

THE BRITISH COMPUTER SOCIETY

THE BCS PROFESSIONAL EXAMINATIONS BCS Level 5 Diploma in IT

DATABASE SYSTEMS

19th October 2006, 10.00 a.m.-12.00 p.m.

Answer FOUR questions out of SIX. All questions carry equal marks.

Time: TWO hours.

*The marks given in brackets are **indicative** of the weight given to each part of the question.*

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| Calculators are NOT ALLOWED in this examination. |
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Attached Appendix A: SWIFT, for use in Question 5.

1.
 - a) Compare and contrast the file-based approach to data management with the database approach. In your answer you should discuss the advantages and disadvantages of each approach. **(9 marks)**
 - b) The following outline schema was developed for a customer company database for a large organisation manufacturing and wholesaling a wide range of chemicals for agricultural pest control and land fertilization:

Customerno, customer name, customer address, invoice address, delivery address, contact name, contact_tel_no, customer type, product category, delivery day, salesmanno, credit limit, credit terms, invoice date, discount, turnover this year, turnover last year, current balance.

Identify some potential users of this data and specify suitable external schemas for each. **(7 marks)**
 - c) Give a definition of data independence? Distinguish between logical and physical data independence. Illustrate your answer with an example. **(9 marks)**
2.
 - a) Security is of paramount concern when using multi-user systems. Briefly explain the following security issues that arise in a multi-user system:
 - i) authentication of users
 - ii) user privileges
 - iii) confidentiality of data**(6 marks)**
 - b) Describe the DBMS software facilities that are used to support the above security issues in a multi-user system. Give examples (using sql code) of user authentication, user privileges and confidentiality of data. **(12 marks)**
 - c) The Computing Faculty in a University holds information on students, assessments, lecturers, courses and modules in a centralised DBMS. Users of this database fall into the following groups: Administrators, students, Course Administration Staff, and Personnel. What role would the Database Administrator (DBA) play in this situation to ensure security and integrity of the data? **(7 marks)**

Turn over]

3. a) To address the data independence in database systems the ANSI-SPARC three-level architecture was proposed. Compare and contrast the three levels of this ANSI-SPARC architecture. **(10 marks)**
- b) Compare and contrast the two-tier client server architecture for traditional database systems with the three-tier architecture. Why is the latter (i.e. the three tiers architecture) more appropriate for the Web database? **(15 marks)**

4. Consider the following scenario:

A small Bank has two branches, one in Bristol and one in Bath, and has its head-quarters in London. Currently, it has a centralised database in its headquarters where it keeps data about its customers. Local use consists of report generation for trend analysis. On the other hand applications at the two branches access this database via a communication network for whatever data they need. There is also a communication link between the two branches, which is currently used only when one of the main links to the London headquarters fail.

The only relation in this centralized database system is the Customer relation, where data about customer accounts are kept. The attributes of the Customer relation are, the account number (*Acc_no*), the customer's name (*Cust_name*), the branch where the account is kept (*Branch*) and its current balance (*Balance*). An instance of the Customer relation follows:

Customer Relation

| Acc_no | Cust_name | Branch | Balance |
|--------|-----------|---------|---------|
| 200 | Jones | Bath | 1000 |
| 324 | Smith | Bristol | 250 |
| 153 | Gray | Bristol | 38 |
| 426 | Dorman | Bath | 796 |
| 500 | Green | Bristol | 168 |
| 683 | Roy | Bath | 1500 |
| 252 | Elmore | Bath | 330 |

Due to heavy network traffic the bank's service to its customers is suffering. The Bank is concerned and has asked you to investigate database distribution designs that will improve its service.

Propose THREE distribution designs one for each of the following requirements:

- The database should always be available to all sites and access to it should be fast even in the case of data communication link failures. **(7 marks)**
- There should be no redundancy in the allocation of data, i.e. only local data should be stored at a site. **(10 marks)**
- A reasonable compromise between requirements *i*) and *ii*). You should also justify each proposal and outline its advantages and disadvantages. **(8 marks)**

5. Please refer to Appendix A at the back of this paper for this question.

- a) Construct an ER diagram containing Entity Types, Relationship Types and Degrees to give a high level model of the SWIFT information system described in **Appendix A**. Your model should have no more than 10 Entity Types. **(10 marks)**
- b) Extend your ER diagram by assigning the columns listed in the tables in **Figure A1** and **Figure A3** to the appropriate Entity/Relationship Types. Use your ER diagram to explain the interdependencies that exist between the data contained in **Figure A1** and **Figure A3**. **(7 marks)**
- c) Explain with the aid of examples obtained from **Appendix A** the concept of **Relational Integrity** in a data model and explain how **Relational Integrity** is translated into SQL code. **(8 marks)**

STATE any assumptions made in your modelling.

STATE the diagram notation you have used in part a).

- 6. a) Outline the differences between a static SQL query and a dynamic SQL query. **(6 marks)**
- b) Describe with the aid of diagrams the function of database middleware when used to support interaction between a web browser and a database server. **(7 marks)**
- c) JDBC is database middleware supported by Java. Explain the function of JDBC in database access using the sample Java code fragment given below in **Figure 6.1**. **(6 marks)**
- d) Write a fragment of JDBC code or pseudo-code to show how a database connection is made using Java (or equivalent application programming language). Briefly explain how your code works. **(6 marks)**

```
{  
String sqlStmt = "SELECT * FROM CUSTOMER WHERE ";  
  
if(txtCity.Text.length() > 0)  
    sqlStmt += " Address2 = " + txtCity.Text + " "; // London ;  
}
```

Fig 6.1 Java/JDBC code extract for use in Question 6

Appendix A: SWIFT (Shopping With Internet Futures Technology)

A1: INTRODUCTION

SWIFT is a company that sells a range of electronic products to its customers over the internet. Customers purchase products using an on-line order entry system called a 'shopping cart'. A collective has been set up involving SWIFT and a group of suppliers who supply SWIFT with the products they need to meet customer orders. This means SWIFT can negotiate discounted prices for specific products purchased from the supplier group. Each product has an initial price (discounted price) that decreases as the total quantity of products that SWIFT sell to customers increases. SWIFT also benefits from having a higher priority for the supply of products from the supplier group in the collective than other internet shopping companies. SWIFT make a profit on each product it sells as the discounted price includes a small commission that SWIFT receive on sales of that product. The time that a product can be bought by customers at the discounted price is called the offer period.

SWIFT raises supplier orders for products that customers have ordered from them.

SWIFT holds the products in a warehouse before dispatching them to customers. Suppliers can supply SWIFT with products on demand or 'just in time'.

Figure A1 (below) shows a sample customer order and contains data that was captured today (assume the date is 3rd December 2005). **Figure A2** shows those customers who have made orders.

Figure A1: TBL_CustomerOrders

| COrderNo | CustID | ProductCode | Quantity | OrderDate | DiscountedPrice | ClosingPrice | ClosingDate |
|----------|--------|-------------|----------|-----------|-----------------|--------------|-------------|
| 1962 | 343371 | BG_8971 | 1 | 12/Nov/05 | 231.99 | 219.56 | 01/Dec/05 |
| 1962 | 343371 | GTX_281 | 20 | 12/Nov/05 | 2.67 | 2.59 | 14/Nov/05 |
| 1962 | 343371 | TL121_281 | 1 | 12/Nov/05 | 2040.00 | 2033.59 | 16/Nov/05 |
| 1963 | 034933 | GTX_281 | 15 | 11/Nov/05 | 2.69 | 2.59 | 14/Nov/05 |
| 1964 | 984311 | PD0045 | 5 | 12/Nov/05 | 2.67 | 2.59 | 16/Nov/05 |
| 1964 | 984311 | JDYE_6 | 1000 | 30/Nov/05 | 25.99 | 22.37 | 30/Nov/05 |
| 1965 | 343371 | TL121_800 | 1 | 02/Dec/05 | 2035.99 | 1994.72 | 03/Dec/05 |
| 1966 | 953534 | GTX_281 | 1 | 03/Dec/05 | 2.57 | NULL | NULL |

Figure A2: TBL_Customers

| CustomerID | Member | CustomerName | Address1 | Address2 |
|------------|--------|--------------|------------------|------------|
| 343371 | Y | Andrews | 123 Abel Ave | London |
| 034933 | Y | Ling Wing | 6 Princes Street | Hong Kong |
| 984311 | N | Hutton | 564 Holly Road | Manchester |
| 953534 | N | Rivers | 80 Grange Way | Glasgow |

SWIFT do not hold surplus stock in the Warehouse. **Figure A3** (below) shows an example of a supplier order.

Figure A3 TBL_SupplierOrders

| SOrderNo | SupplierID | Product Code | Product Price | Quantity OnOrder | OrderDate | DeliveryDate |
|----------|------------|--------------|---------------|------------------|-----------|--------------|
| 1004 | B&G | BG_8971 | 219.56 | 10 | 01/Dec/05 | 02/Dec/05 |
| 1005 | B&G | GTX_281 | 2.59 | 9 | 14/Nov/05 | 17/Nov/05 |
| 1006 | B&G | TL121_2 | 2033.59 | 100 | 17/Nov/05 | 19/Nov/05 |
| 1007 | JH Price | GTX_281 | 229.99 | 26 | 16/Nov/05 | 17/Nov/05 |
| 1006 | B&G | PD0045 | 2.59 | 26 | 17/Nov/05 | 20/Nov/05 |
| 1008 | JH Price | JDYE_6 | 22.37 | 900 | 30/Nov/05 | NULL |
| 1009 | B&G | JDYE_6 | 22.37 | 100 | 30/Nov/05 | NULL |