2020 Post-Prelim H2 Computing Theory Mock Paper 1

Total Marks: 108 (3 hr 15 mins)

HCI BT 2020 Q1

1. The Human Resource department of an organization would like to develop a system using object-oriented approach to manage the information of the employees.

   One of the functions of the system is to compute the monthly pay of the full-time employees which comprise of the monthly salary and the overtime allowance.

   Due to the rapid expansion of the organization, the organization starts to employ daily-rated employee. For daily-rated employee, their monthly pay are computed based on the rate per day and the number of days worked per month.

   (a) Draw a class diagram which exhibits the following:
   - Suitable classes with appropriate properties and methods
   - Inheritance
   - Polymorphism   [6]

   (b) Explain how your design in **(a)** demonstrates code reuse.   [2]

   (c) Explain the term **polymorphism** and how it is applied in your design in **(a)**.   [2]

HCI BT 2020 Q2

2. A queue data structure is implemented using an array `Queue` and two pointers, `Head` and `Tail`. The space in array is fully utilized to perform the queue operations.

   `Queue`: 1-dimensional array with index 1 to 10

   `Head`: pointing to the index of the first item in the queue

   `Tail`: pointing to the index of the next item that is inserted

   (a) Describe an algorithm, using pseudocode, to insert a new item `NewItem` into the queue.
                                                                                      [4]

   (b) Describe an algorithm, using pseudocode, to delete an item from the queue.   [6]

(c) Peter intends to use the pseudocode `Length ← Tail − Head` to find the length of the queue. Give an example to explain why he fails. Write down the correct pseudocode to find the length. [3]

(d) This data structure can also be implemented using linked list. Give **one** advantage and **one** disadvantage of linked list over array implementation. [2]

2019 Promo HCI Q8

3 (a) Using an insertion sort, show how the following list of codes can be sorted in alphabetical order:

MYS, AUS, CAN, SGN, JPN. [3]

(b) Below is a bubble sort pseudocode for sorting `List` into ascending order.

```
01   NoSwaps ← False
02   WHILE NoSwaps = FALSE
03        NoSwaps ← TRUE
04        UpperBound ← ListLength - 1
05        FOR Posn ← 0 TO ... A ...
06             IF List[Posn] > ... B ...
07                  THEN
08                       // Swap
09                       NoSwaps ← ... C ...
10                       Temp ← List[Posn]
11                       List[Posn] ← List[Posn + 1]
12                       List[Posn + 1] ← ... D ...
13             ENDIF
14        ENDFOR
15   ENDWHILE
```

(i) Write the pseudocode for **A**, **B**, **C** and **D** in the algorithm. [4]

(ii) State the number of passes needed to apply this algorithm to the following list of numbers:

42, 36, 37, 40, 45, 48.

Explain why bubble sort is more efficient in this case. [2]

2019 Promo HCI Q4

4   A student care center has a library. The librarian keeps the loan records using a flat file database. An extract of the loan data is as shown below.

Student ID	Student Name	Phone Number	Book Title	Date Borrowed	Date Due	Date Returned
1	Kelly	92219928	Frogcatchers	10-Aug-2019	09-Sep-2019	09-Sep-2019
2	Smith	88322121	Boneshaker	18-Jul-2019	17-Aug-2019	17-Aug-2019
3	Joyce	88611123	Into the Planet	18-Jul-2019	17-Aug-2019	17-Aug-2019
3	Joyce	88611123	The Falling Machine	18-Jul-2019	17-Aug-2019	17-Aug-2019
1	Kelly	92219928	Boneshaker	16-Jun-2019	15-Jul-2019	14-Jul-2019
4	Jones	88165542	Dash & Lily's Book of Dares	10-Apr-2019	9-May-2019	7-May-2019
4	Jones	88165542	Into the Planet	10-Apr-2019	9-May-2019	7-May-2019
5	Peter	88612211	We Are the Weather: Saving the Planet Begins at Breakfast	3-Mar-2019	2-Apr-2019	1-Apr-2019

(a)   Describe, using an example, why this file has data redundancy.   [2]

(b)   The student care center has requested your help to design a relational database.   The   loan rules are :

(i)   A student can loan more than one book at a time.

(ii)   A book can be loaned by one student at a time.

Using the information provided, draw the Entity-Relationship (E-R) diagram showing   the tables and relationships between them.   [4]

(c)   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 by using a dashed underline.

Write table descriptions for the tables you identified in the Entity-Relationship (E-R) diagram in part **(b).**   [5]

 (e)   The center collects data from the students, describe **two** data protection obligations on how the center must comply with the Personal Data Protection Act (PDPA).   [2]

(f)   State **two** differences between backup and archive, for the center to prevent data loss   due   to system failure.   [4]

(g)   Explain why version control and naming convention is important for the relational database system.   [2]

2020 ACJC Prelim Q1

5   A food delivery app offers promotions to customers based on their usage pattern.

First time customers would receive a $5 discount on their first purchase. If a customer has spent at least $1000 on the app in the last 3 months, the app would upgrade the customer to Gold status and offer 10% discount on all orders.

Gold status customers who have been inactive for 1 month would be offered an additional 5% discount on top of the existing 10% discount. Customers who have made their first purchase and have been inactive for 1 month would receive a $5 discount instead.

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

(b)   Simplify your decision table by removing redundancies from the decision table.   [1]

2020 ACJC Prelim Q2

6   The recursive function `Binomial` has two parameters, `N` and `R`.


```
01  FUNCTION Binomial(N, R : INTEGERS) RETURNS INTEGER
02      IF R = 0 OR R = N
03          THEN
04              Answer ← 1
05          ELSE
06              Answer ← Binomial(N − 1, R) + Binomial(N − 1, R −
1)
```
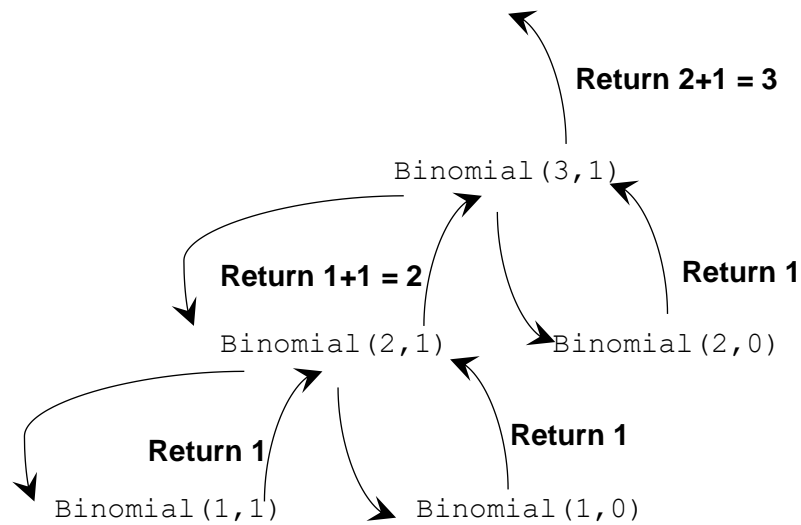
```
07        ENDIF

08        RETURN Answer

09  ENDFUNCTION
```

(a) State what is meant by a recursive function, and identify the line number that makes `Binomial` **recursive.** [2]

(b) An example of a trace tree diagram showing the recursive function call `Binomial(3,1)` is shown.

Use the above example to create a trace tree diagram for the recursive function call `Binomial(3,2)`. [4]

(c) Give values of `N` and `R` which would cause the function to enter infinite recursion. [2]

2020 NJC Prelim Q6

7 The public Internet is often described as a system of interconnected networks that uses the TCP/IP protocols.

(a) Explain what is the difference between a Local Area Network (LAN) and a Wide Area Network(WAN). [2]

(b) How are the concepts of LAN and WAN apply to the public Internet? [2]

(c) What is a protocol ? Explain how the TCP/IP protocols are used on the Internet. [4]

(d) A school wants to implement a system for Home-Based Learning (HBL) where students can submit their assignments in digital form, from their home, to their teachers for feedback and marking. The school wants the assignments to be submitted and stored on a server connected to a LAN in the school premise. The teachers must also be able to access their students' submissions from their home.

Describe with the help of a network diagram, how such a system can be implemented. Describe also the network devices, services and applications that are needed to implement the solution. [4]

(f) The school also wants the server to have a unique DNS name for the students and teachers to access. Explain what is a DNS name and how can we obtain and assign a DNS name to the file server. [2]

2020 NYJC Prelim Q7

8 (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.

(i) The company will need to follow the Data Protection Act as they will be storing personal data. What is meant by personal data?
[1]

(ii) 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]

2020 NYJC Prelim Q2

9 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:
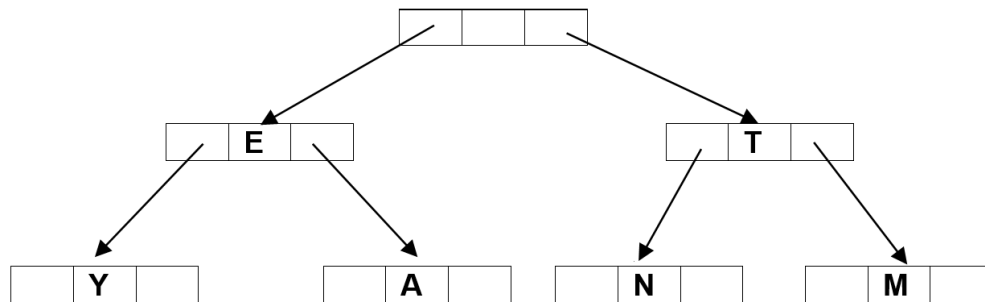
(a) What are the Morse codes for the letters N and Y?
[2]

(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]

10 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**.

Figure 3

```
FOR Count ← 1 TO 2
   INPUT HexString
   Number ← 0
   FOR EACH HexDigit IN HexString
      Value ← ToDecimal(HexDigit)
      Number ← Number * 16 + Value
   ENDFOR
   OUTPUT Number
ENDFOR
```

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

Figure 4

```
SUBROUTINE ToDecimal(HexDigit)
   IF HexDigit = "A" THEN
      Value ← 10
   ELSEIF HexDigit = "B" THEN
      Value ← 11
   ELSEIF HexDigit = "C" THEN
      Value ← 12
   ELSEIF HexDigit = "D" THEN
      Value ← 13
   ELSEIF HexDigit = "E" THEN
      Value ← 14
   ELSEIF HexDigit = "F" THEN
      Value ← 15
   ELSEIF HexDigit IN ["0", "1", ..., "9"] THEN
      Value ← ASCII(HexDigit) - 48
   ELSE
      Value ← -1
   ENDIF
   RETURN Value
ENDSUBROUTINE
```

Table 1

Subroutine used in Figure 4	Description
`ASCII(Char)`	Returns the ASCII code of the character passed as a parameter. Example: `ASCII("1")` returns `49`

(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.

Count	HexString	Number	HexDigit	Value	Output

[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]