

Contents

<i>Preface</i>	xvii
<i>List of Figures</i>	xi
<i>List of Tables</i>	xiii
<i>List of Abbreviations</i>	xv

1 Introduction to Database Systems 1

Unit Introduction	1
1.1. Basics of Database Systems	4
1.1.1. Data	4
1.1.2. Database	5
1.2. History of Database Systems	6
1.3. Importance of Database Systems	7
1.3.1. Data Integration and Data Quality	7
1.3.2. Decision Making	7
1.3.3. Efficient Data Management	8
1.3.4. Cost Savings	8
1.3.5. Scalability	8
1.3.6. Regulatory Compliance	9
1.3.7. Improved Customer Experience	9
1.4. Components of Database Systems	9
1.4.1. Data Definition Language (DDL)	10
1.4.2. Data Manipulation Language (DML)	11
1.4.3. Data Query Language (DQL)	12
1.4.4. Data Control Language (DCL)	13
1.4.5. Database Management System (DBMS)	14
1.5. Data Storage and Retrieval	15
1.5.1. Primary Storage	16
1.5.2. Secondary Storage	16
1.5.3. Indexing	16
1.5.4. Query Optimization	16
1.5.5. Query Execution	16
1.6. Characteristics of Database Systems	17
1.6.1. Data Independence	17
1.6.2. Concurrent Access	17
1.6.3. Data Integrity	17
1.6.4. Security	18
1.6.5. Scalability	18
1.7. Architecture of Database Systems	19
1.7.1. Client-Server Architecture	19
1.7.2. Tiered Architecture	19
1.7.3. Distributed Architecture	19
1.8. Query Processing and Optimization	20
1.8.1. Query Processing Phases	20
1.8.2. Query Optimization Techniques	21
1.8.3. Query Execution Plans	21
1.9. Importance of Database Systems in Modern World	21
1.9.1. Data Management	22
1.9.2. Decision Making	22
1.9.3. Improved Efficiency	22
1.9.4. Cost Savings	22
1.9.5. Data Security	22
1.9.6. Compliance	22
1.9.7. Innovation	23

1.10. Summary	24
Review Questions	24
Multiple Choice Questions	24
References	26

2 Database Development Process 31

Unit Introduction	31
2.1. Development Life Cycle – Waterfall	33
2.2. Database Life Cycle	34
2.3. Requirements Gathering	35
2.4. Analysis	36
2.5. Logical Design	37
2.6. Implementation	40
2.7. Realizing the Design	41
2.8. Populating the Database	41
2.9. Guiding Principles for the Development of an ER Diagram	42
2.10. Summary	44
Review Questions	44
Multiple Choice Questions	44
References	45

3 Types of Databases 49

Unit Introduction	49
3.1. Hierarchical Databases	52
3.1.1. History of Hierarchical Databases	52
3.1.2. Importance of Hierarchical Databases	53
3.1.3. Applications of Hierarchical Databases	54
3.1.4. Advantages of Hierarchical Databases	55
3.1.5. Disadvantages of Hierarchical Databases	57
3.2. Network Databases	58
3.2.1. History of Network Databases	60
3.2.2. Importance of Network Databases	61
3.2.3. Applications of Network Databases	62
3.2.4. Advantages of Network Databases	63
3.2.5. Disadvantages of Network Databases	65
3.3. Relational Databases	66

3.3.1. History of Relational Databases	67
3.3.2. Importance of Relational Databases	68
3.3.3. Applications of Relational Databases	69
3.3.4. Advantages of Relational Database	71
3.3.5. Disadvantages of Relational Database	72
3.4. Object-Oriented Databases (OODBs)	73
3.4.1. History of Object-Oriented Databases (OODBs)	74
3.4.2. Importance of Object-Oriented Databases (OODBs)	75
3.4.3. Applications of Object-Oriented Databases (OODBs)	76
3.4.4. Advantages of Object-Oriented Databases (OODBs)	78
3.4.5. Disadvantages of Object-Oriented Databases (OODBs)	79
3.5. Graph Databases	80
3.5.1. History of Graph Databases	81
3.5.2. Importance of Graph Databases	82
3.5.3. Applications of Graph Databases	83
3.5.4. Advantages of Graph Databases	85
3.5.5. Disadvantages of Graph Databases	86
3.6. NoSQL Databases	87
3.6.1. History of NoSQL Databases	89
3.6.2. Importance of NoSQL Databases	89
3.6.3. Applications of NoSQL Databases	91
3.6.4. Advantages of NoSQL Databases	92
3.6.5. Disadvantages of NoSQL Databases	93
3.7. Document Databases	94
3.7.1. History Document Databases	95
3.7.2. Importance Document Databases	96
3.7.3. Applications of Document Databases	97
3.7.4. Advantages of Document Databases	98
3.7.5. Disadvantages of Document Databases	100
3.8. Summary	102
Review Questions	102
Multiple Choice Questions	102
References	105

4 Database Modeling 115

Unit Introduction	115
4.1. Overview of Data Modeling	118
4.1.1. Methodology	118

5.4. Components of Relational Database	167
5.4.1. Table	167
5.4.2. Record/Row	168
5.4.3. Field/Column	168
5.4.4. Datatype	168
5.4.5. Query/View	170
5.4.6. Stored Procedure	171
5.5. Overview of SQL	171
5.5.1. Working of SQL	172
5.5.2. History of SQL	172
5.5.3. Standard of SQL	173
5.5.4. Importance of SQL Today and Tomorrow	174
5.6. The Practice Of SQL Commands	175
5.6.1. Microsoft Access	175
5.6.2. SQL Server	176
5.6.3. MySQL	177
5.6.4. Oracle	178
5.7. Summary	179
Review Questions	179
Multiple Choice Questions	179
References	180

6.4.1. Scalability	195
6.4.2. Availability and Fault Tolerance	195
6.4.3. Efficient Network Setup	195
6.4.4. Flexibility	196
6.4.5. Privacy and Access Control	196
6.4.6. Elasticity	196
6.4.7. Batch Processing and Interactive Processing	196
6.4.8. Efficient Storage	196
6.4.9. Multi-Tenancy	196
6.4.10. Efficient Processing	197
6.4.11. Efficient Scheduling	197
6.5. Summary	198
Review Questions	198
Multiple Choice Questions	198
References	199

6 Role of Big Data in Database Systems 185

Unit Introduction	185
6.1. Understanding Big Data	187
6.1.1. Characteristics of Big Data	187
6.1.2. Importance of Big Data	188
6.2. Big Data Technologies	189
6.2.1. Hadoop	190
6.2.2. Spark	191
6.2.3. NoSQL Databases	191
6.2.4. Comparison of the Technologies	192
6.3. Type of Data: Transactional or Analytical	193
6.3.1. Transactional Systems	193
6.3.2. Analytical Systems	193
6.3.3. CAP Theorem	194
6.3.4. ACID vs. BASE	195
6.4. Requirements and Challenges of Big Data	195

7 Data Warehousing and Business Intelligence 203

Unit Introduction	203
7.1. Data Warehouse (DW) Concepts	205
7.2. Statements Business Intelligence (BI)	206
7.3. Business Intelligence (BI) Architecture	208
7.3.1. Operational Applications vs. Business Intelligence (BI) Applications	208
7.3.2. Requirement for Data Warehouse (DW)	209
7.3.3. Improved Decision-Making via Analysis and Reporting	210
7.4. Data Warehouse (DW) Data Model	212
7.4.1. DW Modeling Techniques	213
7.4.2. DW Database Design Modeling	213
7.4.3. Developing Data Warehouse (DW)	214
7.5. Business Intelligence (BI) Concepts	215
7.5.1. Customer and Market Analysis	216
7.5.2. Channel Analysis	216
7.5.3. Forecasting and Planning	216
7.6. Data Warehousing Online Transactional Processing (OLTP)	217
7.7. Data Warehouse (DW) and Business Intelligence (BI) High-Level Architecture	217

7.8. Summary	219
Review Questions	219
Multiple Choice Questions	219
References	220

8 Applications of Database Systems 225

Unit Introduction	225
8.1. E-Commerce	227
8.1.1. Importance of Database in E-Commerce	227
8.1.2. Examples of E-Commerce Databases	228
8.2. Healthcare	229
8.2.1. Role of Databases in Healthcare	229
8.2.2. Examples of Healthcare Databases	230
8.3. Banking and Finance	231
8.3.1. Importance of Databases in Financial Management	231
8.3.2. Examples of Financial Databases	232
8.4. Social Media	233

8.4.1. Role of Databases in Social Media Platforms	233
8.4.2. Examples of Social Media Databases	234
8.5. Education	235
8.5.1. Importance of Databases in Education	235
8.5.2. Examples of Educational Databases	236
8.6. Logistics and Supply Chain Management	237
8.6.1. Role of Databases in Logistics and Supply Chain Management	237
8.6.2. Examples of Logistics and Supply Chain Databases	238
8.7. Internet of Things (IoT)	239
8.7.1. Role of Databases in IoT Data	239
8.7.2. Examples of IoT Databases	240
8.8. Summary	242
Review Questions	242
Multiple Choice Questions	242
References	243

INDEX 247