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FACULTY OF EGINEERING AND TECHNOLOGY

Soft Computing

LECTURE -13

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OUTLINE

- Fuzzy knowledge based system
- Challenges in fuzzy knowledge based system
- Linguistic Variable Problem
- Linguistic Variable Problem explain with example
- Reference

Knowledge-Based Systems

This is a computer program which, with its associated data, embodies organized knowledge concerning some specific area of human activity. Such a system is expected to perform competently, skillfully and in a cost-effective manner. It may be thought of as a computer program which mimics the performance of a human expert.

Fuzzy Knowledge-Based System

KBS that performs approximate reasoning. Typically a fuzzy KBS uses knowledge representation and reasoning in systems that are based on the application of Fuzzy Set Theory. A fuzzy knowledge base comprises vague facts and vague rules of the form:

KB Entity	Fuzzy KB	Crisp KB
Fact	X is μ_X	X is true or X is not true
Rule	If X is μ_X, then Y is μ_Y	If X then Y

Challenges in fuzzy knowledge based system

There are two challenges of this:

1. How to interpret and how to represent vague rules with the help of appropriate fuzzy sets?
2. How to find an inference mechanism that is founded on well-defined semantics and that permits approximate reasoning by means of a conjunctive general system of vague rules and case-specific vague facts?

The fuzzy rules are also called Linguistic Rules comprising an Antecedent/Premise (the IF part) and a Consequent/Conclusion (the THEN part). The antecedent/premise describes an object or event or state in the form of a fuzzy specification of a measured value. The consequent/conclusion specifies an appropriate fuzzy value.

Linguistic Variable Problem

Informally, a Linguistic Variable is a variable whose values are words or sentences in a natural or artificial language. For example, if age is interpreted as a linguistic variable, then its term-set T(·), (that is, the set of its linguistic values) might be

T(age) = young + old + very young + not young + very old + very very young + . . .

where each of the terms in T(age) is a label of a fuzzy subset of a universe of discourse, say U = [0, 100]. A linguistic variable is associated with two rules:

1. a Syntactic Rule, which defines the well-formed sentences in T(·)
2. a Semantic Rule, by which the meaning of the terms in T( ) may be determined. If X is a term in T(·), then its meaning (in a denotational sense) is a subset of U. A primary fuzzy set, that is, a term whose meaning must be defined a priori, and serves as a basis for the computation of the meaning of the nonprimary terms in T(·)

Example based on Age

The primary terms in the equation above are young and old, whose meaning might be defined by their respective compatibility functions µY and µO. From these, then, the meaning - or, equivalently, the compatibility functions - of the non-primary terms in Tage) above may be computed by the application of a semantic rule.

$$\mu_{\text{very young}} = (\mu_Y)^2$$
$$\mu_{\text{more or less old}} = \sqrt{\mu_O}$$
$$\mu_{\text{not very young}} = 1 - (\mu_Y)^2$$

Composition

But, of course, we have to see what influence each rule has given the fuzzy input values. An “averaging” procedure is adopted to compute the effective contribution of each of the rules. This is the process of Composition. Max and Sum are two composition rules

1. In MAX composition, the combined fuzzy subset is constructed by taking the point wise maximum over all the fuzzy subsets assigned to the output variable by the inference rule.
2. The SUM composition, the combined output fuzzy subset is constructed by taking the point wise sum over all the fuzzy subsets assigned to output variable by their inference rule. (Note that this can result in truth values greater than 1).

Defuzzification

And, finally, we have to convert the fuzzy values outputted by the inference procedure onto a crisp number that can be used in the “real” world. This process is called Defuzzification.

Example:

Air Conditioner We’ll return to the above example of an air conditioner. Suppose that we require that the air conditioner operates at 16◦C. Then our above processes are as follows:

Fuzzification: 16◦C corresponds to Cool/Pleasant.

Inference: Check the rules which contain the above linguistic variables.

Composition: Create new membership function of the alpha leveled functions for Cool and Pleasant.

Defuzzification: Examine the fuzzy sets of Slow and Medium and obtain a speed value.

MULTIPLE CHOICE QUESTION

6. Decision Nodes are represented by ____________

a) Disks

b) Squares

c) Circles

d) Triangles

7. Chance Nodes are represented by __________

a) Disks

b) Squares

c) Circles

d) Triangles

8. End Nodes are represented by __________

a) Disks

b) Squares

c) Circles

d) Triangles

9. Which of the following are the advantage/s of Decision Trees?

a) Possible Scenarios can be added

b) Use a white box model, If given result is provided by a model

c) Worst, best and expected values can be determined for different scenarios

d) All of the mentioned

REFERENCES

- https://www.maths.tcd.ie/~ormondca/notes/Fuzzy%20Logic%20Notes.pdf