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UNIVERSITY OF LONDON 279 0103 ZA

BSc degrees and Diplomas for Graduates in Economics, Management, Finance and the Social Sciences, the Diploma in Economics and Access Route for Students in the External Programme

Elements of Information and Communication Technologies

Tuesday, 23 May 2006 : 2.30pm to 5.30pm

Candidates should answer **FIVE** of the following **ELEVEN** questions: **ONE** from Section A (40 marks) and **TWO** from **each of two** of the remaining Sections B, C and D (20 marks each). **Candidates are strongly advised to divide their time accordingly.**

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SECTION A: Principles of Programming

Answer **one** question from this section (40 marks).

1. (a) A soft drinks vending machine sells three types of drink (Lemonade, Iced Tea, and Water). To function, the vending machine needs a program that will allow it to determine when the correct amount of money has been input to the machine. The machine can only take 10, 5, 2 and 1 unit coins. The vending machine can also run out of drinks of a particular type.

The program must therefore meet the following requirements:

REQ1: A user must be able to select a drink type (Lemonade, Iced Tea, or Water). The machine will then either display the price of the drink or if the machine has run out of drinks of a particular type.

REQ2. A user must then be able to enter coins to the value of the price of the drink. If the user inputs too much money, the program must calculate the amount of change in each type of coin. When this has finished, the number of drinks must be reduced appropriately.

Write an algorithm based on the above description that satisfies the requirements REQ1 and REQ2. When you have written your algorithm, discuss exactly how your algorithm satisfies these requirements. Any interaction with a user can be represented as appropriate display messages. **(20 Marks)**

(b) Define the behaviour of the logical operator OR. Discuss how this is used in a program to choose between different conditions in an IF statement. Use an example to illustrate your discussion. **(10 marks)**

(c) A test plan is typically made to demonstrate that a program satisfies a set of requirements. Write a test plan with expected outcomes for each of the requirements REQ1 and REQ2. **(10 marks)**

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2. (a) A cinema owner needs to know information about how his theatre is performing. Specifically, he needs to know the average number of tickets sold for each day of the week over a four week period. He also needs to know which are the best selling days of the month. A program is therefore required to allow him to enter the data for each day of the four week period. The program must then output the average number of tickets for Monday, Tuesday, etc. Finally, the program must output the best selling day (this will be a number – for example '1' indicates day one).

A program that performs the above must satisfy the following requirements.

REQ1: A user must be prompted to input data in the correct format as described above. If the data is incorrect, then the user must be prompted to re-enter the data. The user must be able to tell the program that data entry has finished.

REQ2. The program must be able to perform the calculations as identified above and to inform the user of the results.

Write an algorithm based on the above description that satisfies the requirements REQ1 and REQ2. When you have written your algorithm, discuss exactly how your algorithm satisfies these requirements. Any interaction with a user can be represented as appropriate display messages. **(20 Marks)**

(b) Parameters can be passed to procedures by values or by reference. Using one example for each approach, discuss in what situations you would use each approach. **(10 marks)**

(c) A test plan is typically made to demonstrate that a program satisfies a set of requirements. Write a test plan with expected outcomes for each of the requirements REQ1 and REQ2. **(10 marks)**

SECTION B: Databases

If this is one of the two sections you choose, answer **two** questions from it (20 marks each).

3. (a) Create an ER diagram to represent the data requirements for the case study (see the following IT Training Company (Itrain) case study). You must state any assumptions you make when creating the model, e.g. regarding your choice of entities and/or relationships. Assumptions, however, must not contradict the requirements. You can use any standard notation (e.g. as used in Connolly and Begg's book, Chen or Crow's Feet notations) but you must clearly label the name of each entity and relationship, and mark the cardinality of each relationship (i.e. specify if it is 1:1, 1:M or M:N). **(12 marks)**

(b) Map the ERD you have created to a relational schema. For each entity that you have identified from the case study (see the following IT Training Company (Itrain) case study), list the main attributes (no more than 3-4), primary and foreign keys. Underline primary keys with a single line and foreign keys with a double line. You do **not** have to normalise the relations. **(8 marks)**

Case study – IT Training Company (Itrain)
Itrain has contacted you to create a conceptual model for a database that will meet the information needs for its training program. The Company Director gives you the following description of the training group's operating environment.

The Company has twelve instructors and can handle up to one hundred trainees per training session. The Company offers five advanced technology courses, each of which is taught by a teaching team of two or more instructors. Each instructor is assigned to a maximum of two teaching teams or may be assigned to do research. Each trainee undertakes one advanced technology course per training session.

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4. (a) List and describe in a sentence or two **nine** functions that should be provided by a modern full-scale multi-user DBMS. **(9 marks)**

(b) Explain why it is necessary to select the target DBMS before beginning the physical database design phase. **(5 marks)**

(c) Explain the purpose and scope of database security. **(6 marks)**

5. (a) Using the database tables below express the following queries in SQL. The primary keys are underlined.

Table	Attributes
Hotel	hotelNo, name, address
Room	roomNo, hotelNo, type, price
Booking	hotelNo, guestNo, dateFrom, dateTo, roomNo
Guest	guestNo, name, address

i. List the bookings for which no dateTo has been specified. **(4 marks)**

ii. List the names and addresses of all guests in London, alphabetically ordered by name. **(5 marks)**

iii. List the price and type of all rooms at the Grosvenor Hotel. **(7 marks)**

(b) What does a NULL represent? Can a primary key have a NULL value? Briefly justify your answer. **(4 marks)**

SECTION C: Networking: intranets and the Internet

If this is one of the two sections you choose, answer **two** questions from it (20 marks each).

6. (a) Define the term **connection-oriented protocol** as used in computer networks. **(4 marks)**

   (b) The Transmission Control Protocol is a connection-oriented protocol widely used over the Internet. Describe its functionality, emphasizing the mechanisms via which it is achieved. **(16 marks)**

7. (a) Imagine that you are working in a small company (10 employees) which does not have a LAN, and that it is up to you to convince your technically-minded boss of the opportunity to introduce a LAN in the company. What would your arguments be? **(10 marks)**

   (b) What is the difference between a packet and a frame in communication networking? Describe and name the mechanism through which, in a LAN, frames are selected only by those computers that are its intended recipients. **(10 marks)**

8. (a) Define and discuss the role of a **DNS server** in communication networking. **(10 marks)**

   (b) Describe the role and functionality of the **transport and application layers** in the ISO/OSI reference model. **(10 marks)**

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SECTION D: Human Computer Interaction

If this is one of the two sections you choose, answer **two** questions from it (20 marks each).

9. (a) Define the role of HCI in interactive systems design. **(10 marks)**

   (b) Discuss the following statement: "In human-computer interaction, the term 'usability' refers to how user friendly an interactive system is". You will need to address if and why this is a limited definition, and how the statement might be improved. **(10 marks)**

10. (a) What are mental models? How can interactive system designers use their knowledge about mental models in developing the user interfaces to new interactive systems? **(10 marks)**

    (b) When examining the implementation of new interactive systems within an organisation and the potential for organisational change, there are a number of areas (or viewpoints) that we need to examine. Describe what these are and briefly illustrate them with examples from your own experience or academic reading of how the system's user interface succeeded or failed to support its organisational context. **(10 marks)**

11. **Scenario**: You have been asked to design the interface to an interactive system; this will be a drawing and painting system for use by children at school under the age of 10. This system will involve the design of a series of interlinked, wall sized, touch-sensitive screens: what is drawn on one screen will be visible on others. Children in different classrooms will be able to freely draw and paint on these screens using their hands or special pens. Teachers will have administrator access and be able to manage these screens to 'undo' any mistakes, delete material, and save the paintings to file.

    Question: From an HCI perspective (i.e. without detailing the networking, security, programming or commercial considerations), describe the factors that you would have to consider in the design. Clearly justify your answers. **(20 marks)**

    Marks will be awarded equally between your designs, for the application of HCI knowledge, and for the application of an appropriate HCI design approach.

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