YISHUN INNOVA JUNIOR COLLEGE
JC 2 PRELIMINARY EXAM
Higher 2

CANDIDATE NAME			
CG		INDEX NO	

COMPUTING **9569/01**

Paper 1 Written **15 Sep 2020**

3 hours

Additional Materials: Nil

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class clearly on the cover page.

Write in dark blue or black pen on the writing paper provided.
You may use an HB pencil for any diagrams, graphs, tables or rough working.

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

Answer **all** questions.
Approved calculators are allowed.

The number of marks is given in brackets [ ] at the end of each question or part question.
The total number of marks for this paper is **100**

1 A list of data items is stored in a hash table using an array `Values`. The following pseudocode describes an algorithm for searching the table using the hashing function `Hash`.

```
01    Index <- Hash(Key)
02    WHILE Values[Index] <> Key
03          Index <- Index + 1
04    ENDWHILE
05    Return Values[Index]
```

(a) Explain the situations when "`Values[Index] <> Key`" in line `02` will be True. [2]

(b) Describe the two problems with this algorithm. [2]

(c) Without writing any program code, describe the modifications required to overcome each of the problems stated in **(b)**. [4]

2 An array `seq` contains a list of sorted data items except the last element. `[1,2,5,8,9,6]` is an example of such an array.

The function `sortInner` takes two parameters, the array `seq` and the index position `j` of the last element, and returns the mutated array `seq`.

```
def sortInner(seq, j):
   if j == 0:
      return seq
   else:
      if seq[j] <= seq[j-1]:
         seq[j], seq[j-1] = seq[j-1], seq[j]
      return sortInner(seq, j-1)
```

(a) State what is meant by a recursive function. [2]

(b) Describe what happens when the function `sortInner([1,2,5,8,9,6],5)` is executed. [2]

(c) Write a recursive function `insertionSort` for the Insertion Sort algorithm by using the given function `sortInner(seq,j)`. [2]

(d) Explain whether the Quick Sort algorithm in **(c)** is performing an "in-place" or "non in-place" sorting and whether it is stable or unstable. [4]

(e) State and explain the efficiencies of the Insertion Sort algorithm in **(c)** in the worst case scenario, using the Big-O notation for the time complexity. [2]

3 A wildlife information application is being developed to store and display information about birds. The application uses a binary search tree to store the name of the bird.

(a) The binary search tree has its data inserted in the following order.

```
Magpie
Cockatiel
Jay
Pigeon
Mynah
Crow
Albatross
Quail
```

Draw the binary search tree. [4]

(b) The binary search tree in part **(a)** can be implemented using object-oriented programming that involves the use of two pointers and an array.

(i) Describe the purpose of the two pointers in the implementation of the binary search tree class. [2]

(ii) Describe the purpose of the array in the implementation of the binary search tree class. [1]

(c) **(i)** List the nodes, in order, that are visited for an in-order traversal. [2]

(ii) State the property exhibited by the list of items produced in part **(c)(i).** [1]

(d) Describe an algorithm, using pseudocode, which uses a stack to perform an in-order traversal for the tree. [5]

[Turn over

4 *HoLi Tea* is a popular chain selling a wide variety of bubble tea. Each drink is categorised by the flavor (e.g. brown sugar, peppermint, lemon …), the type of tea leaves used (e.g. green tea, red tea, black tea …), the pearl options (e.g. black pearl, white pearl, or no pearl) and the price.

There are two variants of bubble tea: Milk Tea and Fruit Tea. Each milk tea has a specific type of milk used (e.g. fresh milk, condensed milk) and some milk tea come with pudding. Some fruit tea include cultured milk.

The owner of *HoLi Tea* intends to use object-oriented programming language to store and process the information on the types of drink in the self-ordering web application system.

The base class `BUBBLE_TEA` has a method to display the properties of the bubble tea.

(a) **(i)** Draw a UML class diagram showing: [6]

- any derived classes and inheritance from the base class
- the properties needed in the base, and any derived classes
- suitable methods to support the system with at least one getter and one setter method

(ii) Explain why inheritance is an important feature of object-oriented programming. [2]

(iii) Explain why polymorphism is useful in object-oriented programming. [2]

HoLi Tea has a loyalty programme to reward their regular customers. Members are entitled to a 20% discount for their purchases and a free drink on their birthday. To pay tribute to the frontline workers during the COVID-19 pandemic, all frontline workers are entitled to a 20% discount for their purchases, and those who are also members will receive a free drink on any day.

(b) **(i)** Create a decision table showing all the possible conditions and actions. [5]

(ii) Simplify your decision table by removing redundancies. [3]

5 YI restaurant serves a variety of local dishes at reasonable prices and plans to provide food delivery services to its customers via a web application. A customer places an online order and an employee will be assigned by the system to deliver the order to the customer. The customer can choose to pay online when ordering or make cash payment upon delivery. Customers can choose more than one dish in the same online order and each order has a unique ID.

At the time of ordering, the application records the following data:

- Customer name, delivery address and email, if the customer has not made a booking before
- Customer ID
- Order date
- Order time
- Payment mode
- Dish and quantity

The following shows an example of the order receipt which will be sent to the customer's email address.

ORDER RECEIPT

OrderID:	YI150920123
Customer ID:	C1234
Name:	Annabelle Dallas
Email:	annabelledallas@gmail.com
Address:	5 Yishun Ring Rd, Singapore 768675
Date:	15/09/2020
Time:	14:11:30
Payment Mode:	Online

Dish	**Quantity**	**Unit Price**	**Price**
NASI LEMAK SET	2	4.50	9.00
CURRY CHICKEN SET	1	5.00	5.00
CHICKEN RICE SET	1	4.50	4.50
		Subtotal:	18.50
		Delivery:	4.00
		Total:	22.50

[Turn over

The restaurant assigns a unique ID to each employee and maintains its employees' information, such as their name, contact number and bank account number. The restaurant keeps a record of the employees' delivery assignments, the date and time when the order is successfully delivered to the customer.

(a) The company wants to model this application using a relational database.

(i) The database needs three tables to store the data for the customers' food order: `CUSTOMER`, `ORDER` and `FOOD`.

Draw an Entity-Relationship (E-R) diagram showing the three tables and the relationships between them. [2]

(ii) The database needs three tables to store the data for the employees' delivery assignment: `EMPLOYEE`, `ORDER` and `ASSIGNMENT`.

Draw an Entity-Relationship (E-R) diagram showing the three tables and the relationships between them. [2]

(iii) Draw the overall Entity-Relationship (E-R) diagram showing the five tables and the relationships between them. [1]

(b) 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 using a dashed underline.

Write table descriptions for the five tables**.** [6]

(c) Describe a method to protect data from loss or corruption. [2]

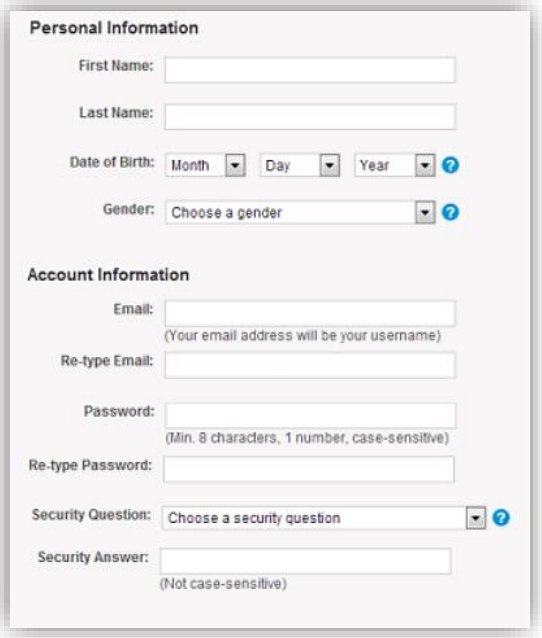
(d) Explain how Singapore's Personal Data Protection Act (PDPA) protects the customers' and employees' personal data stored in the database. [2]

(e) Describe the impact of such food delivery applications on the society and economy. [4]

(f) As there is an increase in demand for food delivery, the restaurant wishes to enhance the food delivery services to cater to the larger volume of orders and to include more features in the application such as real time location tracking of the food order and customers' review of the dishes, yet ensuring that the application maintains fast performance. The restaurant is now considering using a NoSQL DBMS instead of a relational database.

State and explain **two** reasons why NoSQL DBMS may be more suitable for the proposed scenario. [4]

6 A Web Developer is designing an online Sales portal for a company. The customer needs to submit an online form to register before ordering through the portal.



(a) Explain the difference between data validation and data verification. [2]

(b) Describe two validation checks that the above form should perform for the customer's inputs. [2]

(c) Describe, with a specific example, how the customer's inputs are being verified. [2]

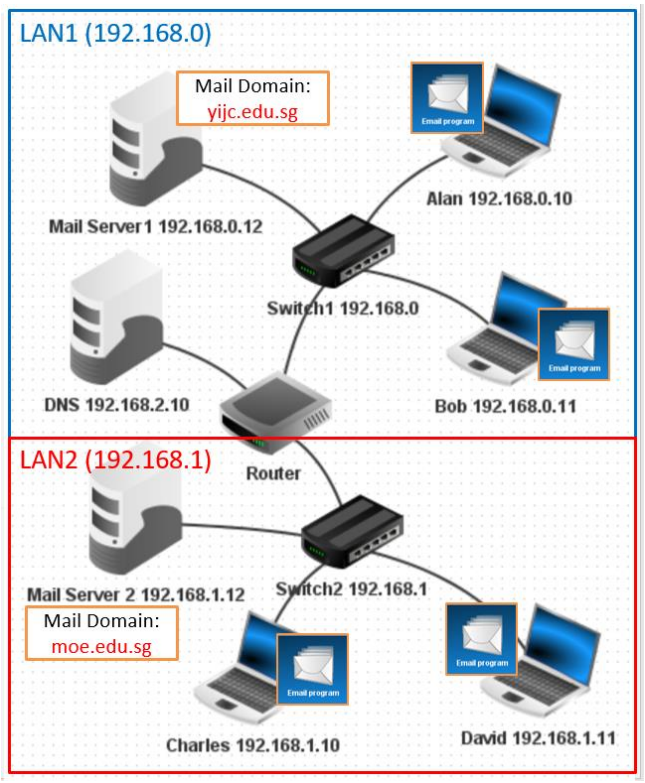
The web developer intends to use **CAPTCHA** for the above form

(d) Explain what this added feature helps to verify. [2]

(e) Describe the required server scripting to process the customer's input on his email address and password. [4]

(f) Describe the differences between a web application and a native application. Explain how the developer should decide between designing a web or a native application. [4]

7 The College's local area network (LAN) is connected to the MOEHQ's LAN over the internet.



A college's staff, Alan, sends an email to Charles who works in the MOEHQ.

(a) With reference to the above network diagram,

(i) describe the function of the Domain Name System (DNS) server, [1]

(ii) explain how the router identifies that the MOE's Mail server is residing in another network, [1]

(iii) describe in detail how Alan's email is delivered and kept in the MOE's Mail server, [2]

(iv) describe how Charles eventually receive Alan's email. [2]

(b) Charles forwards Alan's email to his colleague, David. Describe how David could receive the email even when he is away from the office. [2]

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