**NANYANG JUNIOR COLLEGE**

**JC2 PRELIMINARY EXAMINATION**

Higher 2

**COMPUTING** **9569/01**

Paper 1 Written **16 SEPTEMBER** **2020**

**3 Hours**

**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.

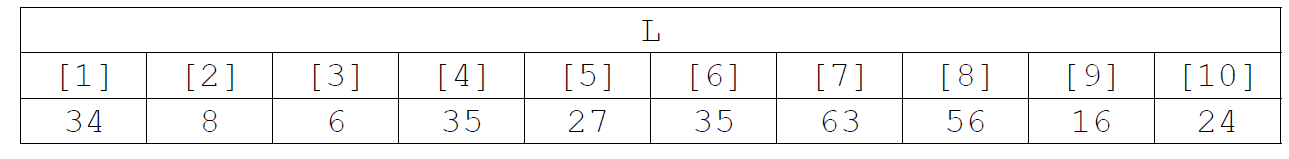
The number of marks is given in brackets [ ] at the end of each question or part question.

The total number of marks for this paper is 100.

This document consists of **9** printed pages.

**1 Figure 1** shows ten numbers stored in an array L.

**Figure 1**



The numbers in L are to be sorted.

**Figure 2** shows an **incomplete** structure chart that has been created while developing a solution to the problem of sorting the numbers in L.

The constant MAX has been used to represent the size of the array.

A close up of a map

Description automatically generated**Figure 2**

**(a)** **(i)** Describe the goal of this problem. [1]

**(ii)** How should the curved arrow **(a)** in **Figure 2** be labelled? [1]

**(iii)** What should be written in box **(b)** in **Figure 2**? [1]

**(iv)** What should be written in box **(c)** in **Figure 2**? [1]

A new Bubble Sort routine is developed using the structure chart shown in **Figure 2**.

**(b)** What value will be in L[1] when thisBubble Sort routine has finished executing on the array L shown in **Figure 1**? [1]

**(c)** A Bubble Sort routine, based on the structure chart in **Figure 2**, always completes MAX - 1 passes through the array. Often, this number of passes is not required, as the contents of the array will be sorted after fewer passes have been made. If a pass is made through the array during which no swaps need to be made, then the array has been sorted.

Describe the changes that need to be made to the Bubble Sort routine so that it will only complete the minimum number of passes through the array that are needed to fully sort the contents of the array. [3]

**(d)** The Bubble Sort routine can also be implemented using recursion.

1. Define what is meant by a **recursive function**. [2]
2. Using pseudocode, write a recursive Bubble Sort routine. [3]
3. Explain a disadvantage of a recursive Bubble Sort function over an iterative one. [2]
4. Name and describe another recursive sort algorithm. [5]

**2** In Morse code, each letter of the alphabet is represented by a unique combination of dots and dashes. Study the following table carefully:

|  |  |  |
| --- | --- | --- |
| **Letter** | **Morse Code** |  |
| A | **. -** | dot dash |
| B | **- . . .** | dash dot dot dot |
| C | **- . - .** | dash dot dash dot |
| D | **- . .** | dash dot dot |

A binary tree is used to represent this coding system. Each node, except the root node, contains a letter of the alphabet. The position of each letter in the tree is determined by its Morse code. Moving from one node to another down the tree is done by traversing either a left branch or a right branch. A left branch corresponds to a **.** (dot) and a right branch corresponds to a **–** (dash).

The first three levels of the tree are shown below:

A picture containing object, clock

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**(a)** What are the Morse codes for the letters N and Y? [2]

**(b)** Draw a diagram of the binary tree which clearly shows the position of the letters D, C and B in the tree. [3]

**(c)** **(i)** Explain why this binary tree representation is not the most suitable data structure for performing English to Morse code conversion. [2]

**(ii)** Describe a better alternative and explain how the Morse code of a letter could be found. [3]

|  |
| --- |
| **3** The algorithm represented using pseudo-code in **Figure 3** describes a method to convert two hexadecimal numbers into decimal. The subroutine ToDecimal used in **Figure 3** is shown in **Figure 4** and the built-in subroutine ASCII is explained in **Table 1**. |

**A picture containing bird

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The FOR EACH command steps through each character in a string working from left to right.

**A screenshot of a cell phone

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**Table 1**

**A screenshot of a cell phone

Description automatically generated**

**(a)** Copy and complete the following table by hand-tracing the algorithm in **Figure 3**. Use "A2" and "1G" as input strings. You may not need to use all the rows.

A picture containing sitting

Description automatically generated

[6]

**(b)** Explain how the algorithm in Figure 3 has attempted to deal with the conversion of "1G" into decimal and why this method is not fully effective. [2]

**(c)** Other than a trace table, describe two other debugging methods a programmer can use to find bugs in his code. [4]

**4** Company X sells merchandise to wholesale and retail outlets. Wholesale customers receive a two percent discount on all orders. The company also encourages both wholesale and retail customers to pay cash on delivery by offering a two percent discount for this method of payment. Another two percent discount is given on orders of 50 or more units. Discounts can be stacked for each order.

**(a)** Create a decision table to show these conditions and actions. [4]

**(b)** Write pseudo-code to implement a function ComputeDiscount that takes in the appropriate parameters and returns the message “Discount rate is X%” where X is the calculated discount. [6]

**(c)** Draw a system flowchart of your pseudo-code in **(b)**. [4]

**5** Athletes, who are members of teams, compete in running events, which are held at fixtures throughout the year. For example, athlete 15 might compete in the Girls’ 1500m Under 18 race in the fixture at National Stadium on 12 September 2020.

A relational database is used to store the details of which athletes enter each event at each fixture. The relations used in the database are shown in **Figure 5**.

**Figure 5**

Athlete(AthleteID, Surname, Forename, DateOfBirth, Gender, TeamName)

EventType(EventTypeID, Gender, Distance, AgeGroup)

Fixture(FixtureID, FixtureDate, LocationName)

EventAtFixture(FixtureID, EventTypeID)

EventEntry(FixtureID, EventTypeID, AthleteID)

* Each Athlete, EventType and Fixture is identified by a unique identity number, for example AthleteID for athletes.
* An EventType is a type of event, such as Boys’ 100m Under 15 race.
* If an athlete wants to take part in an event at a particular fixture, then an entry is created in the EventEntry relation to represent this.

**Figure 6** shows an incomplete entity-relationship diagram for part of the database.

**Figure 6**

A screenshot of a cell phone

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**(a)** Copy and draw lines on **Figure 6** to show the degree of any **three** relationships that exist between the four entities shown. [3]

**(b)** The following SQL statement is intended to make a table to represent the Athlete relation. The statement contains some errors.

**Figure 7**

CREATE TABLE Athlete (

PRIMARY KEY AthleteID,

VARCHAR(50) Surname,

VARCHAR(30) Forename,

DATE DateOfBirth,

VARCHAR(6) Gender,

VARCHAR(30) TeamName

)

You may assume that all of the data types used in **Figure 7** are valid and the field lengths are appropriate. State **two** errors that have been made. [2]

**(c)** State **two** reasons why database designs, such as this one, are usually normalised. [2]

**(d)** A list is to be produced of the names of all athletes who are competing in the fixture that is taking place on 17/09/20. The list must include the Surname, Forename and DateOfBirth of these athletes and no other details. The list should be presented in alphabetical order by Surname. With reference to the database design shown in Figure 3, write an SQL query to produce the list. [5]

**(e)** An IT consultant is suggesting changing to the use of a NoSQL database instead.

1. Describe two advantages that a NoSQL database have over a SQL database. [4]
2. Explain with reasons if you agree or disagree with making the change. [2]

**6** Computers connected to the Internet use the TCP/IP suite of protocols for data transmission.

**(a)** What is a protocol? [1]

**(b)** The TCP/IP stack is divided into four layers. One of these is the application layer protocol. **Table 1** shows four different scenarios that all use the TCP/IP protocol. Complete **Table 1** by writing the name of the particular **application layer protocol** that would be used to transfer data during each operation. You must give a different answer in each case.

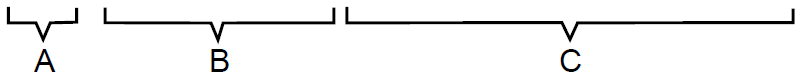
**Table 1**

|  |  |  |
| --- | --- | --- |
|  | **Operation** | **Application**  **Layer Protocol** |
| **(i)** | Managing a server remotely |  |
| **(ii)** | Retrieving e-mail from an e-mail server |  |
| **(iii)** | Viewing a sports news web page using a web browser |  |
| **(iv)** | Accessing your online bank account using a web browser |  |

[4]

**(c)** A student uses the following URL to download a copy of a previous year’s Computing exam paper.

https://www.nanyang.moe.sg/gce/computing/2019H2Computing2.pdf

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**(i)** Describe the **three** labelled parts (A, B and C) of this URL. [3]

**(ii)** State the top-level domain part in the URL [1]

**(d)** To access the exam paper, the student’s computer might need to make use of a Domain Name System (DNS) query which is transmitted to a DNS server.

**(i)** What is the role of a DNS server? [2]

**(ii)** In some circumstances the student’s computer will not need to contact a remote DNS server to access a resource. Describe **two** situations when a DNS query will **not** be sent to a remote DNS server. [2]

**(e)** In the process of requesting a web page, a browser will generate an HTTP GET request.

**(i)** In which layer of the TCP/IP stack is the browser operating? [1]

**(ii)** Explain why the student’s computer might need to make several HTTP GET requests to display one web page. [2]

**(iii)** The HTTP GET requests are being sent to port 80 on the remote machine. The browser has been allocated a **client port number**. What is meant by a client port number? [1]

**7** Below is a numbered list of the names of some of the legislation that applies in situations where computers are used:

1. Copyright, Designs and Patents Act

2. Computer Misuse Act

3. Regulation of Investigatory Powers Act

4. Health and Safety Regulations

5. Data Protection Act

For each of the situations given below, identify the relevant legislation which is being followed. Write the number that corresponds to the appropriate legislation in each situation.

1. **(i)** Marcus wanted an MP3 of a recent song so he went to an online music store. After paying

he was able to immediately download the purchased song. [1]

**(ii)** A new workstation is installed in an office and an assessment is performed regarding the lighting for the workstation and the positioning of the desk, monitor and chair. [1]

**(iii)** Mr Smith hands over his 50-character encryption key in response to a request from the authorities investigating a fraud case. [1]

**(b)** The operators of a number of multi-storey car parks have installed systems to scan and recognise number plates. The system is used at both the entrance and exit of the car parks so that the arrival and leaving times can be recorded.

Customers can set up an account so that money is automatically debited when their car number plate is recognised as the car leaves the car park. Customers who do not have an account can use their mobile phones to pay the car parking fees by sending a text message to a specified number with their number plate details and length of stay.

As these car parks are based around Singapore, the company also collects location specific data.

1. The company will need to follow the Data Protection Act as they will be storing personal data. What is meant by personal data? [1]
2. Why might the storing of number plate details, mobile phone numbers and location specific data be a concern for privacy campaigners? [2]

**(c)** Explain with specific examples why a code of conduct for computing professionals is necessary. [3]