YISHUN INNOVA JUNIOR COLLEGE
JC 2 PRELIMINARY EXAMINATION
Higher 2

CANDIDATE NAME	

CG		INDEX NO	

COMPUTING   **9569/01**

Paper 1 Written   **13 Sep 2022**

                                                3 hours

Additional Materials:
            Answer Sheet

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**

This document consists of **11** printed pages and **1** blank page.

1 A digital handheld device is used to scan vehicle numbers and the data will be sent to the server using a six-bit binary encoding method. The characters in the data, comprising numbers from `0` to `9` and letters `A` to `Z`, are represented by the binary numbers as shown in the following table:

Character	Denary Number	Binary Number
'0'	0	000000
'1'	1	000001
'2'	2	000010
'3'	3	000011
'4'	4	000100
'5'	5	000101
'6'	6	000110
'7'	7	000111
'8'	8	001000
'9'	9	001001
'A' to 'Z'	10 to 35	001010 to 100011

(a) State the number of other characters that can be represented besides `0` to `9` and `A` to `Z` using the six-bit binary encoding method. [1]

(b) Explain the benefit of using this six-bit binary encoding method to represent `0` to `9` and `A` to `Z`. [2]

(c) Express the number representing the letter 'X' as:

(i) a six-bit binary number [1]

(ii) a hexadecimal number [1]

2

A Media Access Control (MAC) address is a twelve-digit hexadecimal number assigned to each device connected to the network.

An example of a MAC address is as follows:

`3A-34-52-C4-69-B8`

(d) Give two reasons why hexadecimal numbers are used in computing. [2]

(e) Convert the above MAC address to:

    (i) a 48-bit binary number [2]

    (ii) an octal number [2]

2 A large online store has a team of Customer Service Officers (CSO) to assist customers regarding their online purchases over the phone. When a customer calls, the CSO can use the phone number appearing on a Caller-ID device to retrieve the customer's details from the store's database.

Since the customer's registered phone number is unique, it can be used as a primary key to retrieve the customer's data.

The programmer can either use a sorted array or a hash table to store and retrieve customers' data.

(a) Describe the process of storing customers' data in an array and performing a binary search to retrieve a customer's data using the registered phone number.

[4]

(b) **(i)** Give **one** disadvantage of using an array to store customers' data sorted by the phone numbers. [1]

(ii) Give **two** advantages of using a hash table to store customers' data. [2]

A hash table of size 10 is used to store the following customers' data according to the order in which the online purchases are made.

Order Number	Customer Name	Phone Number
62423	Aileen Goh	84621039
72525	Benjamin Teo	85269413
73536	Charlie Lee	96348217
74511	Damian Wong	84903216
83472	Elsa Ng	83209547
93642	Fatimah Siti	89321065
96262	Gerald Lim	82345917

4

The hash value for the phone number `84621039` can be found using the following algorithm:

```
hash('84621039') = (8 + 4 + 6 + 2 + 1 + 0 + 3 + 9) % 10
                 = 33 % 10
                 = 3
```

The hash value for the phone number will be used as the index position to store the customer's data in the hash table.

All collisions are resolved using the Linear Probing (Closed Hashing) technique.

(c) The customer's data for `Aileen Goh` has been inserted into the hash table for your reference.

Complete the following hash table in the Answer Sheet. [3]

Index	Hash Value	Customer's Data (Order Number, Name, Phone Number)
0		
1		
2		
3	3	62423, Aileen Goh, 84621039
4		
5		
6		
7		
8		
9		

(d) The programmer uses a searching algorithm to retrieve customers' data from the hash table completed in **part (c)**. It prints the customer's data if found; Otherwise, it prints 'Customer data not found'.

Explain the process in which the algorithm searches for the following phone numbers:

(i) 89321065 [1]

(ii) 87951032 [1]

(iii) 90381485 [1]

5

3 An airline sells both Business Class and Economy Class tickets. The customers buying the tickets are either members or non-members of the airline. All members are eligible for a 10% discount. Members will be given **an additional** 10% discount for the off-peak Business Class tickets. Non-members will only receive 10% discount for the off-peak Business Class tickets.

(a) Create a decision table showing all the possible conditions and actions. [4]

(b) Simplify your decision table by removing redundancies. [4]

(c) With reference to your answer in **part (b)**, write a function using pseudocode. The function will prompt the customer to indicate the membership, the type of flight ticket and the travelling period (Peak or Off-Peak).

Use the following variable names in your pseudocode:

Name	Use
Membership	`True` for member; Otherwise, `False`.
Ticket_Type	"`Economy`" or "`Business`"
Period	"`Peak`" or "`Off-Peak`"

The function should print one of the following outputs:
- "20% discount"
- "10% discount"
- "No discount" [5]

The members are issued membership cards with unique seven-digit membership numbers. The last digit is a check digit generated using the Luhn algorithm. The validity of a membership number can be checked with the following steps :
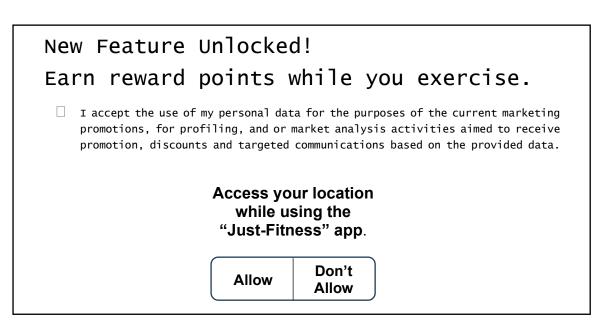
1. Starting with the first digit from the left, double the value for each digit in the even positions (2nd, 4th and 6th):
   a. if the doubled value is smaller than 10, do not change the doubled value; Otherwise, deduct 9 from it
   b. sum all the doubled values
2. Sum all the values of the digits in the odd positions (1st, 3rd, 5th and 7th)
3. Find the total by adding the values obtained in steps 1b and 2
4. The membership number is valid if the total is divisible by 10; Otherwise, it is invalid.

(d) Determine if the following two membership numbers are valid:
- 2316214
- 2543543 [6]

(e) The use of check digits is one of the validation techniques.

(i) State the purpose of validation. [1]

(ii) State **two** types of error that a check digit usually detects. Explain by demonstrating how the Luhn algorithm is used for each type of error. [4]

(f) **(i)** State the purpose of verification. [1]

(ii) State two methods of verification. [2]

[Turn over

4   A fitness company *Just-Fitness* provides a phone application ("app") for customers to book their training sessions and enter the gym.

The company recently updated its app to reward customers who jog actively. The app will access the phone's location and time to compute the speed and distance covered during the jogging session. Reward points will be awarded if the speed is above a certain minimum requirement.

The reward points earned can be used to pay for the membership fee or other merchandise in the gym.

After updating the app, the customers will receive the following notification each time they want to use the app:

```
New Feature Unlocked!
Earn reward points while you exercise.
```
☐   I accept the use of my personal data for the purposes of the current marketing
    promotions, for profiling, and or market analysis activities aimed to receive
    promotion, discounts and targeted communications based on the provided data.

**Access your location
while using the
"Just-Fitness" app**.

| Allow | Don't Allow |

If a customer does not allow the phone location to be accessed, the app will not be loaded.

(a)   Give two reasons why the above notification is required under the Personal Data Protection Act (PDPA).   [4]

(b)   Describe one positive social impact made with this updated feature in the app.
                                                                                      [2]

(c) Describe one ethical issue associated with the installation of the new update in the app. [2]

(d) Give a suggestion regarding the installation of the updated app to address the concerns arising from the ethical issue described in **part (c)**. [2]

The programmer implemented the speed module in the updated app using Object-Oriented Programming (OOP). In his program code, he defined the base *class* and sub-classes with methods to gather and process the data of the *objects*.

(e) State an OOP concept and explain how it can help to reduce software development time. [3]

(f) Explain the difference between a '*class*' and an '*object*'. [2]

(g) Explain the meaning of the term '*encapsulation*'. [2]

(h) Explain the meaning of the term '*polymorphism*'. [2]

A project team at another company selling Personal Mobility Devices (PMD) saw the potential in *Just-Fitness*'s updated app. They adapted the feature for their PMD app to compute the speed using the phone's location and time.

(i) State a legal issue involved and suggest the correct approach to take to avoid the legal issue. [2]

[Turn over

5   A website allows customers to book rooms in a resort at least one day before the start of a staycation. Customers pay a 30% deposit at the time of booking and the balance when they check in at the resort.

At the time of booking, the customer is required to submit the following data through the website:

- Customer data, including the passport number
- Booking date
- Staycation start date
- Staycation end date
- Type of room

The room types and cost are as follows:

- Standard Room (SR) - $150 per day
- Deluxe Room (DR) - $200 per day
- Family Suite (FS) - $280 per day

A customer may make more than one booking. A sequential booking number will be auto generated when the customer pays the deposit to confirm the booking.

An example of the document generated for the customer to check in at the resort:

BOOKING RECEIPT

Name: Mr John Tan (Passport No.: SIN253486K)

Email: johntan@gmail.com

Booking No.:   2023-007563

Booking Date: 14/09/2023

Room Type: DR

Start Date	End Date	Days Charged	Rate	
23/12/2023	26/12/2023	3	$200	$600.00
			Deposit Paid:	$180.00
			Amount Due:	$420.00

(a) The resort models this web application using a relational database.

(i) The database needs a few tables to store the data for this application. Draw the Entity-Relationship (E-R) diagram showing the tables and the relationships between them. [6]

(ii) A table description can be expressed as:

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

The primary key is indicated by underlining one or more attributes.

Write table descriptions for the tables you identified in **part (i)**. [6]

(b) The room rates fluctuate according to the low and high peak seasons. Describe how you would modify tables in **part (a)** to ensure that the correct rates are recorded in the database. [2]

(c) Explain by giving two reasons why the resort should use a relational database instead of a NoSQL database. [2]

Customers are required to submit their *personal data* like name, passport number and email address when they do a booking.

(d) Define the term "*personal data*". [2]

(e) Describe how the website protects the personal data when they are transmitted from a customer's web browser to the server. [2]

(f) Describe **two methods** to prevent unauthorised access to the customers' personal data stored in the database. [2]

(g) Describe **two methods** to prevent remote access to the customers' data. [4]

(h) State a possible threat of losing the customers' data and suggest a method to prevent it. [2]

11

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Hash Table for Question 2 (c):

index	Hash Value	Customer's Data (Order No., Name, Phone No.)
0		
1		
2		
3	3	62423, Aileen Goh, 84621039
4		
5		
6		
7		
8		
9		

[Turn over