ISE204-INFORMATION SYSTEMS ANALYSIS, DESIGN AND MODELING

- **Chapter 6 – Data and Logic Modeling**

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The Data Dictionary

- A reference source of data about data (metadata)
- Collects and coordinates data terms, and confirms what each term means to different people in the organization
- Also called Metadata Repository

- Understanding the Data Dictionary
  - Provide documentation
  - Eliminate redundancy
  - Validate the data flow diagram
  - Provide a starting point for developing screens and reports
  - Determine the contents of data stored
  - To develop the logic for DFD processes
  - Create XML

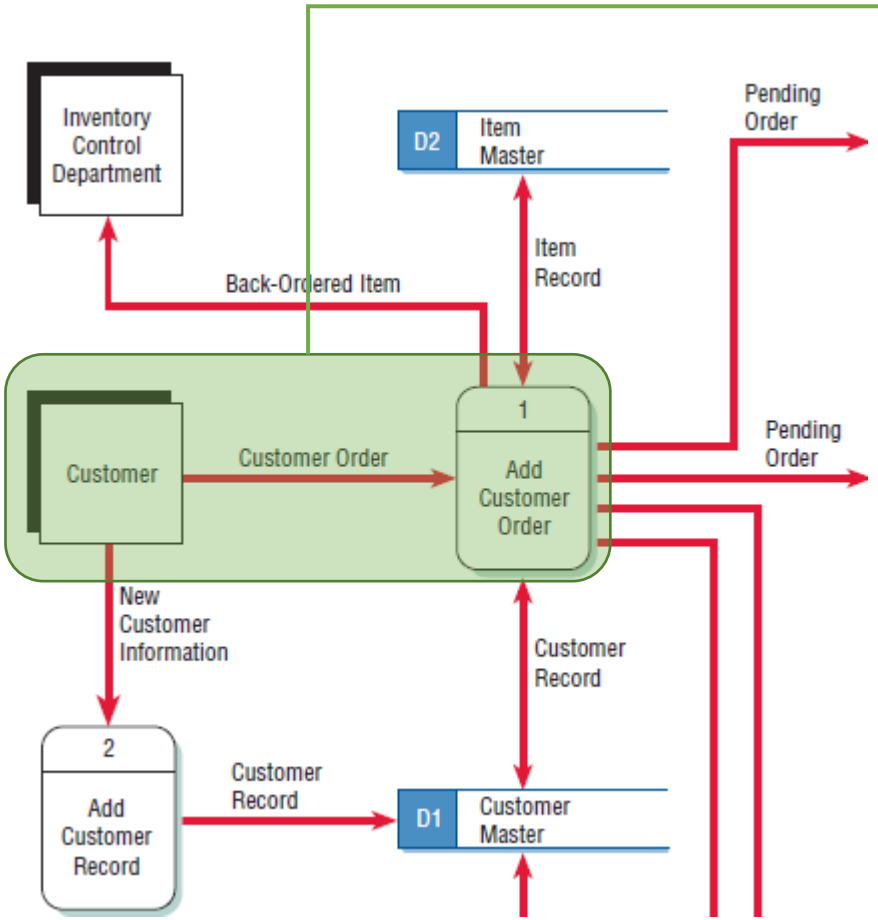
The Data Dictionary

- Top-Down Approach

- Creating Data Dictionary
    1. Understand DFD and data flows
    2. Transform data flows to data structures
    3. Transform data structures to structural records
    4. Create data elements for structural records
    5. Create data stores for every structural record

The Data Dictionary

1. Understanding DFD and data flows



Data flows are structured with the help of tables as follows.

Source	Name	Destination
Customer	Customer Order	Process 1

The Data Dictionary

- Data structures are made up of smaller data structures (structural records) and elements
- An algebraic notation is used to describe data structures

Operator	Definition
=	Equal sign means “is composed of”
+	Corresponds to the AND operator
{ }	Used for repeatable expressions
[ ]	Preferred in OR / EITHER situations
( )	Used for optional elements

The Data Dictionary

2. Transform Data Flows to Data Structures

Source	Name	Destination
Customer	Customer Order	Process 1

Source	Name	Destination	Data Structure	
Customer	Customer Order	Process 1	Customer Order =	Customer Number + Customer Name + Address + Telephone + Catalog Number + Order Date + {Available Order Items}+ (Tax) + Shipping and Handling + Order Total + Method for Payment +

The Data Dictionary

3. Transform Data Structures to Structural Records

Data Structure	
Customer Order =	Customer Number + Customer Name + Address + Telephone + Catalog Number + Order Date + {Available Order Items}+ (Tax)+ Shipping and Handling + Order Total + Method for Payment + (Credit Card Info)

Customer Name =	First Name + (Middle Name) + Last Name
Address=	Street + (Apartment) + City + State + Zip Code + (Country)
Telephone=	Area Code + Local Number
Available Order Item=	Order Quantity + Item Number + Item Description + Size + Color + Prize + Item Total
Method for Payment =	[Check; Credit Card; Money Order; Cash]
Credit Card Info =	Card Number + Expiration Date

The Data Dictionary

4. Create Data Elements for Structural Records

Structural Records		Data Type	Data Format	Description	Example
Customer Name	First Name	String		First name of Customer	Ahmet
	Middle Name	String		Middle name of Customer	Can
	Last Name	String		Surname of Customer	Erden
Address	Street	String		Street name or number	Muradiye
	Apartment	String	XXXX/NN	Apartment name	Deniz/13
	City	String		City name	Serdivan
	State	String		State name of City	Sakarya
	Zip Code	Integer	NNNNN	5 digit postal code	54187
	Country	String		Country name	Turkey
Telephone	Area Code	Integer	NNN	3 digit area code (no zero)	264
	Local Number	String	NNN NN NN	7 digit phone number	294 71 23
Available Order Item	Order Quantity	Integer		Total quantity of an order	125
	Item Number	String	XNNNNNN	Automatic, unique number with predefined character	A130023
	Item Description	String		Brief explanation of an ordered item	Book
	Size	String	NN*NN*NN	Package size (dimensional)	5*25*33
	Prize	Float	$NN.NN	Unit prize of an ordered item	$27.15
Method for Payment	Method for Payment	String		Check, Cash, C.Card or Money Order	Check
Credit Card Info	Card Number	String	NNNN NNNN NNNN NNNN	16 digit number with spaces	1632 1225 1295 2563
	Expiration Date	Date	MM/YY	Month and year of expiration	09/2018

The Data Dictionary

some data types

Data Type	Description	Example
Boolean	The Boolean type represents the values true and false. Also can be used if there is only two possible values	True/False, 0/1
Character	A letter of the alphabet, digit, blank space, punctuation mark, etc.	A
Date	Provides for storage of a year-month-day	03.01.2018
Double	Represent values as floating point format	1.12455896389 E308
Floating-Point Number	Floating point data types, usually represent values as high-precision floating point values	1.234
Integer	The integer data types, or "non-floating point numbers"	1234
Long	Type of integer data type with larger values	123456789
Short	Type of integer data type with smaller values	2
String	Alphanumeric strings, a sequence of characters. They are typically used to represent words and text.	abcd

The names of the data types differ in the programs.

The Data Dictionary

5. Create Data Stores for Every Structural Record

- Data stores are created for each different data entity being stored
- When data flow base elements are grouped together to form a structural record, a data store is created for each unique structural record
- Because a given data flow may only show part of the collective data that a structural record contains, many different data flow structures may need to be examined to arrive at a complete data store description

The Data Dictionary

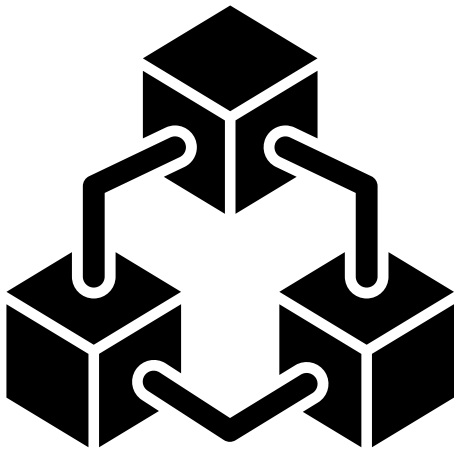
5. Create Data Stores for Every Structural Record

Data Structure	
Customer Order =	Customer Number + Customer Name + Address + Telephone + Catalog Number + Order Date + {Available Order Items}+ (Tax)+ Shipping and Handling + Order Total + Method for Payment + (Credit Card Info)

Customer Name =	First Name + (Middle Name) + Last Name
Address=	Street + (Apartment) + City + State + Zip Code + (Country)
Telephone=	Area Code + Local Number

Store ID	Data Store Name	Data Structure	Description	Primary Key	Secondary Key
D1	Customer Master	Customer Records	Information about each customer	Customer Number	Customer Name
D2	..	..	..	..	..

Logic Modeling



- Data flow diagrams do not show the logic within 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

- ***Process 1.1 = Check Customer Record***
  - How ???
- ***Process 1.2 = Inventory Availability Control***
  - How ???
- Process logic is the last part of the process specification

Logic Modeling

Structured English(Language)

- a method of writing process specifications that combines structured programming techniques with narrative English

Decision table

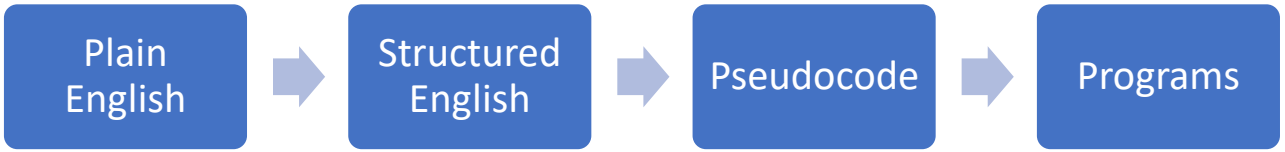
- logic modeling (decision analysis) tool that simplifies creating action under certain conditions in tables.

Decision tree

- a graphical description of process logic that uses lines organized like branches of a tree

Structured English

- Modified form of English used to specify the logic of information processes
- Facilitates the understanding of the process logic by all employees (especially at the system analysis stage).
- The stage before the pseudo code is prepared.
- No specific standards



- Before logic modeling can be done with the structured language, data dictionaries must be created.

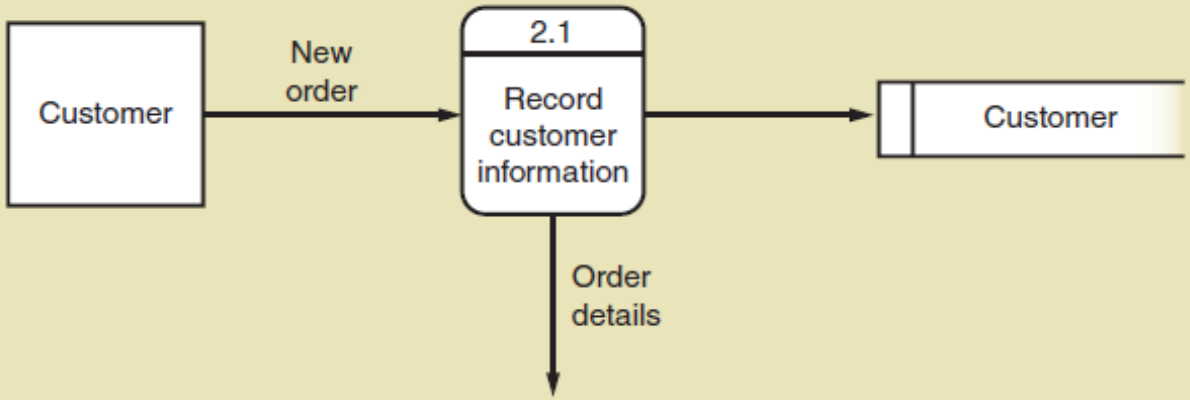
Structured English

Structured English Type	Example
Sequential Structure A block of instructions in which no branching occurs	Action #1 Action #2 Action #3
Decision Structure Only IF a condition is true, complete the following statements; otherwise, jump to the ELSE	IF Condition A is True THEN implement Action A ELSE implement Action B ENDIF
Case Structure A special type of decision structure in which the cases are mutually exclusive (if one occurs, the others cannot)	IF Case #1 implement Action #1 ELSE IF Case #2 Implement Action #2 ELSE IF Case #3 Implement Action #3 ELSE IF Case #4 Implement Action #4 ELSE print error ENDIF
Iteration Blocks of statements that are repeated until done	DO WHILE there are customers. Action #1 ENDDO

Structured English

Process 2.1 - Record Customer Information

```
Ask if customer has an account (or has made a previous order)
If customer has an account then
   Ask for identification information
   Query database with identifying information
   Copy query response data to Order details
Else
   Create an empty Customer record in the database
   Ask customer for Customer attributes
   Update empty Customer record with Customer attributes
Endif
Ask customer for order information for first item
While more order items Do
   Update Order details with order information
Endwhile
```



Structured English

Structured English

Format the Shipping Statement. After each line of the statement has been formatted, write the shipping line.

```
1.  GET Order Record
2.  GET Customer Record
3.  Move Order Number to shipping statement
4.  Move Order Date to Shipping Statement
5.  Move Customer Number to Shipping Statement
6.  DO format Customer Name (leave only one space between First/Middle/Last)
7.  DO format Customer Address lines
8.  DO WHILE there are items for the order
9.      GET Item Record
10.     DO Format Item Line
11.     Multiply Unit Price by Quantity Ordered giving Extended Amount
12.     Move Extended Amount to Order Item Lines
13.     Add Extended Amount to Merchandise Total
14.     IF Quantity Backordered is greater than zero
15.         Move Quantity Backordered to Order Item Lines
16.     ENDIF
17. ENDDO
18. Move Merchandise Total to Shipping Statement
19. Move 0 to Tax
20. IF State is equal to CT
21.     Multiply Merchandise Total by Tax Rate giving Tax
22. ENDIF
23. Move Tax to Shipping Statement
24. DO calculate Shipping and Handling
25. Move Shipping and Handling to Shipping Statement
26. Add Merchandise Total, Tax, and Shipping and Handling giving Order Total
27. Move Order Total to Shipping Statement
```

Decision Tables

- A matrix representation of the logic of a decision
- Specifies the possible conditions and the resulting actions
- Suitable for complex decision processes.

- Consists of three parts
  - Conditions
    - List of possible conditions
  - Actions
    - Alternative action list to be applied as a result of the conditions
  - Rules
    - Indicates which action will be decided under which condition.

Decision Tables

Developing Decision Tables

1. Identifying the conditions that affect decisions
2. Identifying possible actions that can be taken
3. Identifying alternatives for each condition
4. Calculating the number of columns in the decision table
5. Filling in alternative condition columns
6. Filling each cell where the rules suggest action with an «X»
7. Combine rules where it's obvious
8. Check for impossible situations
9. Rearrange to make it clearer

Decision Tables

Developing Decision Tables

1. ***Identifying the conditions that affect decisions***
   - Customer orders from the autumn catalog
   - Customer orders from the New Year's catalog
   - Customer orders from Special Catalog

2. ***Identifying possible actions that can be taken***
   - Sending this year's New Year's catalog
   - Sending the special catalog
   - Sending both catalogs together

Decision Tables

Developing Decision Tables

3. Determine condition alternatives for each condition

Customer orders from the autumn catalog

- Yes/No

Customer orders from the New Year's catalog

- Yes No

Customer orders from special catalog

- Yes/No

4. Calculating the number of columns in the decision table

Calculate the maximum number of columns in the decision table

- 2 x 2 x 2= 8 Column

Decision Tables

Developing Decision Tables

5. Filling in alternative condition columns

Rules

Conditions	1	2	3	4	5	6	7	8
Customer ordered from Fall Catalog	Y	Y	Y	Y	N	N	N	N
Customer ordered from New Year's Catalog	Y	Y	N	N	Y	Y	N	N
Customer ordered from Special Catalog	Y	N	Y	N	Y	N	Y	N

Decision Tables

Developing Decision Tables

6. Filling each cell where the rules suggest action with an «X»

Rules

Conditions and Actions	1	2	3	4	5	6	7	8
Customer ordered from Fall Catalog	Y	Y	Y	Y	N	N	N	N
Customer ordered from Christmas Catalog	Y	Y	N	N	Y	Y	N	N
Customer ordered from Specialty Catalog	Y	N	Y	N	Y	N	Y	N
Send out this year's Christmas Catalog		X		X		X		X
Send out Specialty Catalog			X				X	
Send out both Catalog	X				X			

Decision Tables

Developing Decision Tables

7. Combine rules where it's obvious

Rules

Conditions	1	2	3	4	5	6	7	8
Customer ordered from Fall Catalog	Y	Y	Y	Y	N	N	N	N
Customer ordered from Christmas Catalog	Y	Y	N	N	Y	Y	N	N
Customer ordered from Specialty Catalog	Y	N	Y	N	Y	N	Y	N
Send out this year's Christmas Catalog		X		X		X		X
Send out Specialty Catalog			X				X	
Send out both Catalog	X				X			

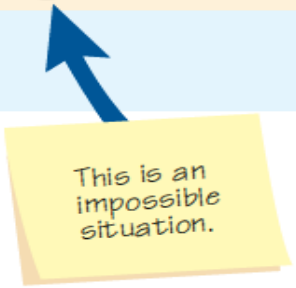
Decision Tables

Developing Decision Tables

8. Check for impossible situations

There is no impossible situation in this example

Conditions and Actions	Rules 1	2	3	4
Salary > $50,000/year	Y	Y	N	N
Salary < $2,000/month	Y	N	Y	N
Action 1				
Action 2				



Decision Tables

Developing Decision Tables

9. Rearrange to make it clearer

Rules

Conditions	1	2	3	4	5	6	7	8
Customer ordered from Fall Catalog	Y	Y	Y	Y	N	N	N	N
Customer ordered from Christmas Catalog	Y	Y	N	N	Y	Y	N	N
Customer ordered from Specialty Catalog	Y	N	Y	N	Y	N	Y	N
Send out this year's Christmas Catalog		X		X		X		X
Send out Specialty Catalog			X				X	
Send out both Catalog	X				X			

Conditions	1	2	3
Customer ordered from Fall Catalog	-	-	-
Customer ordered from Christmas Catalog	Y	-	N
Customer ordered from Specialty Catalog	Y	N	Y
Send out this year's Christmas Catalog		X	
Send out Specialty Catalog			X
Send out both Catalog	X		

Decision Tables

CASE STUDY 1 :
Let's prepare a decision table based on 2 conditions required to pass a course at the university (Taking passing grades, not absenteeism).

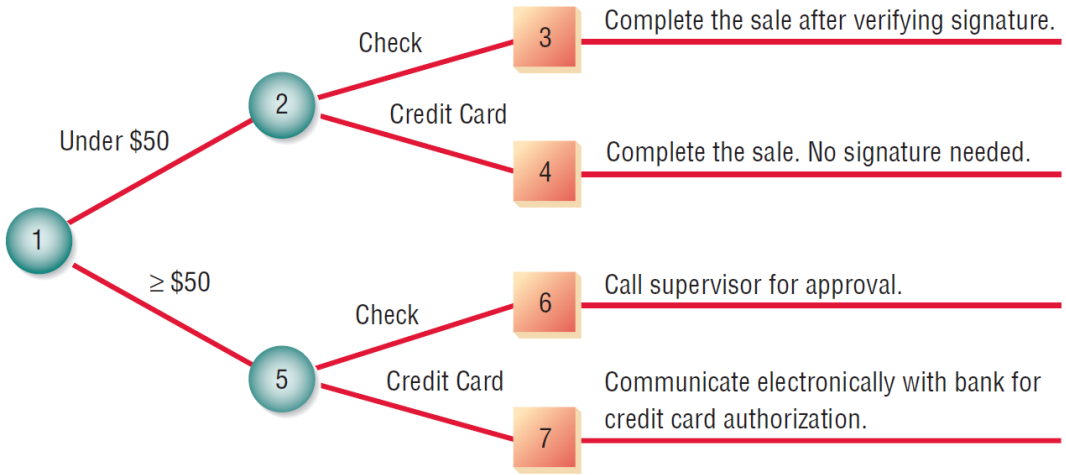
CASE STUDY 2:
We want to write a program that divides the two numbers it receives from the textboxes.

For example, if we divide a number by 0, we get an error. Now let's think about what might happen when writing this program and prepare a decision table.

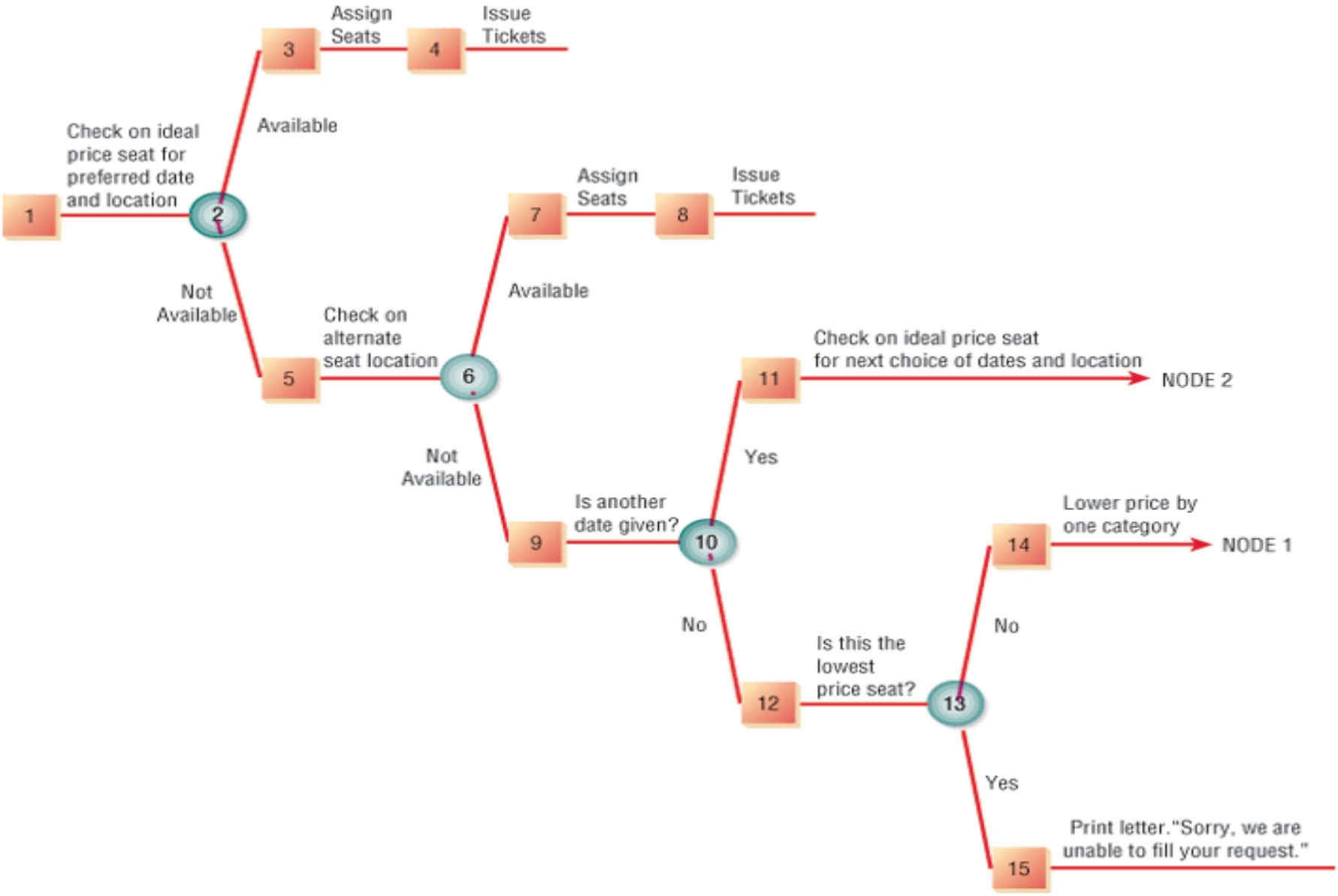
https://ercanhilal.wordpress.com/2016/04/20/karar-tablolari-decision-table/

Decision Trees

- A graphical representation of a decision situation
- Decision state points connect by lines and end with ellipses
- Read from left to right
- Each node corresponds to a numbered choice on a legend
- All possible actions are listed on the far right



Decision Trees



Decision Trees

- **Advantages of the Decision Tree**

  - The order of checking conditions and executing actions is immediately noticeable
  - Conditions and actions of decision trees are found on some branches but not on others
  - Compared to decision tables, decision trees are more readily understood by others in the organization

Decision Trees

Entropy is used for Information Gain measurement. Entropy shows randomness, uncertainty, and the likelihood of an unexpected situation occurring.

Information Gain: Information gain is measured for each feature in order to determine the most distinctive quality in decision tree methods such as ID3, C4.5.

$$Entropy(S) = \sum_{i=1}^{n} -p_i \log_2(p_i)$$

$$Gain(S, A) = Entropy(S) - \sum_{v \in Values(A)} \frac{|S_v|}{|S|} Entropy(S_v)$$

Logic Modeling

Selecting a Structured Decision Analysis Technique

- Use **Structured English** when
  there are many repetitious actions
  or
  when communication to end users is important

- Use **Decision Tables** when
  a complex combination of conditions, actions, and rules are found
  or
  you require a method that effectively avoids impossible situations, redundancies, and contradictions

- Use **Decision Trees** when
  the sequence of conditions and actions is critical
  or
  when not every condition is relevant to others(the branches are different)

REFERENCES

CEBECİ, H. İ. (2019). *System Analysis and Design lecture notes*

http://ccg.doc.gold.ac.uk/ccg_old/teaching/artificial_intelligence/lecture11.html