University of Dhaka
Department of Computer Science and Engineering
2nd Year 1st Semester Incourse Examination, 2019
CSE-2101: Data Structures and Algorithms

Total Marks: 30 **Answer all the questions** Time: 1 Hour 30 Minutes

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1. For each of the following functions in C, perform runtime analysis and express runtime in Θ notation. [4]

(a)
```
void program(int n){
    int sum=0;
    for(int i=0;i<n;i++)
        for(int j=0;j<n;j++)
            a+=i;
    for(int i=0;i<n*n;i++)
        for(int j=0;j<n;j++)
            a+=j;
}
```

(b)
```
void program(int n){
    int a=0;
    for(int i=1;i<n;i*=3)
        for(int j=1;j<=n;j*=5)
            a+=i+j;
}
```

2. Determine which of the following sorting algorithms are stable: Counting Sort, Quick Sort. Justify your opinions with example. [4]

3. Write pseudocode of a linear time sorting algorithm and determine the complexity of your proposed algorithm. Is there any case when your proposed sorting algorithm fail to work? [5]

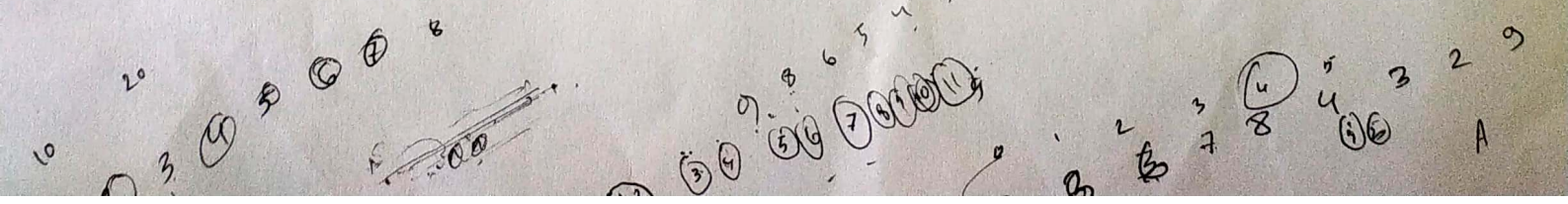
4. (a) Insert the following numbers into an empty min-heap: 11, 9, 10, 7, 12, 3 in that order. [4]
   (b) Now delete the minimum number from the above min-heap and show the modified heap. [1]
   * Show all the intermediate steps for both questions. You don't have to show the array representations.

5. Can a binary tree be max-heap and binary search tree (BST) at the same time? Justify with an example. [2]

6. Suppose an array is sorted in decreasing order. Is it a max-heap? [1]

7. Suppose you have an array A and you have to search a number X. Now write the pseudocode of ternary search algorithm and determine the runtime complexity. [5]

8. Write the pseudocode to delete an element from circular doubly linked list. [4]



2nd Year 1st Semester Incourse Examination

Course No. CSE-2102
Title: Object Oriented Programming

Department of Computer Science and Engineering, University of Dhaka
March 30, 2019

WARNING: You shall have to answer all the questions. Read the questions thoroughly, find what is asked for and then please answer to the point. Full marks in this examination is 30 and you have to answer the questions in 90 minutes.

Question 1 (Total 6 marks)

(a) In Object Oriented Programming, we often recommend set visibility of the fields of a class to private (or, protected) and use *setter* and *getter* methods to access them. Why? (2 marks)

(b) What are the *static variables* and *static methods*? What are their specialities? (2 marks)

(c) Explain the *static binding* and *dynamic binding* of class methods. Please explain with examples. (2 marks)

Question 2 (Total 7 marks)

(a) Suppose, you have to implement the following algorithm for a java project. Define the minimum class(es) and write the algorithm in a method. (4 marks)

Algorithm 1: `FastTwoSum`

Input: (a, b), two floating-point numbers
Result: (c, d), such that $a + b = c + d$

if $|b| > |a|$ **then**
  exchange a and b ;
end
$c \leftarrow a + b$;
$z \leftarrow c - a$;
$d \leftarrow b - z$;
return (c, d) ;

2 5
c = 7
7 → 5

(b) Write a server-side and a client-side java program to communicate with each other. The client-side program will send a sentence in small letters to the server-side program and the server-side program would echo-back the same sentence in capital letters to the client-side program. (3 marks)

Question 3 (Total 5 marks)

A beginner in Java writes the following program to test *inheritance* with basic shapes. Find the errors in the program and mention the corrections (Pinpoint the lines where the errors are located and mention the corrections). (2+3 marks)

BasicShapes.java

```
import java.lang.*;
class Shape
{
    private String name;
    private String color;
    public abstract String __toString();
    public Shape(String pName){
        name=pName;}
}

public class Rectangle extends Shape
{
    double width, height;
    public Rectangle(double w, double h){
        width=w; height=h;}
    public double computeArea() {
     return 'Area='+width*height;
    }
}

public class Circle extends Shape
{
  private double radius;
  public Circle(double r) {
    radius = r;}
  double computeArea() {
  return 'Area='+22/7*radius*radius;}
}

public class BasicShapes {
  public static void main(int argc, String argv[]) {
    Rectangle r=new Rectangle(4,2);
    Circle c = new Circle(12);
    Shape s = r;
    System.out.println(s.computeArea());
    s = c;
   System.out.println(s.computeArea());
   }
  }
```

Question 4 (Total 12 marks)

Let, the Department of Computer Science and Engineering, University of Dhaka has decided to convert its undergraduate program into an open-credit system. In the open-credit system, a student can choose a minimum of two and at most five courses in a semester. A teacher may offer 0 (zero) or any number of courses in a semester and the same course may be offered by different teachers. However, in a semester, a student can choose courses offered by different teachers only. Academic classes are taken in *Sections* and a section for a course is formed when at least 15 students takes the course. There are a number of classrooms in the department with different capacities where the teachers conduct the courses. The maximum number of students in a section is the capacity of the classroom. Classes are taken from Sunday to Thursday between 8:30 AM and 1:00 PM, and again between 2:00PM and 5:00 PM. Each class duration is 1 hour 30 minutes.

Now, the department of Computer Science and Engineering, University of Dhaka want to develop a Java application to take offered courses from the teachers and course options from the students and prepare the class-routine for a semester. If you require any other component/rule in the system, you are free to include that.

Based on the system described above, answer the following:

(a) Draw the class diagram for the system including visibility, multiciplity and direction (3 marks). The design should also meet the following constraints (1+2 marks):

i. There are at least two inherited classes. (1 mark)

ii. The diagram must have *composition* association. (2 marks)

(b) Define the java classes for the system (you do not need to implement a method, just use {} to specify the code block). (3 marks)

(c) Mention in which class methods (just mention the class and method name) you will ensure the following constraints :

S/N	Constraint	Marks
i.	Limits on number of chosen courses by a student	1
ii.	Two courses of a student do not coincide into the same time slot	1
iii.	Two different courses does not use same classroom in the same time slot	1

— GOOD LUCK —

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University of Dhaka
Department of Computer Science and Engineering
In course Examination , 2019
Subject : Bangladesh Studies (GED – 2104)

Total : 30
Time: 1 Hour

(Answer Any 5 Questions, Question 1 is Mandatory)

1. Order the following positions in correct order (from higher to lower order) according to the warrant of precedence. 2

Deputy Speaker, Cabinet Minister, General in Armed Forces

2. Briefly discuss the role of the rivers in especially the river delta system of Bangladesh. 7

3. Briefly discuss the physical geography of Bangladesh. 7

4. Briefly discuss the administrative structure of Bangladesh government. 7

5. How two nations concepts emerge during the movement against the British rule? Explain in your own words. 7

6. Mention the events at the aftermath of the Division of Bengal (1905-12). 7

7. Discuss the nature of climate in Bangladesh. Also mention few of the effects of global climate change already visible in our country. 7

2nd Year 1st Semester Midterm Examination – 2019
Dept. of Computer Science and Engineering
University of Dhaka
MATH 2105: Linear Algebra

Answer all questions. Time: 1 Hour

1. For which three values of k will the following system of linear equations have 1.5*3
   i. No solution
   ii. 1 solution (but will need a row exchange), and
   iii. infinite solutions?

$$kx + 3y = 6$$
$$3x + ky = -6$$

2. Find LU factorization of the matrix $A = \begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{bmatrix}$ 5

3. True or false (with a counterexample if false) 4
   a. the vector b that are not in the column space $C(A)$ form a subsplace
   b. if $C(A)$ contains only the zero vector, then A is the zero matrix.
   c. The column space of $2A$ equals the column space of A
   d. The colun space of $A - \mathbf{I}$ equals the column space of A

4. If the 9 by 12 system $Ax = b$ is solvable for every b, then define $C(A)$. 1

5. Construct a matrix whose column space contanis (1, 1, 0) and (0, 1, 1) and whose mullspace contains (1, 0, 1) and (0, 0, 1). 2

6. Fill out the matrix so that it has rank 1. 1.5

$$\begin{bmatrix} a & b \\ c & \end{bmatrix}$$

7. Find the complete solution to 5

$$\begin{bmatrix} 1 & 3 & 1 & 2 \\ 2 & 6 & 4 & 8 \\ 0 & 0 & 2 & 4 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \\ t \end{bmatrix} = \begin{bmatrix} 1 \\ 3 \\ 1 \end{bmatrix}$$

8. If a 7 by 9 matrix has rank 5, what are the dimensions of its four subspaces? 2

9. Find the bases of the four subspaces for the matrix 4

$$A = \begin{bmatrix} 0 & 3 & 3 & 3 \\ 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 1 \end{bmatrix}$$

10. Explain why $v = (1, 0, -1)$ cannot be a row of A and also be in the nullspace. 1