

BCS The Chartered Institute for IT

BCS HIGHER EDUCATION QUALIFICATIONS
BCS Level 5 Diploma in IT

DATABASE SYSTEMS

Monday 27th September 2010 - Afternoon
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.*

Calculators are NOT allowed in this examination.

Question 1

a) Discuss the main limitations of database systems that led to the evolution from first generation to the third generation of database systems.

(5 Marks)

b) Discuss the major functionalities and standards provided in the web server (middle tier) that enables communication between the Internet and database systems?

(10 Marks)

c) 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?

(10 Marks)

Question 2

The following data structure and constraints exist for a magazine publishing company. The company publishes one regional magazine each in the states of Florida (FL), South Carolina (SC), Georgia (GA), and Tennessee (TN). The company has 300.000 customers (subscribers) distributed throughout the four states. On the first of each month, an annual subscription INVOICE is printed and sent to all customers whose subscription is due for renewal. The INVOICE entity contains a REGION attribute to indicate the state (FL, SC, GA, TN) in which the customer resides.
CUSTOMER (CNUM, CNAME, ADDR, CITY, ST, ZIP, SUBSDATE)
INVOICE (INVNUM, REGION, CNUM, DATE, TOTAL)

The company's management is aware of the problems associated with centralised management and has decided that is time to decentralise the management of the subscription into its four regional subsidiaries. Each subscription site will handle its own customer and invoice data. The company's headquarters management wants to have access to customer and invoice data to generate annual reports and to issue *ad hoc* queries, such as:

List all current customers by region

List all new customers by region

Report all invoices by customer and by region

Given the above requirements answer the following questions:

a) What recommendations will you make regarding the type and characteristics of the required database system?

(3 Marks)

b) What type of data fragmentation is needed for each table?

(3 Marks)

c) What must be the criteria used to partition each database?

(7 Marks)

d) Design the database fragments. Show an example with node names, location, fragment names, and attribute names.

(6 Marks)

e) What type of distributed database operation or queries must be supported at each remote site?

(3 Marks)

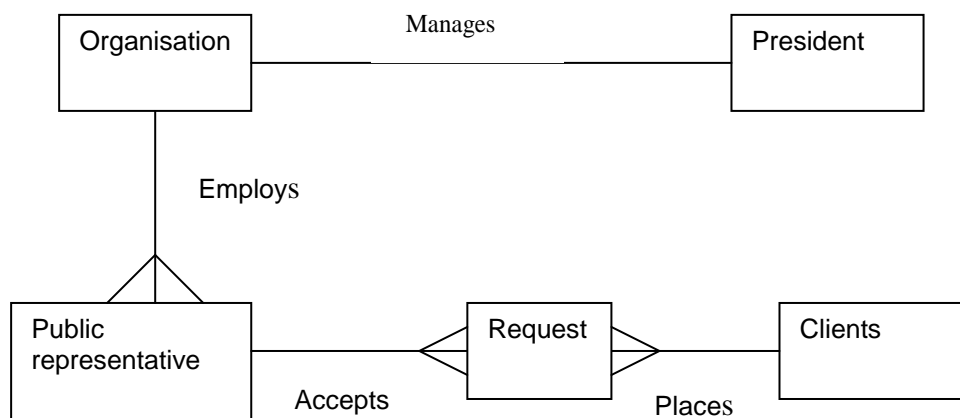
f) What type of distributed database operation or queries must be supported at the headquarters site?

(3 Marks)

Question 3

Use the concepts of entity integrity and referential integrity in relational database to answer the questions stated below.

An organisation's database system is shown in the data model below:



Work to do:

a) Explain what the data model represents. Explain the concepts of entity integrity and referential integrity, which may be used in the model.

(5 marks)

b) List the Primary key and foreign key(s) for each entity, stating the assumptions you made.

(10 marks)

c) For each relationship and in each direction explain your choice of optional/mandatory. State any assumptions made.

(10 marks)

Question 4

Normalisation is a key method used to design a relational database management system. Use the concepts of normalisation to answer the question stated below:

Analyse the following data stored in a typical university file to record information with regard to students, courses, modules and class times. Essentially, a student is enrolled onto a course and may take several modules as part of this course.

StudentID	StudentName	CourseID	CourseDuration	ModuleID	ModuleName	ClassRoom
C0123456	Mike	C101	3	M360	Database	CW3/19
				M301	WebTech	CW2/17
				M102	Software	CWG/02
C0212345	Anne	C102	4	M201	BusinessIT	CWG/01
				M203	MusicTech	CW5/18
				M102	Software	CWG/02
C0321234	Jack	C103	5	M301	WebTech	CW2/17
				M103	Network	CW4/04
				M360	Database	CW3/19
				M201	BusinessIT	CWG/01
C0432123	Helen	C104	4	M203	MusicTech	CW5/18
				M102	Software	CSG/02
				M360	Database	CW3/19
C0543212	Ben	C105	3	M102	Software	CWG/02
				M201	BusinessIT	CWG/01
				M203	MusicTech	CW5/18
				M301	WebTech	CW2/17

Work to do:

- a) Represent the above as an un-normalised relation and identify any candidate keys. From these candidate keys choose the primary key. State any assumptions you make.

(5 marks)

- b) Normalise your un-normalised relation, showing the development of your design through the forms 1NF, 2NF and 3NF. At each of the three stages state any assumptions you make about the choice of primary key. Indicate the foreign keys for relevant entities.

(20 marks)

Question 5

- a) Work out the overall function of the following SQL code samples:-

```
--- CODE SAMPLE 1
CREATE VIEW V1 AS SELECT name,
    amount_received,
    amount_sent,
    (amount_received - amount_sent) AS balance
FROM table_customers c
    JOIN accounts_table a
    ON a.customerid = c.customer_id

SELECT balance FROM V1 where CustomerType = 'Personal'
```

```
--- CODE SAMPLE 2
START TRANSACTION;
    UPDATE accounts_table SET balance=balance-200 WHERE
account_number=1234;
    UPDATE accounts_table SET balance=balance+200 WHERE
account_number=2345;
IF ERRORS=0 COMMIT;
IF ERRORS<>0 ROLLBACK;
```

(12 marks)

- b) Describe the factors you would consider in deciding whether to use either a VIEW or a TABLE to express a database query.
- (7 marks)**
- c) Describe the factors you would consider when deciding to use either a single SQL statement or a database transaction to express a database update operation.

(6 marks)

Question 6

Maintaining THE consistency between entities is essential for relational database management systems. The existence of Weak entity strongly affects on the integrity of a relational database system.

- a. Explain what happens when a weak entity is subject to a cascade delete/update process.
- (5 marks)**
- b. Illustrate an example of the use of cascaded delete/update process with an explanation.
- (10 marks)**
- c. Explain the integrity rules which are applied in the cascaded delete/update process
- (5 marks)**
- d. Give a definition and an alternative terminology for the term of weak entity
- (5 marks)**