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Implementing Rank Based Genetic Algorithm on Cotton Expert Advisory System

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Abstract: The present paper deals with the design and development of expert systems to advice the farmers in villages through online. An expert system is a computer program, with a set of rules encapsulating knowledge about a particular problem domain. This is a web based application developed using machine learning techniques. In the present paper genetic algorithm technique[1] has been considered and applied to generate new set of rules using the existing set of rules provided by human expert. Here a rule based expert system and a machine learning systems are integrated to form the proposed Rank Based Genetic Algorithm on Cotton Expert Advisory System. The proposed system examines the symptoms provided by the user and process the information through the new set of rules generated by the algorithm and determines the diseases affected to the Cotton crop. The system works as follows: At First, the symptoms provided by the user are examined by the rule based system and determines the diseases if they are sufficient to identify the disease. If the rules required for processing the data are not sufficient in the existing knowledge base, then the system automatically calls the machine learning algorithm technique for the new set of rules and determines the probable diseases. As a whole, the system results global solution for recognizing the diseases in Cotton crop cultivation and also suggests the corresponding treatments to the diseases. This expert system is a web based online application for online users with java as front end and MySQL as backend.

Key words: Expert Systems, Machine Learning, Genetic Algorithm, Cotton, Cross over, Selection, Mutation, JSP & MYSQL.

I. INTRODUCTION

A. Cotton Crop Cultivation Information

Cotton is produced by small trees and shrubs which bears the botanical name Gossypium. One or two Weeks after sowing shoots appear and 50 to 80 days later flowering begins. First buds are formed. After three weeks blossoms, appear after blossoming the petals fall of and the offspring or the boll develops. The boll is divided by partition in to 3-5 sections contain seeds. Fiber grows on the seeds. The plant has certainly been grown and used in India for at least 5000 years and probably for much longer. Cotton was used also by the ancient Chinese, Egyptians, and North and South Americans. Cotton is a natural vegetable fiber of great economic importance as a raw material for cloth. Its widespread use is largely due to the ease with which its fibers are spun into yarns. Cotton's strength, absorbency, and capacity to be washed and dyed also make it adaptable to a considerable variety of textile products.

B. Expert Systems

Expert system [5] in general; simulates both the knowledge and the know how of human experts. i.e., the expert system solves problems that are normally solved by human experts. All expert systems include at least three basic elements; a Knowledge base, which represents, what is known about a given subject at present, an inference engine comprises of the logistics to apply what is known to what is as yet unknown, and a user interface, which facilitates communication between the system and the user. A series of Expert advisory systems [12], [13], [15] were developed in the field of agriculture and implemented in www.indiakisan.net [14].

C. Machine Learning

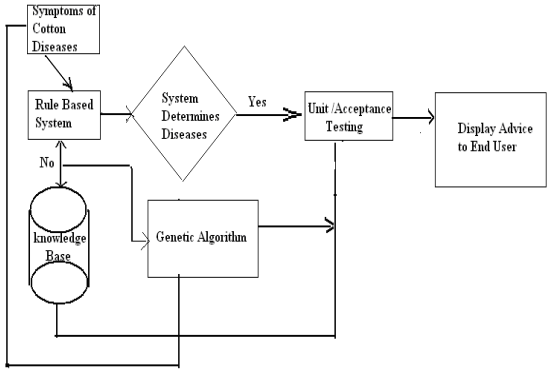
Machine Learning [2, 4, and 6] is a mechanism, concerned with writing a computer program that automatically improves with experience. It is a very young scientific discipline whose birth can be placed in the mid-seventies. The First Machine Learning Workshop was taken place in 1980 at Carnie-Mellon University (USA). The goal of machine learning is to program computers to use example data or past experience to solve a given problem. Many successful applications of machine learning exist already, including systems that analyze past sales data to predict customer behavior, recognize faces or spoken speech, optimize robot behavior, so that a task can be completed using minimum resources, and extract knowledge from bioinformatics data. Machine learning refers to the changes in systems that perform tasks associated with artificial intelligence (AI). Such tasks involve recognition, diagnosis, planning, robot control, prediction, etc. The changes might be either enhancements to already performing systems or abs initial synthesis of new systems. Some of the machines learning algorithms are Genetic Algorithm, Decision Tree Algorithm, Optimization Algorithm, and Particle Swarm Optimization Algorithm, Bayesian classifier Algorithm, C5 Algorithm.

D. Genetic Algorithm

The GA [7, 8] is a search procedure based on the principle of evolution and natural genetics. The GA combines the exploitation of past results with the exploration of the new areas of the search space by using the "survival-of-the-fittest" technique combined with a structured yet randomized information exchange. In each new generation, a set of strings is created by using information from the previous ones. Occasionally, a new part is tried from the good measure. The GA is randomized, but it is not a simple random walk. GAs efficiently exploits historic information to speculate on new search points with expected improvement. GAs start with an initial population, which is derived from the solution space and Genetic operators are then applied on the population for the appropriate mixing of exploitation and exploration. A selection strategy is used to carry forward the better population for reproduction.

II. PROPOSED INTEGRATED COTTON EXPERT ADVISORY SYSTEM

A web based application of Expert advisory system for cotton is developed here by integrating a rule based expert system and a machine learning systems using Genetic Algorithm. The proposed architecture is as follows:



A. Rank Based Selection

Rank selection [6, 9] first ranks the population and then every string receives fitness from this ranking. Selection is made based on these ranking rather than absolute differences in fitness. The worst will have fitness 1, second worst 2 etc. and the best will have fitness N (number of strings in population). So advantage of taking ranking selection is to preserves genetic diversity (by preventing dominance of "fitter" string). Ranking selection supports Elitism. Elitism is the best string which is copied to the population in the next generation.

Rank based Genetic Algorithm uses following function for calculating string fitness.

f(x) = MAX(x2): 0 <= x <= 32

2.2. Proposed Rank Based Genetic Algorithm RBGA:

GA (Fitness, Fitness threshold, p, r, m)

Step.1. Initialize population: p Generate p hypotheses at random.

Step.2. Evaluate: For each h in P, Compute Fitness (h)

Step.3. While [max Fitness] < Fitness _threshold do

Step.4. Create a new generation, Ps:

1. **Select**: Select two parent hypothesis from a population according to their fitness (the better fitness, the bigger chance to be selected) The idea is to choose the better parents.
2. **Crossover**: Probabilistically select r-p/2 pairs of hypotheses from P, according to Pr (hi) given above. For each pair (h1, h2) produce two offspring by applying the Crossover operator add all offspring to Ps
3. **Mutate**: Choose m percent of the members of Ps with Uniform probability for each invert one randomly selected bit in this representation

Step.5. **Update:** P←Ps

Step.6. **Evaluate**: for each h in p compute Fitness (h)

Step.7. Return the hypothesis from P that has the highest fitness

III. DATABASE GENERATION

In this section, the setup for production rules in the knowledge base is presented. Generally the rules are of the form,

Rule 1: S1=1,S2= 0,S3= 0,S4= 0, S5=0,S6= 1,S7= 0,S8=1, S9= 0,S10= 0,S11= 0,S12= 0

Resultant disease may be D3

Rule 2: S1= 1,S2=1 ,S3= 0 ,S4= 0, S5= 0,S6= 0 ,S7=1,S8= 0 ,S9= 0 ,S10= 0 ,S11=0,S12= 1Resultant disease may be D1

Rule 3: S1= 0,S2= 1 ,S3= 0 ,S4= 0 , S5= 1,S6= 1 ,S7= 0,S8= 0 ,S9= 0 ,S10=1 ,S11=0 ,S12= 0 Resultant disease may be D5.

IV. RESULTS

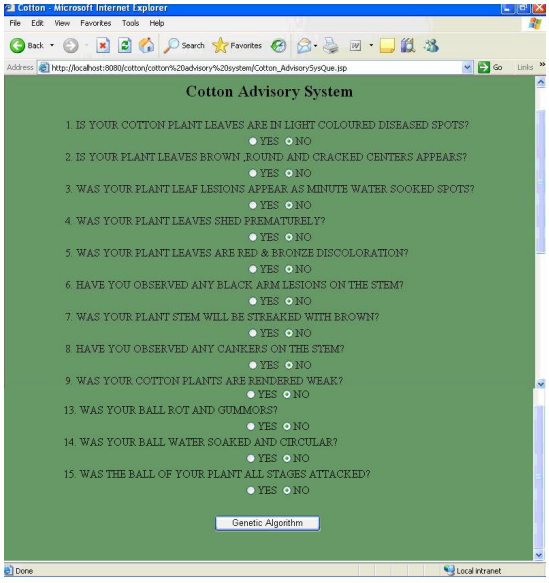


Figure.1 Selection of Symptoms

Description: In this screen shot, the user can submit the observed symptoms to the cotton advisory system through online by selecting the appropriate radio buttons for the processing of the symptoms observed.

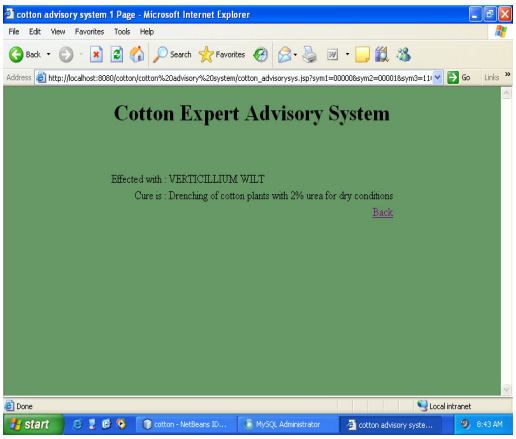


Figure.2 Displaying advice to the end user

From the above screen shot it may be observed the following:

May be affected with: "Verticilium Wilt"

Cure is: 2% urea for dry conditions.

V. CONCLUSIONS

An Expert Advisory System entitled "Cotton Expert Advisory System Using Rank based Genetic Algorithm" was developed using Java Server Pages (JSP) and MySql database as backend. Its main emphasis is the integration of a rule based algorithm and a machine learning algorithm. It also have a well designed interface to provide cotton plant related information and advices to farmers. It also provides facilities like online interaction between expert system and the user without the need of expert all times. The expert is having the additional features like the addition, modification, and deletion of symptoms, diseases, rules and their combinations. The expert can also make any type of changes in the information system. But, the overall permissions for making any type of changes in the designed systems lie with the system administrator.

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