System Analysis and Design

Chapter 5
System Analysis

5.2
Structuring System Requirements

5.2.3
Logic Modeling

Learning Objectives

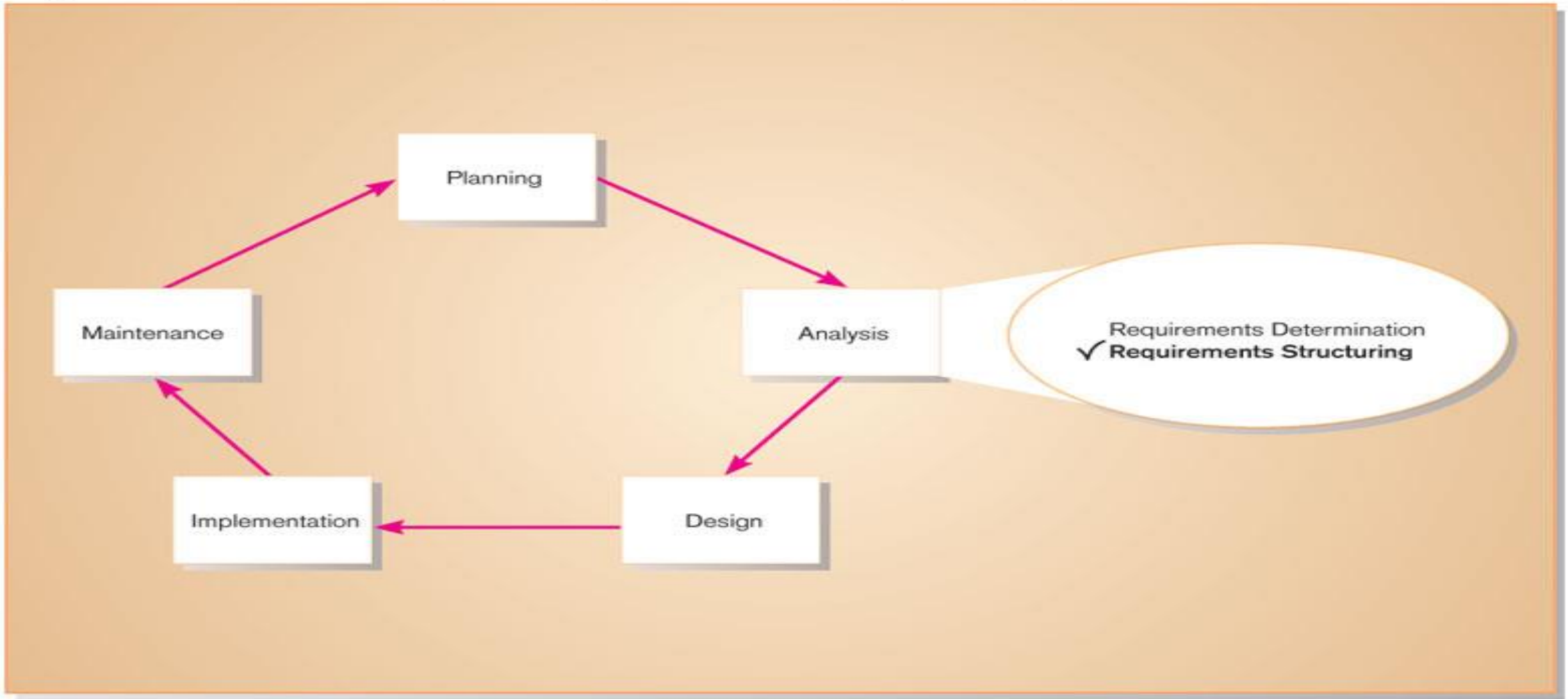
- ✓Use Structured English as a tool for representing steps in logical processes in data flow diagrams
- ✓Use decision tables and decision trees to represent the logic of choice in conditional statements
- ✓Select among Structured English, decision tables, and decision trees for representing processing 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
- Logic modeling can also be used to show when processes on a DFD occur

Modeling a System's Logic

Figure 8-1 Systems development life cycle with the analysis phase highlighted



Logic Modeling

Deliverables and Outcomes

- Structured English representation of process logic.
- Decision Tables representation.
- Sequence diagram.
- Activity diagram

Structured English
Decision Tables
Decision Trees
State-transition diagrams
Sequence diagrams
Activity diagrams

5. Decision Table

- A decision table is a tabular form that presents a set of conditions and their corresponding actions.
- A decision table allows us to identify the exact course of actions for a given conditions
- Decision table provides unambiguous decisions, leading to a good program design.
- It is a precise way to model a complicated logic.
- It is a non-graphical way of representing the steps involved in making a decision.

Conditions	Rules		
Sun is shining	✓		
Car is repaired	✓	✓	×
Music is playing		✓	
Actions			
Driving	✓		
Staying at home			✓
Dancing		✓	
Repairing a car			✓

Decision Table …

- Decision table is preferred when one action is to be selected among many actions.
- The action selected depends upon alternative conditions.
- The decision table and the decision tree are equivalent descriptions but the table is far less ‘user friendly’ It is usually easier to construct a decision tree first from the description of how a decision is made and then create the decision table.

Components / Areas of Decision Table

The decision table is divided into three main areas:

1. Conditions –

- these are created from each decision question.
- Only one possible answer from each question is selected for use in the table.
- Each answer corresponds to one of each pair of branches in the tree.

2. Actions –

- these are the final outcomes of the decision process and are the branch ends or outcomes.

3. Rules –

- these give the combinations of conditions that lead to the final actions.
- Y (for Yes) and N (for No) characters in the table normally indicate which combinations of conditions are allowed.

Structure / Format of Decision Table

		Rules			
Conditions	Condition 1	True	True	False	...
	Condition 2	True	False	False	...
	...	...	...	...	...
	Condition n	True	True	False	...
Actions	Action 1	√			
	Action 2		√		
	...			√	
	Action n				...

Fig: Format of a decision Table

Example of Decision Table

The discount policy of a departmental store is as follows:

i. If a customer is a member and purchase exceeds Rs. 1,000 then discount is 15%
ii. If a customer is a member and purchase is less than or equal to Rs. 1,000 then discount is 10%
iii. If a customer is not a member and purchase exceeds Rs. 1,000 then discount is 6%
iv. If a customer is not a member and purchase is less than or equal to Rs. 1,000 then discount is 0%

Conditions	Customer is a member	True	True	False	False
	Purchase exceeds Rs. 1,000	True	False	True	False
Actions	15 % discount	√			
	10 % discount		√		
	6 % discount			√	
	No discount				√

Example of Decision Table

Yes/No questions

Conditions	Rules							
Car is in good condition	Y	Y	Y	Y	N	N	N	N
Its price is under $7500	Y	Y	N	N	Y	Y	N	N
Its registration is current	Y	N	Y	N	Y	N	Y	N
Actions								
Purchase the car	X	X			X			
Reject the car			X	X		X	X	X

Y = Condition is true

X = This action matches the given rules

Possible outcomes

Example of Complete Decision Table : payroll system

	Conditions/ Courses of Action	Rules					
		1	2	3	4	5	6
Condition Stubs	Employee type	S	H	S	H	S	H
	Hours worked	<40	<40	40	40	>40	>40
Action Stubs	Pay base salary	X		X		X	
	Calculate hourly wage		X		X		X
	Calculate overtime						X
	Produce Absence Report		X				

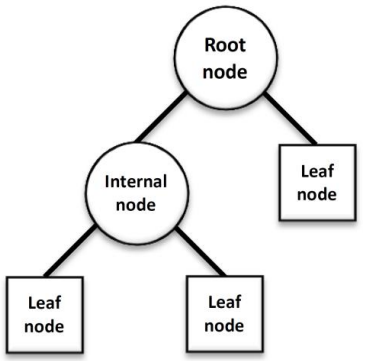
Example of Simplified Decision Table : payroll system

Figure 8-5 Reduced decision table for payroll system example

Conditions/ Courses of Action	Rules			
	1	2	3	4
Employee type	S	H	H	H
Hours worked	–	<40	40	>40
Pay base salary	X			
Calculate hourly wage		X	X	X
Calculate overtime				X
Produce Absence Report		X		

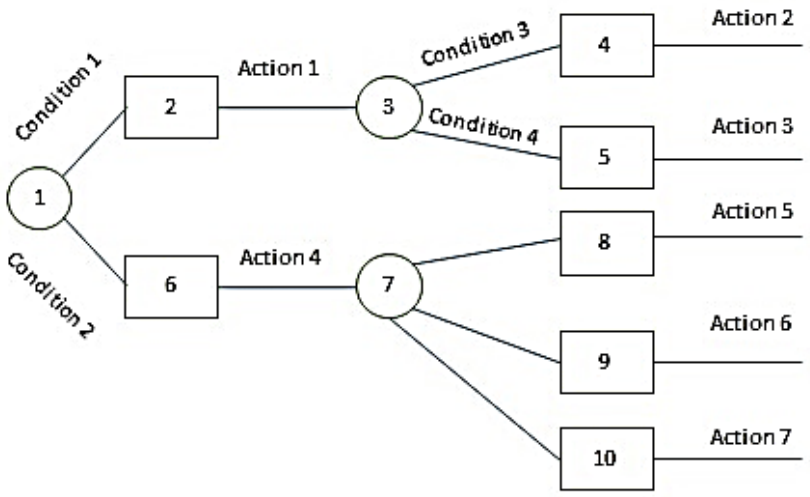
6. Decision Tree

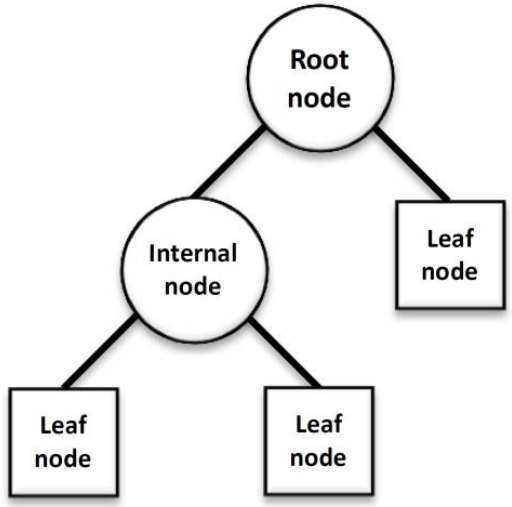
- A decision tree is a graphical way of representing the steps involved in making a decision.
- A user can look at a decision tree that describes a decision process they use and identify any errors in the diagram.
- Decision tree also does more or less the same job as decision table, except that, it follows the tree structure and each node of tree denotes conditions
- Decision Tree is more user-friendly than decision table because it provides graphical hierarchical diagrammatic view of conditions and actions.
- Decision tree is more popular because it is simple to understand and interpret



Structure of Decision Tree …

- Each ‘branch’ of the tree represents the result of a decision or a series of decisions.
- The ‘roots’ where the branches join are the decision points – each point represents a separate decision, a question that much be answered.
- Decision points typically have two or three branches.
- At the ends of the branches are the outcomes of the decision process.
- It may represented horizontally from left to right, or vertically from top to bottom.





Example of Decision Tree

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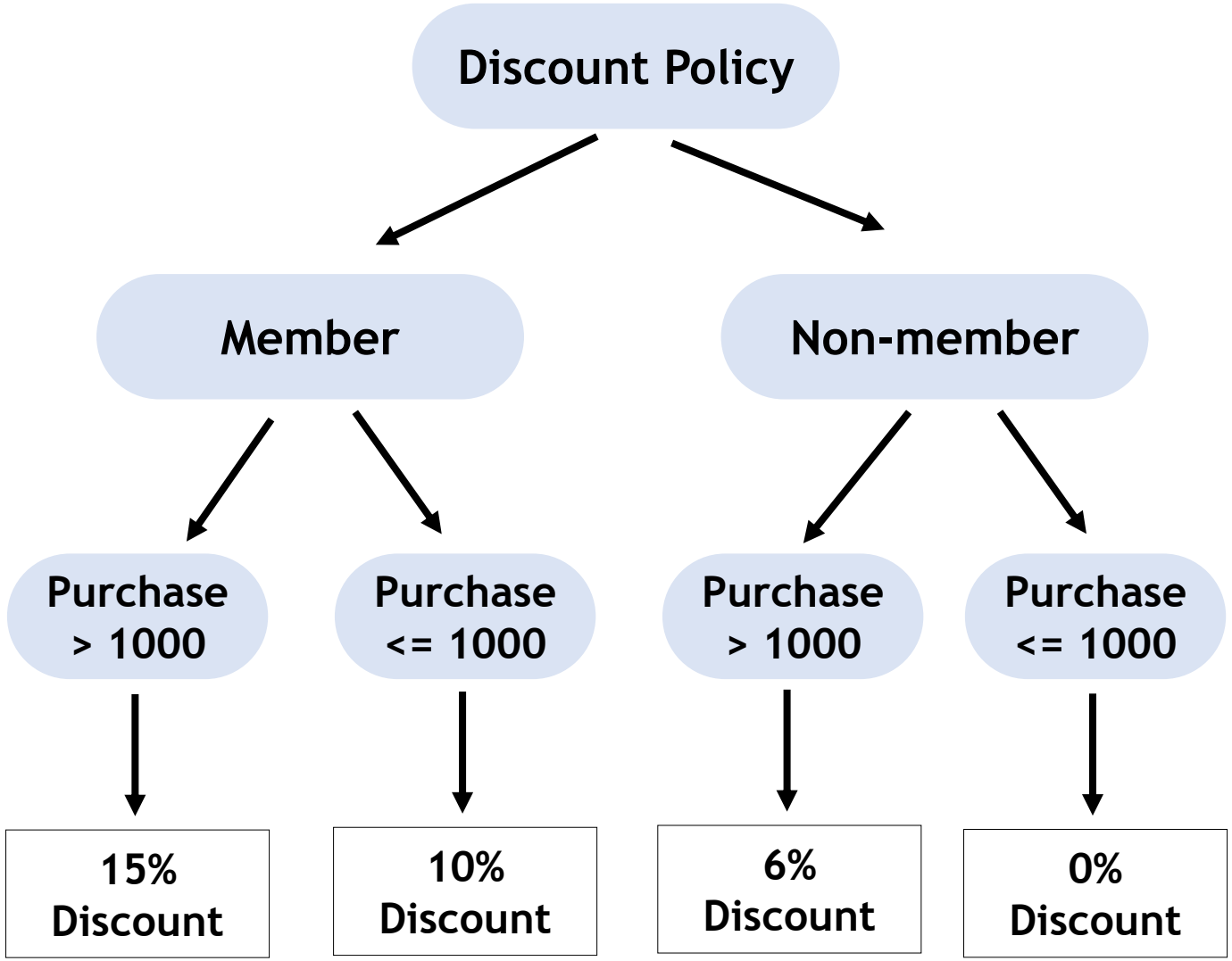
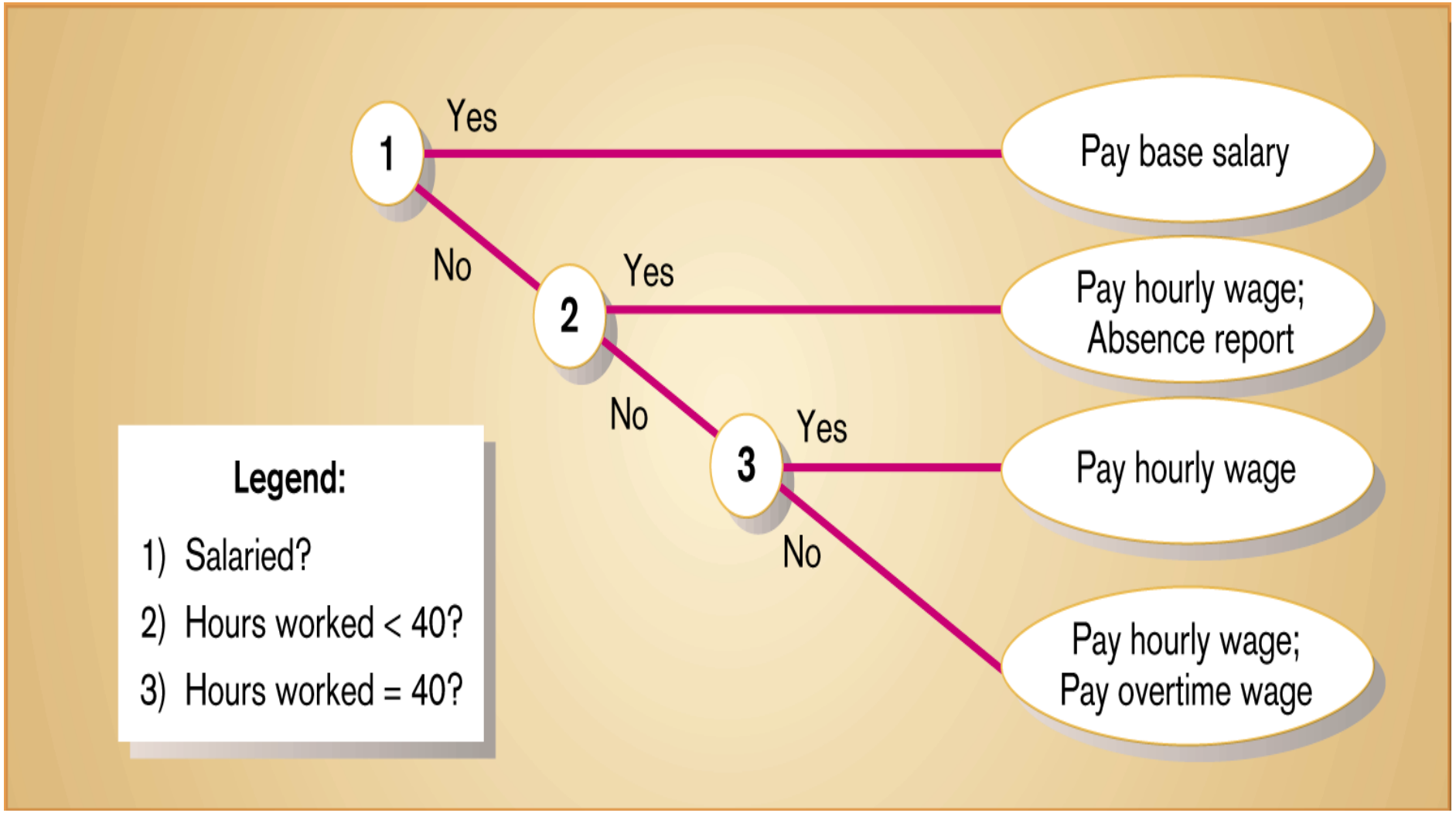


Figure 9-9
Decision tree representation of the decision logic in the decision tables in Figures 9-4 and 9-5, with only two choices per decision point



Another Example :

The ticket price in a concert is as follows:

i. For a single person, without dinner : Rs 1,000.00
ii. For a single person, with dinner : Rs. 1,500.00
iii. For a couple, without dinner : Rs 1,800.00
iv. For a couple, with dinner : Rs. 2,500.00

Based on the given conditions, create the following:

a. Decision Table
b. Decision Tree

Decision Table

Condition	Single person	Y	Y	N	N
	With dinner	Y	N	Y	N
Actions	Rs. 1,000.00		X		
	Rs. 1,500.00	X			
	Rs. 1,800.00				X
	Rs. 2,500.00			X	

Table : Decision table for ticket price in a concert

Decision Tree

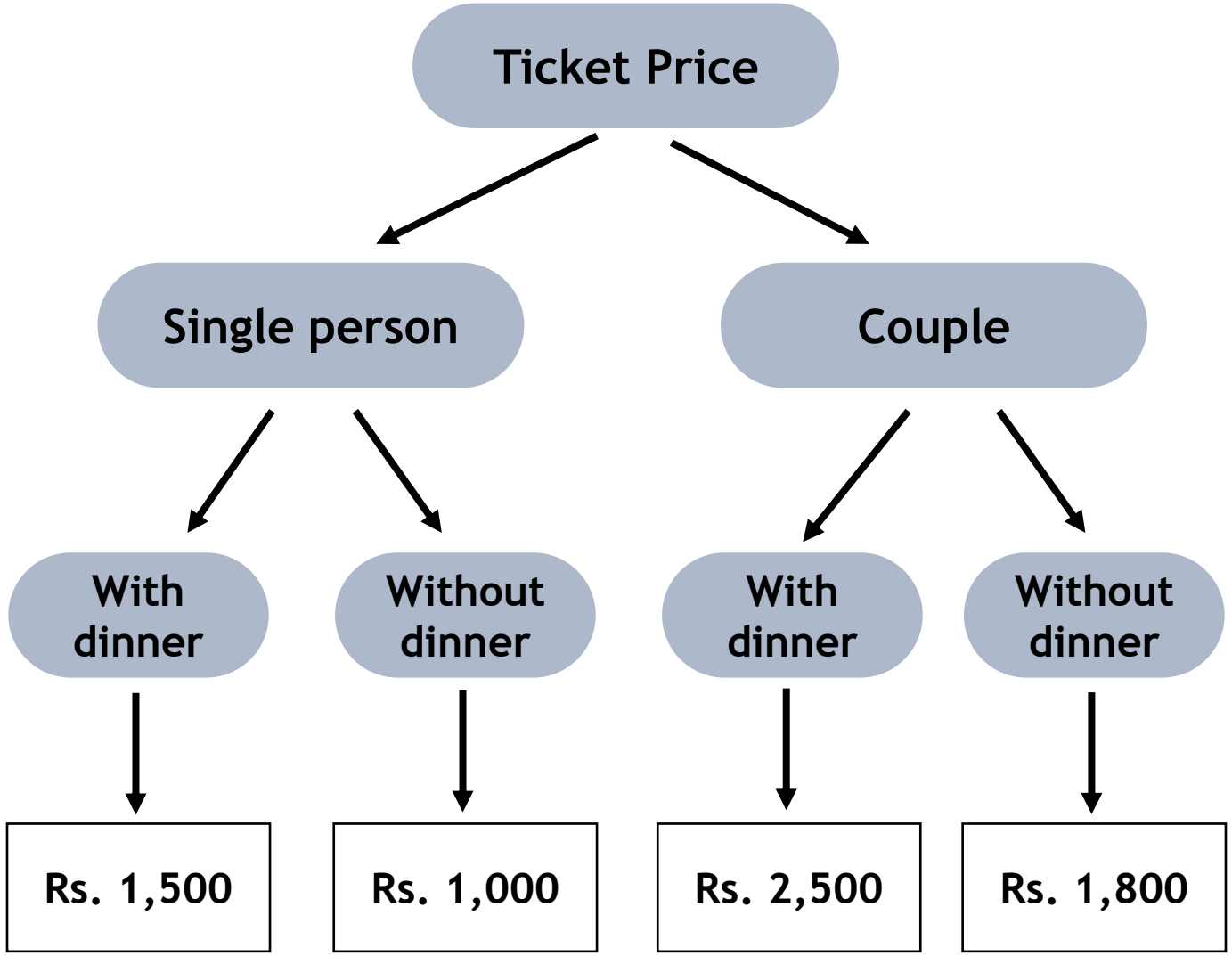


Fig : Decision tree for ticket price in a concert

Modeling Logic with Structured English

Structured English:

- modified form of English language used to specify the logic of information system processes.
- Typically relies on action verbs and noun phrases and contains no adjectives or No specific standards.
- **Uses a subset of English**
  - **Action verbs**
  - **Noun phrases**
  - **No adjectives or adverbs**
- **No specific standards**

Elements of Structured English

Structured English generally consists of the following elements:

1. Operation statements written as English phrases executed from the top down
2. Conditional blocks indicated by keywords such as **IF, THEN, and ELSE**
3. Repetition blocks indicated by keywords such as **DO, WHILE, and UNTIL**

Guidelines for using Structured English:

1. All logic should be expressed in operational, conditional, and repetition blocks
2. Statements should be clear and unambiguous
3. Logical blocks should be indented to show relationship and hierarchy
4. Use one line per logical element, or indent the continuation line
5. Keywords should be capitalized
6. Group blocks of statements together, with a capitalized name that describes their function and end with an EXIT.
7. Underline words or phrases defined in a data dictionary
8. Mark comment lines with an asterisk

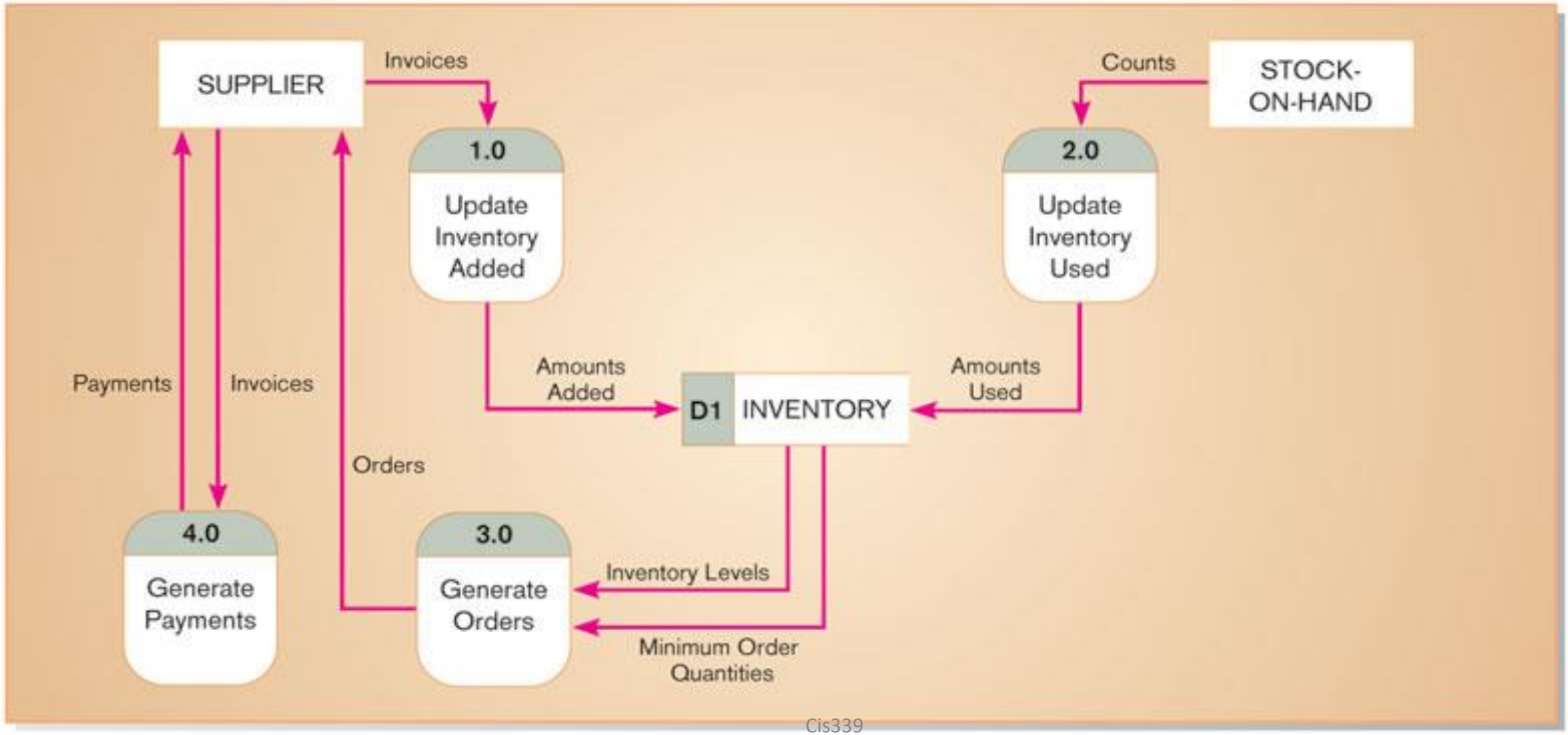
Example of Structured English

APPROVE LOAN

```
IF customer has a Bank Account THEN
   IF Customer has no dues from previous account THEN
      Allow loan facility
   ELSE
      IF Management Approval is obtained THEN
         Allow loan facility
      ELSE
        Reject
      ENDIF
   ENDIF
ELSE
   Reject
ENDIF
EXIT
```

Modeling Logic with Structured English

Figure 8-2 Current logical DFD for Hoosier Burger's inventory control system



Modeling Logic with Structured English

Figure 8-3
Structured English representations of the four processes depicted in Figure 8-2

```
Process 1.0: Update Inventory Added
DO
    READ next Invoice-item-record
    FIND matching Inventory-record
    ADD Quantity-added from Invoice-item-record to Quantity-in-stock on
      Inventory-record
UNTIL End-of-file
```

```
Process 2.0: Update Inventory Used
DO
    READ next Stock-item-record
    FIND matching Inventory-record
    SUBTRACT Quantity-used on Stock-item-record from Quantity-in-stock on
      Inventory-record
UNTIL End-of-file
```

```
Process 3.0: Generate Orders
DO
    READ next Inventory-record
    BEGIN IF
        If Quantity-in-stock is less than Minimum-order-quantity
        THEN GENERATE Order
    END IF
UNTIL End-of-file
```

```
Process 4.0: Generate Payments
READ Today's-date
DO
    SORT Invoice-records by Date
    READ next Invoice-record
    BEGIN IF
        IF Date is 30 days or greater than Today's-date
        THEN GENERATE Payments
    END IF
UNTIL End-of-file
```

Deciding Among Structured English, Decision Tables and Decision Trees

Criteria	Structured English	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

Deciding Between Table and Tree

Criteria	Decision Table	Decision Tree
Portraying complex logic	Best	Worst
Portraying simple problem	Worst	Best
Making decision	Worst	Best
More compact	Best	Worst
Easier to manipulate	Best	Worst