HWA CHONG INSTITUTION
C2 PRELIMINARY EXAMINATION 2009

COMPUTING
Higher 2

17 September 2009 **Paper 1 (9754 / 01)** **0815 -- 1115 hrs**

Answer ***ALL*** questions.
Begin ***EACH QUESTION*** on a ***FRESH SHEET*** of paper.

The maximum mark for this paper is 120.

1. Before the advent of LANs and the Internet, the most common mechanism for spreading a virus was through floppy disks and CD-ROM disk. Today, a virus can be transmitted over a LAN in a fraction of second, and around the world in less than a second.

   (a) What is a virus? [1]

   (b) What kind of damage can virus cause? [2]

   (c) How does a worm virus differ from a Trojan horse? [4]

   (d) Explain why hacking and computer viruses are undesirable. Identify **TWO** precautions which can be taken to discourage them. [6]

2. Many industrial plants use computer controlled equipment, including robotic machinery in the manufacturing process. The introduction of this equipment has affected manufacturing performance, the safety of the workforce and employment.

   A robotic vehicle is to be launched from earth and sent to the moon to undertake exploration, including the analysis of minerals found on the moon's surface.

   (a) Explain how such a vehicle would be able to provide useful data for scientists on earth. [6]

   (b) Explain **ONE** benefit and **ONE** drawback compared with sending human astronauts to the moon. [4]

   (c) Is there any effect on employment by using robotic machinery in the manufacturing process? [1]

   (d) Give **ONE** situation where an expert system might be used for the above. [1]

   (e) Give **THREE** constituent parts of an expert system. [3]

   (f) The use of expect systems was claimed that they are much more useful than a very large database. Give **TWO** reasons to justify this claim. [2]

3. A variable name in a certain high level language is defined in BNF as:

<VARIABLE NAME>::=<LETTERS> | <LETTERS><DIGIT>
<LETTERS>::=<LETTER>|<LETTER><LETTERS>
<LETTER>::=A|B|C|D|E|F|G|H|I|J|K|L|M|N|O|P|Q|R|S|T|U|V|W|X|Y|Z
<DIGIT>::=0|1|2|3|4|5|6|7|8|9

(a) Which of the following will not be accepted as a variable name? Give your reasons for each rejection.

(i) a7
(ii) A
(iii) AA7
(iv) AB17
(v) 7A

(b) Rewrite the BNF rules so that all the identifiers in (a) will be accepted. However, when rewriting the rules you should also ensure that it is not possible to have a leading 0 in the digits – your rules should not allow A01 or A00027 [7]

4. A vending machine dispenses chocolate bars. It contains 5 different types of bar which are priced at either 20c, 30c, or 50c (where c stands for one unit of money). The machine will accept 10c and 20c coins. There are 5 buttons on the front of the machine next to pictures of the 5 bars.

To purchase a bar of chocolate, customers:

- Press the button corresponding to the bar required.
- The machine will then check how many of the bar remain and flash a message if there are no more of that bar.
- If there are bars available then the machine will indicate how much needs to be paid
- And as coins are inserted, this amount will be correspondingly decreased.
- When enough money has been input, the machine delivers the bar and any change and resets itself.

(a) A 2-dimensional array BAR is used to store the necessary information about the bars. What information is stored and how will it be stored? [3]

(b) Using pseudocode, write an algorithm which will control the vending machine. [8]

(c) It was decided to include a cancel button which will refund any money input if customers change their minds. Indicate how and where this would be incorporated into your algorithm. [4]

5. All's Well Hospital is in the process of computerizing its clinic processes. At the clinic, there are various doctors specializing in different areas e.g. neuroscience specialists, gynaecologists, etc. All patients of the clinic must be registered in the patient database and make prior appointments to see the relevant doctors. No walk-in patients will be entertained. Appointments are made based on the doctor's weekly schedule i.e. different doctors have clinic sessions at different day/time of the week.

On the day of appointment, patients are to register at the counter before proceeding to the doctor's room. Upon seeing the doctor, the doctor will input the diagnosis into the system. After the doctor's consultation, the patient is to proceed to make payment. Upon payment, a prescription slip, reference letter, medicate certificate, will be printed as necessary for the patient. In addition, the next appointment may be scheduled, if necessary.

(a) Make a list of all the essential data items the system will need to store and show clearly how this data could be structured. [9]

(b) Use a diagram to show the data flows, processes, data stores and external links in the system. [9]

6. (a) Digital computers cannot generate truly random numbers. Why not ? [2]

(b) Given that a library function *random( )* which returns a pseudo-random real number between 0 (inclusive) and 1 (exclusive) is available, write a function *rnd(n, m)* which returns a randomly generated integer between n and m. both inclusive, where n and m are integer parameters passed by value to the function. [2]

(c) A game which uses a coin is played between two players, P (the player) and R (the receiver), as follows. The coin is tossed. If it is a head, P pays R one penny and the game is over. Otherwise, it is a tail, and the coin is tossed a second time. If it is a head this time, P pays R two pence and the game is over. But if it is another tail, the coin is tossed a third time. If it is now a head, P pays R four pence and the game is over. If it is still a tail, the coin is tossed again. This continues, doubling the payment each time a tail is tossed, until a head is tossed, at which point P pays R and the game is over.

(i) Describe in detail an algorithm, or write a program in a programming language of your choice, which will simulate the playing of this game 1000 times and will print the mean payment made by P to R.
(You may assume the existence of a suitable pseudo-random number generating function, but you must provide a specification of what it produces.) [6]

(ii) A table is required to show in addition how many of the 1000 games ended in a payment of one penny, of two pence, of four pence, and so on. Describe how your algorithm would need to be changed to produce this. [5]

7. An Abstract Data Type (ADT) contains of both data type and associated operations.

A binary search tree (also called ordered binary tree) ADT has the following operations defined:

(i) Create(x) -- creates an empty binary search tree x;

(ii) Insert(x, item) -- inserts new value, item, into the binary search tree x;

(iii) Delete(x, item) -- deletes the value, item, from the binary search tree x;

(iv) Search(x, item) -- returns true if the value, item, is in the binary search tree x, otherwise returns false;

(v) Count(x) -- returns the number of nodes in the binary search tree x;

(vi) IsEmptyTree(x) -- returns true if the binary search tree x is empty.

(vii) SortedDisplay(x) -- displays values stored in the binary search tree x in sorted order;

The binary search tree is implemented by the use of a collection of nodes that have three parts: the item data and two pointers; the left pointer points to the root node of the left subtree; the right pointer points to the root node of the right subtree. In addition there is a Root pointer which points to the root node of the binary search tree.

(a) (i) Given the following sequence of values, explain how these values should be inserted into the binary search tree and draw the diagram of the final generated binary search tree.

60, 50, 30, 70, 80, 35, 57, 75, 32, 40 [4]

(ii) Write an algorithm that could be used to implement the 'Insert' operation. [4]

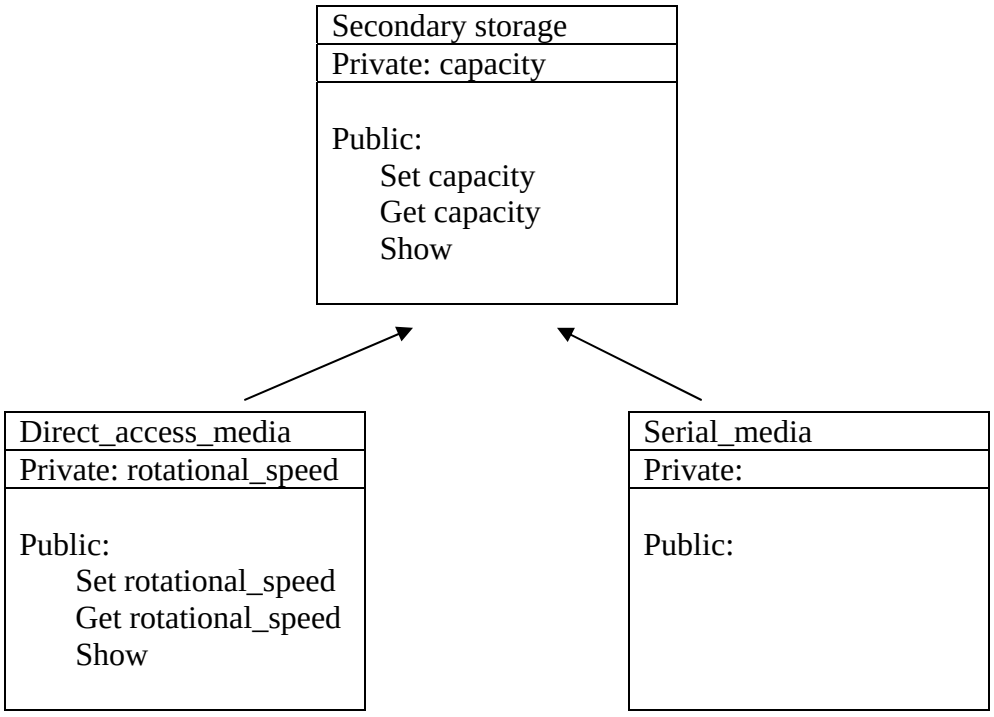
(b) Write recursive algorithms to implement

(i) the 'Search' operation;

(ii) the ‘SortedDisplay’ operation. [8]

(c) Draw the two possible binary search tree diagrams after the value, 60, is deleted from the tree. [2]

8. The following figure shows three classes and some of their private attributes and public methods.



(a) Use this example to explain the following terms:

(i) encapsulation
(ii) inheritance
(iii) polymorphism [6]

(b) Give an appropriate attribute for the class 'Serial_media'. [1]

(c) A software developer uses the above classes in a program. There is a need for another class: compact_disk.

Describe where this new class should be placed on the diagram and give a reason for this position. [2]

(d) Explain the purpose of a public method. [2]

(e) (i) Explain the meaning of the term reusability.

(ii) Explain the benefits of reusability when developing software. [6]

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