Databases, networks and the web

Module description

Many computer systems involve networks of computers interacting with each other to deliver coherent, integrated services such as banking, shopping and social media. A vital element of these services is how they represent, store and access data. This module provides practical and theoretical skills which will enable you to reason about networked systems and use them to create coherent services such as data- driven web applications. These skills build on the computing and web fundamentals taught earlier in the programme, and will allow you to work on more advanced data and web systems later in the programme.

In this module, you will learn theory and practical skills focused on the modern web, internet and client- server applications. You will learn about relational database systems, mainly from a development perspective, emphasising issues related to data modelling and database implementation in SQL. You will learn how to model data in a database, retrieve data from the database and provide access to data through dynamic web application. In particular, you will learn about the Relational Model, Query processing, and networking concepts to enable communication.

Module goals and objectives

Upon successful completion of this module, you will be able to:

1. (CLO1) Explain the context behind the relational model and describe the process of schema development
2. (CLO2) Devise, explain and implement an appropriate representation of data in an SQL RDBMS
3. (CLO3) Explain and apply the basic concepts of computer networking, including, what is a network, what is it used for and how to characterize it
4. (CLO4) Explain the importance of dynamic web-based applications and their interaction with database servers
5. (CLO5) Perform queries on databases using multiple related tables
6. (CLO6) Write web-based applications that run in a web-browser and interact with a database server

Textbook and Readings

Specific essential readings for each week from the following list are included in the Readings page:

1. Advanced Internet Protocols, Services, and Applications
   https://ebookcentral.proquest.com/lib/londonww/detail.action?docID=818520
2. Designing Data-Intensive Web Applications
   https://ebookcentral.proquest.com/lib/londonww/detail.action?docID=300580
3. Fundamental of Databases Systems, Pearson, 7th edition, 2016 (978-0133970777)
   https://ebookcentral.proquest.com/lib/londonww/detail.action?docID=5174454
4. Modern Database Management, Global Edition
   https://ebookcentral.proquest.com/lib/londonww/detail.action?docID=5185641&query=tcp%2Fip
5. Programming Web Applications with Node, Express and Pug.
   https://ebookcentral.proquest.com/lib/londonww/detail.action?docID=4772248
6. Express Web Application Development.
   https://ebookcentral.proquest.com/lib/londonww/detail.action?docID=1220932

Some key online references are:

- W3 Schools Online Tutorials, https://www.w3schools.com/nodejs/ and https://www.w3schools.com/sql/
- Node.js https://nodejs.org/en/docs/guides/
- Express https://expressjs.com

The specific pages for the reading activities will be given on the platform, and there is no need to read beyond the recommended pages.

In addition to the text book, there are additional reading activities written by the module author, some of which involve coding exercises.

There will also be discussion prompts asking you to do some independent research using online sources.

Module outline

The module consists of ten topics that focus on key areas of Databases, networks and the web.

Topic 1. Three-tier web application	**Key concepts:** • Intro to module and lab • Static vs. dynamic web applications • 3-tier web applications architecture **Learning outcomes:** • Recognize the tools available for this module to edit a node.js file and run it. (CL6) • Describe what static and dynamic web applications are. (CLO4, CLO6) • Describe what a 3-tier web application architecture is (CLO4, CLO6)
Topic 2. Building simple web servers	**Key concepts:** • Web server and web hosting • How to build a simple web server with Node.js • Building an Express web server **Learning outcomes:** • Explain what a web server is (CLO4, CLO6) • How to build a simple web server with Node.js (CLO6) • Building an Express web server (CLO 6)

Topic 3. Generating web pages from data using templates	**Key concepts:** • Routing in dynamic web applications • Separation of Concern (SoC) • Rendering html files and Templating **Learning outcomes:** • Describe and apply routing in web server development (CLO6) • Describe and apply Separation of Concern principle of programming in your web application development (CLO4, CLO6) • Describe and apply templating in web application (CLO6)
Topic 4. Handling forms to input data	**Key concepts:** • Form handling and HTTP GET and POST methods • HTTP GET method, form handling and collecting form-data • HTTP POST method, form handling and collecting form-data **Learning outcomes:** • Describe and apply form handling in their web application (CLO6) • Describe and apply GET and POST request methods in dynamic web application (CLO6) • describe and run the code to retrieve form data in middleware (CLO6)
Topic 5. Representing data in databases, Relational databases	**Key concepts:** • introduction to databases • Relational databases • MySQL shell **Learning outcomes:** • Describe what a list of data is (CLO1)

	• Describe modification problems related to lists of data (CLO1) • Describe what a relational database is (CLO1, CLO2)
Topic 6. Basic database operations, Providing access to databases from middleware	**Key concepts:** • Basic SQL, review create, select and insert into and introduce update and delete • Primary keys • Access to database from middleware **Learning outcomes:** • Describe and apply statements in SQL to do basic database operations. (CLO2) • Describe and apply primary key and foreign keys in relational databases (CLO1, CLO2, CLO5) • Recognize and apply access to databases from middleware code in Node.js to build dynamic web applications (CLO4, CLO6)
Topic 7. Building a dynamic web application	**Key concepts:** • Passing variables from middleware to front-end (templates) • Passing variables from middleware to backend (database) • Review what you have learned so far for development of a dynamic web application **Learning outcomes:** • Create a complete dynamic web application performing basic database operations (CLO1, CLO2, CLO4, CLO6) • Describe and apply passing variables from middleware to front-end (templates) (CLO6) • Describe and apply passing variables from middleware to backend (database) (CLO6)

Topic 8. Database schema, ERD	**Key concepts:** • Database schema • Junction (bridge) tables • SQL Join **Learning outcomes:** • Explain the context behind the relational model and describe the process of schema development (CLO1) • Explain the context behind the junction (bridge) tables in relational model and describe the process of schema development (CLO1, CLO2) • Explain and apply foreign keys in relational databases (CLO1, CLO2, CLO5) • Perform queries on databases using multiple related tables by JOIN queries (CLO5)
Topic 9. Querying a database (advanced)	**Key concepts:** • Aggregate functions in SQL • Left and right joins in SQL • Nested select in SQL **Learning outcomes:** • Perform advanced queries on databases using aggregate functions (CLO5) • Perform advanced queries on databases using multiple related tables by LEFT and RIGHT JOIN queries (CLO5) • Perform advanced queries on databases using multiple related tables by nested SELECT queries (CLO5)
Topic 10. Networking concepts	**Key concepts:** • Basic concepts of computer networking • TCP/IP model and network protocol **Learning outcomes:** • Explain and apply the basic concepts of computer networking (CLO3)

	• Describe TCP/IP model and layers in the model (CLO3) • Identify network protocols in each layer (CLO3)

Activities of this module:

The module is comprised of the following elements:

- **Lecture videos**
  In each topic the concepts you need to know will be presented through a collection of short video lectures. You may stream these videos for playback within the browser by clicking on their titles or download the videos.
- **Graded Quizzes**
  In topics 1-6, there is an end-of-topic quiz that will contribute to your coursework grade. You will be allowed maximum two attempts per each quiz, and 15 minutes per quiz. Your highest score will be used when calculating your final score.
- **Practice Quizzes**
  In topics 7-10, there is an end-of-topic quiz. You will be allowed maximum 2 attempts per quiz and 15 minutes at each end-of-topic quiz. There are also post-video, post-lab and post-discussion quick quizzes, in topics 1-10, intended for you to assess your understanding of the topics. These quizzes do not contribute toward your final score in the course.
- **Ungraded lab exercises**
  These are additional reading activities written by the course author, which involve coding exercises. Some ungraded lab exercises follow by a discussion prompt to share a screencast of your web application on the discussion prompt.
- **Discussion Prompts**
  Each topic may include one or more discussion prompts. You will see the discussion prompt alongside other items in the lesson. Each prompt provides a space for you to respond. After responding, you can see and comment on your peers' responses. All prompts and responses are also accessible from the general discussion forum and the module discussion forum.
- **Readings**
  Each topic may include several suggested readings. They are good supplementary materials for you to further understand the course topics.
- **Staff graded assignment** (mid-term programming assessment)
  This involves implementing a dynamic web application using Node.js and SQL and uploading it to the platform to be graded.

How to pass this course

The course has two major assessments each worth 50% of your grade:

- Coursework: this consists of several activities that you do on the Coursera platform and which will be assessed half way through course (after week 12).
- Written examination: you will take this at an examination centre in your country.
- The mark shown on the Coursera platform is your coursework mark and you should remember that the exam counts for another 50%.
- The coursework consists of six summative end-of-topic quizzes and one written, staff graded assignment consisting of development of a dynamic web application.
- There are also several activities that are graded but have 0% weight. That means that they will not count towards your final grade, but they are a key part of your learning and you need to do them.
- The coursework consists of several activities. This is a detailed breakdown of all of the mark:

Activity	Required?	Deadline week	Estimated time per course	% of final grade
End of topic quizzes for topics 1-6	Yes	1-12	12 hours	30%
Written, staff graded coursework	Yes	14	Approximately 20 hours	20%
Written examination	Yes	22	2 hours 15 minutes	50%