

ANGLO-CHINESE JUNIOR COLLEGE  
JC2 PRELIMINARY EXAMINATION

Higher 2

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## COMPUTING

9569/01

Paper 1 Written

31 August 2021

3 hours

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### READ THESE INSTRUCTIONS FIRST

An answer booklet will be provided with the question paper. You should follow the instructions on the front cover of the answer booklet. If you need additional answer paper ask the invigilator for a continuation booklet.

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.

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This document consists of **10** printed pages.



Anglo-Chinese Junior College

[Turn Over

- 1 A famous restaurant only accommodates one seating daily from 6.00 pm to 8.00 pm. It has 10 tables, each with a maximum capacity between 2 and 8 people. Advanced reservation is required to dine in at the restaurant.

The owner of the restaurant decides to write a program to handle reservations. As a trial, it can only take a booking for one evening only.

A procedure to initialise the arrays `TableSeats`, `IsBooked` and `GroupSize` has been defined. The indexes of each array corresponds to the table number.

Index	MaxSize	IsBooked	GroupSize
1	2	1 FALSE	1
2	2	2 FALSE	2
3	4	3 FALSE	3
4	4	4 FALSE	4
5	4	5 FALSE	5
6	6	6 FALSE	6
7	6	7 FALSE	7
8	6	8 FALSE	8
9	8	9 FALSE	9
10	8	10 FALSE	10

The procedure `BookTable` is shown below. When a booking enquiry is made, the number of customers is keyed in.

```

01  PROCEDURE BookTable
02      DECLARE NumberOfCustomers, TableNumber : INTEGERS
03      DECLARE Found : BOOLEAN
04      INPUT NumberOfCustomers

05      TableNumber ← 0
06      FOUND ← False
07      REPEAT
08          TableNumber ← TableNumber + 1
09          IF MaxSize[X] > NumberOfCustomers AND IsBooked[X] = FALSE
10              THEN TableNumber TableNumber
11              Found ← TRUE
12          ENDIF
13      UNTIL Found = TRUE AND TableNumber = 11

14      IF Found = FALSE
15          THEN
16              OUTPUT "No tables with enough seats available."
17          ELSE
18              GroupSize[TableNumber] ← NumberOfCustomers
19              OUTPUT "Booking is successful! Table no:", TableNumber
20          ENDIF
21  ENDPROCEDURE

```

- (a) There are two errors and one missing line of code in the procedure above.
- (i) Name the type of the errors. [1]
  - (ii) Describe the errors and the changes required to correct them. [3]
  - (iii) Write the missing line of code and state where it should be located. [2]
- (b) Once the procedure `BookTable` is able to run correctly, the owner decides to improve its functionality.

The procedure should ask the user to input the name and the mobile number of the person making the reservation when a table with enough seats can be found.

Name and describe two data validation techniques that can be applied to any of the inputs mentioned above. [2]

- (c) Explain the difference in the type of memory allocation for an array and a linked list. [2]

2 A hash table has 8 spaces to store strings, indexed from 1 to 8 inclusive.

The hash function finds the ASCII number of the first letter of the string, then counts the number of 1s in its binary representation. This is the index in which the string will be inserted into the hash table.

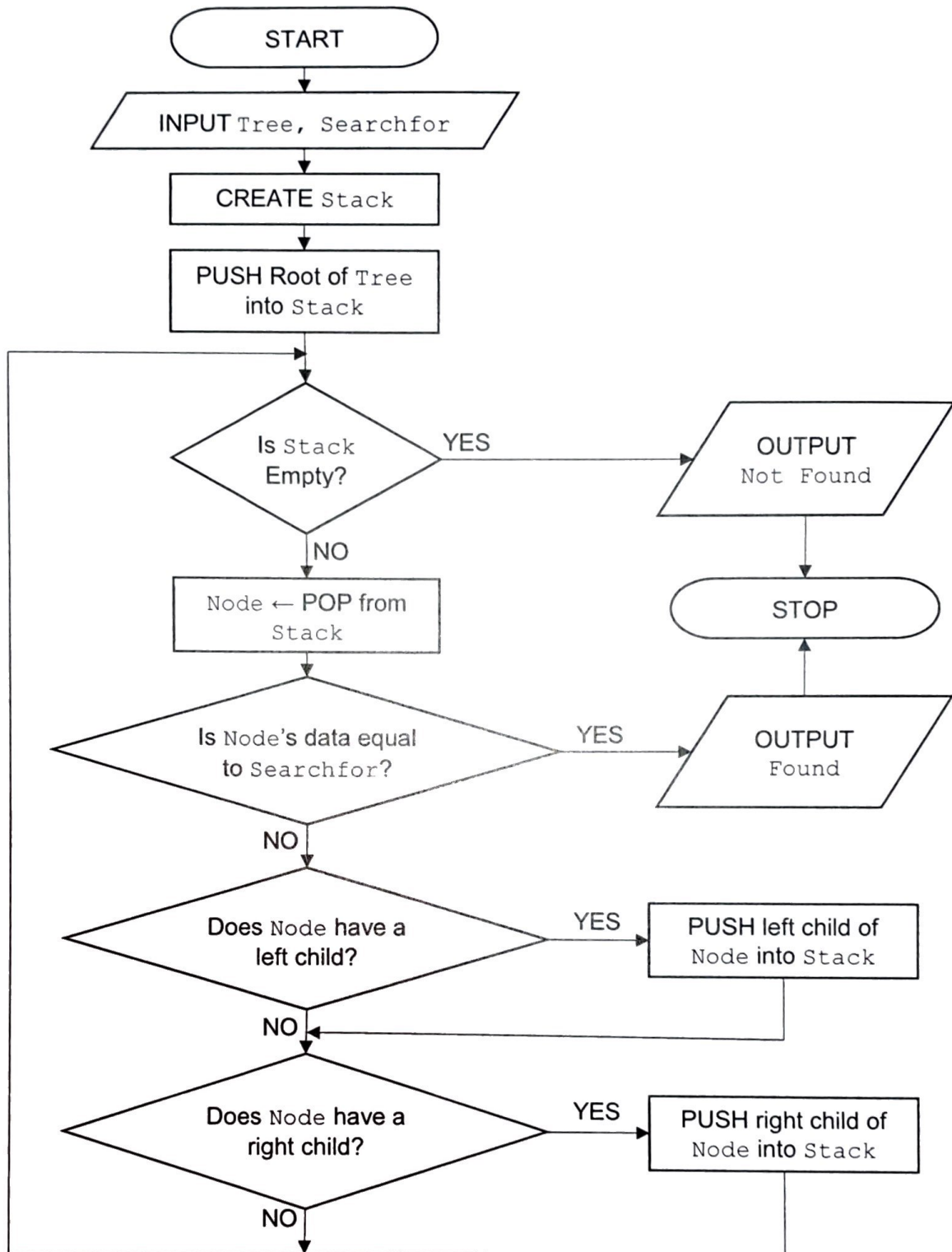
For example, the string 'Arlington' will have index 2 because the ASCII number of 'A' is 65, which is 1000001 in binary, and there are two 1s.

The following strings are to be inserted into the hash table in the order given.

'Grover',  
'Horsburgh',  
'Island',  
'Jordan',  
'Kalman'

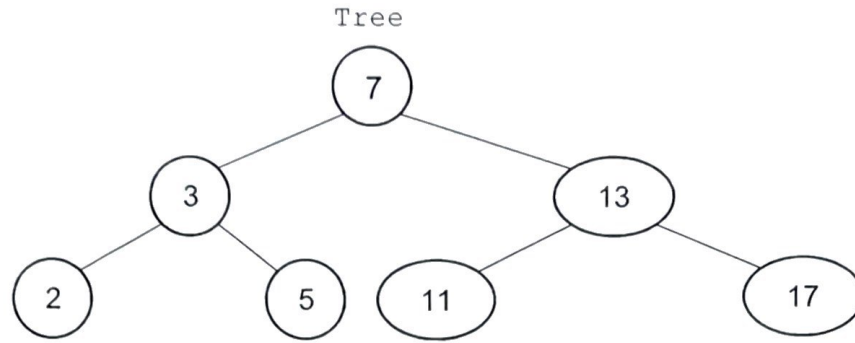
- (i) Find the output of the hash function for each of the strings. [5]
- (ii) (a) Suppose collisions in the hash table are to be resolved using open hashing.  
Draw the hash table after all five strings are inserted. [5]
- (b) Suppose instead that collisions in the hash table are to be resolved using closed hashing, where spaces 6 to 8 (inclusive) are used as the overflow storage.  
Draw the hash table after all five strings are inserted. [2]
- (iii) Explain why the space with index 1 in the hash table will never be occupied unless there is a collision. [2]

- 3 The diagram below shows a flowchart for performing a search through a binary tree. The algorithm searches through *Tree* for *Searchfor*. If it finds a node whose data is equal to *Searchfor*, it outputs *Found*. Otherwise, it outputs *Not Found*.



- (i) Given the input *Tree* below and a *Searchfor* value of 5, draw a trace table to illustrate the algorithm. [5]





- (ii) State whether this is a depth-first search or a breadth-first search. [1]
- (iii) Draw a flowchart to illustrate how the other kind of search in (ii) can be carried out using the same input parameters. [3]
- (iv) Given the same input `Tree` and the same `Searchfor` value of 5, draw a trace table to illustrate the algorithm in (iii). [5]

4 Merge sort and bubble sort are two sorting algorithms that can be applied to sort a list of integers in ascending order.

- (a) By briefly comparing the operation of merge sort and bubble sort, state which algorithm would be more efficient. [3]

The pseudocode for the recursive `MergeSortDesc` function is shown below, which takes in a list of integers and returns a new list with the integers sorted in descending order. It makes use of the `MergeDesc` function in line 10 that merges two lists of integers sorted in descending order into a single list of integers sorted in descending order as well.

```

01 FUNCTION MergeSortDesc(MyList: LIST) RETURNS LIST
02   MaxIndex ← LENGTH(MyList)
03   IF .....A.....
04     THEN
05       Half ← .....B.....
06       LeftList ← LEFT(MyList, Half)
07       RightList ← RIGHT(MyList, Half)
08       SortedLeftList ← MergeSortDesc(LeftList)
09       SortedRightList ← MergeSortDesc(RightList)
10       Result ← MergeDesc(SortedLeftList, SortedRightList)
11     ELSE
12       .....C.....
13   ENDIF
14   RETURN Result
15 ENDFUNCTION
  
```

- (b) State what is meant by a **recursive** function. [2]
- (c) Write the pseudocode for **A**, **B** and **C** in the algorithm. [3]
- (d) Describe the operation of the `MergeDesc` function. [4]

Assume that the function does not modify the two input lists.

- 5 A gym organises various classes and runs a loyalty membership programme with four tiers: Bronze, Silver, Gold and Diamond

Upon joining, each member is given a unique membership number and starts with a Bronze membership. Each member can sign up for multiple classes at a reduced rate based on the membership tier.

Each class has a unique class name. Some classes are offered at three different levels: Beginner, Intermediate and Advanced

Each instructor is identified with a unique three-character code and can take one or more classes.

A relational database is to be created to store data about members, employees and classes.

Part of the table `MEMBER`, which is a first attempt at the database design, is shown below.

MemberNo	MemberName	MemberTier	ClassName	InstCode
5	Lindy White	Silver	Body Pump	WAY
			Yoga (Beginner)	DAV
			Zumba	ROG
...	...	...	...	...
78	Derek Davis	Bronze	Muay Thai (Beginner)	CHA
...	...	...	...	...
132	John Chua	Diamond	Circuits (Intermediate)	JON
			Muay Thai (Intermediate)	LEX
			Yoga (Advanced)	DAV
			Zumba	ROG
...	...	...	...	...

- (a) The table `MEMBER` is not normalised.
- Describe **one** potential issue that may be encountered when the data are maintained in such a non-normalised table. [1]
  - Explain why the table is not in first normal form (1NF). [1]
- (b) A second attempt at the database design gives rise to two tables:
- ```
MEMBER(MemberNo, MemberName, MemberTier)
```
- ```
MEMBERCLASSES(MemberNo, ClassName, Instructor)
```
- The primary keys are not shown.
- State what is meant by a **primary key**. [1]
  - By referring to the relationship between the tables `MEMBER` and `MEMBERCLASSES`, state how the relationship is implemented. [2]
  - Write an SQL query to create the table `MEMBER` with the appropriate constraints. [4]
- (c) Another attempt at the database design needs to be made to ensure that all the tables are in third normal form (3NF).

In addition, the following data need to be recorded in the database:

- the date on which each member signs up for the gym membership;
- the attendance of each member in any classes taken;
- the original fee, i.e. before discount, of each class;
- the name and the salary of each instructor.

(i) State the total number of 3NF tables required and give their names. [1]

(ii) Draw the Entity-Relationship (E-R) diagram to show the 3NF tables and the relationships between them. [4]

(iii) A table description can be written 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 provided, write table descriptions for all the 3NF tables you identified in (c)(i). [8]

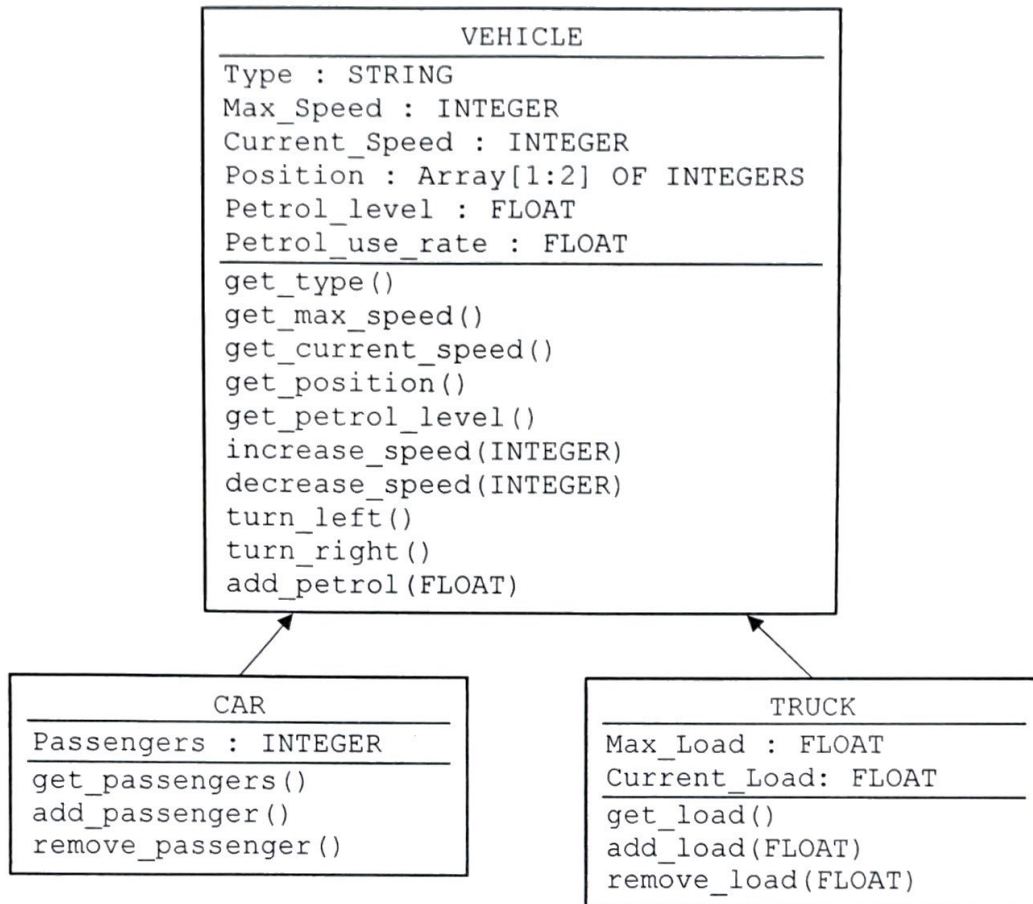
(d) Making backups and archives are performed to prevent the loss of data.

Explain the difference between a backup and an archive. [2]



- 6 A driving simulator is programmed using Object-Oriented Programming (OOP).

The diagram below shows a UML Class Diagram with **some** of the classes, attributes, and methods used in the simulator.



- (a) State the relationship between the CAR class and the VEHICLE class. [1]
- (b) Explain briefly, in this context, how each of the following features of Object-Oriented Programming help the simulation to be developed more efficiently.
- (i) Abstraction [2]
  - (ii) Inheritance [2]
- (c) The petrol use rate depends on the speed at which the vehicle is travelling, as well as the mass of the vehicle and the contents of the vehicle – the number of passengers in a car, or the mass of the load in a truck. Explain how polymorphism can be used in this case to write the simulation. [2]

- 7 A new social media platform is to be created. In years to come, it is expected to be as popular globally as other trending social media platforms.

- (a) Give two reasons why a NoSQL database is likely to be more suitable than an SQL database for the social media platform. [2]

A basic login page that controls access to user accounts is shown below. The password field masks the user input with a dot (•) replacing each of the characters supplied.



### LOGIN PAGE

Username:

Password:

- (b) When the login button is clicked, the program processes the username and password supplied by the user.

It displays an error message if the username entered does not exist in the database. If the password entered matches the registered password for the username, login is granted. Otherwise, the program displays an error message to indicate the user of the incorrect password entered.

The account will be locked if the user enters the correct username, but enters the wrong password three times.

- (i) Create a decision table to show these conditions and actions. [4]
  - (ii) Simplify your decision table by removing redundancies. [1]
- (c) It is known that users tend to have different problems associated with passwords. Besides the error message to tell the user when an incorrect password is entered, describe **two** examples based on usability principles that can be applied to improve the functionality of the login page. [2]
- (d) Explain why the HTTP POST method should be used instead of the HTTP GET method for the login request. [2]

- 8 In a hypothetical scenario, a data security company is helping a client company manage a database of the client company's customers. The data security company notices a possible vulnerability in the database.

Further investigation shows that the vulnerability is obscure and that none or few of the programmers anticipated it. Since the vulnerability is obscure, they determine that the chances of the database being breached are minimal, and decide not to tell the client company about it.

Instead, the data security company waits until the next time the database is due for scheduled maintenance to attempt to fix the vulnerability. By doing so, they can give themselves enough time to learn how to fix the vulnerability and avoid causing unnecessary panic within the client company or among the customers, which could lead to a potential loss of business.

Describe how each of the following ethical guidelines was breached by the data security company.

- |                     |     |
|---------------------|-----|
| (a) Integrity       | [2] |
| (b) Responsibility  | [2] |
| (c) Competence      | [2] |
| (d) Professionalism | [2] |