Medical Diagnostic System using Fuzzy Logic

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Abstract- The last decades have witnessed a considerable development of knowledge-based systems in medicine aiming at providing support for physicians in the decision-making process. Fuzzy methods can be used to address the specific problem of disease classification in the presence of uncertain or vague knowledge of a linguistic nature. Of course, diseases can be considered fuzzy because it is possible to have a disease to some degree. The problem context is typified by clinical diagnosis, whereby an expert is attempting to classify a patient into a disease category using limited vague knowledge consisting primarily of elicited linguistic information. Experimental results show the estimation of a disease and its stage by applying fuzzy logic.

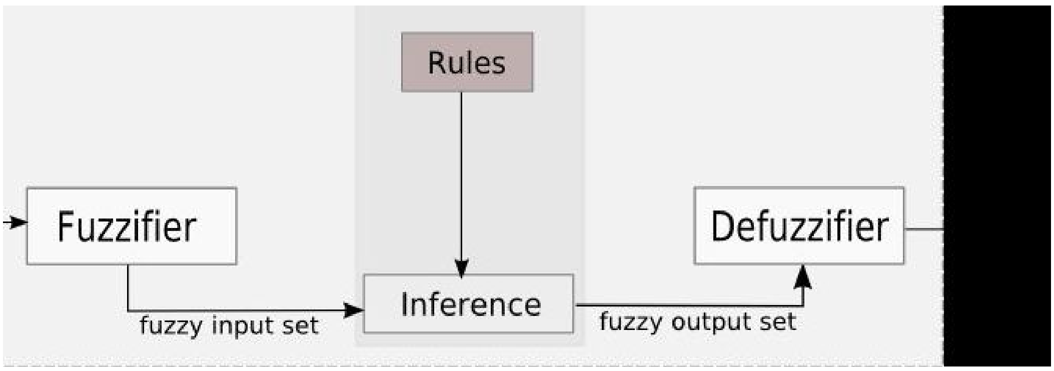
Keywords – Fuzzy logic, clinical diagnosis, knowledge representation

I. INTRODUCTION

Medical diagnosis usually involves careful examination of a patient to check the presence and strength of some features relevant to a suspected disease in order to take a decision whether the patient suffers from that disease or not. One of the problems that characterized the traditional method of medical diagnostic is inaccuracy and imprecision. A feature, like a runny nose for instance, may appear to be very strong for one patient but it can be moderate or even very light for another. It is the experience of the physician that tells him how to combine a set of symptoms (features and their strengths) to find out the correct diagnostic decision. Fuzzy inference is employed to develop a computer program that can automatically find out the certainty whether a patient having some specified symptoms suffers from any one of a set of suspected diseases. This certainty is specified as a crisp percentage value for every suspected disease

II. PROPOSED ALGORITHM

A Fuzzy logic system consists of four main parts: Fuzzifier, rules, inference engine, and defuzzifier.



Fuzzy logic algorithm
1. Define the linguistic variables and terms (initialization)
2. Construct the membership functions (initialization)
3. Construct the rule base (initialization)
4. Convert crisp input data to fuzzy values using the membership functions (fuzzification)

5. Evaluate the rules in the rule base (inference)
6. Combine the results of each rule (inference)
7. Convert the output data to non-fuzzy values

Firstly, fuzzy linguistic variables, fuzzy linguistic terms and membership functions are used to convert a gathered crisp set of input data into a fuzzy set. This step is known as fuzzification. Enabling interpretation of fuzzy condition in a rule is the purpose of the fuzzification process. The fuzzy rules that are important for any fuzzy system are defined after the inputs are fuzzified. A fuzzy rule contains a condition and a conclusion and its structure is similar to the IF–THEN rule. An entire fuzzy rule that is created to control the output variable exists in the rule base. Subsequently, a set of rules defined in the fuzzy rule base is used as the basis for interpreting and by employing reasoning fuzzy outputs are generated. A fuzzy set (the aggregate output fuzzy set) is used as the input for the defuzzification process and membership functions based mapping of fuzzy sets to a crisp output is used to obtain a single number as the output.

Consider the set of "obese men," which usually includes men with Body Mass Index (BMI) greater than 30. This set is crisp. Fuzzy set "obese" includes not only men with BMI>30, but those with BMI<30 as well, with a smaller degree of membership. The lower the BMI the smaller the membership, smoothly decreasing to zero. In FST, an object can partially belong to several mutually exclusive sets simultaneously. For instance, in addition to the set "obese," let us define the fuzzy set overweight" as the set of men with 25<BMI<30. Then, a person with BMI=29 is belonging to both classes, of obese" and "overweight" men, although with different degrees of membership. There is no sharp transition between the two classes. With the increase of BMI, the person gradually becomes "less" overweight and "more" obese. A representation of clinical guidelines suitable for algorithmic purposes would be a collection of If… then… rules. Such rules can be easily followed, and also transformed to another representations, such as a decision table of a flowchart. The rules have the form: If x is A then y is B. In such rule, x is a variable, whose value may represent a physical parameter, like in this case: If BMI>30 then provide dietary advice. In fuzzy logic, x can also be a linguistic variable, which is the variable whose possible values are fuzzy sets rather than numbers. Consider the statement: If x is obese then provide dietary advice. Here "obese" is the label of a fuzzy set, the membership in which depends on the physical parameter BMI. The linguistic variable x has possible values "obese", "overweight", "normal", "underweight". As opposed to classical logic, in which the rules are "executed" if the antecedents are true, in fuzzy logic the rules are executed partially. The strength of the recommendation depends on the membership value of x in the set "obese." The lower the value, the weaker the recommendation.

III. KNOWLEDGE REPRESENTATION

The disease–symptom relationships can be encoded as statements of causal relationships in the following form..Disease A causes symptom S1 in context X-disease A causes symptom S2 in context X-disease B causes condition C in context X. Disease A is a weak negative cause of symptom S2 .The basic goal of the inference engine is to establish the stage of a disease at the current day given observations of symptoms in the crisp form "Symptom occurred from M days ago up to and including N days ago" where a value of 0 is interpreted to mean the current day. e.g., "influenza started five days ago and is still present" is represented as "influenza occurred during time interval (5, 0)."

Decision Making and Statistical Theories

Bayes' Theorem: A number of workers in medical sciences have used a variety of statistical methods and techniques for examining and utilizing evidence (e.g. clinical signs, patient history etc.) to select a diagnosis or to support a prescription. Bayes' Theorem has been used extensively in computer-based medical decision support systems. For example, the medical diagnosis problem can be viewed as the assignment of probabilities to specific diagnosis after all the relevant data has been analyzed:

$$P\left(\frac{di}{\xi}\right) = \frac{P\left(\frac{\xi}{di}\right) * P(di)}{\sum_i P\left(\frac{di}{\xi}\right) * P(di)}$$

IV. RESULT DISCUSSION AND CONCLUSION

The implementation of Fuzzy logic based medical diagnostic system will reduce doctors' job during consultation and ease other problems associated with hospital consultations.

Table 1 consists of symptoms of various diseases during different stages and its relevance. The table given below shows the symptoms of influenza like fever, head ache etc, the stage of the disease in which the the symptom is shown and its relevance. For example, the person having influenza always have fever from third day to fifth day from the onset of the disease ,sometimes show collapse from third day to fifth day etc.

Table 1

Disease				
index	**Symptom**	**lower**	**upper**	**relevance**
1	Fever	3	5	always
2	Headache	3	5	always
3	Vertigo	3	5	always
4	Chills	3	5	always
5	pains in the back	3	5	always
6	pains in the muscles	3	5	always
7	Collapse	3	5	sometimes
8	Coughing	4	5	often
9	eyes are running	4	5	often
10	nose is running	4	5	often
11	sore throat	4	5	often

The Table 2 shows the patient id, and different symptoms shown by the patient during different days.

Table 2

Patient		
patient_id	**Symptom**	**fromday**
1	Fever	3
1	Headache	4
2	Fever	3
2	Chills	3
2	Vertigo	4
2	pains in the back	5
2	Headache	3
3	Fever	3
3	Chills	3
3	Vertigo	4
3	pains in the back	5

3	Headache	3
4	Chills	1
4	Fever	1
5	Fever	4
5	Chills	4
5	Vertigo	3
5	pains in the back	5

Table 3 shows the patient id, his disease and the stage of the disease in days. For example the patient with id 1 has no symptoms of influenza while patient with id 2 may be having influenza at its fifteenth day.

Table 3

Results	
Patientid	**Stage**
1	No symptoms of Influenza
2	May be Influenza At Day:15
3	May be Influenza At Day:15
4	No symptoms of Influenza
5	No symptoms of Influenza

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