Name:		Index Number:		Class:	

DUNMAN HIGH SCHOOL
Preliminary Examination
Year 6

COMPUTING

9754

Paper Number 1

15 September 2011

Time: 0930 – 1230

Duration: 3 hours

Additional Materials:
Answer papers

INSTRUCTIONS TO CANDIDATES

Write your Center number, index number 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, tables or rough working.

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

Answer all questions. Total marks is 120.

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.

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1 (a) Explain the function of the following sub-systems inside a typical microprocessor:

(i) control unit

(ii) instruction register

(iii) memory data register

(iv) memory address register

(v) internal bus

[5]

(b) By showing the stages and register contents in the execution of a branch instruction, describe the machine instruction (fetch-execute) cycle. [6]

(c) Describe how this cycle has to be altered to allow for an interrupt. [2]

2. State with reason the type of operating system suitable for the following applications:

(a) end of year processing of school examination results

(b) students accessing the school learning management system from school and from home

(c) student listening to background music while surfing the Internet

(d) IT Club members splitting a large video file for parallel rendering on multiple machines in the computer laboratory

(e) Physical Education teacher recording fitness test data using a laptop on the track with no network coverage

[10]

3. The following is a recursively defined function which calculates the nth Fibonacci number for all positive integers.

```
Fibonacci(n)
    if 0 < n < 3
        Fibonacci = 1
    else
        Fibonacci = Fibonacci(n-1) + Fibonacci(n-2)
```

(a) Explain what is meant by recursively defined? [1]

(b) Trace the execution of this function for n = 4 showing carefully, for each re-entry into the function, the value passed to the function and the results returned. [4]

(c) Why should this function not be used when n = 0? [1]

(d) (i) Provide the specification for the abstract data type (ADT) stack. [3]

(ii) Carefully explain the role of the stack in the execution of the Fibonacci function. [2]

(e) What is iteration and how does it differs from recursion? [2]

(f) Produce an algorithm for an iterative Fibonacci function. [3]

(g) (i) Give one reason why an iterative Fibonacci function may be preferred to a recursive one. [1]

(ii) Give one reason why a recursive Fibonacci function may be preferred to an iterative one. [1]

4. The following names are placed on a binary search tree structure:

Candice Samantha Patrick Peter Bernard Vanessa Albert Bernice

(a) Draw the alphabetically ordered binary search tree after all the items have been inserted. [3]

(b) Write down the output if the tree is traversed using:

(i) Preorder [1]

(ii) Inorder [1]

(iii) Postorder [1]

A binary search tree Abstract Data Type (ADT) is to be implemented using a one-dimensional array.

(c) Show how the above binary search tree would be implemented using this array. [4]

(d) Provide the algorithm for the Search operation using this implementation. [4]

(e) Give **one** disadvantage of implementing a binary search tree using a one-dimensional array. [1]

5. A programmer develops an online purchase system for a company using top-down design strategy. To bill a customer, the system has to make several function calls and require the use of many global and local variables.

(a) (i) Explain what is meant by top-down design. [2]

(ii) Describe **two** advantages of using top-down design. [2]

(b) State **three** advantages of using functions in system development. [3]

(c) **(i)** Distinguish between a global and a local variable. [2]

(ii) Why is the use of global variables discouraged? [1]

(iii) How can the problems associated with global variables be overcome? [1]

This online purchase system went through several testing phases which include alpha testing and white box testing.

(d) Explain what is meant by

(i) alpha testing [2]

(ii) white box testing [2]

6. An audiologist designs hearing aids to patients with hearing impairment. Each hearing aid is tagged with a unique code generated with the following rules:

- A capital letter identifies the brand
- A single digit number indicates the style and ranges from 1 to 6
- Three or more lowercase letters denote the country of manufacture

For example, P1den identifies a Phonak brand with behind the ear style manufactured in Denmark.

(a) Using Backus-Naur (BNF), define <hearing aid code>. [3]

(b) Draw the syntax diagram for <hearing aid code>. [3]

The customer id is to be engraved onto the hearing aid after customization. One way is to append the customer id to the hearing aid code. A customer id comprises up to four digits followed by two alphabets (which denote citizenship code) in that order.

(c) Define <customer hearing aid> using BNF. [3]

7. A library issues membership identification numbers to its members. Each membership identification number is a unique six-digit number followed by a seventh digit which serves as a check digit. Access to the library's online website is by entering this number to verify with its membership database. A member also needs to key in a password associated with his/her membership identification number.

(a) Using suitable examples, explain the concepts of validation and verification. [4]

(b) Using modulus-11, explain how the check digit can be used to validate the membership identification number. [3]

(c) Name **two** types of errors reduced by the check digit? Give examples to illustrate your answer. [4]

(d) Give **one** possible error which may not be detected by the check digit. [1]

Members may reserve books using an online reservation facility. The transmission of the membership identification number and the password via the Internet is prone to being tapped for other unauthorized purposes.

(e) Suggest a method of ensuring

(i) that data transmission is kept confidential. [2]

(ii) that a reservation is made by a genuine member. [2]

8. A healthcare service provider received a significant increase in its number of patients, leading to an increase in the retrieval times of patients' records. The suggestion of a random file organization is proposed. It is organized into 500 blocks. Each block can hold up to 20 fixed length records. The block in which a record is stored is obtained by means of a key transformation (hashing) algorithm on the record key to produce an address in the range 0 to 499. The patient key is a system generated sequence with the first character H, followed by 5 digits.

(a) Explain what is meant by a key transformation (hashing) algorithm and give an example of such an algorithm. [3]

A record is inserted to the file by finding its block address and then doing a linear search within that block to find a free space to insert the record. If this block is full, the next block is tested and so on, until a free space is found, into which the record is written. If block 499 is full, the search is continued in block 0.

(b) Assuming h is a hashing algorithm that produces the block address, h(KEY), for the record whose key is KEY, and that the file never becomes full, write an algorithm to insert a record into the file. [4]

(c) How can the deletion of a record be done without re-organising the file? [1]

A patient consultation schedule is to be produced for all consultants. This schedule is ordered by alphabetical order of consultants' names, and then by chronological order of their patients' surgeries.

A linked list data structure is used to manage this consultation schedule.

(d) What are the components of a linked list? Draw a diagram to illustrate your answer. [2]

(e) A linked list is dynamic. Explain what dynamic means and why it is appropriate for this application. [2]

For a surgery booking to be made, a patient is assigned to a particular consultant with the date and time of the operation. This new surgery booking is then inserted into the linked list.

(f) Draw the data structure of this linked list with the consultants and their list of patients. [3]

(g) Produce an algorithm to insert a new patient surgery booking record into this linked list. [5]

Over time the healthcare service provider needs to solve the problem of an increasing number of inactive patients. The other concern is the recovery of the computer system from failure/destruction or data corruption.

Suggest what can be done to manage

(h) the increasing number of inactive patients [2]

(i) the recovery of the computer system [2]