

ST ANDREW'S JUNIOR COLLEGE

Preliminary Examination

H2 COMPUTING

9754/01

PAPER 1

28 AUG 2009

TIME: 0800 – 1100 hrs

3 hours

READ THESE INSTRUCTIONS FIRST

If you have been given an Answer Booklet, follow the instructions on the front cover of the Booklet.

Write your class and name on all the work you hand in.

Write in dark blue or black pen on both sides of the paper.

You may use a soft pencil for any diagrams, graphs, music or rough working.

Do not use staples, paper clips, highlighters, glue or correction fluid.

Answer **all** questions.

At the end of the examination, fasten all your work securely together.

The number of marks is given in brackets [] at the end of each question or part question.

Total marks for this paper is **120** marks.

This question paper consists of 4 printed pages.



Answer **all** questions.

- 1
 - (a) In a network of computers, it is necessary to pass information between computers. Explain the purposes of protocols and handshaking in this situation. [3]
 - (b) During transmission, it is essential that any errors are detected. Explain the use of
 - (i) parity bits,
 - (ii) check sums
 to detect any errors. [4]
 - (c) Describe **two** methods that may be used to correct any errors that occur. [4]

- 2
 - (a) Explain the following aspects of an operating system:
 - (i) a multi-user and multi-tasking operating system [2]
 - (ii) memory management [2]
 - (iii) roles of a scheduler [2]
 - (b) Describe the functions of a buffer. [2]

- 3

A Chinese restaurant in a social club only serves its members and operates with a manual system. There are two managers who take order of dishes from the members based on the table number of the dining table they sit using an order sheet. You are appointed as a system analyst to design a relational database system with the following information:

 - Members of a dining table may order a number of dishes.
 - Each dish is specifically cooked by one chef.
 - A chef can cook more than one dish.
 - The restaurant has a pool of privileged members who are entitled for a 10% discount of the bill; whereas, an ordinary member enjoys a 5% discount only.
 - The date that a member patronizes the restaurant is recorded.
 - (a) Suggest a way how an ordinary member can become a privileged member. [1]
 - (b) Suggest how this data could be organised in such a database, indicating how many files (i.e. tables) there would be. Also, specify the attributes (fields) required and state the primary key for each table. [10]
 - (c) Draw a relationship diagram to show the relationships between files. Explain how the tables are linked. [4]
 - (d) Explain how to generate a report of the top five popular dishes with details of the chefs who cook the dishes from the database. [4]

- 4 (a) Explain the process of top-down analysis and explain why it helps in the solution of complex problems. [5]
- (b) A toy company holds, on a computer system, details of over 3,000 products. Each product has a unique identifier.
- (i) Using an example, explain how the data can be organised as a random file. [4]
- (ii) Describe how the random file is updated when a particular toy is no longer produced by the company. [5]
- (c) The company accepts a product, if it passes the following three tests.
- All dimensions are correct
 - Safety tests are passed
 - Paint tests are passed
- If the first test is passed but exactly one of the other two fails, the toy is sent for repair. Otherwise the toy is rejected.
- (i) Create a **decision table** showing all the possible outcomes and results. [4]
- (ii) Simplify your solution by removing redundancies. [3]
- 5 (a) Explain the difference between an iterative solution and a recursive solution to a problem. [2]
- (b) A program prints out the digits of a positive number starting with the rightmost digit.
- For example, 5234 will be printed as 4 3 2 5.
It makes use of the function **MOD** such that, for any number N, $N \text{ MOD } 10$ gives the rightmost digit.
- Write, in pseudocode,
- (i) an iterative algorithm [4]
- (ii) a recursive algorithm [4]
- to print the digits of a positive number starting from the rightmost digit.
- 6 (a) (i) State what is held in the Program Counter (PC) during the fetch/execute cycle. [1]
- (ii) Explain how the contents of the PC change during the fetch/execute cycle. [4]
- (b) Describe the contents of the memory address register (MAR) during the fetch/execute cycle. [4]
- (c) Explain what is meant by an *embedded processor* and how it differs from a processor found in a typical desktop computer. Give **one** example where an embedded processor would be used. [4]

- 7 A programmer is tasked to design a software solution for a bank. He chose to use the **object-oriented** paradigm to design his solution. When working on one of the deliverables for the software solution, he defined a **generic bank account class** followed by two more specific types of bank accounts:

Savings account: an interest-bearing account, i.e. this account pays interest on a monthly-rest basis. The interest rate is regularly updated by the bank.

Current account: a non-interest bearing account (i.e. no interest is paid) with a overdraft facility option, i.e. a facility that allows the member to withdraw money up to a maximum amount determined by the bank even if the account has zero dollars.

- (a) Explain the difference between a class and an elementary data type. [3]
- (b) Using appropriate object-oriented design diagrams, draw the relationship between the three account classes. [6]
- (c) Explain, with appropriate references to your answer in part (b), the following terms in object-oriented programming:
 - (i) Encapsulation
 - (ii) Data-hiding
 - (iii) Inheritance [6]
- (d) Differentiate between method overloading and polymorphism. [4]

- 8 A Binary Search Tree (BST) Abstract Data Type (ADT) has the following associated operations defined:

- (i) Create() – creates an empty BST
- (ii) Insert(item) – inserts a new value, item, into the BST
- (iii) Delete(item) – deletes a value, item, from the BST
- (iv) Find(item) – searches for a value, item, in the BST, returns true when found.
- (v) Size() – returns the number of items in the BST
- (vi) IsEmptyBST() – returns true if BST is empty, false otherwise

Assuming that the ADT is implemented using pointers and a BST, **testBST**, is created with the following operations carried out:

```
testBST.insert(mary)
testBST.insert(john)
testBST.insert(zac)
testBST.insert(lynn)
testBST.insert(tim)
```

- (a) (i) Draw a diagram to show the state of the BST after the operations have been carried out. [4]
- (ii) Write the algorithm to implement the '**Insert**' operation. [6]
- (b) Write the algorithm for a new operation called '**DisplayItemsSorted**' that will display the items in the BST in alphabetical order and the total number of items displayed. [5]
- (c) Describe a possible scenario that may occur when many subsequent items were inserted to the testBST and briefly discuss its significance to the efficient operation of the BST. [4]

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