TABULAR DECISION LOGIC FOR MEDICAL DIAGNOSIS

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ABSTRACT

A method is proposed in which the diagnostic evaluation of medical data is accomplished on the basis of a series of decision tables. The decision table is laid out consisting of rules each specifying conditions which must be satisfied for a given diagnostic category. For example, a rule may read: "If the QRS duration in any two limb leads is greater than or equal to 0.12 sec., and if the PR interval in any two limb leads is greater than 0.12 sec., and if intrinsicoid deflection onset in V1 or V2 is greater than or equal to 0.06 sec. then right bundle branch block should be diagnosed." Decision tables can be very easily translated into FORTRAN language and used for the computer-aided evaluation of medical data.

DECISION TABLE STRUCTURE

The structure of the decision table is straightforward. Each table is physically divided into four quadrants by double lines (see Fig. 1). The vertical double line separates the stub on the left from the entry which appears on the right. The horizontal double line separates conditions from actions. Thus the upper left quadrant contains a series of conditions (questions) which are to be tested while the lower left quadrant describes the actions to be taken depending on the outcome of these tests (1-4).

Each column in the entry makes up a decision rule. A decision rule may consist of at least two of the four entries shown in Fig. 2.

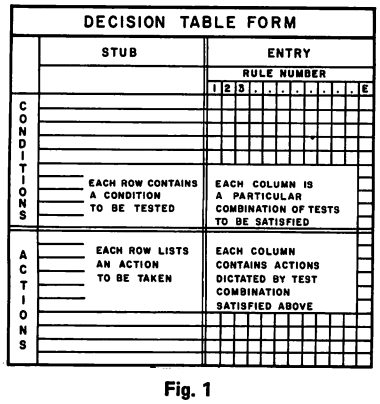

Fig. 1

Rules are sequence numbered for convenience, as shown in Fig. 1; however, this does not imply that the rules must be executed in this sequence. If each rule is unique and does not have to rely on other rules or the sequence in which they are written, then that sequence which is most desirable can be selected.

The set of conditions specified by each rule must be unique to avoid ambiguity. Equivalent sets of conditions leading to different actions are erroneous. The converse-different conditions leading to the same action-is permissible and even may be desirable.

Any rules not specified or implied in the table are assumed to be part of the ELSE-RULE. This is the rightmost column which contains no entries in the condition part of the table. It specifies the actions to be taken if none of the rules are satisfied.

There is no limit to the number of rules in any given decision table. Also, there is no limit to the number of conditions and actions. However, it is more convenient to use small tables and link them appropriately. Table linkage involves an exit from one decision table to go to another decision table. This is accomplished by using "GO TO . . ." as an action in this decision table from which the checking is transferred into some other decision table. By using table linkage, it is possible to break up a job into parts and prepare decision tables for respective parts.

On the other hand, it is often desirable within one table to execute another table and then return to the original table so that remaining actions can be executed. A notation such as "DO . . . ." can be used to accomplish this.

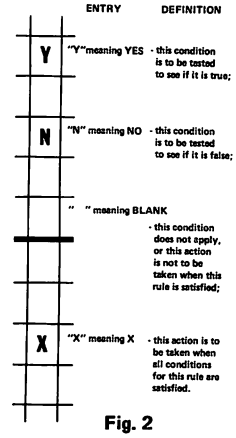

Fig. 2

MEDICAL APPLICATION OF DECISION TABLES

It is apparent that decision tables are best suited to applications involving complex logic. This is true whether the application is manufacturing, scientific data processing, or biomedical data evaluation.
Decision tables provide an excellent means of describing the relationship between symptoms and diseases which may be thought of as a sequence of statements that fit the pattern:

> "If ... and if ... and if ... (conditions are true), then ... and ... and (actions are to be taken)."

As an example, let us consider the decision table for diagnosing ventricular conduction defects (see Fig. 2). The first condition row in this table checks to see whether QRS duration in any two limb leads is greater than or equal to 0.12 sec. The outcome YES of this test appears in rule no. 1, no. 3, no. 5, and no. 7. The outcome NO of the first test appears in rule no. 2, no. 4, no. 6, and no. 8. Let us now concentrate on the rule no. 3. In this rule a YES entry is made for the first, third and sixth conditions. No entry is made for the second and seventh conditions because these conditions are immaterial for this rule. For the fourth and fifth conditions NO entries are made. The action specified for the rule no. 3 is row 3 which says: "Complete right bundle branch block" and action row 8 which says: "Go to table Infarction Part I".

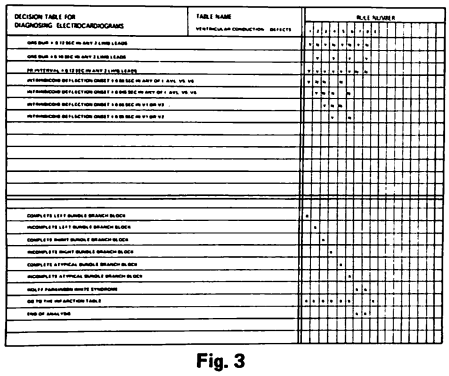

Fig. 3

Thus the rule no. 3 reads: "If QRS duration in any two limb leads is greater than or equal to 0.12 sec., and if PR interval in any two limb leads is greater than 0.12 sec., and if intrinsicoid deflection onset in any lead of L1, aVL, V5, V6 is not greater than or equal to 0.045 sec., and if intrinsicoid deflection onset in V1 or V2 is greater than or equal to 0.06 sec., then the diagnosis of complete right bundle branch block is issued and the checking of Infarction Part I table is ordered" (5-7).

CONCLUSION

The use of decision tables technique for computer-aided diagnosis provides a number of important advantages. The most important is that they can express a complex problem of medical diagnosis in a greatly simplified form. They enable the physician or programmer to partition a complex decision making process into a set of small interconnected tables in which the process is shown in a series of easily digestible, parallel steps.
The utility of decision tables is further broadened by the ease with which they can be translated into computer language. Also special processors have been developed which directly convert decision tables into an object program either as separate "table-oriented-languages" or as extensions of algebraic languages such as FORTRAN.

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