UNIVERSITY OF LONDON

CM2040

BSc EXAMINATION

COMPUTER SCIENCE

Databases, Networks and the Web

Release date: Monday 9 September 2024 at 12:00 midday British Summer Time

Close date: Tuesday 10 September 2024 by 12:00 midday British Summer Time

Time allowed: 4 hours to submit

INSTRUCTIONS TO CANDIDATES:

Part A of this assessment consists of a set of **TEN** Multiple Choice Questions (MCQs). You should attempt to answer **ALL** the questions in **Part A.** The maximum mark for Part A is **40**.

Candidates must answer **TWO** out of the **THREE** questions in **Part B**. The maximum mark for Part B is **60**.

Part A and Part B will be completed online together on the Inspera exam platform. You may choose to access either part first upon entering the test area but must complete both parts within **4 hours** of doing so.

Calculators are **NOT** permitted in this examination. Credit will only be given if all workings are shown.

You may use **ONE** A4 page of previously prepared notes in this examination. Please hold up your notes to the camera at the start of the examination.

File upload is **NOT** permitted in this examination.

Do not write your name anywhere in your answers.

Part A

Question 1

Candidates should answer the **TEN** Multiple Choice Questions (MCQs) in Part A.

Part B

Candidates should answer any **TWO** questions in Part B.

Question 2

This question is about web application development.

(a)

i. Explain what is meant by an HTTP request and response.

[2 marks]

ii. Explain the difference between static and dynamic web applications.

[2 marks]

iii. Explain the concept of HTTP GET and POST methods.

[2 marks]

You are tasked with developing a web-based application for a local library to manage book loans.

The application should allow library staff to add new books, update existing book details, and check out books to library members. You decide to implement the system using node.js, Express, EJS and MySQL.

(b) Thinking about your application architecture and design:

i. Outline the design of your middleware, detailing how the chosen technologies interact to handle an HTTP request `/books/list`, which returns a page showing the list of available books. There is no need to provide code for this answer.

[4 marks]

ii. Detail how your system will use these technologies to dynamically generate a web page for each book based on the book id. Include a brief example of the key middleware code to handle the HTTP request and return the HTML page showing the book title, author and ISBN. You won't be penalised for syntax errors or small logic errors in your code.

[6 marks]

(c) A web page is required to allow librarians to add new books.

i. Describe how your web application will handle the form data for a new book, capturing the book title, author and ISBN. Include code to illustrate how the data from the form is processed in the middleware before being inserted into the database. You won't be penalised for syntax errors or small logic errors in your code.

[5 marks]

ii. Describe how this form could implement validation to ensure the correctness of the entered data (title, author, and ISBN). There is no need to provide code, but you can if you want.

[3 marks]

(d) The library requires a search capability so that users can search for books based on the book ISBN number. Consider these two different approaches to implementing this:

Method 1: an HTML form is presented to the user. The ISBN is entered by the user into the form. In the middleware, the entered ISBN is embedded in a database query and if a matching book is found the details are shown to the user in an HTML page.

Method 2: the entire list of ISBNs are returned in an HTML form. The user selects from the provided ISBNs and submits the form.

Evaluate these two approaches in terms of performance of the application and usability.

[6 marks]

Question 3

This question is about database modelling.

(a)

i. Describe what is meant by the term *'Relational Database'*.

[2 marks]

ii. Define what a primary key is in the context of relational databases.

[2 marks]

iii. Explain the difference between a SQL inner join and a SQL left join.

[2 marks]

Imagine you are designing a database for a system for an online retail store that needs to manage customer orders and product inventory through a web application. The system should allow users to view products, add them to a shopping cart, and place orders.

(b) Identify the key entities in the database, specifying the entity name, attributes, data types, relationships, and cardinality constraints.

[10 marks]

(c) The store requires reports on the orders made in the store. Create SQL statements that can produce each of the following reports:

i. A list of all products and the quantity held in stock.

[1 mark]

ii. A list of all products and the quantity sold in each month.

[3 marks]

iii. The top 10 spending customers of all time.

[4 marks]

(d) The retail store merges with another store who have their own database. Describe the challenges that might be encountered in merging these databases and explain how these challenges might be overcome.

[6 marks]

Question 4

This question is about web architectures and networking.

(a)

i. Briefly describe **TWO** ways in which the TCP/IP model facilitates data communication across a network.

[2 marks]

ii. What is SSL/TLS, and why is it important for securing communications over the internet?

[2 marks]

iii. Explain what is meant by a three-tier web application architecture.

[2 marks]

You have been hired to design a hospital's medical records system. The system should allow clinicians and patients to view records, and clinicians and admin staff to update records.

(b) Outline a high-level design of your web application using the three-tier architecture model. Include the role of each tier and **TWO** examples of responsibilities of each tier in your description.

[9 marks]

(c) The hospital stress that the security of patient data is of critical importance.

i. Briefly explain **THREE** ways in which such a system's security might be at risk.

[3 marks]

ii. Explain **THREE** architectural decisions you would make to ensure the system security is maintained.

[6 marks]

(d) A colleague suggests that NoSQL databases and relational databases (RDBMS) are both potential options for the data storage in this application. Critically evaluate these **TWO** methods' suitability for the hospital system.

[6 marks]

END OF PAPER