

Unit 4: Database Design & Development

Unit code A/618/7400

Unit type Core

Unit level 4

Credit value 15

Introduction

Organisations depend on their databases for providing information that is essential for their day-to-day operations and to help them take advantage of today's rapidly growing and maturing e-commerce opportunities. An understanding of database tools and technologies is an essential skill for designing and developing systems to support them.

As applications get increasingly more sophisticated, database systems continue to demand more complex data structures and interfaces. Most organisations collect and store large volumes of data, either on their own systems or in the cloud, and this data is used not just for the operational running of their business but is also mined for other more intelligent and complex applications. Databases stand as the back-end of most systems used by organisations for their operations.

Database design and development is a fundamental and highly beneficial skill for computing students to master, regardless of their specialism.

The aim of this unit is to give students opportunities to develop an understanding of the concepts and issues relating to database design and development. It will also provide the practical skills needed to be able to translate that understanding into the design and creation of complex databases.

Topics covered in this unit are: examination of different design tools and techniques; examination of different development software options; consideration of the development features of a fully-functional robust solution covering data integrity, data validation, data consistency, data security and advanced database querying facilities across multiple tables; appropriate user interfaces for databases and for other externally linked systems; creating complex reports/dashboards, testing the system against the user and system requirements; and elements of complete system documentation.

On successful completion of the unit, students will be able to use appropriate tools to design and develop a relational database system for a substantial problem. They will be able to test the system to ensure that it meets user and system requirements, and fully document the system by providing technical and user documentation. For practical purposes, this unit covers relational databases and related tools and techniques. A brief overview of object-oriented databases will also be covered. As a result, students will develop skills such as communication literacy, critical thinking, analysis, reasoning and interpretation, which are crucial for gaining employment and developing academic competence.

Learning Outcomes

By the end of this unit students will be able to:

- LO1 Use an appropriate design tool to design a relational database system for a substantial problem
- LO2 Develop a fully-functional relational database system, based on an existing system design
- LO3 Test the system against user and system requirements
- LO4 Produce technical and user documentation.

Essential Content

LO1 Use an appropriate design tool to design a relational database system for a substantial problem

Database design:

Principles and uses of relational and non-relational databases.

The role of database systems, e.g. as back-end systems, in e-commerce, for data mining applications, blockchain.

Determining user and system requirements.

Design tools and techniques for a relational database system.

Logical design for relational databases, including structured data in tables, data elements, data types, indexes, primary and foreign keys, entity relationship modelling, referential integrity, data normalisation to third normal form.

Designs for data integrity, data validations, data security and data controls. User interface design.

Output designs for user requirements.

Overview of object-oriented databases and their design tools.

LO2 Develop a fully-functional relational database system, based on an existing system design

Implementation:

Consideration of database and platform options for system development.

Examination of different software development options for developing the relational database system.

Implementation of the physical data model based on the logical model and linking code to data sets.

Data stores, internal storage and external storage, e.g. the cloud.

Implementation of security elements in databases.

Relational databases with controls like data validation using; input masks, dropdown lists, option buttons.

Consideration of user interface requirements looking at functionality, reliability, consistency, performance and accessibility for a range of different users.

Develop effective user interfaces linked with other systems, e.g. internet-based applications.

Data manipulation using appropriate query tools, including complex queries to query across multiple tables and using functions and formulae.

Database maintenance and data manipulation: inserts, updates, amendments, deletions, data backup and recovery.

System reports using report-writing tools and report generators, dashboards.

Implementation of security elements in a database, including consideration of permissions, access rights, network vulnerabilities, physical location of data, multi-tenancy and data separation, encryption.

Consideration of GDPR issues, including data crossing borders and other nations' data protection regulations.

LO3 Test the system against user and system requirements

Testing methodologies:

Identify elements of the system that need to be tested. Consider data that should be used to fully test the system.

Match tests against user and system requirements.

Test procedures to be used: test plans, test models, e.g. structural testing, functional testing; testing documentation.

Functional and system testing and testing the robustness of the system, including help menus, pop-ups, hot-spots, data validation checks.

LO4 Produce technical and user documentation

Structure and functionality documentation:

Technical and user documentation and their contents.

Technical documentation to include diagrams showing movement of data through the system and flowcharts describing how the system works.

User documentation, including how to use the system, outputs produced by the system, menu operations and other functions.

Learning Outcomes and Assessment Criteria

Pass	Merit	Distinction
LO1 Use an appropriate design tool to design a relational database system for a substantial problem		D1 Evaluate the effectiveness of the design in relation to user and system requirements.
P1 Design a relational database system using appropriate design tools and techniques, containing at least four interrelated tables, with clear statements of user and system requirements.	M1 Produce a comprehensive design for a fully-functional system, which includes interface and output designs, data validations and data normalisation.	
LO2 Develop a fully-functional relational database system, based on an existing system design		LO2 and LO3 D2 Evaluate the effectiveness of the database solution in relation to user and system requirements and suggest improvements.
P2 Develop the database system with evidence of user interface, output and data validations, and querying across multiple tables.	M2 Implement a fully-functional database system, which includes system security and database maintenance.	
P3 Implement a query language into the relational database system.	M3 Assess whether meaningful data has been extracted through the use of query tools to produce appropriate management information.	
LO3 Test the system against user and system requirements		
P4 Test the system against user and system requirements.	M4 Assess the effectiveness of the testing, including an explanation of the choice of test data used.	

Pass	Merit	Distinction
LO4 Produce technical and user documentation		D3 Evaluate the database in terms of improvements needed to ensure the continued effectiveness of the system.
P5 Produce technical and user documentation.	M5 Produce technical and user documentation for a fully-functional system, including data flow diagrams and flowcharts, describing how the system works.	

Recommended Resources

Textbooks

Churcher, C. (2012) *Beginning Database Design: From Novice to Professional*. 2nd edn. Apress.

Connolly, T. and Begg, C. (2014) *Database Systems: A Practical Approach to Design, Implementation and Management*. 6th edn. Global Edition. Pearson.

Flejoles, R. P. (2018) *Database Theory and Application*. Arcler Press.

Karwin, B. (2017) *SQL Antipatterns: Avoiding the Pitfalls of Database Programming* Pragmatic Programmers, LLC, The.

Kroemke, D. and Auer, D. (2012) *Database Concepts: International Edition*. 6th edn. Pearson.

Journals

The Computer Journal – Oxford Academic

International Journal of Database Management (IJDMS)

Journal of Emerging Trends in Computing and Information Sciences

Journal of Systems Analysis and Software Engineering

Systems Journal of Database Management

Web

mva.microsoft.com	Microsoft Virtual Academy Database Development (Training)
mva.microsoft.com/ebooks	Microsoft Virtual Academy Microsoft Press (E-books)
www.lynda.com	Database Training (Tutorials)

Links

This unit links to the following related units:

Unit 11: Strategic Information Systems

Unit 41: Database Management Systems.