Athlone Institute of Technology

Faculty of Engineering & Informatics

Semester 1 Examinations 2018

December Session

AiT
Connect & Discover

Bachelor of Science (Hons) in Software Design (Cloud Computing)
Bachelor of Science (Hons) in Software Design (Game Development)

Year 4

Databases 4

External Examiner(s):   **Mr Jerh O'Connor & Dr Steven Davy**

Internal Examiner(s):   **Dr Sheila Fallon**

<u>**Instructions to Candidates:**</u> *(make sure you have received the <u>**correct**</u> exam paper)*

Read all questions carefully.
All questions carry equal marks.
Answer THREE out of FOUR Questions.

Time allowed: 2 Hours
No. of pages (including cover sheet, attachments/drawings): 5

Q.1. (a) Based on the tables in the **appendix:**

   I.   Outline an SQL query to list all customers from Cork city.
   II.   Outline an SQL query to count the number of customers. Use an alias to display your result as NUM_CUSTOMERS.
   III.   Outline an SQL query to list the full name of the customer, with customer_id = 103
   IV.   Outline an SQL query to list in descending order of lastName, the firstName and lastName of any Customer who's customer_id does **not appear** in the orders table.

(4 marks)

(b) Based on the tables in the **appendix:**

(i)Write a trigger named **orders_after_update**. This trigger should insert old data about the orders into an **orders_audit** table after the row is updated. The orders_after_update trigger should also insert an action_type ("UPDATED") and an action_date (today's date) into the orders_audit table.

(ii)Write the SQL to create the **orders_audit** table.

(iii)Write an appropriate SQL statement to test the trigger.

(iv)Write a recurring event named **monthly_delete_audit_rows** that starts from today and will delete all rows from the orders_audit table that are more than 1 month old.

(8 marks)

(c) With reference to Burtica et.al's article "Practical application and evaluation of no-SQL databases in Cloud Computing" compare the applicability of variant NOSQL approaches; key value pair stores, document oriented data stores, BigTable clones and Graph Databases. Your comparison should discuss why the authors choose MongoDB for their web application and explain with reference to the CAP Theorem the implications of this choice.

(8 marks)
[20 marks]

Q.2. (a) The relational model is a predominant database paradigm, while the object oriented model is a predominant programming paradigm. Discuss this paradigm mismatch and clearly explain five technical challenges when implementing object relational mapping.

(10 marks)

(b) As a JSON-style data store MongoDB is often referred to a schema-less database. However, for certain applications the designer may model the structure of the documents to be stored.

Given the Student data below you are required to model the data in JSON with (1) embedded documents and (2) document references. Discuss key points that a designer should consider when choosing between (1) and (2). The student system will require fast data reads. How does this impact on the decision between embedded documents versus document references? Document any assumptions you make.
Student data:
Students have a name and Id. Students also have 3 types of address (1) home (2) term (3) work placement. Each address consists of street name, town, county and country. Assume all three addresses have different values, e.g. a home address in Galway, a term address in Westmeath, and a work placement address in Dublin.

(10 marks)
[20 marks]

Q.3. (a) Explain what is meant by a transaction. Based on the tables the **appendix**, write a stored procedure, for a sample transaction. Explain your approach and outline why a transaction is required.

(5 marks)

(b) Draw a diagram showing all possible sequences of states through which a transaction may pass. With reference to the transaction you wrote in part (a) above explain why each state transition may occur.

(5 marks)

(c) With 800 million vehicles on the world's roads today – a number forecast to grow to 4 billion by 2050 – intelligent transportation management systems will need to analyze real-time sensor data dynamically and on a massive scale in order to reduce congestion and optimize personal mobility.

The City Council requires a system with the following functionality:
- Real-time traffic flow and congestion alerts.
- Integration to operational systems e.g. for managing stop lights and speed signs
- Real-time integration to prioritized emergency vehicle route planning
- Aggregated traffic data feeds and analytics to inform future road network design

Compare and contrast the applicability of MongoDB and Hadoop for the proposed System. Is a Relational Database applicable for this system? Document any assumptions you make. Your answer should include a discussion on Polyglot persistence.

(10 marks)
[20 marks]

Q.4. (a)   The following table is not normalized.

student ID	Name	Phone Number	Course Code	Course Title	Module	Number of Credits	Result
A000102	Tom Dolan	085 8832453	Data5	BSc in Software Engineering	Databases	5	A
					Java	5	C
					Project	10	B

Convert this table into
   i.   First Normal Form (1NF)
   ii.   Second Normal Form (2NF)
   iii. Third Normal Form (3NF)

Your answer should include a **definition** of 1NF, 2NF and 3NF and clearly explain all steps involved.

(6 marks)

(b)   A view consists of a SELECT statement that's stored as an object in the database. Briefly discuss **four** benefits of using a view. Write the SQL statement to create the following view for the customers table given in the **appendix**.

name	phone
Tom Kelly	0868823241
Ellen Doyle	0868762531
Peter Kelly	0878823242
Pat Browne	0868833349
May Whyte	0868222241

customer_phone view

(4 marks)

(c)   Stored Procedures and Stored Functions are two types of Stored Programs that can be stored in a database.

(i) With reference to the tables outlined in the **appendix** compare and contrast Stored Procedures and Stored Functions outlining their key differences and explain when each is appropriate to use. Use appropriate SQL statements to illustrate your answer.

(ii) Using the tables in the **appendix**, write a Stored Function named **calculate_order_total** that takes in an order_id and returns the total value of the order. E.g. for order _id = 50125 calculate_order_total returns 81.85.
Write a select statement that uses the calculate_order_total Stored Function.

(10 marks)
[20 marks]

4

Appendix

The Following tables are used in Q1, Q3 and Q4.

product_id	name	price
6020	Wireless Mouse	17.95
6021	Wireless Keyboard	45.95
6022	Wireless Gaming Headset	199.99
6023	Wireless Speakers	79.95
6024	Wireless Printer	87.95

products

order_id	customer_id	order_date	shipped_date
50125	103	2013-11-01	2013-11-12
50126	104	2013-12-01	2013-12-03
50127	102	2013-12-06	2013-12-11
50128	102	2013-12-10	2013-12-23
50129	105	2013-12-10	2014-01-05
50130	103	2013-12-12	2014-01-05

orders

order_id	product_id	order_qty
50125	6020	2
50125	6021	1
50126	6023	1
50127	6024	2
50128	6020	1
50128	6023	2
50129	6021	2
50130	6020	1

order_details

customer_id	firstName	lastName	address	city	phone
101	Tom	Kelly	155 Old Town	Cork	0868823241
102	Ellen	Doyle	20 The Square	Waterford	0868762531
103	Peter	Kelly	16 The Manor	Cork	0878823242
104	Pat	Browne	56 New Road	Tralee	0868833349
105	May	Whyte	18 Beech Road	Waterford	0868222241

customers