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Application of Rough Set Theory in Apple Disease Diagnosis

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Abstract

This paper based on rough set, the original data, attribute reduction, value reduction, the rule extraction, the final diagnosis model building apple's disease, disease diagnosis for apple to provide practical diagnostic tool.

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Keywords: rough set; Attribute reduction; Value reduction.

1. Introduction

During the past 20 years, China's apple industry is rapidly developed. Since 1991, planted area and production, have been ranked first in the world. But from the yield per unit area, our country is still lower than the world average, apple tree disease which cause low level of apple yield is important reason ^{[1][2]}. In order to ensure that apple dominated in a market economy fruit retail industry, Disease diagnosis is important and indispensable part of the process in orchard cultivation. Apple lesions were widespread in various production areas of China, lead to production decline and economic losses, seriously the main bar, large branches victims, causing destruction of park, has suffered serious losses.

According to our survey, the main apple producing areas in Shanxi Province the rate of disease park is 100% , serious orchard is over 90% , tended to be worse. and there are similarities between apple's disease symptoms ,the non-professionals is sometimes difficult to distinguish, and the production control is difficult, and control effect is poor, throughout the past decade, the papers which China published on the disease diagnosis of apple trees and control theory are of the lack of systematic in-depth study. And because of pathogenicity and disease resistance evaluation system could not have a science and unified approach standards, making these studies difficult to conduct or poor reliability of outcome. So this paper proposed apple tree disease diagnosis model based on rough sets and it is proved feasible.

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2. The basic concept of rough set

Definition 1: For a given decision-making system $S=(U, C \cup D, V, f)$, reduction of condition attribute set C is a non-empty subset of $C - P$. It meets:

- ① $\forall a \in P$, Can not be omitted by D
- ② $POSp(D) = POSc(D)$

Claimed : P is a reduction of C , the set of all reduction of C denoted $RED(C)$.

By the reduction of the definition, every decision-making system reduction may have several, but reduction is equivalent, that is say they have the same classification ability. The reduction of nuclear is the most important attribute set, which includes all of the reduction.

Definition 2: In decision-making system $S = (U, C \cup D, V, f)$, $a \in C$ defined as the importance of attribute

$$\sigma_{(C,D)}(a) = \frac{\gamma_C(D) - \gamma_{C-\{a\}}(D)}{\gamma_C(D)} = 1 - \frac{\gamma_{C-\{a\}}(D)}{\gamma_C(D)}$$

Definition 3: In decision-making system $S = (U, C \cup D, V, f)$, $P \subseteq C$ defined as the importance of attribute

$$\sigma_{(C,D)}(P) = \frac{\gamma_C(D) - \gamma_{C-\{P\}}(D)}{\gamma_C(D)} = 1 - \frac{\gamma_{C-\{P\}}(D)}{\gamma_C(D)}$$

3. Rough set algorithm

3.1 the discrete algorithm based on boolean logic and rough set theory [3],

The algorithm described below:

- 1) denote all the property values;
- 2) denote all the interval between consecutive attribute values in symbolic form;
- 3) representate such symbols disjunction each two different records;
- 4) conjunctive normal form represent all the above disjunction;
- 5) convert the conjunctive form into disjunctive;
- 6) In disjunctive normal form arbitrarily select any conjunctive normal form as a result of discretization.

3.2 reduction algorithm based on attribute importance

Step 1: For each condition attribute $a_i \in C$, calculate $POS_{(C-\{a_i\}}(D)$.

Step 2: If $POS_{(C-\{a_i\}}(D) = POS_C(D)$, attribute a_i relative to decision attribute D is redundant, can remove the property from decision table.

Step 3: or, attribute a_i relative to decision attribute D is necessary, can not be deleted.

Step 4: repeat the previous three steps until the property collection do not change, end algorithm, output reduction results.

4. application of rough set theory in apple disease diagnosis

Data preprocessing based on rough set: Discernible matrix theory based on a complete decision table of numerical data and descriptive, Lesion symptoms { Round, Oblong, Oval }={0, 1, 2}, Lesion color { Black, Orange, Hazel, Yellow, Orangeor Yellow }={0, 1, 2, 3, 4}, Growth period { Adulthood, Childhood }={0, 1}, Hazard site { Leaves,

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