. Enter completely or partially as answer for the question

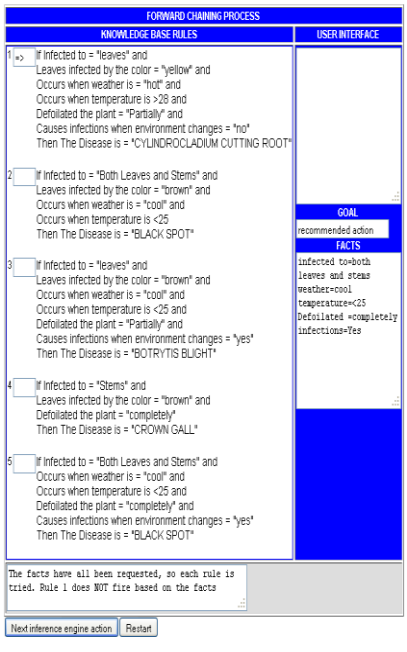


8. Now the next question is displayed in the USER INTERFACE is

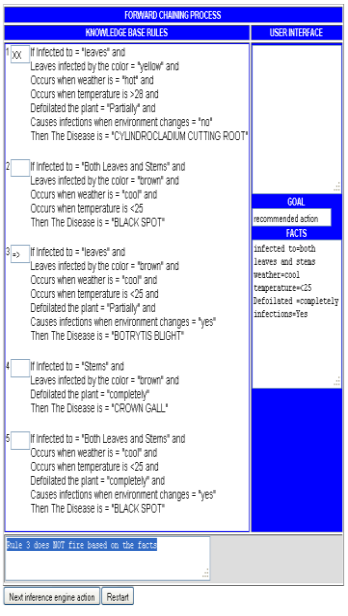
Q: Causes infections when the environment changes



9. The facts have all been requested, so each rule is fired. Rule 1 does NOT fire based on the facts



10. Rule 2 does NOT fire based on the facts



Rule 3does NOT fire based on the facts

Rule 4 does NOT fire based on the facts

Rule 5 fires, concluding that the disease is

BLACKSPOT.

This is how the forward chaining mechanism can be done in rule based expert system.

3.1. Rose Crop Rule Based Expert System

1. Initially the user has to choose a disease of rose plant
2. Next user has to choose which part of the plant it is infected to.

i.e. it may be to leaves, stems or it may be to both

According to attribute entered by the user it will connect to next rule. Likewise the user enters each one according to the information so that he will get the final result disease. It also explain that result how could it achieved through the rules in the knowledge base.

Example

1. Infected to

   Enter **leaves**

   Then it will show the next fact
2. Leaves infeted by the color

   Enter **brown**

   Next
3. Occurs when the weather is

   Enter Cool

   Next
4. Occurs when temperature

   Enter 25

   next
5. Causes infections when environment changes

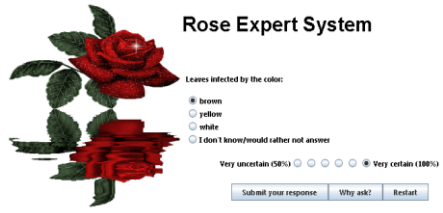
   Enter **no**

Based on the above facts the knowledge base will display the the disease is

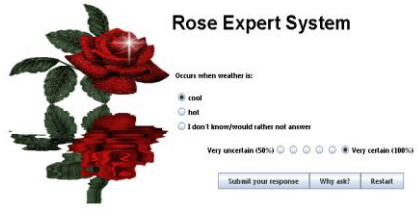
botrytis blight

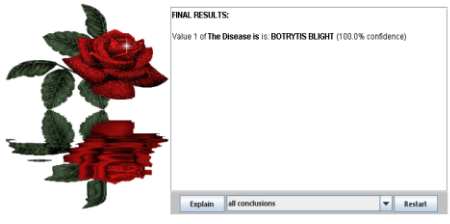
once the disease display by clicking Explain button it will give which rule will be fired and how it will be fired and also the minimum confidence factor.

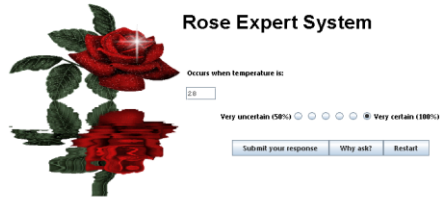
4.Screen shots:

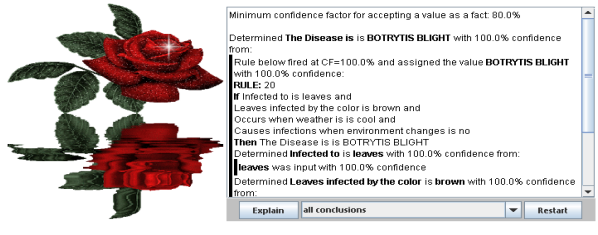

Rose Expert System
Leaves infected by the color:
brown
yellow
white
I don't know/would rather not answer
Very uncertain (50%)
Very certain (100%)
Submit your response
Why ask?
Restart

Rose Expert System
Causes infections when environment changes:
yes
no
I don't know/would rather not answer
Very uncertain (50%)
Very certain (100%)
Submit your response
Why ask?
Restart


Rose Expert System
Occurs when weather is:
cool
hot
I don't know/would rather not answer
Very uncertain (50%)
Very certain (100%)
Submit your response
Why ask?
Restart


FINAL RESULTS:
Value 1 of The Disease is is: BOTRYTIS BLIGHT (100.0% confidence)
Explain
all conclusions
Restart


Rose Expert System
Occurs when temperature is:
20
Very uncertain (50%)
Very certain (100%)
Submit your response
Why ask?
Restart


Minimum confidence factor for accepting a value as a fact: 80.0%
Determined The Disease is is BOTRYTIS BLIGHT with 100.0% confidence from:
Rule below fired at CF=100.0% and assigned the value BOTRYTIS BLIGHT with 100.0% confidence:
RULE: 20
If Infected to is leaves and
Leaves infected by the color is brown and
Occurs when weather is is cool and
Causes infections when environment changes is no
Then The Disease is is BOTRYTIS BLIGHT
Determined Infected to is leaves with 100.0% confidence from:
leaves was input with 100.0% confidence
Determined Leaves infected by the color is brown with 100.0% confidence from:
Explain
all conclusions
Restart

5. Conclusion:

Expert systems represent an important set of applications of Artificial Intelligence to problems of commercial as well as scientific importance. Rule-based systems currently the most advanced in their system-building environments and explanation capabilities, and have been used to build many demonstration programs. Most of the programs work on analysis tasks such as medical diagnosis, electronic troubleshooting, or data interpretation. The capability of current systems is difficult to define. It is clear, however, that they are specialists in very narrow areas and have very limited (but not totally missing) abilities to acquire new knowledge or explain their reasoning.

The rose crop rule based expert system main emphasis is to have a well designed interface for giving diseases in the area of horticulture (Rose) field by providing facilities like dynamic interaction between expert system and the user without the need of expert at all times.

6. References

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