**HWA CHONG INSTITUTION**

**C2 BLOCK TEST 2020**

**COMPUTING**

**Higher 2**

**30 June 2020 Paper 1 (9569 / 01) 0815 -- 0945 hrs**

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# READ THESE INSTRUCTIONS FIRST

Write in dark blue or black pen on both sides of the paper.

You may use a soft pencil for any diagrams, graphs, tables or rough working.

Do not use staples, paper clips, glue or correction fluid.

Answer **all** questions.

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

Total marks for this paper is **50** marks.

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This document consists of **4** printed pages.

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.

1. Draw a class diagram which exhibits the following:

* Suitable classes with appropriate properties and methods
* Inheritance
* Polymorphism [6]

1. Explain how your design in **(a)** demonstrates code reuse. [2]
2. Explain the term **polymorphism** and how it is applied in your design in **(a)**. [2]
3. 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

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

1. Describe an algorithm, using pseudocode, to delete an item from the queue. [6]
2. 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]
3. This data structure can also be implemented using linked list. Give **one** advantage and **one** disadvantage of linked list over array implementation. [2]
4. (a) The following is an algorithm for an insertion sort procedure.

PROCEDURE **sort** ( A, n )

{insertion sort the array A, items 1 to n}

IF n > 1 THEN

sort ( A, n - 1 )

insert ( A, n - 1, A[ n ] )

ENDIF

ENDPROCEDURE

PROCEDURE  **insert** ( A, i, X )

{the array A has items 1 to i already sorted; insert the item X into position to make items 1 to i + 1 sorted}

IF i = 0 THEN

A[ 1 ] 🡨 X

ELSE

IF X > A[ i ] THEN

A[ i + 1 ] 🡨 X

ELSE

A[ i + 1 ] 🡨 A[ i ]

insert ( A, i - 1, X )

ENDIF

ENDIF

ENDPROCEDURE

Illustrate the operation of procedure **insert** ( A, 4, X ) where

A[ 1 ] is ‘Amy’

A[ 2 ] is ‘Ben’

A[ 3 ] is ‘Ken’

A[ 4 ] is ‘Tim’ and

X is ‘Jin’

by completing the trace table given below.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | A[1] | A[2] | A[3] | A[4] | A[5] | i | X |
| **insert**(A,4,’Jin’) | Amy | Ben | Ken | Tim |  | 4 | Jin |
| **insert**(A,3,’Jin’) |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |

[4]

1. Write an algorithm, in pseudocode, for a **non-recursive** version of the insertion sort to sort items held in an array in ascending order. [6]
2. Identify **two** features of the array that would have an impact on the performance of this insertion sort algorithm in **(b)**. [2]
3. State the time complexity of the sort algorithm in **(b)** if items in the array are initially in
4. reverse order [1]
5. sorted order [1]

What is the maximum number of comparisons needed to sort an array of N items? [1]

1. A mall operator operates 4 malls in Singapore. Due to the recent outbreak, the mall operator decides to develop a centralized system to accurately limit the number of people entering in its premises to prevent overcrowding.

In each mall, there will only be one entrance and one exit. There is a sensor at the entrance to capture the timestamp when a person enters the mall. At the exit, there is also one sensor to capture the timestamp when a person exits the mall.

1. The mall operator wants to model this system using a relational database.
   * + 1. A database needs a number of tables to store the data for this system.

Draw the Entity-Relationship (E-R) diagram to show the tables in third normal form (3NF) and their relationships between them. [4]

* + - 1. 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.

Using the information given, write table descriptions for the tables you identified in **(a) (i)**. [4]

1. State **two** reasons why the mall operator may wish to choose a NoSQL database. [2]

**--- END OF PAPER ---**