Class _____   Name _____

HWA CHONG INSTITUTION
C2 PRELIMINARY EXAMINATION 2020

COMPUTING
Higher 2
18 Sep 2020   **Paper 1 (9569 / 01)**   **1300 -- 1600 hrs**

READ THESE INSTRUCTIONS FIRST

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, glue or correction fluid.

Answer **all** questions.

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 document consists of **6** printed pages.

1   (i)   Describe **two** characteristics of client-server network.   [2]

     (ii)   Give **one** advantage and **one** disadvantage of client-server network compared to peer-to-peer network.   [2]

     (iii) Briefly explain how Domain Name Server (DNS) works.   [2]

     (iv)   Describe the DHCP server's process to allocate an IP address to a client.   [4]

2   Computing technology was adopted worldwide during the recent pandemic.

     (i)   Describe **one** positive and **one** negative impact you have observed.   [2]

     (ii)   The national task force sets a code of conduct for all computing professionals working on contact tracing, data analysis, etc. Describe **two** rules that you would expect to be included. For each of your rules, give an example of the unethical behaviour it is designed to prevent.   [4]

3   (a)   Using real-life examples, explain the terms data validation and data verification.   [4]

     (b)   Describe how data is transmitted in a packet switching network, and give **two** advantages of packet switching over circuit switching network.   [4]

     (c)   Explain the purpose of layering in TCP/IP model. List the layers in order and describe each layer's major function.   [6]

4   (a)   The ASCII code in denary for the character '1' is 49.

            (i)   Using 7 bits, express the ASCII code for the character '4' in binary.[1]
            (ii)   Express the character '4' as a hexadecimal number.   [1]

     (b)   Convert 4B1 hexadecimal number to a binary number stored as two bytes.   [2]

     (c)   In a restaurant, every membership account number is made up of five digits followed by a letter e.g. 36514C where the letter is a modulus-eleven check digit for the account number. Each digit is weighted, with the first digit having a weight of 7 and each subsequent digit decreases its weight by 1. Valid check digits are in the range of letter C to letter M, with C corresponding to the value of 1, D corresponds to 2 and so on.

            (i)   What is the purpose of including a check digit at the end of each membership account number?   [1]
            (ii)   Write, in **pseudocode**, an algorithm which checks whether a membership account number is valid.   [4]
            (iii) Using your algorithm, determine whether a person with the account number 47938K is a member of the restaurant. Explain your answer.   [1]

5   (a)   Run-length encoding is a simple data compression technique that can be effective when repeated values occur at adjacent positions within a string. Compression is achieved by replacing groups of repeated values with one copy of the value, followed by the number of times the value should be repeated. For example, "AAAAABBBAAAB" would be compressed as "A5B3A3B1".

Write, in **pseudocode**, a function that implements the run-length compression technique described above. The function will take a string argument and return the run-length compressed string.   [6]

     (b)   Using **pseudo-code**, write a detailed algorithm for a function which will take two string values, called P and Q, and will search the string value P for the first occurrence of the string value Q within it. The value returned is the start position of the first occurrence of Q in P, or zero if there is no occurrence. Assume the string index starts at 1. For example, if P is 'bananas' and Q is 'na' then the function would give the result 3, because 'na' first occurs in 'bananas' starting at character position three.   [6]

6   (a)   State **two** key characteristics of a recursive function, and when is it suitable to be used.   [3]

     (b)   The procedure `MoveTower(n, i, j)` shown below simulates the movement of moving n discs from peg i to peg j.

```
PROCEDURE MoveTower(n, i, j)

    IF n = 1
        OUTPUT ("Move disc from peg", i, "to peg", j)
    ELSE
        MoveTower(n-1, i, 6-i-j)
        OUTPUT ("Move disc from peg", i, "to peg", j)
        MoveTower(n-1, 6-i-j, j)
    ENDIF

ENDPROCEDURE
```

       (i)   Dry-run the procedure and show the output that is produced when the task is to move 3 discs from peg 1 to peg 3.   [3]

       (ii)   Assuming a stack is used for passing parameters to the procedure, show also the contents of the stack, excluding the return address, after each of the first **five** procedure calls.   [3]

     (c)   If a procedure is to be able to call itself recursively, it is usual for the values of any variables used in the procedure to be held in a stack rather than in fixed storage. Why is this?   [1]

7   A linked list ADT has the following operations defined:

      (i)   `Create(x)` -- creates an empty linked list x;

      (ii)   `Insert(x, item, p)` -- inserts new value, *item*, into linked list x so that it is at position p in the linked list;

      (iii)   `Delete(x, p)` -- deletes the item at position p in the linked list x;

      (iv)   `Read(x, p)` -- returns the item at position p in the linked list x;

      (v)   `Length(x)` -- returns the number of items in the linked list x;

      (vi)   `IsEmptyList(x)` -- returns True if linked list x is empty, otherwise returns False;

      (vii)   `Clear(x)` – empties the linked list x;

The linked list is implemented by the use of a collection of nodes that have two parts: the item data and a pointer to the next item in the list. In addition, there is a *Start* pointer which points to the first item in the list.

(a)   Write algorithms that could be used to implement the 'Delete' and 'Insert' operation.   [8]

A stack ADT has the following operations:

      (i)   `Create()` - creates a new stack;

      (ii)   `Push(item)` - adds *item* onto the stack;

      (iii)   `Pop()` - deletes and returns item from the stack;

      (iv)   `IsEmpty()` – if the stack is empty returns True, otherwise False;

      (v)   `Clear()` – removes all items in the stack;

(b)   Show how to implement 'Create', 'Push' and 'Pop' operation using the list ADT operations.   [4]

The stack implementation above is used to implement the undo/redo mechanism of a text editor. An Undo stack is used to keep the edit history of the editor and the Redo stack is used to keep the history of the undo operations. The content of the text editor is stored as a string in the Undo stack and Redo stack.

When an undo is invoked, the Undo stack is popped and the content is pushed into the Redo Stack. When a redo is invoked, the Redo stack is popped and the content is pushed into the Undo Stack.

(c)   Using the stack ADT operations, show how to implement the following functions which return the contents. Assume that `undoStack` and `redoStack` are created.

      (i)   `FUNCTION Undo() RETURNS STRING`

      (ii)   `FUNCTION Redo() RETURNS STRING`   [3]

8   S-Cut offers haircut service at a price based on age group at 60 outlets located around Singapore. S-Cut has engaged you to develop an application that runs on kiosk stationed at their outlets. The application uses a relational database to store the data.

Customers need to register as a regular member with their name, contact number and price. They can purchase a haircut service using the kiosks provided. The service record should contain date of service, member information and the outlet information.

Based on the requirements given above, design the database that consists of 3 tables: Member, Outlet and ServiceRecord.

(a)   (i)   Draw the Entity-Relationship (E-R) diagram to show the tables in third normal form (3NF) and their relationships between them.   [3]

(ii)   A table description can be expressed as:

```
TableName( Attribute1, Attribute2, Attribute3, …)
```

The primary key is indicated by underlining one or more attributes. Foreign keys are indicated by using a dashed underline.

Using the information given, write table descriptions for the tables you have identified in part **(a)(i)**.   [5]

(b)   To attract more customers, some outlets offer 20% discount on Saturday and Sunday. Write the table description with the changes to the database to capture the change in price per haircut on Saturday and Sunday.   [1]

(c)   S-Cut offers platinum membership which entice members to additional benefits. Platinum member needs to credit $100 to their account which entitles them to 12 sessions of haircut services, in addition they will receive a birthday gift on their birthday month. To ensure greater productivity in development of the membership system, object oriented design is used.

(i)   Draw a class diagram for member class(es) which exhibit the following:
- Suitable classes with appropriate properties and methods
- Inheritance
- Polymorphism   [6]

(ii)   Explain the term **encapsulation** and how it is applied in your design in **(c)(i)**.   [2]

(iii)   Explain the term **polymorphism** and how it is applied in your design in **(c)(i)**.   [2]

(d)   An alternative way to develop an application that runs on the kiosk would be a web-based application. State **two** differences between a native application and a web-based application. [2]

(e)   S-Cut collects data from the customer, describe **two** data protection obligations on how S-Cut must comply with the Personal Data Protection Act (PDPA). [2]