...and Beyond: Fuzzy Logic in Medical Diagnosis

The purpose of this chapter is to provide a review and commentary on the current state of fuzzy logic applications in medical diagnosis. A symposium on fuzzy diagnostic and therapeutic decision support, organized by Adlassnig (2000) may be considered a watershed in the application of fuzzy logic in medical problems. For a deeper discussion on fuzzy logic in medicine see Szczepaniak et al. (2000).

Doctors have always been fascinated by diagnosis and the means by which it can be reached (see figure 13.1), but the purpose of studying diagnostic logic has simply been to improve thought processes (Macartney, 1987). More recently, however, a second purpose is becoming more important: the design of expert systems and computer modeling able to perform medical diagnosis. In addition, the paradigm shift represented by the emergence of Evidence Based Medicine, the conscientious, explicit and judicious use of current best evidence in making decision about the care of individual patients (Sackett et al., 1997) is unearthing new problems related to the logic behind diagnosis.

Medical diagnosis has been defined as “the crucial process that labels patients and classifies their illnesses, that identifies their likely prognosis, and that defines the best treatment available” (Sackett et al., 1991). It is, actually, a complex process characterized by uncertainty in many stages (Bellamy, 1997).

The act of clinical diagnosis is, therefore, a process of classification, that is, an effort to recognize the class to which a patient’s illness belongs (Sackett et al., 1991). In a broader context, the clinical practice should be focused on the five clinical objectives, described by Sackett et al. (1997):

1. achieving a diagnosis;
2. estimating a prognosis;
3. deciding on the best therapy;
4. determining harm (related to item 3); and
5. providing care of the best quality.

Therefore, we may think of diagnosis proceedings from symptoms and signs (and laboratory tests) to focus on the documentation of maladaptive alterations in structure, function, and/or response to stimuli (Sackett et al, 1991).
Alternatively, diagnosis can proceed from symptoms and signs (and laboratory tests) to focus on prognosis. Finally, diagnosis may focus on a therapeutic trial of identifying the target disorder on the basis of its response to specific therapy (Sackett et al., 1991).

13.1 The Diagnostic Process

Several attempts have been made to identify the possible cognitive pathways that lead to diagnosis. In this chapter we focus on Sackett et al. (1991) description of the four strategies of clinical diagnosis.

The first strategy is called pattern recognition, and is based on gestalt methods. It is defined as the “instantaneous realization that the patient’s presentation conforms to a previously learned pattern of disease” (Sackett et al., 1991). It is usually sensorial and reflexive. Doctors do it but cannot explain to others why or how they do it. This strategy is applied by experienced clinicians and is often described as intuitive. Normally, the diagnosis is performed at first sight (or any other sensorial input from the patient) of the patient. An example of such an approach is the diagnosis of parkinsonism in which the doctor labels the patient rather quickly just by watching her gait or by hearing his/her speech.

The second strategy is called multiple-branching or arborization strategy of diagnosis. It is defined as “the progression of the diagnostic process down but