Logic Modeling

Lecture 9

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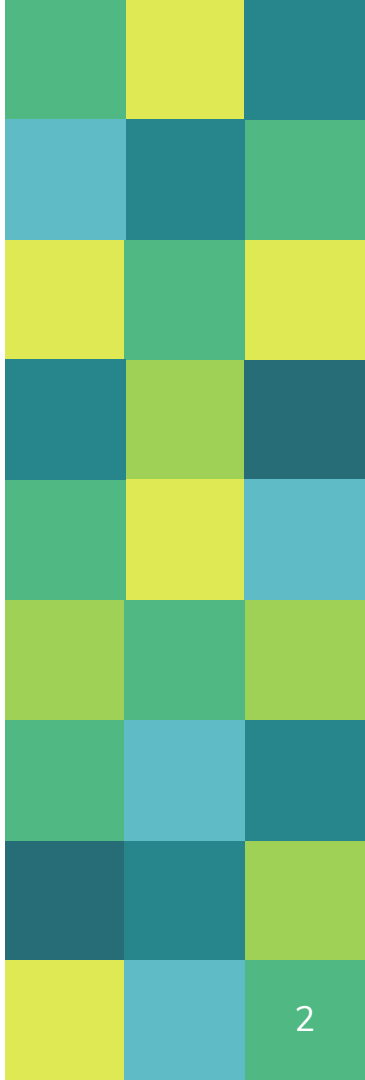
Learning Outcomes

End of this lecture you will be able to learn ,

LO1: Use decision tables and decision trees to represent the logic of choice in conditional statements.

LO2: Differentiate among Structured English, decision tables, and decision trees for representing processing logic



Logic Modeling

Data flow diagrams do not show the logic inside the processes

Logic modeling involves representing internal structure and functionality of processes depicted on a DFD.

- In this chapter, you will learn how to do logic modeling using following 3 techniques.
    1. **Decision tree**
    2. **Decision table**
    3. **Structured English**

Decision Trees

- A decision tree gives a graphic view of the processing logic involved in decision-making and the corresponding actions taken.
- A decision tree is a diagram which depicts conditions and corresponding actions in a tree structure.
- The tree depicts the order in which the conditions have to considered.
- Notations to follow in drawing decision trees.
    - **Conditions – Circle nodes**
    - **Values – Edges**
    - **Actions – Square nodes**

Decision Trees

A decision tree is a graphical view of:

- The logic involved in decision making
  - Example: the order in which decisions are made
- The corresponding actions taken.

Edges (branches) of a decision tree represent conditions to be tested.

Nodes (leaves) of a decision tree represent actions to be performed:

The choice of actions depends on whether or not the various conditions are satisfied.

Steps to draw a Decision Tree

Step 1:

Identify all conditions and actions and the order and timing of these (if they are critical).

Step 2:

Begin building the tree from left to right while making sure you are complete in listing all possible alternatives before moving over to the right.

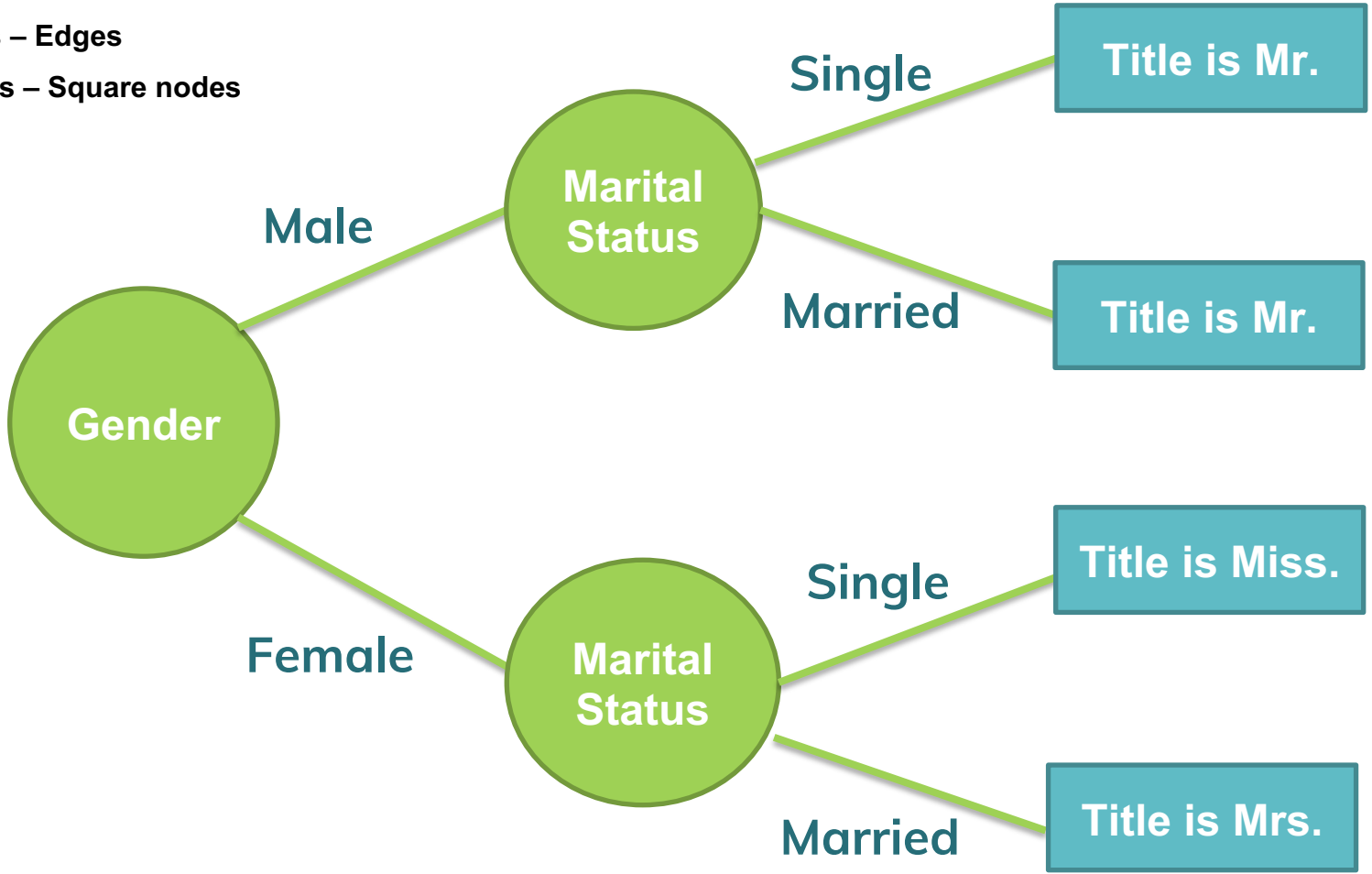
Let’s see an example

- There are different titles assigned to people depending on the gender and marital status. Prepare a decision tree to find the title of a person.
    - **If the gender is male and single, title is Mr**
    - **If the gender is male and married title is Mr**
    - **If the gender is female and single, title is Miss**
    - **If the gender is female and married, title is Mrs**

Conditions – Circle nodes

Values – Edges

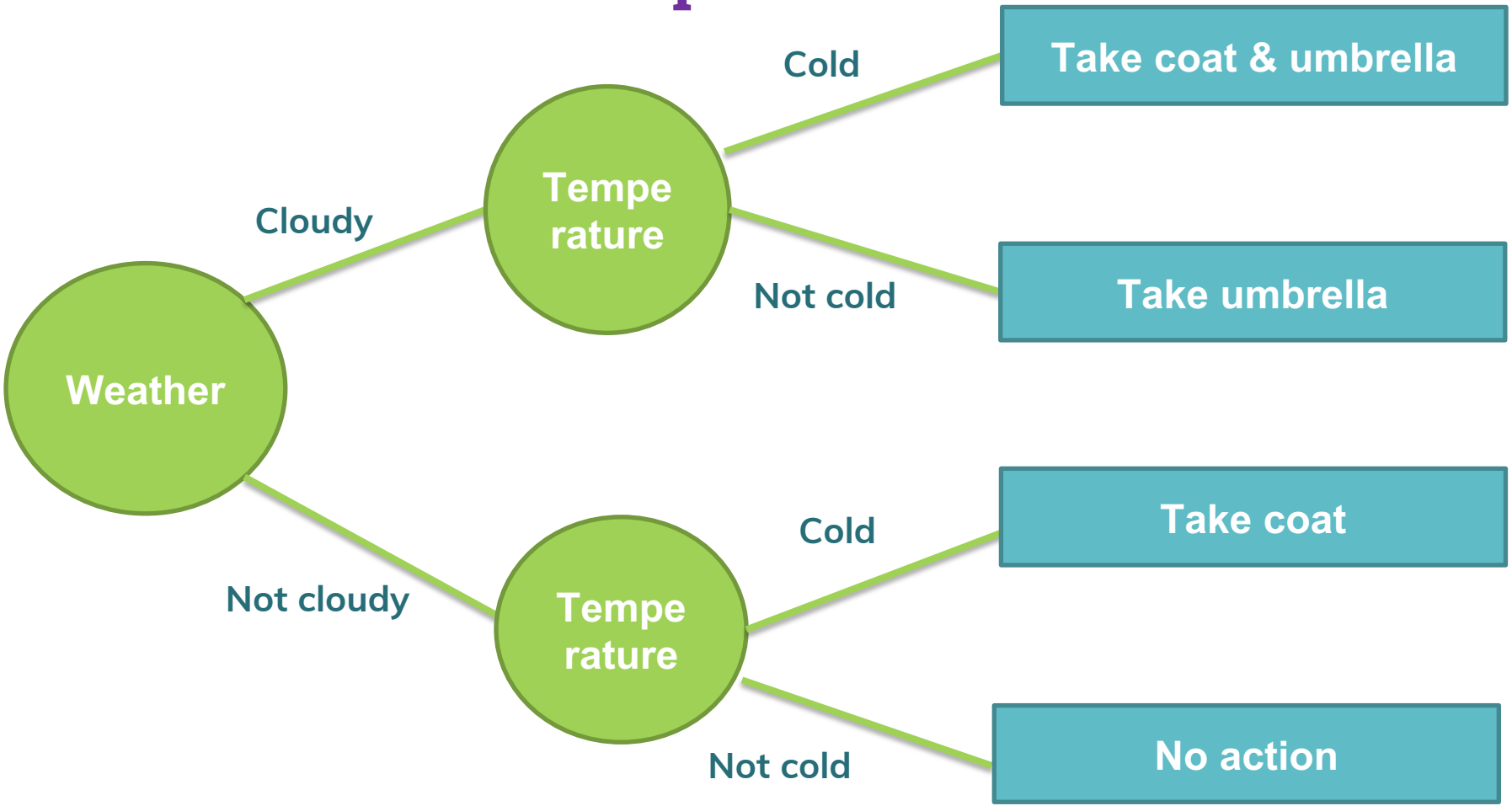
Actions – Square nodes



Let’s see another example

If a person needs to go out, he/she checks the weather report. If the weather report says the day is cloudy, he/she checks the temperature. If the temperature is cold, he/she takes both the coat and umbrella. Otherwise, he/she takes only the umbrella. If the weather report says the day is not cloudy, but the temperature is cold, he/she takes only the coat. Otherwise, he/she will go out without anything.

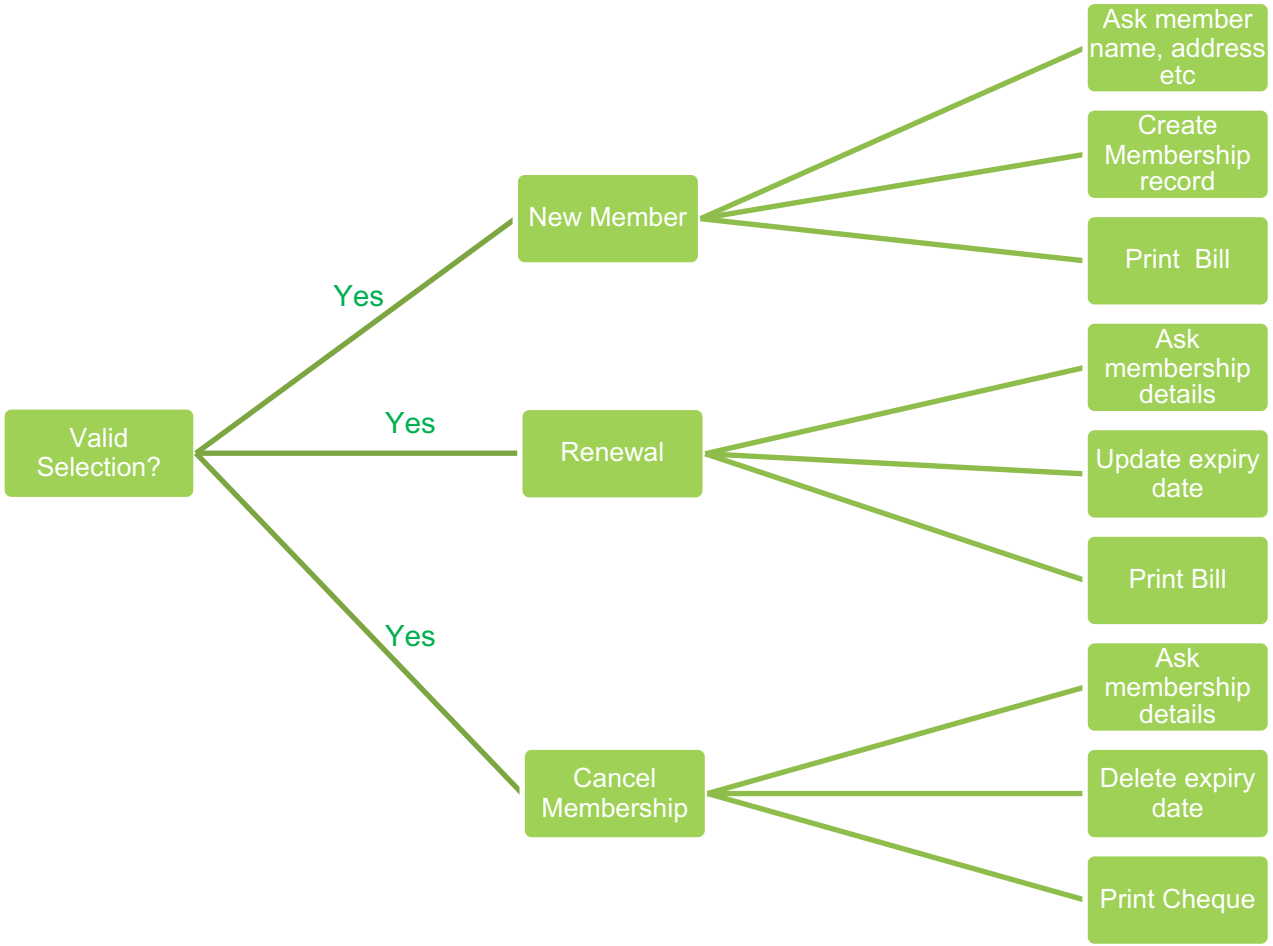
Let's see another example



Activity

Library Membership Software (LMS) should support the following three options: new member, renewal, and cancel membership. When the new member option is selected, the software asks the member's name, roll number, address, and phone number. If proper information is entered, the software creates a membership record for the new member and prints a bill for the annual membership charge and the security deposit payable. If the renewal option is chosen, the LMS asks the member's name and his membership number and checks whether he is a valid member. If the name represents a valid member, then the membership expiry date in the membership record is updated and the annual membership bill is printed. If the cancel membership option is selected and the name of a valid member is entered, then the membership is cancelled, a cheque for the balance amount due to the member is printed and his membership record is deleted.

Sample Answer



Limitation of Decision Trees

The major limitation is, in some cases you can not show other combinations of conditions. It is a single representation of relationships between conditions and actions.

Decision Table

- A decision table is a representation of conditions and their actions in a tabular format.
- A decision table shows processing logic in the form of conditions and actions.
- Easily understandable.
- Useful when resulting actions depend on one or several combinations of conditions.

Layout of a Decision Table

Condition stubs	Condition entry
Action Stubs	Action entry

Decision Table for Example 1:

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 name etc.	×			
Build customer record		×		
Generate bill		×	×	
Ask membership details			×	×
Update expiry date			×	
Print cheque				×
Delete record				×

Elements of a Decision Table

- The basic 4 elements of a decision table are:

1. **Condition stub -** lists all the conditions to be checked.
2. **Action Stub -** lists all the actions to be carried out.
3. **Condition entry -** provides answers to the given condition. These can be true (Y), false (N), or irrelevant/ (–);
4. **Action entry -** indicates appropriate actions resulting from the answers to the conditions.

Steps to develop Decision Tables

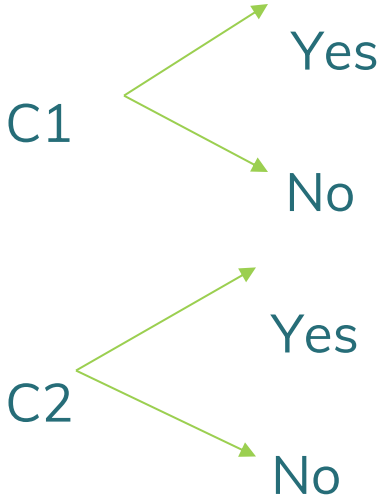
1. Step 1: Identify all the conditions.
2. Step 2: Identify the set of possible actions/outputs/responses.
3. Step 3: Determine number of rules. (Rules : if the given set of conditions is satisfied, then execute the corresponding action.)
4. Define actions for all rules.
5. Simplify the table (Table compression)

How to determine no. of rules?

Determine Number of rules

Decision rules defines the combinations of conditions.

Example 1: Suppose we have two conditions with two possibilities.



The total number of rules =

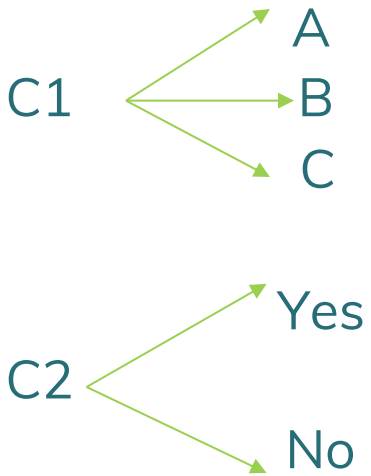
$$(\textbf{no of possibilities})^{\textbf{no of conditions}}$$

No of rules= $\mathbf{2^2}$ =4

Determine Number of rules Cond....

Example 2:

Suppose we have two conditions different number of possibilities.



No of rules= $3^1 * 2^1$ =6

Table Compression

- Check the table for any impossible situations, contradictions, and redundancies and eliminate such rules.
- Rewrite the decision table with the most reduced set of rules; rearranging the rule order is permissible if it improves user understanding.

Exercise 1: Draw a decision table for the given description

If you feel hungry, and if you have money, you will eat from a restaurant. But then if you don’t have money, you will go home and eat. However you will not eat either way if you are not hungry.

Identification of Conditions and Actions

Step 1 : Identify all the Conditions

- Hungry ? (Yes / No)
- Have Money ? (Yes / No)

Step 2 : Identify all the actions

- Eat from Restaurant
- Eat from Home

Step 3 : Determine no. of rules

- $2^2 = 4$ rules

Step 4 : Draw the decision table and simplify

Sample Answer:

Conditions	Rule 1	Rule 2	Rule 3	Rule 4
Hungry?	Y	Y	N	N
Have Money?	Y	N	Y	N
Actions				
Eat from a restaurant	X			
Eat from home		X		
Do not eat			X	X

Table Compression

Combine

Conditions	Rule 1	Rule 2	Rule 3	Rule 4
Hungry?	Y	Y	N	N
Have Money?	Y	N	Y	N
Actions				
Eat from a restaurant	X			
Eat from home		X		
Do not eat			X	X

Simplified Table

Conditions	Rule 1	Rule 2	Rule 3
Hungry?	Y	Y	N
Have Money?	Y	N	—
Actions			
Eat from a restaurant	X		
Eat from home		X	
Do not eat			X

Don't Care Condition

Advantages & Disadvantages of decision tables

Advantages

- Provide a clear tabular representation linking conditions with actions
- Ensure coverage of all possible cases
- Highlight inconsistencies, redundancies, and ambiguities
- Easy to follow

Disadvantages

- Can become large and unwieldy

Deciding Between Decision Tables & Decision Trees

Criteria	Decision Tables	Decision Trees
Portraying /complex logic	Best	Worst
Portraying simple rules	Worst	Best
Making decisions	Worst	Best
More compact	Best	Worst
Easier to manipulate	Best	Worst

Deciding Among Structured English, Decision Tables, and Decision Trees

Criteria	Pseudo Code	Decision Tables	Decision Trees
Determining Conditions and Actions	Second Best	Third Best	Best
Transforming Conditions and Actions into Sequence	Best	Third Best	Best
Checking Consistency and Completeness	Third Best	Best	Best

Any Questions?