Athlone Institute of Technology

Faculty of Engineering & Informatics

Semester 1 Examinations 2019

December Session

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

Year 4

Databases 4

External Examiner(s): **Mr Derek O'Reilly & Mr Joe Dowling**
Dr Thomas Newe & Mr Dave Dolan

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

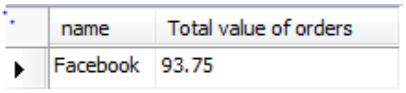
Instructions to Candidates: ***(****make sure you have received the* ***correct*** *exam paper****)***

Read all questions carefully.
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 **Appendix A**:

I. Outline an SQL query to give the following result



name	Total value of orders
Facebook	93.75

II. Outline an SQL query to give the following result

Type	email
Supplier	customerService@Amazon.com
Supplier	info@Amazon.com
Customer	info@Google.com
Customer	info@SAP.com
Customer	info@Vodafone.com
Customer	sales@Ericsson.com
Customer	sales@Facebook.com

(4 marks)

(b) Based on the tables in **Appendix A**, 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 = 80360 calculate_order_total returns 49.85.

(4 marks)

(c) An index is a structure that provides a mechanism for a database management system to locate one or more rows directly. Outline an SQL statement to create an index of your choice based on the tables **Appendix A**. Briefly discuss some key points you should consider before deciding to create an index.

(4 marks)

(d) 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 four technical challenges when implementing object relational mapping.

(8 marks)

[20 marks]

Q.2. (a) Discuss the advantages and disadvantages of MongoDB's flexible schema. Explain the benefits of validating documents in MongoDB. Your answer should include a comparison with fixed-schema databases.

(7 marks)

(b) Based on the following structure of the **contacts** collection in the Mongodb database:

```
{  "_id": "125876",
 "name": "Anne",
 "phone": "+353 86 1123 456",
  "city": "Galway",
 "loyalty_level": "Silver",
 “status”: “Complete” }
```

I. Write a MongoDB statement to display all the documents in the contacts collection.
II. Write a MongoDB statement to find all the documents where the city field has the value Galway.
III. Write a MongoDB query to count all the documents where the loyalty_level field has the value Silver.
IV. Write a MongoDB statement to add a document with the following information to the contacts collection: Mary, +353 87 1234567, Dublin, Gold, Incomplete.
V. Write a MongoDB statement to set the status field for **all** documents to Complete.

(5 marks)

(c) Hadoop is an open-source software framework that supports data-intensive distributed applications. Using a diagram, explain the functionality of the **Hadoop Distributed File System and Hadoop MapReduce**.

(8 marks)

[20 marks]

Q.3. (a) Based on the tables in **Appendix A**, write a stored procedure to implement a transaction to add an order to the orders table and 2 corresponding entries to the order_details table as shown below:

80364	104	2014-01-12	2014-01-13

orders

80364	6020	2
80364	6024	1

order_details

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) In Rautmare et. al article “MySQL and NoSQL database comparison for IoT application” the authors compare SQL and NoSQL databases for a small scale water sprinkler system and investigate whether NoSQL performs better than SQL in different scenarios.
With regard to this article and other relevant material discuss the implications of choosing a NoSQL database versus a Relational Database for an Internet of Things (IoT) application. Your answer should address the implications of business requirements and deployment on database selection policy e.g. a large telecommunications system versus a small IoT application.

(10 marks)

[20 marks]

Q.4. (a) A basic objective of the First Normal Form defined by Codd was to permit data to be queried and manipulated using a universal data sub-language such as SQL. Discuss the objectives of normalization beyond First Normal Form as outlined by Codd in “Further Normalization of the Data Base Relational Model"

(5 marks)

(b) The following table illustrates the number of shares held by a stockbroker on behalf of a customer. This table is not normalized.

Convert this table into

i. First Normal Form (1NF)
ii. Second Normal Form (2NF)
iii. Third Normal Form (3NF)

Customer ID	Name	Phone Number	Stockbroker Name	Stockbroker Location	Share	Share Price	Number of Shares
100011	Amy Browne	087 9874561	Goodbody	Dublin	Apple	671.80	580
					IBM	206.66	900
					Facebook	21.26	150

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

(6 marks)

(c) Explain the term denormalization. Discuss **three** reasons why a database designer would use denormalization. Your answer should include an example of (a) an application that may benefit from using a denormalized database and (b) an application for which a denormalized database is not appropriate.

(9 marks)
[20 marks]

Appendix

The Following tables are used in Q1 and Q3.

customer_id	name	loyalty_status	email
101	Vodafone	Silver	info@Vodafone.com
102	Ericsson	Gold	sales@Ericsson.com
103	Facebook	Gold	sales@Facebook.com
104	Google	Silver	info@Google.com
105	SAP	Silver	info@SAP.com

customers

supplier_id	name	email
4000	Amazon	customerService@Amazon.com
4001	TheGadgetStore.ie	info@Amazon.com

suppliers

gadget_id	name	price
6020	TankBot Desk Pet	25.95
6021	TrekBot Desk Pet	14.95
6022	Classic Newtons Cradle	3.99
6023	Desktop Henry Vacuum Cleaner	11.95
6024	Gumball Machine	7.95

gadgets

order_id	customer_id	order_date	shipped_date
80358	103	2013-11-01	2013-11-12
80359	104	2013-12-01	2013-12-11
80360	102	2013-12-01	2013-12-11
80361	102	2013-12-01	2013-12-11
80362	105	2013-12-01	2013-12-11
80363	103	2013-12-01	2013-12-11

orders

order_id	gadget_id	order_qty
80358	6020	2
80358	6021	1
80358	6023	1
80359	6024	2
80360	6020	1
80360	6023	2
80361	6021	2
80362	6020	1
80363	6021	1

order_details