เลขที่

ข้อสอบปลายภาค ภาคการศึกษาที่ 2 ปีการศึกษา 2563

954170 Elementary Business Process Modeling

(Data Structures and Algorithms)

ข้อสอบสำหรับนักศึกษาหลักสูตรบรูณาการอุตสาหกรรมดิจิทัล

วัน จันทร์ ที่ 14 เดือน มิถุนายน พ.ศ. 2564 เวลา 9.15-11.45 น.

ชื่อ-สกุล.....รหัสนักศึกษา.....ตอน.....

ไม่อนุญาตให้นักศึกษาเปิดข้อสอบก่อนได้รับอนุญาต

คำชี้แจง

1. ข้อสอบมีทั้งหมด 4 ตอน ทั้งหมด 7 หน้า (รวมปก)

ตอนที่ 1 General	6 คะแนน
ตอนที่ 2 Linked List	10 คะแนน
ตอนที่ 3 Searching and Sorting algorithms	10 คะแนน
ตอนที่ 4 Tree	4 คะแนน
คะแนนรวม	**30** คะแนน

2. สัดส่วนคะแนนสอบปลายภาคคิดเป็นร้อยละ 30 ของคะแนนทั้งหมด

3. **หากพบว่ามีการทุจริตในการทำข้อสอบ จะถูกปรับเป็นสอบตก (F) ในวิชานี้ทันที**

Section 1 General

1. Student A wants to eat chocolate bars. One chocolate bar is packed in one plastic bag. Each bag of the chocolate bar costs 30 baths. Currently, the shop has the chocolate bar promotion, which is three empty plastic bags of chocolate bars can get one chocolate bar for free.
    a. Student A has 240 baths in his wallet. What is the maximum number of the chocolate bars student A can eat? (1 point)
    b. Explain the solution of the answer in a. (1 points)

2. Given an integer array as an input. Write an algorithm to determine whether two numbers sum to 13. For example, if the give array is [6 , 9 , 2 , 4 , 3]. The algorithm will print out "YES" as the output because 9 and 4 sum to 13. Note that a number may be used twice. Let n denote the length of the input array.

    a. Write an algorithm/code to solve the problem in $O(n^2)$. (2 points)

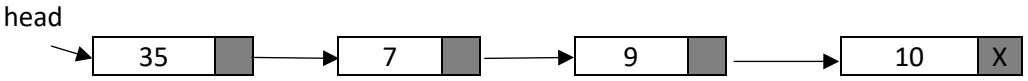
    b. Write an algorithm/code to solve the problem in O(nlogn). (2 points)
    Hint:
    You sort the array first with the sorting time complexity is O(nlogn). After that, you will be able to solve the problem, which its time complexity is less than nlogn.
    Note that you don't need to write the sorting steps. However, you must state which sorting algorithm you want to use to solve this problem.

Section 2 Linked List

3. A linked list is a data structure consisting of a number of nodes chained together to represent a sequence.

    a. What are the differences between a linked list and an array?
        i. ……
        ……
        …… (1 point)
        ii. ……
        ……
        …… (1 point)
    b. What are the advantages of using linked lists over arrays?
        i. ……
        ……
        …… (1 point)
        ii. ……
        ……
        …… (1 point)

4. Draw a diagram/picture to present how to remove the **third** element from the below linked list, i.e., `removeThird()` method. From the below linked list, the third element is 9.



    a. Draw a diagram/picture. (1 point)
    b. Write an algorithm to explain the answer in a. step by step. (2 points)
    Note that you may write code instead of an algorithm.

5. Write the missing code of method `copyReversedListToFront()`.
The method `copyReversedListToFront()` will copy the reversed linked list and add the elements to the front of the linked list. (3 points)

For example:

If the linked list is [6 , 9 , 2, 4 , 3], the resulting linked list will be [3 , 4 , 2 , 9 , 6 , 6 , 9 , 2, 4 , 3].

If the linked list is [2 , 4 , 5, 7], the resulting linked list will be [7, 5 , 4 , 2 , 2 , 4 , 5, 7].

```
public class Node {
    int element;
    Node next;

    public Node(int data){
        element = data;
        next = null;
    }
}
```

```
public class LinkedList {
    Node head;

    public LinkedList(int data) {
        head = new Node(data);
    }

/*IN CASE YOU NEED AN ADDITIONAL METHOD, YOU CAN WRITE IT
HERE*/

    public void copyReversedListToFront()
    {
            /*MISSING CODE*/
    }

}
```

```
public class AlgorithmFinal {
    public static void main(String[] args) {

        LinkedList x = new LinkedList(7);
        x.addFirst(5);
        x.addFirst(4);
        x.addFirst(2);
        x.copyReversedListToFront();

    }
}
```

Section 3 Searching and Sorting algorithms

6. You have a random integer array, i.e., [1,5,7,9,0,2,3]. You want to search for 9.
    a. Between linear search and binary search, which algorithm you will choose to solve this problem? (1 point)
    b. Explain the reasons. Why don't you use the another one? (1 point)

7. Show how to sort the following array step by step by using the **bubble sort** algorithm. (3 points)

35	7	1	7	9	10

8. Show how to sort the following array by using the mergesort algorithm.

35	7	1	7	9	10	20	5

    a. Draw a diagram to present the steps of the **mergesort** algorithm. (2 points)
    b. In your diagram, write down when the `merge` method and `sort` (partition) method are called. (2 points)

Merge Method

```
public static void merge(int arr[], int l, int m, int r)
    {
        int n1 = m - l + 1;
        int n2 = r - m;

        int L[] = new int[n1];
        int R[] = new int[n2];

        for (int i = 0; i < n1; ++i)
            L[i] = arr[l + i];
        for (int j = 0; j < n2; ++j)
            R[j] = arr[m + 1 + j];

        int i = 0, j = 0;
        int k = l;
        while (i < n1 && j < n2) {
            if (L[i] <= R[j]) {
                arr[k] = L[i];
                i++;
            }
            else {
                arr[k] = R[j];
                j++;
            }
            k++;
        }
```

```
        while (i < n1) {
            arr[k] = L[i];
            i++;
            k++;
        }
        while (j < n2) {
            arr[k] = R[j];
            j++;
            k++;
        }
    }
```

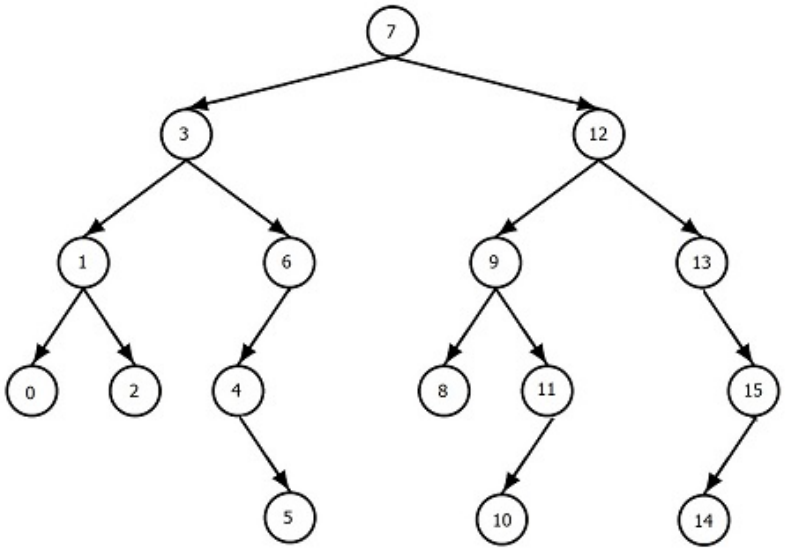
Sort Method

```
public static void sort(int arr[], int l, int r)
    {
        if (l < r) {
            int m =l+ (r-l)/2;
            sort(arr, l, m);
            sort(arr, m + 1, r);
            merge(arr, l, m, r);
        }
    }
```

9. Give a scenario that Quicksort will take n^2 to execute. Let n denote the length of the input array. (1 point)

Section 4 Tree

10. For the following tree, answer the questions in a. and b.



a. What are the children of (12) ? (0.5 point)

b. What is the parent of (12) ? (0.5 point)

c. What will be the output when we travel the tree by Depth First Search (DFS) **Pre-order.** (1 point)

d. If I want to get the output as 0,1,2,3,4,5,6,7,8,9,10,11,12,13,14,15, which order I need to use to travel the tree. Choose one choice below. (1 point)
   i. DFS Pre-order
   ii. DFS Post-order
   iii. DFS In-order

11. What are the differences between a linked list and a tree? (1 point)