Decision Tables: Theory and Practice

Solomon L. Pollack

Wiley Business Data Processing Library
edited by Richard G. Canning and J. Daniel Couger

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Decision Tables

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To Ginny, Elaine, and Anna

(Understanding wives, all)

Foreword

Inventing a new methodology is an exciting, yet often frustrating, experience. The joy of creation shared by a number of people working together is hard to match, but the slow acceptance of the new concept leads one to doubt the value of the invention itself.

Sol Pollack and I, together with a small group of dedicated professionals, shared this combined joy/frustration in developing decision tables. Throughout 1963 we had the pleasure of creating, defining, and proselytizing. Since 1963 we have had the frustration of finding that business analysts, system engineers, and computer programmers did not immediately accept decision tables as a major technique to assist in program design, implementation, and maintenance.

One of the most serious barriers to getting decision tables accepted as a standard technique has been the lack of a book which logically and fully covered the conceptual, mathematical, procedural, and operational foundations of decision tables. The coauthors have taken the time necessary to do a thorough, competent, professional job in all of these areas. I believe this is a comprehensive book which may be used by students as well as professional and managerial personnel to gain an understanding of the techniques and use of decision tables.

Decision tables provide a means for organizing your thoughts, clarifying the conditions behind alternate actions, and communicating this logic to someone else. By its highly structured nature it permits various explicit techniques to be used to ensure accuracy, eliminate redundancy, and improve programmability. The original purpose of decision tables was for use in preparing information for computer programmers. I find today, however, that much of my own use relates to a comprehensive examination of business and technical alternatives; that is, to understand and explain the various conditions

under which I wish to take different courses of action. It has been an invaluable technique to get a number of people to focus on a single problem, agree on the criteria, state the alternatives available, and finally accept the relation between the criteria and the alternatives.

Today even those people most involved with the development of decision tables recognize that decision tables are not able to eliminate all the difficulties involved in handling complex decisions. Rather they are a most valuable addition to the set of tools that any good programmer, systems engineer, and businessman should have. They seem to be accepted readily by those who are comfortable with parallel thought processes. They appeal to the individual capable of examining ideas in parallel; the individual who does not require that each process be sequential. This capability requires training and, therefore, the individual must be willing to dedicate a certain amount of time to skill development.

The payoff, however, is very substantial. When you are skilled in using decision tables you may be sure that when you provide a solution statement to a problem it is accurate, complete, and capable of being used in a precise fashion.

So I wish all of you the pleasure of working with the technique of decision tables. I am confident you will enjoy learning how to use it from this fine book.

B. Grad

Series Preface

The Wiley Communigraph Series on Business Data Processing is intended for professionals and for persons desiring to improve their competence in business management applications of the computer. Within each of some twenty subject areas, publications will be provided over a range of technical depth. The objective is a series of publications that enable readers to gain an understanding in specialized subject areas.

The term "communigraph" was coined to reflect this philosophy—succinct treatment of specialized subjects. A communigraph requires only a modest investment in time on the part of the reader. The cummunigraph format has also allowed many authorities in the computer field—persons who have too many demands on their time to allow them to write full-length books—to participate as authors.

The series is designed to cover three levels of interest for detailed technical information:

Red Titles. For data processing managers, business programmers, analysts, and others who wish to gain background information about this subject.

Blue Titles. For business programmers and analysts, and data processing managers, who have some experience in this subject and who wish to study it in more technical depth.

Gold Titles. For senior business programmers and analysts, and data processing managers, with extensive experience in the subject, who wish a highly technical discussion of it.

The increase in breadth, complexity, and the dynamic characteristics of the computer field make a series such as this imperative—for training and for reference. The breadth is illustrated by the many subject areas covered in the series: from data base design to business planning by way of simula-

tion; from hardware-software evaluation and selection to personnel considerations for business data processing. The growth of complexity is apparent in each of these subject areas; for instance, the variations in data base design and data management systems are increasing almost weekly. The dynamics of the field are obvious, with the multitude of new hardware and software products reaching the market each year.

In the face of this growth in depth and complexity, practitioners encounter the problems of developing and maintaining technical competence. The novice must upgrade his competence to reach the experienced practitioner level. The experienced system analyst and programmer must strive to reach senior levels. The professional must broaden his knowledge to include new specialties that adjoin his areas of technical competence.

Training, updating, and upgrading professionals in the computer field will be a continuous problem. We hope that the communigraph series will be an effective method in helping to cope with this problem.

Richard G. Canning
J. Daniel Couger
Series Editors

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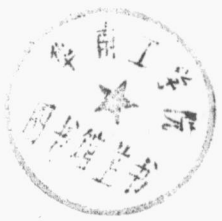

Part I

INTRODUCTION

SECTION 1

Historical Discussion

Tables are a familiar part of everyone's life. From mathematical tables to the box score of yesterday's baseball game, they provide us with an orderly presentation of data. While such tables often assist us in making a decision, they are not decision tables. A decision table is a special form of table that codifies a set of decision rules based on a specific, clearly identified set of conditions and resulting actions. While the history of tables in general can be told in terms of centuries, decision tables are a fairly recent phenomenon.

In November 1957 General Electric initiated a research effort called the "Integrated Systems Project." Its objective was the study of the manufacturing processes that occur from the receipt of a customer order through the production of the finished product and the part that computers might play in them. It soon became apparent that the available methods of describing decisions—flowcharts, formuli, narratives, and the like—were inadequate for expressing the complex logic encountered in the processes being studied. For this reason the project team began a search for a new method of expression that culminated in the development of "decision structure tables" and a computerized method for solving them. These tables had all the characteristics of what we know today as decision tables but had a format similar to the truth tables from which they originated. Examples of a truth table and a TABSOL table are shown in Figures 1-1 and 1-2. The processor for solving these tables operated initially on an IBM 702 and was successively implemented on an IBM 305, 650, and 704. An improved processor and language called TABSOL were implemented on the GE 225 in early 1961.

At approximately the same time, and independently of GE's efforts, the Sutherland Company developed a decision table different in form but identical in concept. Whereas

A	B	A ∨ B	A ∧ B
T	T	T	T
T	F	T	F
F	T	T	F
F	F	F	F

Figure 1-1 **Truth Table indicates for each of the truth values that A and B can assume, the truth value of the logical statements "A OR B," "A AND B." The table is read horizontally.**

General Electric developed the concept of decision tables and the computer-based solution method almost simultaneously, Sutherland developed their tables strictly as an aid to system analysis and documentation, leaving the solution of the table to the programmer. As a result, the subject matter expressed within the two forms of tables differed. General Electric utilized their tables to describe manufacturing decisions in great detail, whereas Sutherland used tables to express more general "management rules"—expressions of policy independent of the eventual processing media. As was the case with GE, Sutherland was forced to develop decision tables out of desperation. They had expended almost one man-year of effort attempting to specify the logic of a complex file update procedure without useful results. When the effort was restarted using decision tables, it was completed successfully in about 12 man-weeks. Following this initial experience, Sutherland continued using decision tables for documenting a wide variety of systems. An example of a communication-oriented decision table is shown in Figure 1-3.

ITEM-1	ITEM-2 EQ	ITEM-3 EQ	GO TO
EQ 4	3	05	TABLE-2
EQ 6	4	10	TABLE-2
GR 7	5	15	TABLE-3

Figure 1-2 **A decision structure table in TABSOL format. Decision rules are read horizontally; for example the first rule reads, "If ITEM-1 EQ 4 and ITEM-2 EQ 3 and ITEM-3 EQ 05, then GO TO TABLE-2."**

		L-CODE = 6		
		DESC = 8	DESC = 9	DESC = 10
CLASS = 2	TYPE = 4	ACTION-1	ACTION-1	ACTION-2
	TYPE = 3	ACTION-3	ACTION-2	ACTION-1

Figure 1-3 **An example of a decision table used for man-to-man communication. The conditions are listed both horizontally on the left and vertically across the top, with the actions shown in the center. Just as the TABSOL table is related to truth tables, this form appears related to the Karnaugh map.**

Another early user, Hunt Foods and Industries, began using decision tables as an aid in man-to-man communication in 1959. This work was described in one of the earliest published works on decision tables.[1]

In May 1959 the Conference on Data Systems Languages (CODASYL, the organization that developed COBOL) was convened. It designated one of its committees, the Systems Group, to pursue the objective of developing a machine-independent, systems-oriented language. After reviewing several approaches to this objective, they began to study decision tables—an effort that was to occupy two years and result in a decision table language known as DETAB-X (Decision Tables, Experimental).

In 1960, General Electric presented their work on decision tables at the Eastern Joint Computer Conference and during the next two years a great deal of effort, most of it unreported in the literature, was spent in

[1] Orren Y. Evans, "Advanced Analysis Method for Integrated Electronic Data Processing." *IBM General Information Manual, F20-8047.*

developing decision table processors. IBM guided the implementation of at least three decision table processors, one on the IBM 1401, one on the 7080 in cooperation with the Boeing Company, and one on the 7090 in conjunction with RAND Corporation (FORTAB). Insurance Company of North America produced a decision table processor of their own called LOBOC, also on the IBM 7080, and GE, as noted earlier, implemented TABSOL on the GE-225.

In September 1962 the CODASYL Systems Group held a seminar in New York to present the results of their study of decision tables to the public. The product of their effort, called DETAB-X, consisted of a language supplement to COBOL-61 to be used within the framework of decision tables. The seminar featured talks by the early developers: Sutherland, General Electric, Insurance Company of North America, RAND, and IBM. Its objective was to stimulate interest and experimentation in the use of decision tables and their translators. In spite of the enthusiasm of the Systems Group and the information content of the seminar, the experimentation and resulting exchange of information that was hoped for never took place. The Group shortly moved on to other projects, leaving as their testament the format of decision table now accepted as "standard." An example of this format is shown in Figure 1-4.

The period from the DETAB-X seminar until 1965 was marked by inactivity. Few articles were written and little expansion in the use of decision tables by new users was observable. Then, in June 1965, the Special Interest Group for Programming Languages (SIGPLAN) of the Los Angeles Chapter of the Association for Computing Machinery appointed a working group to develop a decision table preprocessor. In order to guarantee a wide distribution, the preprocessor was written in a restricted subset of COBOL and accepted decision tables coded in COBOL to convert them to COBOL source code. The preprocessor, called DETAB/65, was released free of charge and distributed through the Joint Users Group. Although it was implemented on a number of computers, including the CDC 1604, 3400, and 3600 and the IBM 7040, 7044, and 7094, its admittedly inefficient conversion algorithm and lack of maintenance led to its disuse and eventual disappearance. It seems evident, however, that DETAB/65 was the ancestor of the current group of proprietary decision table preprocessors that have been developed since 1966. These preprocessors generally follow the DETAB/65 design—a preprocessor written in COBOL that converts decision tables containing COBOL components to a stream of COBOL code suitable for presentation to a compiler. The exception is IBM's System/360 Decision Logic Translator that processes decision tables coded in FORTRAN. Some of the preprocessors originally developed for COBOL offer the option of using FORTRAN.

Table 3	1	2	3	4	ELSE
FIELD-1 = 3	Y	Y	N	N	–
FIELD-2 =	3	4	10	15	–
FIELD-3 =	ZERO	ZERO	POSITIVE	NEGATIVE	–
MOVE A-6 TO A-7	X	–	X	X	–
GO TO	TABLE-4	TABLE-4	TABLE-5	TABLE-6	TABLE-9

Figure 1-4 **A decision table in the "standard" format. Conditions and actions are listed on the left-hand side with decision rules read vertically from top to bottom; for example, Rule 2 reads "If FIELD-1 = 3 and FIELD-2 = 4 and FIELD-3 = ZERO, then GO TO TABLE-4."**