ST ANDREW'S JUNIOR COLLEGE

PRELIMINARY EXAMINATIONS

H2 COMPUTING **9754/02**

PAPER 2 **22 SEP 2011**

TIME: 0800 – 1030 hrs **2 ½ 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 **100** marks.

This question paper consists of 4 printed pages.

Answer **all** questions.

The Mass Rapid Transit or MRT is a rapid transit system that forms the backbone of the railway system in Singapore, spanning the entire city-state. The MRT has 79 stations with 129.7 km of lines and operates on standard gauge. The rail lines have been constructed by the Land Transport Authority (LTA), a statutory board of the Government of Singapore, which allocates operating concessions to the profit-based corporations SMRT Corporation and SBS Transit. These operators also run bus and taxi services, thus ensuring that there is a full integration of public transport services in Singapore.

At present, the four operating lines are North-South line, East-West line, North-East line and Circle line. The LTA intends to greatly expand the existing system by adding new lines, Thomson line, down-town line, East Region line and extensions to the existing lines. It has decided to investigate the introduction of an island-wide computerised travel information system.

1 A system analyst is employed to decide on the feasibility of producing such a system.

(a) Explain why it is important to have a clear definition of the problem to be solved before the analyst starts work. Illustrate your answer with an example of a difficulty which may arise if the problem is not clearly defined. [3]

(b) The system analyst, when documenting the system, can use a number of different diagrammatic methods to support what is written. Give three examples of diagrams that might be found in the technical documentation and explain why they are included.

[6]

2 There is also a Local Area Network (LAN) facilitating an Intranet within the LTA main office besides the Internet facilities using a Wide Area Network (WAN).

(a) Describe the characteristics of a local area network (LAN) and wide area network (WAN) using a diagram for each network. [6]

(b) If the LAN is based on a Ring topology, draw a labeled diagram to describe the hardware of the network. [4]

(c) Justify the choice of a Ring network in preference to a Star network [4]

It is decided to implement a system of terminals on each station which are all connected to a central file server. Passengers will be able to make enquires at the terminals about the times of trains.

3 (a) With reference to these examples, describe the main characteristics of a Network Operating System (NOS) and give an example of a NOS. [3]

(b) Describe a suitable software interface for passengers, giving reasons for your answer. [4]

(c) Enquires from passengers may also include checking on whether he/she is entitled a concession travel fare. The concession fare is given to a passenger if he or she fulfills the following three conditions.

- Able to produce a senior citizen card or a student card
- Travelling during weekdays non-peak hours (6am to 9am)
- Travelling on Saturdays, Sundays and Public Holidays

Create a **decision tree** showing all the possible outcomes and results. [4]

4 Besides the terminals at the stations, commuters can also download a mobile application or access the Internet web portal to access the information. Requests to the server are stored in a queue before processing. After processing, the required data is transmitted back to the terminals, computers or mobile devices that initiated the request.

(a) Write the algorithms for the following queue operations,

(i) insert

(ii) delete., [6]

(b) It is possible that errors may occur during the transmission of data from terminal to server and vice versa.

(i) describe two ways of detecting data transmission errors, [6]

(ii) give two ways of correcting errors detected during transmission. [2]

(c) Besides being able to access train arrival time information, the mobile application software also provides real-time information of the arrival times public buses.

(i) Explain what is meant by real-time. [1]

(ii) Using the current capability, briefly describe a service feature that can be added to the mobile application to improve commuter traveling efficiency and experience. [2]

The details of the trains are stored over a period of a week. The number of trains that are expected to leave a station in a week varies depending on the time of year, but is never more than 2000 a week. Trains are identified by a 5-digit code number. The first digit, from 0 to 5, identifies the last station that the train is going to. The second digit, from 0 to 4, identifies the type of train, and the third and fourth digits provide an identifier of the specific train. The fifth digit is a check digit.

5 (a) Explain what is the purpose of having a check digit in the code and how this check digit may be calculated. [5]

(b) Full details of all trains are stored in a random access file. The operator of the system needs to be able to access individual trains in order to change the data held in the record in the file.

(i) Devise a hashing algorithm which would be suitable for this application. [2]

(ii) State two train codes which would cause a collision using your hashing algorithm, giving a reason for your answer. [2]

(iii) Explain two methods that could be used to overcome the problem in (ii). [4]

(iv) In this random file, when a record is deleted, it is not physically removed but is only marked as deleted. After many insertions and deletions of records, the main area and the overflow area of the file contain many records marked as deleted. This causes inefficient access. Describe, in steps, how the file can be re-organised to improve the efficiency of accessing the file. [4]

6 The actual train arrival times for each train to each station are logged daily and stored in a file for audit of performance adherence on a weekly basis. The fields stored in the file are the day of the week (where day 1 refers to a Monday), train code, station number, arrival time (each time is stored as three separate fields of hour, minute and seconds respectively, e.g 10 seconds past 3.35 pm is stored as 15, 35, 10, 49 seconds past 9.05 am is stored as 9, 5, 49).

(a) Backups and archives are done on the file. Explain the difference between backups and archives. [4]

(b) At the end of each week, a program module is run to check performance adherence against the planned schedule. This module will read in the logged details of the file for a given day and a given train and stored it in an array. It will proceed to compare against the planned schedule, which is stored in another array.

(i) Briefly explain what is a module in the context of programming and what ideal characteristics it should possess. [2]

(ii) A program module can accept parameters passed in by value or by reference. Explain the difference between these two ways. [4]

(iii) Write the algorithm for a module, **timeDifference**, that takes in **two sets** of train times (hour, minute, seconds) as input parameters and will return the difference between the two times in **seconds**. [4]

(iv) A black-box test can be done on the module timeDifference to see if it works as expected. Suggest and explain two different sets of arrival time pairs that can appropriately test the functionality of the module **timeDifference**. [2]

(v) If the black-box test in part (iv) fails, explain the type of error that most likely has occurred and name another suitable test that should be done explaining what it entails. [4]

(vi) Write, using pseudocode, the algorithm for the module that will compare both the arrays (assume that the order of entries for both the planned and actual schedule arrays have already been ordered correctly) and output the number of times the train failed to arrive within 1 minute of the planned **arrival** time (you may make use of the module in part (iii)). [4]

(vii) Explain the modification of the algorithm in part (vi) if a warning about the performance failure is to be displayed when the percentage of failures to comply with the planned schedule within the stipulated 1 minute time-frame is greater than 5%. [2]

7 Name and describe the three types of documentation that should be produced and provided for by the developer of the new system. [6]

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