Decision Table

- A decision table is used to represent the complex processing logic in a tabular or a matrix form.
- The upper rows of the table specify the variables or conditions to be evaluated.
- The lower rows of the table specify the actions to be taken when the corresponding conditions are satisfied.
- A column in a table is called a rule. A rule implies that if a condition is true, then the corresponding action is to be executed.

Example: -

- Consider the Library Management Information System.
- The following decision table shows how to represent the LMIS problem in a tabular form.
- Here, the table is divided into two parts; the upper part shows the conditions and the lower part shows what actions are taken.
- Each column of the table is a rule.

Conditions				
Valid Selection	No	Yes	Yes	Yes
New Member	-	Yes	No	No
Renewal	-	No	Yes	No
Cancellation	-	No	No	Yes
Actions				
Display error message	x	-	-	-
Ask member's details	-	x	-	-
Build customer record	-	x	-	-
Generate bill	-	X	X	-
Ask member's name & membership number	-	-	X	x
Update expiry date	-	-	X	x
Print cheque	-	-	-	x
Delete record	-	-	-	x

fig. Decision table for LMS

- From the above table we can easily understand that, if the valid selection condition is false then the action taken for this condition is 'display error message'.
- Similarly, the actions taken for other conditions can be inferred from the table.

Decision Tree

- A decision tree gives a graphic view of the processing logic involved in decision making and the corresponding actions taken.
- The edges of a decision tree represent conditions and the leaf nodes represent the actions to be performed depending on the outcome of testing the condition.

Example: -
Consider Library Membership Automation Software (LMS) where it should support the following three options:

- New member
- Renewal
- Cancel membership

New member option-
Decision: When the 'new member' option is selected, the software asks details about the member like the member's name, address, phone number etc.

Action: If proper information is entered then a membership record for the member is created and a bill is printed for the annual membership charge plus the security deposit payable.

Renewal option-

Decision: If the 'renewal' option is chosen, the LMS asks for the member's name and his membership number to check whether he is a valid member or not.

Action: If the membership is valid then membership expiry date is updated and the annual membership bill is printed, otherwise an error message is displayed.

Cancel membership option-

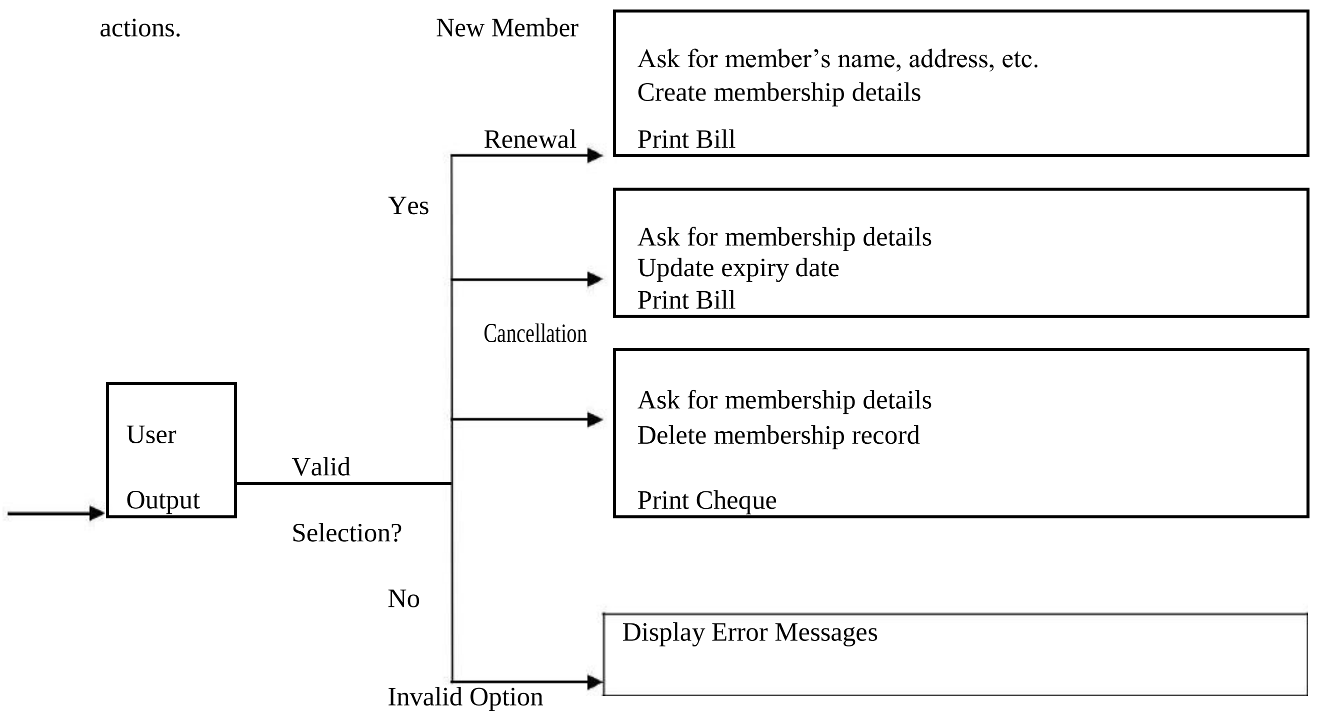
Decision: If the 'cancel membership' option is selected, then the software asks for member's ame and his membership number.

Action: The membership is cancelled, a cheque for the balance amount due to the member is printed and finally the membership record is deleted from the database.

Decision tree representation of the above example -

The following tree (fig.) shows the graphical representation of the above example. After getting information from the user, the system makes a decision and then performs the corresponding

actions.



Structured Methodologies

- Structured methodologies (or structured systems analysis and design) have been used to document, analyze, and design information systems since the 1970s.
- **Structured** refers to the fact that the techniques are step by step, with each step building on the previous one. Structured methodologies are top-down, progressing from the highest, most abstract level to the lowest level of detail – from the general to the specific.
- Structured development methods are process-oriented, focusing primarily on modeling the processes, or actions that capture, store, manipulate, and distribute data as the data flow through a system.
- These methods separate data from processes.
- The primary tool for representing a system’s component processes and the flow of data between them is the **data flow diagram (DFD)**.
- The data flow diagram offers a logical graphic model of information flow, partitioning a system into modules that show manageable levels of detail.
- It rigorously specifies the processes or transformations that occur within each module and the interfaces that exist between them.
- Another tool for structured analysis is a **data dictionary**, which contains information about individual pieces of data and data groupings within a system.
- The data dictionary defines the contents of data flows and data stores so that systems builders understand exactly what pieces of data they contain.

- **Process specification** is another tool that describes the transformation occurring within the lowest level of data flow diagrams.
- They express the logic for each process. We can express the logic using structured English, decision table, decision tree etc.

In structured methodology, software design is modeled using hierarchical structure charts. The **structure chart** is a top-down chart, showing each level of design, its relationship to other levels, and its place in the overall design structure. The design first considers the main function of a program or system, then breaks this function into sub functions, and decomposes each subfunction until the lowest level of detail has been reached. A structure chart may document one program, one system (a set of programs) or part of one program.

Need for Structured Methodology

Most information systems development organizations use structured methodology because it offers the following advantages:

- Improve project management & control
- Make more effective use of experienced and inexperienced development staff
- Develop better quality systems with low cost
- Make projects resilient to the loss of staff
- Enable projects to be supported by computer-based tools such as computer-aided software engineering (CASE) systems
- Establish a framework for good communications between participants in a project
- Enable projects to deliver the product on time because it allows to plan, manage and control a project well
- Respond to the changes in the business environment while project progresses
- Improves the overall productivity by encouraging on-time delivery, meeting business requirements, ensuring better quality, and using human resources effectively.

Advantages and Disadvantages of Modeling and Data Dictionaries

Advantages:

- It minimizes planning overhead because all the phases are planned up front.
- Requirements analysis tends to be more thorough and better documented.
- Business requirements and system designs are easier to validate with pictures.
- It is easier to identify, conceptualize and analyze alternative technical solutions.
- Design specifications tend to be sound, stable, adaptable, and flexible because of models.
- Systems can be constructed more correctly the first time from complete and clear model based specifications
-

Disadvantages:

- It is time consuming because it takes time to collect facts, draw models and validate those models.
- The models can only be as good as the users' understanding of those requirements.
- It reduces the users' role in project to passive participation because most users want to see working software instead of models.
- It is considered to be inflexible; users must fully specify requirements before design; design must fully document technical specifications before construction; and so forth.

Role of CASE in Data Modeling

- Data models are stored in a repository. CASE (computer-aided systems engineering) provides the repository for storing the data models and its detail description.
- Most CASE tools support computer-assisted data modeling and database design.
- CASE supports in drawing and maintaining the data models and their underlying details.
- Using CASE product, you can easily create professional, readable data models without the use of paper, pencil, erasers, and templates.
- The models can be easily modified to reflect corrections and changes suggested by end users – you don't have to start over.

- Also, most CASE products provide powerful analytical tools that can check your models for mathematical errors, completeness, and consistency.
- Some CASE products can even help you analyze the data models for consistency, completeness, and flexibility.
- Also, some CASE tools support reverse engineering of existing files and database structures into data models.
- The resulting data models represent physical data models that can be revised and reengineered into a new file or database, or they may be translated into their equivalent logical models.
- The logical data models could then be edited and forward engineered into a revised physical data model and subsequently a file or database implementations.

Structured English

- Structured English is the additional method which is used for overcoming the problems of the ambiguous language in stating the actions and conditions in making the decisions and formulating the procedures.
- The procedure is described in the narrative format using the Structured English. It doesn't show any decisions and rules but it states the rules.
- Structured English specifications require the analyst to identify the conditions which occur in a process and also identify the decisions which makes these conditions occur.
- It also forces the analyst to find alternative actions to be taken.

Developing Structure Statements-

The process is defined by using three types of statements: sequence structure, decision structure and iteration structure.

Sequence structure: It is the single stepped or action included in the process and it does not depend on the existence of any other condition but if it does encounter a condition, it is taken into consideration.

Decision structure: It occurs when two or more actions take place depending on the value of the condition. The condition is expanded and the necessary decision is taken.

Iteration structure: It is commonly found that certain conditions occur commonly or occur after certain conditions are executed. Iterative instructions help the analyst to describe these cases.

Structured English

- o Structured English is based on structured logic
- o Simple English statements such as add, multiply, move, and so on
- • It is an appropriate technique for analyzing the system when structured decisions are not complex

The following steps are needed:

- Express all logic in terms of sequential structures, decision structures, case structures, or iterations
- Use and capitalize accepted keywords such as IF, THEN, ELSE, DO, and PERFORM
- Indent blocks of statements to show their hierarchy (nesting) clearly
- Underline words or phrases used have been defined in a data dictionary to signify that they have a specialized, reserved meaning
- Be careful when using "and" and "or"
- Avoid confusion when using logical comparisons such as "greater than" and "greater than or equal to”

Structured English Example

```
IF
        Customer pays advance
        THEN
           Give 5% Discount

                ELSE
```

```
                    IF
                    Purchase amount >=10,000
                    THEN
                          IF
                           The customer is a regular customer
                          THEN
                           Give 5% Discount
                          ELSE
                                 No Discount
                          ENDIF
                    ELSE
                    No Discount
                    ENDIF
ENDIF
```

Data Dictionary and Structured English

- The data dictionary is a starting point for creating structured English:
  - Sequenced data dictionary entries become simple structured English statements
  - Selection [] entries become IF..THEN...ELSE statements
  - Iteration { } entries become DO WHILE, DO UNTIL, or PERFORM UNTIL structured English statements

Advantages of Structured English

- Clarifying the logic and relationships found in human languages
- An effective communication tool, and easy to teach and understand

Data Dictionary

- The data dictionary is an organized listing of all data elements that are pertinent to the system, with precise, rigorous definitions so that both user and system analyst will have a common understanding of inputs, outputs, components of stores and [even] intermediate calculations.
- A data dictionary lists all data items appearing in the DFD model of a system.
- The data items listed include all data flows and the contents of all data stores appearing on the DFDs in the DFD model of a system.
- A data dictionary lists the purpose of all data items and the definition of all composite data items in terms of their component data items.
- For example, a data dictionary entry may represent that the data **grossPay** consists of the components regularPay and overtimePay.

grossPay = regularPay + overtimePay

For the smallest units of data items, the data dictionary lists their name and their type. Composite data items can be defined in terms of primitive data items using the following data definition operators:

+: denotes composition of two data items, e.g. **a+b** represents data a and **b**.
[,,]: represents selection, i.e. any one of the data items listed in the brackets can occur. For example, **[a,b]** represents either **a** occurs or **b** occurs.
( ): the contents inside the bracket represent optional data which may or may not appear. e.g. **a+(b)** represents either **a** occurs or **a+b** occurs.
{}: represents iterative data definition, e.g. **{name}5** represents five **name** data. **{name}*** represents zero or more instances of **name** data.
=: represents equivalence, e.g. **a=b+c** means that **a** represents **b** and **c**. **/* */**:
Anything appearing within **/*** and ***/** is considered as a comment.

Example 1 : Tic-Tac-Toe Computer Game

Tic-tac-toe is a computer game in which a human player and the computer make alternative moves on a 3×3 square. A move consists of marking previously unmarked square. The player who first places three consecutive marks along a straight line on the square (i.e. along a row, column, or diagonal) wins the game. As soon as either the human player or the computer wins, a message congratulating the winner should be displayed. If neither player manages to get three consecutive marks along a straight line, but all the squares on the board are filled up, then the game is drawn. The computer always tries to win a game.

Data dictionary for the DFD model in Example 1
move: integer /*number between 1 and 9 */ display:
game+result
game: board
board:
{integer}9
result: [“computer won”, “human won” “draw”]

Data Dictionary for the DFD Model of TAS:

response:	[bill + material-issue-slip, reject-message]
query:	period /*query from manager regarding sales statistics */
period:	[date + date, month, year, day]
date:	year + month + day
year:	integer
month:	integer
day:	integer
order:	customer-id + {items + quantity}* + order#
accepted-order:	order /* ordered items available in inventory */
reject-message:	order + message /*rejection message*/
pending-orders:	customer-id + {items + quantity}*
customer-address:	name + house# + street# + city + pin
name:	string
house#:	string
street#:	string
city:	string
pin:	integer
customer-id:	integer
customer-file:	{customer-address}*
bill:	{item + quantity + price}* + total-amount + customer-address + order#
material-issue-slip:	message + item + quantity + customer-address
message:	string
statistics:	{item + quantity + price}*
sales-statistics:	{statistics}* + date
quantity:	integer
order#:	integer /* unique order number generated by the program */
price:	integer
total-amount:	integer
generate-indent:	command
indent:	{indent + quantity}* + vendor-address
indents:	{indent}*
vendor-address:	customer-address
vendor-list:	{vendor-address}*
item-file:	{item}*
item:	string
indent-request:	command

Importance of data dictionary
A data dictionary plays a very important role in any software development process because of the following reasons:

- A data dictionary provides a standard terminology for all relevant data for use by the engineers working in a project. A consistent vocabulary for data items is very important, since in large projects different engineers of the project have a tendency to use different terms to refer to the same data, which unnecessary causes confusion.
- The data dictionary provides the analyst with a means to determine the definition of different data structures in terms of their component elements.