NATIONAL JUNIOR COLLEGE
Mathematics Department

General Certificate of Education Advanced Level
Higher 2

COMPUTING 9569/01

Written **28 June 2023**

1.5 hours

Additional Materials: Pre-printed A4 Answer Booklet

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.

There are 3 questions totalling 50 marks.

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

The number of marks is given in the brackets [ ] at the end of each question or part question.

This document consists of 7 printed pages and 1 blank pages.

1 A motor insurance company offers insurance to drivers with discount on their insurance premiums and perks depending on the driver's profile and the type of car he/she drives.

A No-Claim Discount (NCD) on premiums are given to drivers who did not have accidents for the last five years. If a driver had purchased a NCD Protector, he/she can still enjoy the NCD discount even if he/she had an accident within the last five years . If the driver had purchased a NCD Protector and drove a luxury car, he/she is also entitled to free road-side assistance.

(a) Copy and complete the decision table below:

Conditions								
Actions								

[4]

(b) Simplify the decision table in (a) [2]

(c) Using a variable to represent each condition and an OUTPUT statement to represent the action to be taken. Translate the decision table into concise and compact pseudocode. [2]
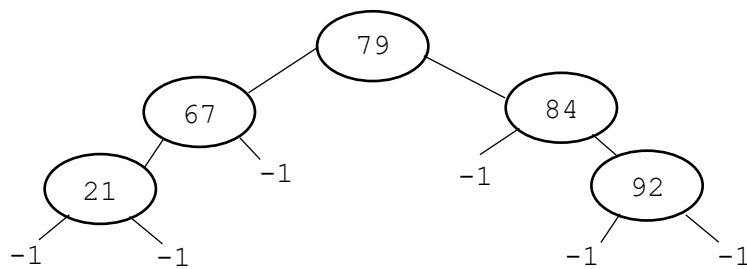
2 A Binary Search Tree (BST) is created by inserting integer values to it. The following lists were generated by the post order and in order traversals of the BST respectively:

Post order list: `[3, 2, 6, 10, 9, 5, 17, 14, 13, 11]`

In order list: `[2, 3, 5, 6, 9, 10, 11, 13, 14, 17]`

(a) Describe how you would derive the structure of the BST. [4]

(b) Using your algorithm in (a), draw the BST. [2]

(c) A Binary Search Tree (BST) can be implemented using three arrays, `Data`, `Left` and `Right`, where the `Data` array stored the data values of the Tree Node, the `Left` and `Right` array store the left and right pointers to the left and right sub-array respectively. A pointer `root` indicates the position of the root node. A value of -1 in the root indicates an empty tree and a value of -1 in a pointer indicates an empty sub-tree. For example, a BST like this:

```
                    79
             67            84
        21      -1     -1      92
     -1    -1               -1    -1
```

can be implemented as : `root`←0 and the arrays as follows:

Data		Left		Right	
0	79	0	1	0	2
1	67	1	3	1	-1
2	84	2	-1	2	4
3	21	3	-1	3	-1
4	92	4	-1	4	-1
:	:	:	:	:	:

Function Z is written to operate on a BST implementation as described above.

The function has a single integer parameter, current. The function returns an

integer.

```
01  FUNCTION Z(current: INTEGER) RETURNS INTEGER
02   IF Left[current] = -1 AND Right[current] = -1 THEN
03      RETURN 0
04   ENDIF
05   IF Left[cur_pointer) <> -1 THEN
06     left_value ← Z(Left[cur_pointer])
07   ELSE
08     left_value ← 0
09   ENDIF
10   IF Right[cur_pointer] <> -1 THEN
11     right_value ← Z(Right[cur_pointer])
12   ELSE
13     right_value ← 0
14   ENDIF
15   RETURN 1 + MAX(left_value, right_value)
16   // MAX will return the larger of the two values
17  ENDFUNCTION
```

(i)   State the purpose of function Z.   [1]

(ii)   State the line number/s for the base case of the function.   [1]

(iii) State the line number/s for the recursive case of the function.   [1]

(iv)   What is the run time complexity of function Z.   [1]

(v)   Using the same type of function as Z, write an algorithm to insert new

       data into the BST. You can assume that the BST is not empty and there

       is always free space in the arrays for inserting new data.   [8]

3   All combat fit national servicemen will need to be proficient in handling and shooting with their SIG X rifle. During their Basic Military Training (BMT), they will need to perform live firing sessions with their rifles at the live firing ranges. They will need to complete a total of four live firing sessions. Each live firing session will require the shooter to fire a total of 16 rounds(shots) at different positions. The score for each session is the total number of shots that hit the targets. A serviceman must get an **average** score of 8 and above for the four live firing sessions in order to be combat ready. He may perform more than one live firing session in one day. If a serviceman is absent for a scheduled session, he will be rescheduled for another session. You can assume that every serviceman will always have exactly four live firing sessions scores.

The live firing sessions may be conducted in different firing ranges in different locations. The firing ranges are all automated and will be able to generate a report of the scores of the shooters. The organisation for all the firing ranges are as follows:

Shooters are organised into details of 24 shooters each. Each detail of 24 shooters is to start and end a live firing session together. After all the shooters have completed their live firing sessions for the day, the result of the shootings will be generated as a flat file. You can assume that for each day, the first live-firing session will start with Detail Number 1 and increment by 1 for the next session. The following examples show the flat files generated from 2 different firing ranges:

```
Range Name: Takka Range
Address: 1 Botak Hill, S(908449)
Contact: 63165432
Unit: 1CMD/Bravo
Commanding Officer: CPT Lim Boey Seng
Date, Start_Time, Detail_Number, Shooter_Number, Score
03/12/2019, 09:00, 1, 1, 10
03/12/2019, 09:00, 1, 2, 0
03/12/2019, 09:00, 1, 3, 2
03/12/2019, 09:00, 1, 4, 14
:
03/12/2019, 09:30, 2, 1, 12
03/12/2019, 09:30, 2, 2, 10
```

```
Range Name: Salah Range 2
Address: 1 Salah Ring Rd, S(507087)
Contact: 66165431
Unit: 9MED/Charlie
Commanding Officer: CPT Maverick Goh
Date, Start_Time, Detail_Number, Shooter_Number, Score
01/10/2019, 14:00, 1, 1, 14
01/10/2019, 14:00, 1, 2, 2
01/10/2019, 14:00, 1, 3, 14
:
01/10/2019, 17:45, 13, 1, 0
01/10/2019, 17:45, 13, 2, 14
```

All servicemen will have the following personal details captured during their enlistment:

Name,NRIC,Address,Contact,Blood_Group,Next_Of_Kin,Emergency_Contact.

Before the servicemen go for their live firing sessions, the Commanding Officer of the unit that the servicemen belong to, will need to book the firing range for the entire day and assign the servicemen to their respective firing range, detail number and shooter number. A firing range can only be booked by one unit per day.

At the end of their BMT, only servicemen who are combat ready can be deployed for leadership training or combat roles.

(a) Design the ERD to model the entities and relationships for a relational database in 3NF. Your solution must be able to implement the use case described above. [6]

(b) Describe the relations to be implemented, indicating the primary and foreign keys clearly. [4]

(c) Explain why the data in the flat file generated from the firing range, as shown above, is not in 3NF. [2]

(d) What are the purposes of performing normalisation in a relational data model. [2]

(e) Assume that at the end of their BMT, all servicemen are able to complete their four firing sessions. Based on the relations created in part **(b)**

(i) Write the SQL statement to query for all the live firing sessions scores for a serviceman with NRIC number "S7652344Z". [2]

(ii) Write the SQL statement to list the NRIC of all the combat ready servicemen at the end of their BMT. [2]

(f) The contractor for the live firing ranges will be upgrading their system to generate more data and statistics, including video capture of each shooter, during each live firing session. Instead of storing the data from each live firing session in a flat file, the contractor is considering using a NoSQL database. What are the advantages of using a NoSQL database in this particular scenario. [2]

(g) The computer systems in all the firing ranges are connected to an intranet. What is an intranet and how is it different from the Internet ? [2]

(h) Describe a situation where a breach in Personal Data Privacy can occur when managing the data described above. [2]

END OF PAPER