uCertify

# Course Outline

## Fundamentals of Database Systems

19 May 2024

1. Course Objective
2. Pre-Assessment
3. Exercises, Quizzes, Flashcards & Glossary

   Number of Questions
4. Expert Instructor-Led Training
5. ADA Compliant & JAWS Compatible Platform
6. State of the Art Educator Tools
7. Award Winning Learning Platform (LMS)
8. Chapter & Lessons

   Syllabus

   Chapter 1: Preface

   Chapter 2: Databases and Database Users

   Chapter 3: Database System Concepts and Architecture

   Chapter 4: Data Modeling Using the Entity–Relationship (ER) Model

   Chapter 5: The Enhanced Entity–Relationship (EER) Model

   Chapter 6: The Relational Data Model and Relational Database Constraints

   Chapter 7: SQL Data Definition and Data Types

   Chapter 8: More SQL: Complex Queries, Triggers, Views, and Schema Modification

   Chapter 9: The Relational Algebra and Relational Calculus

   Chapter 10: Relational Database Design by ER- and EER-to-Relational Mapping

   Chapter 11: Introduction to SQL Programming Techniques

   Chapter 12: Web Database Programming Using PHP

   Chapter 13: Object and Object-Relational Databases

   Chapter 14: XML: Extensible Markup Language

   Chapter 15: Basics of Functional Dependencies and Normalization for Relational Databases

   Chapter 16: Relational Database Design Algorithms and Further Dependencies

   Chapter 17: Disk Storage, Basic File Structures, Hashing, and Modern Storage Architectures

   Chapter 18: Indexing Structures for Files and Physical Database Design

Chapter 19: Strategies for Query Processing

Chapter 20: Query Optimization

Chapter 21: Introduction to Transaction Processing Concepts and Theory

Chapter 22: Concurrency Control Techniques

Chapter 23: Database Recovery Techniques

Chapter 24: Distributed Database Concepts

Chapter 25: NOSQL Databases and Big Data Storage Systems

Chapter 26: Big Data Technologies Based on MapReduce and Hadoop

Chapter 27: Enhanced Data Models: Introduction to Active, Temporal, Spatial, Multimedia, and Deductive Databases

Chapter 28: Introduction to Information Retrieval and Web Search

Chapter 29: Data Mining Concepts

Chapter 30: Overview of Data Warehousing and OLAP

Chapter 31: Database Security

Chapter 32: Appendix A: Alternative Diagrammatic Notations for ER Models

Chapter 33: Appendix B: Parameters of Disks

Chapter 34: Appendix C: Overview of the QBE Language

Videos and How To

9. Practice Test

   Here's what you get

   Features

10. Performance Based labs

    Lab Tasks

    Here's what you get

11. Post-Assessment

## 1. Course Objective

Use the Fundamentals of Database Systems course and lab to learn database concepts and methodologies. Lab simulates real-world, hardware, software, and command-line interface environments and can be mapped to any textbook, course, and training. The database training course covers fundamental concepts necessary for designing, using, and implementing database systems and applications; database modeling and design; languages and models provided by database management systems; and database system implementation techniques.

## 2. Pre-Assessment

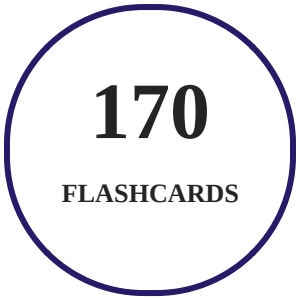
Pre-Assessment lets you identify the areas for improvement before you start your prep. It determines what students know about a topic before it is taught and identifies areas for improvement with question assessment before beginning the course.

## 3. Quiz

Quizzes test your knowledge on the topics of the exam when you go through the course material. There is no limit to the number of times you can attempt it.

## 4. flashcards

Flashcards are effective memory-aiding tools that help you learn complex topics easily. The flashcard will help you in memorizing definitions, terminologies, key concepts, and more. There is no limit to the number of times learners can attempt these. Flashcards help master the key concepts.




## 5. Glossary of terms

uCertify provides detailed explanations of concepts relevant to the course through Glossary. It contains a list of frequently used terminologies along with its detailed explanation. Glossary defines the key terms.

## 6. Expert Instructor-Led Training

uCertify uses the content from the finest publishers and only the IT industry's finest instructors. They have a minimum of 15 years real-world experience and are subject matter experts in their fields. Unlike a live class, you can study at your own pace. This creates a personal learning experience and gives you all the benefit of hands-on training with the flexibility of doing it around your schedule 24/7.

## 7. ADA Compliant & JAWS Compatible Platform

uCertify course and labs are ADA (Americans with Disability Act) compliant. It is now more accessible to students with features such as:

- Change the font, size, and color of the content of the course
- Text-to-speech, reads the text into spoken words
- Interactive videos, how-tos videos come with transcripts and voice-over
- Interactive transcripts, each word is clickable. Students can clip a specific part of the video by clicking on a word or a portion of the text.

JAWS (Job Access with Speech) is a computer screen reader program for Microsoft Windows that reads the screen either with a text-to-speech output or by a Refreshable Braille display. Student can easily navigate uCertify course using JAWS shortcut keys.

## 8. State of the Art Educator Tools

uCertify knows the importance of instructors and provide tools to help them do their job effectively. Instructors are able to clone and customize course. Do ability grouping. Create sections. Design grade scale and grade formula. Create and schedule assessments. Educators can also move a student from self-paced to mentor-guided to instructor-led mode in three clicks.

## 9. Award Winning Learning Platform (LMS)

uCertify has developed an award winning, highly interactive yet simple to use platform. The SIIA CODiE Awards is the only peer-reviewed program to showcase business and education technology's finest products and services. Since 1986, thousands of products, services and solutions have been recognized for achieving excellence. uCertify has won CODiE awards consecutively for last 7 years:

- **2014**
    1. Best Postsecondary Learning Solution

- **2015**
    1. Best Education Solution

2. Best Virtual Learning Solution
3. Best Student Assessment Solution
4. Best Postsecondary Learning Solution
5. Best Career and Workforce Readiness Solution
6. Best Instructional Solution in Other Curriculum Areas
7. Best Corporate Learning/Workforce Development Solution

- **2016**
    1. Best Virtual Learning Solution
    2. Best Education Cloud-based Solution
    3. Best College and Career Readiness Solution
    4. Best Corporate / Workforce Learning Solution
    5. Best Postsecondary Learning Content Solution
    6. Best Postsecondary LMS or Learning Platform
    7. Best Learning Relationship Management Solution

- **2017**
    1. Best Overall Education Solution
    2. Best Student Assessment Solution
    3. Best Corporate/Workforce Learning Solution
    4. Best Higher Education LMS or Learning Platform

- **2018**
    1. Best Higher Education LMS or Learning Platform
    2. Best Instructional Solution in Other Curriculum Areas
    3. Best Learning Relationship Management Solution

- **2019**
    1. Best Virtual Learning Solution
    2. Best Content Authoring Development or Curation Solution
    3. Best Higher Education Learning Management Solution (LMS)

- **2020**

1. Best College and Career Readiness Solution
2. Best Cross-Curricular Solution
3. Best Virtual Learning Solution

## 10. Chapter & Lessons

uCertify brings these textbooks to life. It is full of interactive activities that keeps the learner engaged. uCertify brings all available learning resources for a topic in one place so that the learner can efficiently learn without going to multiple places. Challenge questions are also embedded in the chapters so learners can attempt those while they are learning about that particular topic. This helps them grasp the concepts better because they can go over it again right away which improves learning.

Learners can do Flashcards, Exercises, Quizzes and Labs related to each chapter. At the end of every lesson, uCertify courses guide the learners on the path they should follow.

## Syllabus


### Chapter 1: Preface

### Chapter 2: Databases and Database Users

- Introduction
- An Example
- Characteristics of the Database Approach
- Actors on the Scene
- Workers behind the Scene
- Advantages of Using the DBMS Approach

- A Brief History of Database Applications
- When Not to Use a DBMS
- Summary
- Review Questions
- Exercises
- Selected Bibliography

## Chapter 3: Database System Concepts and Architecture

- Data Models, Schemas, and Instances
- Three-Schema Architecture and Data Independence
- Database Languages and Interfaces
- The Database System Environment
- Centralized and Client/Server Architectures for DBMSs
- Classification of Database Management Systems
- Summary
- Review Questions
- Exercises
- Selected Bibliography

## Chapter 4: Data Modeling Using the Entity–Relationship (ER) Model

- Using High-Level Conceptual Data Models for Database Design
- A Sample Database Application
- Entity Types, Entity Sets, Attributes, and Keys
- Relationship Types, Relationship Sets, Roles, and Structural Constraints
- Weak Entity Types
- Refining the ER Design for the COMPANY Database
- ER Diagrams, Naming Conventions, and Design Issues
- Example of Other Notation: UML Class Diagrams
- Relationship Types of Degree Higher than Two
- Another Example: A UNIVERSITY Database
- Summary
- Review Questions
- Exercises
- Laboratory Exercises
- Selected Bibliography

## Chapter 5: The Enhanced Entity–Relationship (EER) Model

- Subclasses, Superclasses, and Inheritance
- Specialization and Generalization
- Constraints and Characteristics of Specialization and Generalization Hierarchies
- Modeling of UNION Types Using Categories
- A Sample UNIVERSITY EER Schema, Design Choices, and Formal Definitions
- Example of Other Notation: Representing Specialization and Generalization in UML Class Diagrams
- Data Abstraction, Knowledge Representation, and Ontology Concepts
- Summary
- Review Questions
- Exercises
- Laboratory Exercises
- Selected Bibliography

## Chapter 6: The Relational Data Model and Relational Database Constraints

- Relational Model Concepts
- Relational Model Constraints and Relational Database Schemas
- Update Operations, Transactions, and Dealing with Constraint Violations

- Summary
- Review Questions
- Exercises
- Selected Bibliography

## Chapter 7: SQL Data Definition and Data Types

- SQL Data Definition and Data Types
- Specifying Constraints in SQL
- Basic Retrieval Queries in SQL
- INSERT, DELETE, and UPDATE Statements in SQL
- Additional Features of SQL
- Summary
- Review Questions
- Exercises
- Selected Bibliography

## Chapter 8: More SQL: Complex Queries, Triggers, Views, and Schema Modification

- More Complex SQL Retrieval Queries
- Specifying Constraints as Assertions and Actions as Triggers

- Views (Virtual Tables) in SQL
- Schema Change Statements in SQL
- Summary
- Review Questions
- Exercises
- Selected Bibliography

## Chapter 9: The Relational Algebra and Relational Calculus

- Unary Relational Operations: SELECT and PROJECT
- Relational Algebra Operations from Set Theory
- Binary Relational Operations: JOIN and DIVISION
- Additional Relational Operations
- Examples of Queries in Relational Algebra
- The Tuple Relational Calculus
- The Domain Relational Calculus
- Summary
- Review Questions
- Exercises

- Laboratory Exercises
- Selected Bibliography

## Chapter 10: Relational Database Design by ER- and EER-to-Relational Mapping

- Relational Database Design Using ER-to-Relational Mapping
- Mapping EER Model Constructs to Relations
- Summary
- Review Questions
- Exercises
- Laboratory Exercises
- Selected Bibliography

## Chapter 11: Introduction to SQL Programming Techniques

- Overview of Database Programming Techniques and Issues
- Embedded SQL, Dynamic SQL, and SQL J
- Database Programming with Function Calls and Class Libraries: SQL/CLI and JDBC
- Database Stored Procedures and SQL/PSM
- Comparing the Three Approaches

- Summary
- Review Questions
- Exercises
- Selected Bibliography

## Chapter 12: Web Database Programming Using PHP

- A Simple PHP Example
- Overview of Basic Features of PHP
- Overview of PHP Database Programming
- Brief Overview of Java Technologies for Database Web Programming
- Summary
- Review Questions
- Exercises
- Selected Bibliography

## Chapter 13: Object and Object-Relational Databases

- Overview of Object Database Concepts
- Object Database Extensions to SQL
- The ODMG Object Model and the Object Definition Language ODL

- Object Database Conceptual Design
- The Object Query Language OQL
- Overview of the C++ Language Binding in the ODMG Standard
- Summary
- Review Questions
- Exercises
- Selected Bibliography

## Chapter 14: XML: Extensible Markup Language

- Structured, Semistructured, and Unstructured Data
- XML Hierarchical (Tree) Data Model
- XML Documents, DTD, and XML Schema
- Storing and Extracting XML Documents from Databases
- XML Languages
- Extracting XML Documents from Relational Databases
- XML/SQL: SQL Functions for Creating XML Data
- Summary
- Review Questions

- Exercises
- Selected Bibliography

## Chapter 15: Basics of Functional Dependencies and Normalization for Relational Databases

- Informal Design Guidelines for Relation Schemas
- Functional Dependencies
- Normal Forms Based on Primary Keys
- General Definitions of Second and Third Normal Forms
- Boyce-Codd Normal Form
- Multivalued Dependency and Fourth Normal Form
- Join Dependencies and Fifth Normal Form
- Summary
- Review Questions
- Exercise
- Laboratory Exercises
- Selected Bibliography

## Chapter 16: Relational Database Design Algorithms and Further Dependencies

- Further Topics in Functional Dependencies: Inference Rules, Equivalence, and Minimal Cover
- Properties of Relational Decompositions
- Algorithms for Relational Database Schema Design
- About Nulls, Dangling Tuples, and Alternative Relational Designs
- Further Discussion of Multivalued Dependencies and 4NF
- Other Dependencies and Normal Forms
- Summary
- Review Questions
- Exercises
- Laboratory Exercises
- Selected Bibliography

## Chapter 17: Disk Storage, Basic File Structures, Hashing, and Modern Storage Architectures

- Introduction
- Secondary Storage Devices
- Buffering of Blocks
- Placing File Records on Disk

- Operations on Files
- Files of Unordered Records (Heap Files)
- Files of Ordered Records (Sorted Files)
- Hashing Techniques
- Other Primary File Organizations
- Parallelizing Disk Access Using RAID Technology
- Modern Storage Architectures
- Summary
- Review Questions
- Exercises
- Selected Bibliography

## Chapter 18: Indexing Structures for Files and Physical Database Design

- Types of Single-Level Ordered Indexes
- Multilevel Indexes
- Dynamic Multilevel Indexes Using B-Trees and B+-Trees
- Indexes on Multiple Keys
- Other Types of Indexes

- Some General Issues Concerning Indexing
- Physical Database Design in Relational Databases
- Summary
- Review Questions
- Exercises
- Selected Bibliography

## Chapter 19: Strategies for Query Processing

- Translating SQL Queries into Relational Algebra and Other Operators
- Algorithms for External Sorting
- Algorithms for SELECT Operation
- Implementing the JOIN Operation
- Algorithms for PROJECT and Set Operations
- Implementing Aggregate Operations and Different Types of JOINs
- Combining Operations Using Pipelining
- Parallel Algorithms for Query Processing
- Summary
- Review Questions

- Exercises
- Selected Bibliography

## Chapter 20: Query Optimization

- Query Trees and Heuristics for Query Optimization
- Choice of Query Execution Plans
- Use of Selectivities in Cost-Based Optimization
- Cost Functions for SELECT Operation
- Cost Functions for the JOIN Operation
- Example to Illustrate Cost-Based Query Optimization
- Additional Issues Related to Query Optimization
- An Example of Query Optimization in Data Warehouses
- Overview of Query Optimization in Oracle
- Semantic Query Optimization
- Summary
- Review Questions
- Exercises
- Selected Bibliography

## Chapter 21: Introduction to Transaction Processing Concepts and Theory

- Introduction to Transaction Processing
- Transaction and System Concepts
- Desirable Properties of Transactions
- Characterizing Schedules Based on Recoverability
- Characterizing Schedules Based on Serializability
- Transaction Support in SQL
- Summary
- Review Questions
- Exercises
- Selected Bibliography

## Chapter 22: Concurrency Control Techniques

- Two-Phase Locking Techniques for Concurrency Control
- Concurrency Control Based on Timestamp Ordering
- Multiversion Concurrency Control Techniques
- Validation (Optimistic) Techniques and Snapshot Isolation Concurrency Control

- Granularity of Data Items and Multiple Granularity Locking
- Using Locks for Concurrency Control in Indexes
- Other Concurrency Control Issues
- Summary
- Review Questions
- Exercises
- Selected Bibliography

## Chapter 23: Database Recovery Techniques

- Recovery Concepts
- NO-UNDO/REDO Recovery Based on Deferred Update
- Recovery Techniques Based on Immediate Update
- Shadow Paging
- The ARIES Recovery Algorithm
- Recovery in Multidatabase Systems
- Database Backup and Recovery from Catastrophic Failures
- Summary
- Review Questions

- Exercises
- Selected Bibliography

## Chapter 24: Distributed Database Concepts

- Distributed Database Concepts
- Data Fragmentation, Replication, and Allocation Techniques for Distributed Database Design
- Overview of Concurrency Control and Recovery in Distributed Databases
- Overview of Transaction Management in Distributed Databases
- Query Processing and Optimization in Distributed Databases
- Types of Distributed Database Systems
- Distributed Database Architectures
- Distributed Catalog Management
- Summary
- Review Questions
- Selected Bibliography

## Chapter 25: NOSQL Databases and Big Data Storage Systems

- Introduction to NOSQL Systems
- The CAP Theorem

- Document-Based NOSQL Systems and MongoDB
- NOSQL Key-Value Stores
- Column-Based or Wide Column NOSQL Systems
- NOSQL Graph Databases and Neo4j
- Summary
- Review Questions
- Selected Bibliography

## Chapter 26: Big Data Technologies Based on MapReduce and Hadoop

- What Is Big Data?
- Introduction to MapReduce and Hadoop
- Hadoop Distributed File System (HDFS)
- MapReduce: Additional Details
- Hadoop v2 alias YARN
- General Discussion
- Summary
- Review Questions
- Selected Bibliography

## Chapter 27: Enhanced Data Models: Introduction to Active, Temporal, Spatial, Multimedia, and Deductive Databases

- Active Database Concepts and Triggers
- Temporal Database Concepts
- Spatial Database Concepts
- Multimedia Database Concepts
- Introduction to Deductive Databases
- Summary
- Review Questions
- Exercise
- Selected Bibliography

## Chapter 28: Introduction to Information Retrieval and Web Search

- Information Retrieval (IR) Concepts
- Retrieval Models
- Types of Queries in IR Systems
- Text Preprocessing
- Inverted Indexing

- Evaluation Measures of Search Relevance
- Web Search and Analysis
- Trends in Information Retrieval
- Summary
- Review Questions
- Selected Bibliography

## Chapter 29: Data Mining Concepts

- Overview of Data Mining Technology
- Association Rules
- Classification
- Clustering
- Approaches to Other Data Mining Problems
- Applications of Data Mining
- Commercial Data Mining Tools
- Summary
- Review Questions
- Selected Bibliography

## Chapter 30: Overview of Data Warehousing and OLAP

- Introduction, Definitions, and Terminology
- Characteristics of Data Warehouses
- Data Modeling for Data Warehouses
- Building a Data Warehouse
- Typical Functionality of a Data Warehouse
- Data Warehouse versus Views
- Difficulties of Implementing Data Warehouses
- Summary
- Review Questions
- Selected Bibliography

## Chapter 31: Database Security

- Introduction to Database Security Issues
- Discretionary Access Control Based on Granting and Revoking Privileges
- Mandatory Access Control and Role-Based Access Control for Multilevel Security
- SQL Injection

- Introduction to Statistical Database Security
- Introduction to Flow Control
- Encryption and Public Key Infrastructures
- Privacy Issues and Preservation
- Challenges to Maintaining Database Security
- Oracle Label-Based Security
- Summary
- Review Questions
- Exercises
- Selected Bibliography

Chapter 32: Appendix A: Alternative Diagrammatic Notations for ER Models

Chapter 33: Appendix B: Parameters of Disks

Chapter 34: Appendix C: Overview of the QBE Language

- C.1 Basic Retrievals in QBE
- C.2 Grouping, Aggregation, and Database Modification in QBE

## 11. Practice Test

## Here's what you get

| 55 | 50 |
|---|---|
| PRE-ASSESSMENTS QUESTIONS | POST-ASSESSMENTS QUESTIONS |

## Features

Each question comes with detailed remediation explaining not only why an answer option is correct but also why it is incorrect.

### Unlimited Practice

Each test can be taken unlimited number of times until the learner feels they are prepared. Learner can review the test and read detailed remediation. Detailed test history is also available.

Each test set comes with learn, test and review modes. In learn mode, learners will attempt a question and will get immediate feedback and complete remediation as they move on to the next question. In test mode, learners can take a timed test simulating the actual exam conditions. In review mode, learners can read through one item at a time without attempting it.

## 12. Performance Based Labs

uCertify's performance-based labs are simulators that provides virtual environment. Labs deliver hands on experience with minimal risk and thus replace expensive physical labs. uCertify Labs are cloud-based, device-enabled and can be easily integrated with an LMS. Features of uCertify labs:

- Provide hands-on experience in a safe, online environment
- Labs simulate real world, hardware, software & CLI environment
- Flexible and inexpensive alternative to physical Labs
- Comes with well-organized component library for every task

- Highly interactive - learn by doing
- Explanations and remediation available
- Videos on how to perform

## Lab Tasks

- Understanding Physical Schema - ER Model
- Understanding generalization
- Creating a table
- Using Referential Integrity constraints in a table
- Using Check constraints in a table
- Retrieving the data from the table
- Using select-project-join query
- Using alias-naming
- Retrieving all the attribute values using asterisk
- Retrieving the data using multiple condition
- Specifying the cross product of the table
- Using SELECT DISTINCT statement and UNION operator
- Using substring pattern matching
- Using arithmetic operators
- Retrieving the sorted data using ORDER BY clause
- Inserting values into a table
- Inserting values into a table from existing table
- Deleting the rows from a table
- Updating the table
- Retrieving values of a table using nested queries I
- Retrieving values of a table using nested queries II
- Retrieving values of a table using JOIN operator
- Using Aggregate functions
- Counting all the rows of a table
- Using the GROUP BY and HAVING clauses
- Using the CASE clause

- Specifying general constraints as Assertions
- Creating view
- Modifying the table definition
- Retrieving the distinct rows from the table
- Using the UNION operator
- Using the SELECT operator
- Understanding relational set operator
- Drag the object database concept to its description.
- Normalizing the unnormalized model to 1st normal form I
- Normalizing the unnormalized model to 1st normal form II
- Normalizing the 1st normal form to 2nd normal form
- Normalizing the 2nd normal form to 3rd normal form
- Analyzing the normal forms
- Normalizing the 3rd normal form to BCNF
- Identifying inference rules
- Understanding storage device types
- Identifying the components of disk device
- Understanding the buffer replacement strategies
- Understanding program variables
- Describing the hashing techniques
- Creating a function-based index
- Using a function-based index
- Identifying the steps of processing a high-level query
- Counting the number of department from the table
- Using NOT IN operator
- Using INTERSECT operator
- Unnesting query
- Understanding the page replacement method
- Understanding the transaction states
- Identifying deadlock dealing techniques
- Creating a backup
- Click to select the advantages of distributed databases.
- Categorizing NOSQL systems
- Classifying spatial operators
- Identifying the features of databases and IR systems

- Identifying types of queries
- Understanding the applications of data mining
- Identifying database attacks

## Here's what you get

**64**

**PERFORMANCE BASED LAB**

## 13. Post-Assessment

After completion of the uCertify course Post-Assessments are given to students and often used in conjunction with a Pre-Assessment to measure their achievement and the effectiveness of the exam.

## GET IN TOUCH:

3187 Independence Drive
Livermore, CA 94551,
United States

+1-415-763-6300

support@ucertify.com

www.ucertify.com