

BCS The Chartered Institute for IT  
THE BCS PROFESSIONAL EXAMINATIONS  
BCS Level 5 Diploma in IT

**DATABASE SYSTEMS**

Friday 23<sup>rd</sup> April 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 <b>NOT</b> allowed in this examination.
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1.

The following concepts are important parameters when judging the effectiveness of data storage solutions. For EACH concept, briefly compare and contrast how effective the database approach and file-based approach are, highlighting any particular strengths or weaknesses of either.

- Data Integrity (5 marks)
- Data Security (5 marks)
- Data Redundancy (5 marks)
- Data Maintenance (5 marks)
- Data Consistency (5 marks)

2.

In web-based auction sites users submit bids and compete with other users bidding for the same product. Bidding continues for a specified period of time before the highest bidder (who becomes the buyer) secures the product. When the seller receives payment he/she posts the product to the buyer. A transaction is completed when the buyer receives the product. Since the seller is anonymous no correspondence from the buyer to the seller occurs, therefore a large amount of trust occurs. The integrity and honesty of sellers is recorded and this is made known to potential bidders.

- (a) Describe the requirements of a DBMS and database server needed to support the application outlined above.

**(8 marks)**

Explain the interaction between a database server and a web server in order to present data stored in a database on a web browser. Illustrate your answer with references to application data and program code applicable to a web-based auction site.

**(10 marks)**

- (b) Discuss the trade-offs of implementing the program logic and business rules on:-

- (i) The application/web server;
- (ii) The database server.

**(7 marks)**

3.

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**

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:

- (i) 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)**

- (ii) There should be no redundancy in the allocation of data, i.e. only local data should be stored at a site.

**(10 marks)**

- (iii) A reasonable compromise between requirements (i) and (ii). And also justify each proposal and outline its advantages and disadvantages.

**(8 Marks)**

4.

**Refer to Appendix A (2BHired discourse)**

Produce an ER data model for the discourse given in Appendix A using UML class modelling notation. An example of UML notation is given below in figure 4.1

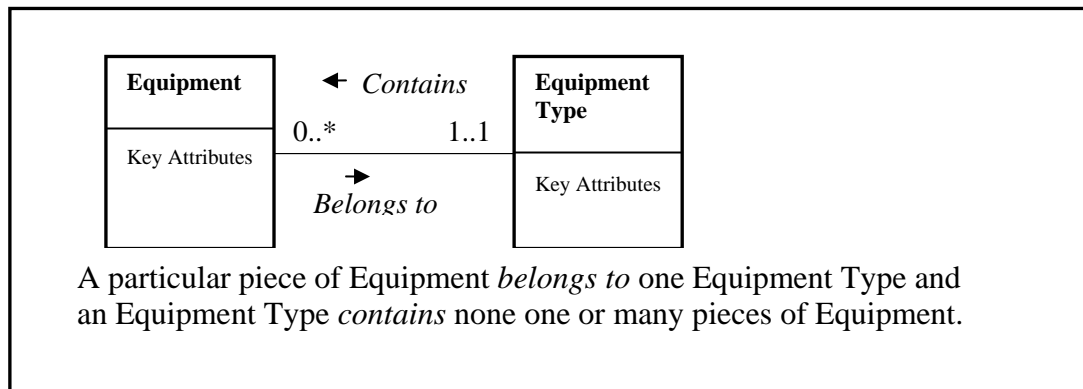


Figure 4.1: UML Class diagram notation

Marks are awarded on the overall accuracy, expressiveness and completeness of your ER model in representing:-

- Entity Types (Classes) (6 marks)
- Key Attributes (5 marks)
- Relationship names (associations) (3 marks)
- Relationship Constraints (7 marks)
- Resolution of many to many relationships. (4 marks)

5.

**Refer to Appendix A.**

**a) Refer to Figure A1 in Appendix A**

Table A1 represents data that is presented on a spreadsheet and is stored in a format called a comma separated value (csv) 'flat file'.

Describe the main disadvantages of processing data held in a flat file compared with processing data held in a database table

**(9 marks)**

b) Explain how EACH of the following problems associated with the existing 2BHIRED information system can be overcome using a database approach:-

- The record card system has created problems such as the same piece of equipment has been entered twice with different serial numbers.
- Store persons often bypass editing changes on the record card on the computer by writing those changes on the printed card.

- The process of recording a hire and issuing a hire agreement to a customer can be very slow at busy times. Customers can become very impatient with the delays this causes.
- Personnel at Head Office find it difficult to extract operational, marketing and management information. This is needed to develop the business and to give them a competitive edge.

(16 marks)

6.

### Refer to Appendix A

Draft a set of tables (using SQL code) that will support the following requirement

*Occasionally a hiring cannot be met because an item of equipment is being serviced at the same time it was due to be hired out. The system needs to recognise also that there may be more than one identical item available or there may be similar items that could be offered if the requested item is not available.*

Marks are awarded on the extent your Table design satisfies the above requirement supported by the following:-

Design is sound and Rules of normalisation have been applied	(5 marks)
Column names assigned to Tables	(5 marks)
Primary keys and Foreign Keys have been assigned	(4 marks)
Applied column constraints (domain, default, Null)	(3 marks)
Supplied consistent sample data	(4 marks)
SQL code is reasonably correct and is consistent	(4 marks)

State any assumptions you make.

## Appendix A – Discourse 2BHIRED

“2BHIRED Ltd” is the name of an equipment hire company that has 5 **branches**. Each branch holds a different range of **equipment** that can be hired out to **customers**. A branch covers a distinct geographical area. A Head Office (or HQ) is located at one of the branches and deals with accounting, sales and marketing.

Last year approximately 5,000 individual **items** were hired and the total turnover was roughly £300,000 pounds sterling. The largest number of items on hire at any one time was 615. Up until last year business was expanding at between 8 – 10% per annum. Future expansion partly depends on improving the IT system used to support the operation of the business.

### 1. Equipment

An example of Equipment that can be hired is a Technical Arc 166I DC 240v Arc Welder. Equipment belongs to a particular **equipment type** as shown in Fig A1 below.

**Fig A1: Equipment Types and Items**

Equipment Type	No of Different Items	Total Items in Stock
D Decorating aids	148	240
W Woodworking power tools & saws	89	100
B Building & construction equipment	35	90
G Gardening equipment and tools	40	190
P Plumbing, welding & vehicle repair	63	160
H Miscellaneous household items	26	80
Totals	401	860

There is usually more than one item of equipment held in stock and available for hire. An equipment record card captures information about all the items of equipment that is held in stock and is created whenever a new item is purchased. Fig A2 depicts an example print out of an equipment record card.

When a new item is purchased it is given a unique serial number consisting of a prefix (D/W/B/G/P/H) according to the equipment type; a numeric suffix (01 for the first item of its kind, 02 for the second and so on). For example, the second ‘Technical Arc 166I DC 240v Arc Welder’ has the unique serial number P06432/02.

The record card lists the *value* of any item of equipment over its life. The first year’s depreciation (normally 10%) is taken off as soon as the item is used. For example a welder that cost £1350, with normal usage, is expected to have a life of five years. After five years it would be scrapped or sold for a nominal sum.

There is a stock of *accessories* that can also be hired out at the same time with certain items. Examples of accessories include extension leads, safety goggles, transformers, chuck keys etc. Accessories are ‘allocated’ to a particular equipment type rather than to items that it is actually used with. An accessory that has not been required in an equipment hire may be reallocated as an accessory for another hired item of the same type.

## 2. Equipment Hiring Process (same for all Branches)

When an item is to be hired a clerk/store person checks its condition and whether its accessories are available. A Hire Order form is prepared (see figure A3). A customer can hire up to seven separate items on each order form. When an equipment item is returned it is given a visual check and the hire charge for the period is calculated. The payment figures are entered on the Hire Form and then transferred to Head Office at the end of the day.

## 3. The current IT system

A spreadsheet is used to *capture* the information shown in Figures A2 and A3. A spreadsheet is also used to *present* the information depicted in Figure A1. Each branch has a file sharing network consisting of office PCs and a couple of printers and scanners. This means the files are shared amongst users across the network and is therefore not based on client-server architecture.

Each branch has the same IT system and data held in files is not accessible outside a home branch.

**Fig A2 EQUIPMENT RECORD CARD**

<b>Item Code</b> P06432/02		<b>Description</b> Technical Arc 166I DC 240v Arc Welder		<b>Manufacturer No</b> MN84G/9870/8	
<b>Manufacturer</b>	Fox	<b>Supplier</b>	MNG	<b>Purchase Cost</b>	£1350
<b>Date Purchased</b> 23/10/2007					
<b>VALUE: Year 1</b> £1200		<b>Year 2</b> £850	<b>Year 3</b>	<b>Year 4</b>	<b>Year 5</b>
<b>Date Scrapped/sold:</b>		<b>Scrap Price:</b>		<b>Replacement cost</b> £1288	
<b>Accessory equipment</b> #1 Welding gloves #2 protective goggles			<b>#1 available</b>	<b>#2 available</b>	<b>#3 available</b>
<b>HIRE RATE DAY</b> £100 (half a day = £65) <b>WEEK</b> £500					
<b>Maximum Hire period</b> 4 weeks		<b>Minimum Hire period</b> 1/2 day		<b>Deposit Required</b> Yes	<b>Status</b> On Hire Damaged Service Due

**REVERSE OF CARD**

**HIRING RECORD**

Order Number	Date Hired	Date Returned	Usable Y/N	Customer Number (trade= T or public= P)	Phone No	Hire Charge
UG5431	3/3/09	6/3/09	Y	T5424	464597	265
UG5432	6/3/09	6/3/09	Y	P64231	M798781	65
UG6734	12/1/09	13/1/09	Y	T5620	M790221	100

**Fig A3: Hire Agreement Form**

<b>2BHIRED LTD Hiring Agreement</b>				<b>BRANCH: LEICESTER</b>			
<b>Address:</b> Athelstone Road , Evington, Leicester LE5 5TR				<b>PHONE</b> (01533) 87654			
<b>Order Number</b> UG6734		<b>Tel No</b> M790221					
<b>Customer No</b> T5620		<b>Name</b> Vijay Konreddy					
				<b>HIRE DATE</b> 12/4/09			
<b>Address</b>				<b>DATE RETURNED</b> 14/4/09			
36 Hawthorpe Ave							
<b>HIRE PERIOD (Days)</b> 1.5				<b>Delivery/Collection?</b> Y/N N			
Hinkley Leics LE12 8BF							
<b>EQUIPMENT HIRED</b>						<b>RETURNED</b>	
<b>Qty</b>	<b>Serial No</b>	<b>Description</b>	<b>Hire Rate Day/Wk</b>	<b>Deposit £</b>	<b>OK ?</b>	<b>Charge £</b>	
1	MN84G/9870	Technical Arc 166I DC 240v Arc Welder	100/day	20			
<b>Totals</b>							

**All hire charges include VAT**

<b>ACCESSORIES (No charge if returned in good order)</b>
#1 Welding gloves x 2

**I agree to hire the above items under the  
TERMS OF HIRE printed overleaf.**

**Signed**

**Date**

## Reverse of Form

<b>EQUIPMENT RETURNED</b>		
	<b>Total Deposit</b>	
<b>Received by:</b>		
	<b>LESS Total Hire Charge</b>	
<b>Date:</b>		
	<b>LESS Delivery/Collection</b>	
	<b>LESS Losses or Damage</b>	
	<b>NET REFUND/CHARGE</b>	
<b>Received by:</b>		<b>Date:</b>