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ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
Department of Computer Science and Engineering (CSE)

MID SEMESTER EXAMINATION   WINTER SEMESTER, 2017-2018
DURATION: 1 Hour 30 Minutes   FULL MARKS: 75

SWE 4101: Introduction to Software Engineering

Programmable calculators are not allowed. Do not write anything on the question paper.
There are **4 (four)** questions. Answer any **3 (three)** of them.
Figures in the right margin indicate marks.

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1. a) Give a brief discussion on the areas of application of computer or computing system. List the characteristics of a computer. — 10

   b) Write down the stages of compilation process of a program. Explain with necessary examples. — 12

   c) **"Programming Language C is a compiled Language"** – Verify this statement with explanation. — 3

2. a) Convert any four of the following numbers: — 16
      (show the steps of calculation)
      i. $(Your\ Student\ ID)_{10} = (?)_{11}$
      ii. $(1011\ 0101\ 0010\ 1101\ 1001\ 111)_2 = (?)_{16}$
      iii. $(1011\ 0101\ 0010\ 1101\ 1001\ 111)_2 = (?)_8$
      iv. $(123)_4 + (567)_8 = (?)_{16}$
      v. $(1903.2018)_{10} = (?)_2$ (Calculate upto 4 digits after fraction point)

   b) Give a brief description on the stages of program development cycle. List all the components of the documentation for any program. — 9

3. a) Give a brief description on the basic organization of a computer system. — 10

   b) A program allows a person to enter values for the number of days, hours, minutes and seconds and outputs the total number of seconds to the screen. — 5+5+5
      i.   Write down the problem definition with IPO chart.
      ii.   Write down the data dictionary for the above problem.
      iii.   Write down the flowchart of the algorithm for the above problem.

4. A palindrome number is such a number that the reverse of that number is equal to the original number. For example: 8, 11, 101, 1221 etc. A program allows the user to give input an integer number. It will check whether the number is palindrome or not and print a message to show the findings. [Hints: First reverse the number then compare]

   a) Write the Pseudo code for the above problem. (Put the line number of the pseudo-code and necessary comments) — 8

   b) Write down the NS diagram for the above problem. — 8

   c) Write down the desk check for the **value 12321** following the pseudo code of Question no. 4(a). — 9

CSE 4105: Computing for Engineers

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There are **4 (four)** questions. Answer any **3 (three)** of them.
Figures in the right margin indicate marks.

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1. a) Explain the basic components of digital computer system with appropriate diagram.   12
    b) Describe the characteristics of a computer system.   8
    c) List three limitations of a computer system.   5

2. a) What do you understand by a compiler and an interpreter? Explain them with appropriate   7
        example.
    b) Explain the four stages of Compiling a C program.   12
    c) Differentiate between syntax error and runtime error with appropriate example.   6

3. a) What do you understand by Program Development Cycle? Explain each of the steps of   13
        Program Development Cycle with appropriate example.
    b) Define system software and application software with examples.   4
    c) Perform the following number conversion   8
        i. $(\text{your student ID})_{10} = (\ ?\ )_{16}$
        ii. $(26A3F)_{16} = (?)_8$
        iii. $(123132113)_4 = (?)_8$
        iv. iv) $(1455)_6 = (?)_5$

4. a) Let us suppose that you have to develop a program that will take a number as input and   9
        check whether it's a prime number. Now develop an algorithm that will perform the
        above mentioned task. You can express your algorithm either in pseudocode or flowchart.
    b) Convert your developed algorithm from Question 4.(a) into NS (Nassi–Shneiderman)   8
        diagram.
    c) Run a desk check on your developed algorithm for the input value 13.   8

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ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
<u>Department of Computer Science and Engineering (CSE)</u>

MID SEMESTER EXAMINATION   WINTER SEMESTER, 2017-2018
DURATION: 1 Hour 30 Minutes   FULL MARKS: 100

Math 4141: Geometry and Differential Calculus
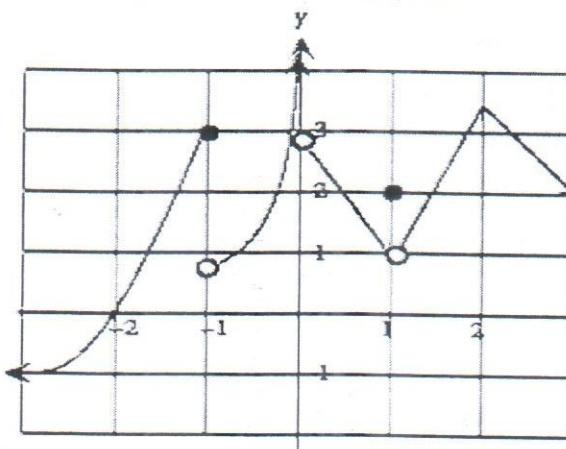
Programmable calculators are not allowed. **Do not write anything on the question paper.**
There are **4 (four)** questions. Answer any **3 (three)** of them.
Figures in the right margin indicate marks.

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1. a) Find the domain and range of the following functions   12

    i. $f(x) = \sqrt{x^2 - 11x + 30}$ ii. $g(x) = \sec x$ iii. $F(x) = \dfrac{x-3}{|x-3|}$ iv. $h(x) = \sin^{-1} x$

    b) Express the function $f(x) = x + |x+1|$ in piecewise form and graph the function.   8

    c) Graph the function $f(x) = 3\sin\dfrac{\pi}{2}x + 1$ using period and amplitude and write their domain   7
        and range.

    d) Find the inverse of the function $f(x) = \ln(x-3) + 1$ and graph the f and f^{-1} in the   6.33
        same plane.

2. a) Write down the precise definition of limit. Using formal definition of limit prove that   8
        $\lim_{x \to 2} \sqrt{9x - 2} = 4$.

    b) Find the Limit of the following functions: 16

    i. $\lim_{x \to 2^+} \dfrac{1}{|2-x|}$ ii. $\lim_{x \to 0} \dfrac{\tan 3x^2 + \sin^2 5x}{x^2}$

    iii. $\lim_{t \to +\infty} \dfrac{6 - t^3}{7t^4 + 3}$ iv. $\lim_{x \to -\infty} \dfrac{1 - e^x}{1 + e^x}$

    c) Discuss the Limit and Continuity of the following function at, $x = 3$ 9.33

    $$f(x) = \begin{cases} 4 - x^2 & x < 3 \\ 6 & x = 3 \\ x - 8 & x > 3 \end{cases}$$

    and draw the graph.

3. a) State Sandwich theorem and using this theorem show that   13.33

   i. $\lim_{x \to 0} \dfrac{\sin x}{x} = 1$ ii. $\lim_{x \to 0} x^2 \sin \dfrac{1}{x} = 0$

   b) Whether the following function f graphed is continuous on [-3, 3] or not. If not where does   8
it fail to be continuous and why? What is the $\lim_{x \to 1} f(x)$?

   c) Use Limit to determine for all horizontal and oblique asymptotes from following   12
equations:

   i. $F(x) = \dfrac{x^3 - 2}{|x|^3 + 1}$ ii. $h(x) = \dfrac{x^2 - 4}{x - 1}$

4. a) Find the tangent line to the curve $f(x) = \sqrt{x - 1} + 2$ at $x = 3$.   8

   b) At what points do the graph of the function $g(x) = x^2 - 7x + 12$ have horizontal tangent   10
line and show in your graph.

   c) The power P, in Watts, supplied to a circuit by a battery is given by the formula   10
$P = 6I - 0.5I^2$ where I is the current in amperes.
   i. What is the average rate of change of power when current is 1 to 4 amperes?
   ii. What is the approximate instantaneous rate of change of power when current is 4
amperes?

   d) Show that $f(x) = |2x + 1|$ continuous everywhere.   5.33

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ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
Department of Computer Science and Engineering (CSE)

MID SEMESTER EXAMINATION   WINTER SEMESTER, 2017-2018
TIME: 1 Hour 30 Minutes   FULL MARKS: 75

PHY 4141: Physics I
Programmable calculators are not allowed. Do not write anything on the question paper.
There are **4 (four)** questions. Answer any **3 (three)** of them.
Figures in the right margin indicate marks.

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1. a) Discuss charge and matter in electrostatics. With the help of a suitable example show that electric charge is quantized.   7

    b) Distinguish electric flux and magnetic flux . Derive Coulombs law from Gauss's law.   10

    c) Protons in the cosmic rays strike the earth's upper atmosphere at a rate, averaged over the earth's surface, of 0.15 protons/cm²-sec. What total current does the earth receive from beyond its atmosphere in the form of incident cosmic ray protons ? (Earth's radius=6.4 x 10^6 meters).   8

2. a) What is an electric dipole ? Draw the electric field lines and the equipotential lines for an electric dipole.   7

    b) An infinite long line charge has a linear charge density λ coul/m. Show that the electric field E at distance y from the line charge is given by $E = \dfrac{\lambda}{2\pi\varepsilon_0 y}$, where the symbols have their usual meaning.(*Do not use Gauss's law*). Write down the corresponding equation for the magnetic field B produced due to a current i flowing through a wire.   10

    c) An electric dipole consists of two opposite charges of magnitude q = 1.0 x 10^{-6} coul. separated by d = 2.0 cm. The dipole is placed in an external field of 1.0 x 10^5 nt/coul. (i) Calculate the maximum torque exerted by the field on the dipole (ii) How much work must an external agent do to turn the dipole end for end from a position $\theta = 180°$ to $\theta = 0$?   8

3. a) Discuss Gauss's law and Coulomb's law in electrostatics. Show with an example that an excess charge put on a metallic conductor will move onto the outer surface of the conductor.   7

    b) Describe with a clear circuit diagram the phenomenon of Einstein's Photo-electric effect. Discuss photocurrent, stopping potential, threshold frequency ,and the work function .   10

    c) A laser gun produces a beam of light 2.0 mm in diameter. The wavelength of the light is 532 nm (1 nm = 10^{-9} meter) and the output power is 20 mW(1 mW = 10^{-3} Watt) . Calculate the number of photons emitted by the gun in one second .   8

4. a) Write down the postulates of Special theory of relativity. What are inertial and non-inertial frames of reference ?   7

    b) Derive Lorentz Transformation equations. Also write down the inverse transformation equations.   10

    c) Give a geometrical description of Michelson-Morley's experiment. Discuss how the fringe shift in this experiment is related to the existence of Ether pervading the Universe ?   8

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ORGANISATION OF ISLAMIC COOPERATION (OIC)
Department of Computer Science and Engineering (CSE)

MID SEMESTER EXAMINATION   WINTER SEMESTER, 2017-2018
DURATION: 1 Hour 30 Minutes   FULL MARKS: 75

CSE 4175: Computer Programming

Programmable calculators are not allowed. Do not write anything on the question paper.
There are **4 (four)** questions. Answer any **3 (three)** of them.
Figures in the right margin indicate marks.

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1. a) Explain the different kinds of loops available in C with examples.   8
    b) Suppose an institute follows the following rules shown in Table 1 for their grading system.   12

Table 1: Grading system for question 1(b)

Class Interval	Letter Grade
80-100	A+
70-79	A
60-69	A-
50-59	B
40-49	C
30-39	D
0-29	F

   Write a program using *switch-case* that will take an integer x (0<=x<=100) as input and give
   the corresponding letter grade as output.
    c) Distinguish between constant and variable.   5

2. a) What are keywords and Variables? List the rules for naming a variable in C?   8
    b) What is the functionality of **break** and **continue**? Where do we use them and how do they   7
        differ? Explain with example.
    c) Write a program that prints the next 20 leap years.   10

3. a) The following code in Figure 1 contains some errors. Try to find out those errors and write   9
        down the correct code.

```c
#include <studio.h>
int main
{
    integer main, ball, char;
    char 1at, 2bt;
    for(i=0,i=<2,i++){
        printf("this is text.")
        printf("this is %f.",a+i);
    }
}
```

Figure 1: Code for question no. 3(a)

b) Given an integer number **n**, write a C program using **while** loop to print the average of all digits. For example, n=12345. Your output should print 3. In this case, digits are 1, 2, 3, 4 and 5. If we take average of these numbers then we will get (1+2+3+4+5)/5 = 3. 10

c) What is the difference between Run time error and Compile time error? Give example. 6

4. a) Write a program that generates the following output: 10

$$1$$
$$222$$
$$33333$$
$$4444444$$
$$555555555$$
$$66666666666$$

b) What are the different data types available in C? Write their format specifier. 5

c) Figure 2 contains a program written in C programming language. Write down the output of Figure 2. 10

```c
# include <stdio.h>
int main()
{
    int i=0;
    for(i=0; i<20; i++)
    {
        switch(i)
        {
            case 0:
                i+=5;
            case 1:
                i+=2;
            case 5:
                i+=5;
            default:
                i+=4;
                break;
        }
        printf("%d  ", i);
    }
    return 0;
}} /* end main */
```

Figure 2: Code for question no. 4(c)

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Department of Computer Science and Engineering (CSE)

MID SEMESTER EXAMINATION   **WINTER SEMESTER, 2017-2018**
DURATION: 1 Hour 30 Minutes   **FULL MARKS: 75**

CSE 4301: Object Oriented Programming

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There are **4 (four)** questions. Answer any **3 (three)** of them.
Figures in the right margin indicate marks.

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1. a) Figure 1 presents a class called **MatrixElement**. The class represents an element in a   15
   Matrix. The properties **row** and **col** represents the row number and column number of the
   element in a matrix, respectively. The row and column numbers start from 0. The property
   val represents the integer value of the element.
   Create a class called **Matrix** that stores the elements of a matrix privately in the form of
   MatrixElement objects. Create a public method inside **Matrix** class that asks the user to
   provide the dimensions of the matrix (number of rows and number of columns) and based
   on the user input dynamically create required **MatrixElement** objects. For each of the
   MatrixElement objects, set the **row**, **col** and **val** properties by taking input from the user.
   It should be noted that you cannot change the body of **MatrixElement**.

```
class MatrixElement{
     int row, col, val;
public:
     MatrixElement() :row(0), col(0), val(0) {}

     MatrixElement(int row, int col, int val) :row(row),
col(col), val(val) {}

     int getRow() {
          return row;
     }

     int getCol() {
          return col;
     }
     int getVal() {
          return val;
     }
};
```

Figure 1: MatrixElement class

   b) Update the class **Matrix**, created in Question 1(a), to add a public method that takes one   10
   Matrix object as parameter and multiplies the **MatrixElement** objects from the **Matrix**
   passed as parameter with its own **MatrixElement** objects. You have to at first check for
   dimension of the two matrices before multiplying them. To do that, you can update the
   class **Matrix** to include the number of rows and columns for each matrix.

2. Create a class called **StudentInfo** where the details of a student's academic records are stored. In the above mentioned class, the private properties will include the name and ID of the student. Moreover, a student can take any number of courses and the results of the courses are to be kept in an integer array inside **StudentInfo** class. All these properties need to be private and can only be accessed outside of **StudentInfo** class by **CalculateAvgResult** method from **ResultService** class and through the parameterized constructor of the **StudentInfo** class. It should be noted that the properties of the **StudentInfo** class can only be set once through this its constructor as parameters and the values should be immutable. **CalculateAvgResult** method calculates the average result of a given student. Moreover, ResultService include another method called **SortStudents** which takes an array of students as parameter and sorts them according to their average results in ascending order. Finally, **SortStudents** prints the names of the students according to the sorted list.

   Note: The **interface** and **implementation** for both the classes should be in separate files with each file marked elaborately along with their names. Moreover, you should include a main function in a separate file to demonstrate your implementation. Each file should refer to all required header and library files according to necessity.

   25

3. a) Create a class called **Rectangle**. The class has attributes **length** and **width**, each of which defaults to 1. It has member functions that calculate the **area** and **perimeter** of the rectangle. It has *set* and *get* functions for both **length** and **width**. The *set* function should verify that the length and width of the rectangle are floating point numbers larger than 0.0 and smaller than 20.0

   10

   b) Create a more sophisticated rectangle class than the one in question 3(a), which stores the Cartesian coordinates of the four corners of the rectangle. The constructor calls a set function that accepts four sets of coordinates. Verify that each of these coordinates falls into the first quadrant and none of the x or y coordinates is larger than 20.0. Also verify that the supplied coordinates in fact creates a rectangle. If the length and width are same for the rectangle, classify the rectangle as a Square.

   Hint: Use Pythagorean Theorem $a^2 + b^2 = c^2$. Distance between two points is $\sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2}$.

   10 + 5

4. a) How Structured programming is different from Object Oriented Programming?

   5

   b) Write short notes on

      i.   Separation of Concerns
      ii. Encapsulation
      iii. Polymorphism
      iv. Inheritance

   4×2

   c) Consider the problem in Question 2. If **StudentInfo** class included a destructor that would free up memory for the student's name and results array, will there be any problem in executing the program. Explain your answer.

   12

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ORGANISATION OF ISLAMIC COOPERATION (OIC)
Department of Computer Science and Engineering (CSE)

MID SEMESTER EXAMINATION   WINTER SEMESTER, 2017-2018
DURATION: 1 Hour 30 Minutes   FULL MARKS: 75

CSE 4303: Data Structures

Programmable calculators are not allowed. Do not write anything on the question paper.
There are **4 (four)** questions. Answer any **3 (three)** of them.
Figures in the right margin indicate marks.

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1. a) Define data structure and mention some of its major applications. Consider the data in Figure   9
        1, which gives different flights of an airline. Discuss one way of storing the data so as to
        decrease the time in execution the following:
        i.   Find the origin and destination of a flight, given the flight number.
        ii. Given city A and city B, find whether there is a flight from A to B, and if there is, find
             its flight number.

	CITY			NUMBER	ORIG	DEST
1	Atlanta		1	701	2	3
2	Boston		2	702	3	2
3	Chicago		3	705	5	3
4	Miami		4	708	3	4
5	Philadelphia		5	711	2	5
	(a)		6	712	5	2
			7	713	5	1
			8	715	1	4
			9	717	5	4
			10	718	4	5

(b)

Figure 1: Figure for the question no. 1 (a)

    b) Analyze the worst case scenario of Insertion sort and Quick sort. For the following array and   8
        the specified search key, what will be the number of iterations performed by binary search?
        $array = \{-6, 3, 4, 7, 9, 10, 11, 15, 16, 18, 19, 22, 25, 33, 47\}$, $search\ key = 12$
    c) In a singly linked list, can you speed up the two $O(n)$ operations of   8
        i.   Inserting before an arbitrary node
        ii. Erasing any node that is not the last node
        If possible then describe the solution approach with appropriate figure.

2. a) Define Deque. Translate Q into its equivalent postfix expression P using stack.   9
        $Q = (A + B * C / D - E + F / G / (H + I))$
    b) Explain how queue can be utilized for encoding and decoding a message with a repeated key.   10
        Assume you have queues with operations: *enqueue()*, *dequeue()*, *front()*, *isEmpty()*. How
        would you use the queue methods to implement a stack, in particular, *push()* and *pop()*
        operation?
    c) What is garbage collection? Discuss how and when garbage collection takes place.   6

3. a) Draw the necessary trees for inserting the following numbers one by one into a max-heap.   8
        7, 2, 1, 9, 12, 3, 14
        Now pop the two largest elements off the heap. Draw the heap after each such extraction.

b) Compare Big-oh, Big-omega, and Big-theta. Use figure if necessary. For each pair of functions $f(n)$ and $g(n)$ given below: 9

     i.   Write Θ in the box if $f(n) = \Theta(g(n))$

     ii.   Write O in the box if $f(n) = O(g(n))$

     iii.   Write Ω in the box if $f(n) = \Omega(g(n))$

     iv.   Write X in the box if none of these relations holds

If more than one such relation holds, write only the strongest one. No explanation needed.

$f(n)$	n^2	$n \lg n$	4^{n+4}	3^n	$n \lg n$
$g(n)$	n^3	n	2^{2n+2}	2^n	$n^{\frac{101}{100}}$
O, Θ, Ω or X					

c) Explain which one provides more benefits to store any type of data in between binary search tree and binary search. Let T be a binary search tree storing 128 entries. What is the smallest and height possible height of T? [Note: The height of a tree is the length (number of edges) of the longest path. A tree consisting of just one node has height 0.]   8

4. a) For each of the following situations, name the best sorting algorithm: 10

     i.   The array is mostly sorted already (a few elements are in the wrong place)

     ii.   You need an $O(n \log n)$ sort even in the worst case and you cannot use any extra space except for a few local variables.

     iii.   You have many compound data sets to sort separately and each one has around 100 elements.

     iv.   Instead of sorting the entire data set, you only need the k smallest elements where k is an input to the algorithm but is likely to be much smaller than the size of the entire data.

     v.   The ages (in years) of the people of Bangladesh is stored randomly in a file with at least 1 year. Now, you are given a very simple task of sorting all the ages in descending order.

b) Write short note and two real life applications for each of the followings: 6

     i.   Circular linked list

     ii.   Stack

     iii.   Priority queue

c) Explain Time-Space Tradeoff with suitable example. Analyze the code of Figure 2 and find out the complexity in terms of Big-O notation step by step. (try to make the upper bound tighter)   9

```
void complexity(){
        int i,j,c=2,n;
        for (i = 1; i <= n/c; i++){
                for (j = n; j > 0; j = j/c) {
                        printf("Learn Teamwork!");
                }
        }
        for (i = 1; i <= n; i = i*c) {
                printf("Teamwork Wins!!");
        }
}
```

Figure 2: Figure for the question no. 4 (c)

B.Sc. Engg./HD CSE 3ʳᵈ Semester   20 March 2018 (Morning)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
Department of Computer Science and Engineering (CSE)

MID SEMESTER EXAMINATION   WINTER SEMESTER, 2017-2018
DURATION: 1 Hour 30 Minutes   FULL MARKS: 75

CSE 4305: Computer Organization and Architecture

Programmable calculators are not allowed. Do not write anything on the question paper.
There are **4 (four)** questions. Answer any **3 (three)** of them.
Figures in the right margin indicate marks.

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1. a) What is interrupt? Explain the difference between computer architecture and computer   1+4
        organization.
    b) Draw the connection between processor and memory. List the steps needed to execute the   4+6
        machine instruction below in terms of transfer between the components drawn in your figure.

        Add   LOCA, R0

    c) What do you understand by RISC and CISC instruction set? Suppose complete execution of   5+5
        a high level program requires 100 machine language instructions. The average number of
        basic steps needed per instruction is 13.5. CPU clock cycle time is 5ns. Calculate the
        execution time of the program.

2. a) Evaluate the following expression into two address instruction format.   3
        $$((a+b)*(a+c))/b$$
    b) Register R1 and R2 of a computer contain the decimal values 1200 and 4600. What is the   7
        effective address of the memory operand in each of the following instructions?

        ```
        Move 20(R1), R3
        Load #3000, R3
        Store R3, 30(R1,R2)
        Add -(R2), R3
        Subtract (R1)+, R3
        ```

    c) Convert the expression given at question 2(a) into the format suitable for stack operation and 3+4
        explain the steps involved in executing the expression with diagram.
    d) Perform the following operation on the given binary string 10001011 by 2 bits.   8
        i. Rotate left with carry
        ii. Rotate right with carry
        iii. Arithmetic right shift
        iv. Logical shift right

3. a) Assume A processor has a direct mapped cache. Data words are 8 bits long (i.e. 1 byte). Data   8
        addresses are to the word. A physical address is 20 bits long. The tag is 11 bits. Each block
        holds 16 bytes of data. How many blocks are in this cache? What is the required size for tag
        directory?
    b) Why static RAM is faster than dynamic RAM? Briefly explain with proper diagram   5
    c) Consider a 16-way set-associative cache. Data words are 64 bits long. Data addresses are to   8+4
        the word. The cache holds 2 Mbytes of data. Each block holds 16 data words. Physical
        addresses are 64 bits long.
        i. How many bits of tag, index, and offset are needed to support references to this
            cache?
        ii. Suppose propagation delay of a comparator is 20k ns where k is the number of
            comparator. Propagation delay of OR gate is 10ns. Calculate the cache hit latency.

4. a) What do you mean by conflict miss and capacity miss? Explain with example.   5
    b) Briefly describe the system bus structure with example.   9
    c) Consider a hypothetical 32-bit microprocessor having 32-bit instructions composed of two   6
        fields: the first byte contains the opcode and the remainder the immediate operand or an
        operand address.
            i. What is the maximum directly addressable memory capacity
            ii. How many bits are needed for the program counter and the instruction register
    d) What is the condition of overflow in case of two's complement? If a memory system consists   2+3
        of a single external cache with an access time of 20 ns and a hit rate of 0.92, and a main
        memory with an access time of 60 ns, what is the effective memory access time of this
        system?

$\frac{1}{5}3$

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MID SEMESTER EXAMINATION   WINTER SEMESTER, 2017-2018
DURATION: 1 Hour 30 Minutes   FULL MARKS: 75

CSE 4307: Database Management Systems

Programmable calculators are not allowed. Do not write anything on the question paper.
There are **4 (four)** questions. **Question No. 2 is mandatory**. Answer any **2 (two)** from the remaining questions. Figures in the right margin indicate marks.

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1. a) File-processing system may introduce data redundancy and inconsistency. Explain it with a suitable example.   10

   b) Explain the usefulness of 1-1 cardinality using a real-life example.   5

   c) What is a sub-query (or nested query)? A sub-query can be placed in two places. Briefly mention them with suitable examples.   5

   d) What are Selection and Projection operations in relational algebra? Use a table with few records and show how these operations work. Is it possible to combine Selection and Projection? Justify it.   5

[Mandatory]

2. a) Define super key, candidate key, primary key and foreign key. Now consider the following system description of a typical bank automation: 3+6+7

   Branch Part: ABC is a large bank with more than 150 branches all over the country. Each branch has its geographical location, year of establishment, total no. of employee and current manager name. But management also wants to preserve the history of mangers at different branches with these information: branch name, manger name, joining date, end date.

   Account Part: Before opening account a customer must supply his/her basic information such as : name, DOB, address, phone and introducer. Introducer is an existing customer. There are 3 basic types of accounts such as i) Current ii) Saving and iii) Student. Each type is different only by one attribute (i.e. Interest Rate). Assume other attributes are identical. After fulfilling personal information he/she can open account with the following information: Account No, Title of Account, Owner of the Account (person), Type of Account (either of the 3 already mentioned). One person may have multiple accounts but he/she will fulfill the personal data only once.

   Transaction Part: There are two basic types of transaction as such i) Deposit and ii) Withdraw. Each transaction must include the following information: transaction no, amount, type of operation, date time, account no.

   Your tasks are now:
   i. Design the ERD with appropriate cardinality. In each step comment on how your design satisfy the given requirements.
   ii. Convert ERD into DDL using standard SQL (you should mention the appropriate primary key and foreign key in each definition).

b) Consider the following entities: 3×3

```
Depts(Code, Name)
Students (ID, Name,GPA, Dept (Foreign Key Referring to Depts))
```

Write SQL for the followings:
 i.   List the Student Name whose GPA is above the average GPA of the students.
 ii. List the ID and Name of 2 students: one who got the highest GPA and the other one who got the lowest GPA. (A single list will show these two students information).
 iii. List of Dept Name, Dept Code and total number of student of that department.

3. a) Differentiate between the followings using proper example data: 5
    i. Cartesian Product and Natural Join   ii. Left Outer Join and Right Outer Join

 b) Create tables as described using standard SQL: 10

Table: Division

Attribute	Description and/or Data Type	Requirement / Other information
ID	Numeric with no decimal part.	Primary key
Name	50 characters	It may be used by other than English language such as Chinese.
Size	In Squire KM	Division size cannot be less than 20 squire KM

Table: Person

Attribute	Description and/or Data Type	Requirement / Other
ID	Numeric with no decimal part.	Primary key
Name	50 characters	It may be used by other than English language such as Chinese.
DOB	Date	No date before January 1, 1950 is allowed.
DivisionCode	Foreign Key (Division)	It cannot be empty.
Salary	Monthly Basic Salary	May be null only for unemployed.
BloodGroup	Character	Any value from List{A+ve, A-ve, B+ve, B-ve, AB+ve, AB-ve}

Note that the table Person has only division information. In reality a division has a number of districts. How can you include district information in the person table? Explain.

 c) Write SQL for the followings: 2×5
    i.   List the division name and its size according to its size.
    ii. List the person ID and name who live in divisions that start with 'D'.
    iii. List the person ID and name who live in division with the largest size (in squire KM)
    iv. List the division name and its total inhabitants.
    v.   List the division name and its total inhabitants where total inhabitants is at least 10000.

4. a) What are total participation and partial participation? Explain with example.   5

   b) Consider a result processing system of a large university. The followings are some   8
requirements given with `pseudo code`. Also some additional instructions (marked as **I**) are given. Your task is to convert the pseudo code to appropriate DDL satisfying the additional instructions.
```
Dept(ID, Name)
Prog(ID,Name)
```

I: Correct it so that it preserves *one to many* relationship.

```
Student(ID, Name, DOB, CGPA)
```

I: Make the DDL such that Student maintains one to many relationship with both Dept and Prog.

```
Emp(ID, Name, Dept)
```

I: Now create another entity to store the grades for the individual courses of each students. First justify its relationship (cardinality) and present your solution.

   c) What are weak entity set and discriminator? Present an example in this regard.   7

   d) Discuss the various ways to impose constraints on generalization.   5

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
Department of Computer Science and Engineering (CSE)

MID SEMESTER EXAMINATION   **WINTER SEMESTER, 2017-2018**
DURATION: 1 Hour 30 Minutes   **FULL MARKS: 75**

Math 4341: Linear Algebra

Programmable calculators are not allowed. Do not write anything on the question paper.
There are **4 (four)** questions. Answer any **3 (three)** of them.
Figures in the right margin indicate marks.

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1. a) Determine if the following linear system is consistent (has solution) or not. Calculate the   10+2
        determinant of the coefficient matrix A from its row-echelon form.

$$x_2 - 4x_3 = 8$$
$$2x_1 - 3x_2 + 2x_3 = 1$$
$$5x_1 - 8x_2 + 7x_3 = 1$$

    b) Prove that – "If a linear system is consistent, then the solution is unique if and only if   3
        every column in the coefficient matrix is a pivot column; otherwise there are infinitely
        many solutions."

    c) Find the resultant matrix $C=A \times B$ from matrix multiplication, where   10

$$A = \begin{bmatrix} 2 & 5 & 4 \\ -3 & 0 & -3 \\ 7 & -6 & 8 \end{bmatrix} \qquad B = \begin{bmatrix} 1 & 4 & -6 \\ 0 & 2 & 1 \\ 1 & 3 & 2 \end{bmatrix}$$

    All calculations are to be shown from the concepts of column-picture.

2. a) Find the inverse of matrix A using Gauss-Jordan method: 10

$$A = \begin{bmatrix} 1 & 2 & 3 \\ 2 & 5 & 3 \\ 1 & 0 & 8 \end{bmatrix}$$

    Show all elimination matrices for performing row eliminations.

    b) Factorize the matrix A in Question 2.(a) into its *LDU* form.   5
    c) Find the nullspace of the following matrix A: 10

$$A = \begin{bmatrix} 1 & 2 & 2 & 4 & 6 \\ 1 & 2 & 3 & 6 & 9 \\ 0 & 0 & 1 & 2 & 3 \end{bmatrix}$$

    Which are the free columns and the pivot columns?

3. a) Find the complete solution to   15

$$\begin{bmatrix} 1 & 3 & 1 & 2 \\ 2 & 6 & 4 & 8 \\ 0 & 0 & 2 & 4 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{bmatrix} = \begin{bmatrix} 1 \\ 3 \\ 1 \end{bmatrix}$$

b) Find the dimension and basis for the rowspace, columnspace, nullspace and left-nullspace, respectively, for the coefficient matrix A as given in Question 3.(a)   10

4. a) Define a vector subspace. Prove the followings with examples: 1+3+3
   i. The union of two subspaces is not a subspace.
   ii. The intersection of two subspaces is a subspace

   b) Check that the solutions to $Ax=0$ are perpendicular to the rows: 9+1+3

   $$A = \begin{bmatrix} 1 & 0 & 0 \\ 2 & 1 & 0 \\ 3 & 4 & 1 \end{bmatrix} \begin{bmatrix} 4 & 2 & 0 & 1 \\ 0 & 0 & 1 & 3 \\ 0 & 0 & 0 & 0 \end{bmatrix} = E^{-1}R$$

   How many independent solutions to $A^T y=0$? Why is the y^T the last row of E?

   c) In a $\mathbf{R}^5$ vector-space, suppose two sub-spaces, each being a plane, are orthogonal to each other. Can one of them represent a row-space and the other represents a null-space? Explain your answer.   5

B.Sc. Engg. / HD CSE 5th Semester   19 March 2018 (Afternoon)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
Department of Computer Science and Engineering (CSE)

MID SEMESTER EXAMINATION   **WINTER SEMESTER, 2017-2018**
DURATION: 1 Hour 30 Minutes   **FULL MARKS: 75**

CSE 4501: Operating Systems

Programmable calculators are not allowed. Do not write anything on the question paper.
There are **4 (four)** questions. Answer any **3 (three)** of them.
Figures in the right margin indicate marks.

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1. a) Draw the process state diagram.   5
   b) What is context switch? Show that, if the wait() and signal() semaphore operations are not   1+7
   executed atomically, then mutual exclusion may be violated.
   c) Describe the differences among short-term, medium-term, and long-term scheduling.   3×3
   d) What are the three main purposes of an operating system?   3

2. a) What is deadlock? Explain a scenario in terms of OS that might lead to deadlock.   1+4
   b) Race conditions are possible in many computer systems. Consider a banking system that   10
   maintains an account balance with two functions: deposit(amount) and withdraw(amount).
   These two functions are passed the amount that is to be deposited or withdrawn from the bank
   account balance. Assume that a husband and wife share a bank account. Concurrently, the
   husband calls the *withdraw()* function and the wife calls *deposit()*. Describe how a race
   condition is possible and what might be done to prevent the race condition from occurring.
   c) What are the five major activities of an operating system with regard to process management?   5
   d) Keeping in mind the various definitions of operating system, consider whether the operating   5
   system should include applications such as web browsers and mail programs. Argue both that
   it should and that it should not, and support your answers.

3. a) Including the initial parent process, how many processes are created by the program shown   4
   below

```c
#include <stdio.h>
#include <unistd.h>
int main()
{
    /* fork a child process */
    fork();
    /* fork another child process */
    fork();
    /* and fork another */
    fork();
    return 0;
}
```

   b) What are the two models of inter process communication? What are the strengths and   10
   weaknesses of the two approaches?
   c) Write down the advantages of multiprocessing system. Differentiate between symmetric and   7
   asymmetric multiprocessing.
   d) What is semaphore? What are the three major activities of an operating system with regard to   1+3
   memory management?

4. a) The two processes, P0 and P1, share the following variables: 3×4

```
boolean flag[2]; /* initially false */
int turn;
```
The structure of process *Pi* (i == 0 or 1) is as below:
```
do {
  flag[i] = true;
  while (flag[j]) {
    if (turn == j) {
      flag[i] = false;
      while (turn == j)
        ; /* do nothing */
      flag[i] = true;
    }
  }
  /* critical section */
  turn = j;
  flag[i] = false;
  /* remainder section */
} while (true);
```

The other process is Pj (j == 1 or 0). Prove that the algorithm satisfies all three requirements for the critical-section problem.

b) What is the Dining Philosophers problem? Explain the problem scenario and the two results it   2+4+4
might lead to. Provide two approaches that can solve it with explanation.

c) Define API and System Call. Why API is used rather than system calls? 1+2

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Department of Computer Science and Engineering (CSE)

MID SEMESTER EXAMINATION   WINTER SEMESTER, 2017-2018
DURATION: 1 Hour 30 Minutes   FULL MARKS: 75

CSE 4503: Microprocessors and Assembly Language

Programmable calculators are not allowed. Do not write anything on the question paper.
There are **4 (four)** questions. Answer any **3 (three)** of them.
Figures in the right margin indicate marks.

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1. a) 'Assembly language is a low level language' - True/False? How do the 8085 and 8086 microprocessors differ with each other in terms of register sets?   9

   b) Derive the contents of the Flag (CF, PF, ZF, SF) register of 8086 microprocessor upon executing the following instructions: 8
      i.   CMP AL, ABh   ; Assume AL initially contains FFh.
      ii. SUB AX, 1234h ; Assume AX initially contains 8000h.

   c) Write appropriate assembly language codes to accomplish the following tasks (use as many as possible arithmetic instructions with less number of registers):   8
      i.   0Bh × (200 - 225) + 127
      ii. FFFh × 10h + 1111b

2. a) What is Memory Segment? Write the concept of memory segmentation and addressing for 8086 processor.   9

   b) *"Number of address locations and memory size have a close relation with the Address Bus length"* – How?   8

   c) Suppose, while debugging an assembly language program the values of the registers are: Flag=FEB9h, IP=0102h, CS=0500h, SP=FFFCh. Now, if INT 21h is requested, derive the memory addresses from where the new IP and CS can be retrieved; Also show the new SP value and steps involved in handling the interrupt by the 8086 microprocessor.   8

3. a) Draw the schematic architecture of 8086 microprocessor. Write an example to explain the operation of *Instruction Pointer and Code Segment* register of 8086 microprocessor.   9

   b) Briefly explain the concept of Fetching and Execution cycles of an instruction.   8

   c) Write an assembly language program structure to allocate exactly 64 Kbytes of memory for *data segment*, 128 Bytes for *stack segment* and also consider that the size for *code segment* may exceed 64 Kbytes.   8

4. a) Write a short note on *interrupt* concepts and why it is so necessary?   9

   b) Explain the procedure to perform MUL and DIV operation in assembly language.   8

   c) To perform a SWAP operation amongst the contents of CX and DX registers, write two assembly language programs using: i. 8086 Stack Segment Operation ii. 8086 Instruction   8

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Department of Computer Science and Engineering (CSE)

MID SEMESTER EXAMINATION   WINTER SEMESTER, 2017-2018
DURATION: 1 Hour 30 Minutes   FULL MARKS: 75

CSE 4513: Software Engineering and Object Oriented Design
Programmable calculators are not allowed. Do not write anything on the question paper.
There are **4 (four)** questions. Answer any **3 (three)** of them.
Figures in the right margin indicate marks.

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1. a) Briefly describe waterfall model. When can waterfall process model be more productive   8+2
   even over agile process models?

   b) Event management has become a very lucrative business now a days as organizations and   7+8
   individuals are outsourcing the management of their picnics, annual excursions, wedding
   receptions and miscellenious parties to event management companies. Suppose XYZ are
   running an event management business and they want a software to help them in their
   business. They told you about their business, now after hearing them:
      i. Can you elaborate the use case for booking an event/ party with XYZ?
      ii. Find out the domain classes and their basic relationships/ associations.

2. a) What are the planning activities you can think you when you plan for a software solution?   8
   Two of the planning principles are:
   - 'Planning is iterative' and
   - 'Plan based on what you know'
   Quote your experience in planning one of your projects and how you applied the two
   principles.

   b) Briefly describe how UML diagrams are used in agile process.   4
   c) Describe SCRUM agile development process.   8
   d) What is CRC? Quote a particular example of using CRC in any of your projects.   2+3

3. a) Change is difficult and costly to accommodate in typical software process model. Why? How   6
   does the agile process model accommodate change then? Show the cost savings of agile
   process using a chart/graph.

   b) Value Added Services (VAS) have become common in Cellular Data Network. Elaborate the   8
   VAS architecture?

   c) Describe the following aggregration and composition relationship given in Figure 1.   6
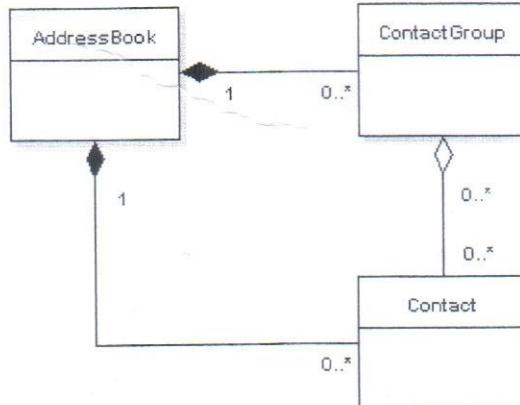

Figure 1.

   d) What are Continuous Integration (CI) and Test Driven Development (TDD)?   5

4. a) What is a Software Requirement Specification (SRS)? What are the elements of a SRS. 3+4
   b) Draw an activity/ swim lane diagram to withdraw money from an ATM machine. 7
   c) Write a short note on sequence diagram. 4
   d) Noun becomes class and Verb becomes method. Discuss the analysis principle with a 7
      suitable example. Also discuss about the placement of the methods into the classes.

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Department of Computer Science and Engineering (CSE)

MID SEMESTER EXAMINATION   WINTER SEMESTER, 2017-2018
DURATION: 1 Hour 30 Minutes   FULL MARKS: 75

CSE 4531: E-Commerce and Internet Security

Programmable calculators are not allowed. Do not write anything on the question paper.
There are **4 (four)** questions. Answer any **3 (three)** of them.
Figures in the right margin indicate marks.

1. a) Define aggregator model for e-business. Classify aggregators along with their description. 10
   b) Describe various advertising models for e-business. 10
   c) What is session? How session can be used to track and analyze customer behavior? 5

2. a) Draw the browsing behavior model of an e-commerce site. Describe various parts of the model. 10
   b) Discuss on various means of advertising used in e-marketing. 10
   c) Explain the advantages of e-marketing over traditional marketing. 5

3. a) Discuss the scenario when e-CRM (Customer Relationship Management) will be valuable for a company. Also write down e-CRM's development strategies. 10
   b) Discuss the issues concerning customer privacy in an e-CRM. 10
   c) Draw a diagram showing typical business touch points of an e-CRM. 5

4. a) Discuss on seven interface elements of a good e-commerce site. 12
   b) You are needed to develop an e-commerce site for your company. You already have few entry level programmer in your company. What type of development strategy you better follow to develop your site? Justify your answer. 10
   c) List the factors that will increase returning visitors to your site. 3

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MID SEMESTER EXAMINATION   WINTER SEMESTER, 2017-2018
DURATION: 1 Hour 30 Minutes   **FULL MARKS: 75**

CSE 4539: Web Programming

Programmable calculators are not allowed. Do not write anything on the question paper.
There are **4 (four)** questions. Answer any **3 (three)** of them.
Figures in the right margin indicate marks.

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1. a) Define "Block-level Elements" and "Inline-elements" in HTML with appropriate examples.   4

    b) Write Short notes on the following CSS attributes with appropriate examples: 4x2.5
        i.   Position: Absolute
        ii. Position: Fixed
        iii. Position: Relative
        iv. Position: Sticky

    c) Write only the necessary **CSS** codes for **converting** Figure.1(c)_1 into Figure.1(c)_2   4

        i.   HTML
        ii. CSS
        iii. JAVASCRIPT

        Figure 1(c) _1

        HTML CSS JAVASCRIPT

        Figure 1(c) _2

    d) Modify the following HTML code for converting to XHTML: 7

        ```
        <Html>
        <BODY>
                <p>HTML is fun! <br> CSS is fun also!
                <p> <b> this is bold text</p> </b>
                <IMG src="image.jpg" width=50%>
        </BODY>
        </html>
        ```

2. a) Both 'Class' and 'ID' attributes are used to define styles of certain HTML elements. With some appropriate examples explain which one of these two is helpful for which cases.   7

b) Write the appropriate HTML code for creating the following table: 9

Figure. 2(b)

c) Modify the HTML code for increasing HTML Accessibility (Use proper HTML tags.) 9

```
<! DOCTYPE html>
<html>
<head>
        <title></title>
</head>
<body>
        <img src="image.jpg">
        <p style="font-size: 20px">Heading 1</p>
        <p>"This is a quotation"</p>
        <p>
            My Address is :<br>Islamic University of Technology<br> Gazipur<br> Dhaka
        </p>
        <p>Newton found the formula: F=M*a</p>
        <p>C program for this formula might be :<br>
                <p>int M,a</p>
                <p>scanf("%d%d",&M,&a)</p>
                <p>Printf("%d",M*a)</p>
        </p>
</body>
</html>
```

3. a) In how many ways can CSS be added to HTML elements? Explain with short examples. 6

b) Write the necessary HTML/CSS codes for generating the following output:[default font is 'Times new roman, 11px', The other font used in the text is 'Courier New']   8

> o On **15th March**, Web exam ~~shall~~ will *take* <u>Place</u>.
> o Everyone should `take good` preparation for the exam.
> o Click this <u>link</u> for exam syllabus.

c) Explain the following CSS properties with example: 3x3
   i.   Outline-offset
   ii. Overflow: auto
   iii. Box-sizing: border box;

d) Write the difference between 'display: none' and 'visibility: hidden' attributes in CSS.   2

4. a) Write the necessary HTML & CSS codes for converting Figure.4 (a) _1 to Figure 4(a) _2 when user hovers the mouse pointer on Figure.4 (a)_1.   6

This is a link

Figure.4 (a) _1

This is a link

Figure.4 (a) _1

b) Mention different types of 'INPUT TYPES' (at least 5) of a **Form** and explain their usage.   10

c) What is the use of JavaScript in a webpage? Write the necessary HTML & JavaScript codes so that if the button is clicked, The heading will be replaced by the current date and time.   1+6

HEADING

Click me to display Date and Time.

d) Explain the CSS attribute: "margin: auto".   2

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
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Department of Computer Science and Engineering (CSE)

MID SEMESTER EXAMINATION	**WINTER SEMESTER, 2017-2018**
DURATION: 1 Hour 30 Minutes	**FULL MARKS: 75**

CSE 4549: Simulation and Modeling

Programmable calculators are not allowed. Do not write anything on the question paper.
There are **4 (four)** questions. Answer any **3 (three)** of them.
Figures in the right margin indicate marks.

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1. Consider a university cafeteria where no waiting staff service or table service is available. At present there exits two food-serving counters named *Main Counter* (serves main meal) and *Dessert Counter* (serves dessert item). Students enjoy their meal service from *Main Counter*, and/or *Dessert Counter* by placing their individual service request at respective counters one by one. If a student arrives and finds the *Main Counter* idle, he/she is served immediately with his requested service, else he/she waits in a *FIFO* Queue. The students have the exponential inter arrival times with mean 2.1 minutes and the service time at *Main Counter* is also exponentially distributed with mean service time 2.0 minutes.

    At the completion of service by the *Main Counter*, a student either departs with p probability or requests next service to *Dessert Counter* with $(1-p)$ probability. The *Dessert Counter* requires exponential service time with mean 2.3 minutes. When the *Dessert Counter* remains busy at the time of service request, arriving students again wait in a FIFO queue associated with it. Upon service completion from *Dessert Counter*, students then return for additional service at the *Main Counter* again. For both counters, as any (served) student departs, if the queue is empty then the counter becomes idle, else a student from top of the queue is served immediately.

    Initially the system is empty and idle, and the simulation is to run for exactly 8 hours. The purpose of the simulation is to improve the system in terms of followings: average delay in each queue, the time average number in each queue, and the utilization of the each counter.

    a) What are the state variables and output variables for this simulation model?   4
    b) Identify the set of events for this simulation model.   5
    c) Write down the state equations for this simulation model.   7
    d) Write down the state space for this simulation model.   4
    e) Write down the output equations for this simulation model.   5

2. For the scenario given in Question 1 answer the followings:
    a) Draw a sample path of the system for a few initial minutes showing the change of the   13
        state variable(s) over time.
    b) Draw the separate flow charts of the events routines (i.e. the event handler functions) for   12
        any two of the events of the system.

3. a) Describe the characteristic properties of *Discrete Event Systems (DES)*.   5
    b) List the steps of *Simulation Development Life Cycle*.   6
    c) Describe what you think would be the most effective way to study each of the following   6
        systems in terms of given possibilities below and discuss why.
        - Possible study approaches:
          i.   Experiment with the physical model of the system
          ii. Experiment with the mathematical model of the system through simulation

- Given systems:
  - i. Earth's thermodynamic in a particular geographic area
  - ii. Small section of an existing inventory system
  - iii. Traffic system in a metropolitan area
  - iv. Water supply system in a commercial building
  - v. Digital communication system in a battlefield

d) For each of the systems in Question 3.c, suppose that it has been decided to make a study   8
via a simulation model. Discuss whether the simulation should be deterministic or
stochastic, time-varying or time-invariant, and continuous state or discrete state. Justify
your answers considering appropriate assumptions.

4.   Consider a single server queuing system in which customers arrive according to Poisson
process with rate $\lambda 1$. Upon arriving, they either enter into service if the server is free or
they join the queue. However, it is assumed that, each customer will only wait a random
amount of time, having distribution F, in queue before leaving the system. Service time
of a customer is exponential with rate $\lambda 2$.

Suppose that each time the server completes a service, the next customer to be served is
the one who has the earliest queue departure time. That is, if two customers are waiting
and one would depart the queue if his/her service has not yet begun by time $t1$ and the
other if his/her service had not yet begun by time $t2$, then the former would enter service
if $t1 < t2$, and the later otherwise.

Assume that the following random variates are available:
- Inter-arrival Times (in second) are:
  $Y_1 = 0.4$, $Y_2 = 0.3$, $Y_3 = 0.4$, $Y_4 = 1.7$, $Y_5 = 1.7$, $Y_6 = 0.5$, and $Y_7 = 0.9$
- Waiting Times (in second) are:
  $X_1 = 0.3$, $X_2 = 0.8$, $X_3 = 1.5$, $X_4 = 0.6$, $X_5 = 1.3$, $X_6 = 0.2$, and $X_7 = 1.1$
- Service Times (in second) are:
  $Z_1 = 1.6$, $Z_2 = 0.5$, $Z_3 = 1.0$, $Z_4 = 0.9$, $Z_5 = 0.8$, $Z_6 = 0.7$, and $Z_7 = 1.1$

a) Draw the sample path of the system for the above data   10
b) Mention the state(s) of the system at every event occurrence time.   5
c) Find the number of customers those left the queue   5
d) Find the average waiting time of the customer in the queue.   5

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
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Department of Computer Science and Engineering (CSE)

MID SEMESTER EXAMINATION   WINTER SEMESTER, 2017-2018
DURATION: 1 Hour 30 Minutes   FULL MARKS: 75

CSE 4551: Computer Graphics and Multimedia

Programmable calculators are not allowed. Do not write anything on the question paper.
There are **4 (four)** questions. Answer any **3 (three)** of them.
Figures in the right margin indicate marks.

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1. a) Compute the access time per pixel for a display system with resolution 1280X1024 assuming   7
   that the refresh rate is 60fps. Also consider that for each scan line 20% time is wasted on
   performing horizontal retrace and it takes about 20 scan lines worth of time for vertical
   retrace.

   b) Prove that two successive 2D rotations are additive; that is $R(\theta_1) . R(\theta_2) = R(\theta_1 + \theta_2)$.   8

   c) Draw the basic architecture of a Refresh and Raster Scan display device. Considering *Full*   10
   Color Frame Buffer, discuss how a color image can be displayed on the CRT monitor.

2. a) Write the sequence of steps required to reflect an object about an arbitrary axis (e.g. *y=mx*   8
   +c) in three dimensional space. Find out the transformed coordinates of a line AB, where A
   = (2, 1, 2) and B = (0, 1, 1) is rotated by 30^0 around Y-Axis.

   b) In modern technology, different manufacturer companies try their best to produce display   7
   devices such that they can commit the naturalistic visionary impression to the viewer. Now
   comparatively discuss about the functional mechanism between LED display devices and
   plasma display devices to touch this goal.

   c) Derive the Rotation matrix required to perform an anti-clockwise rotation in 3D space.   10
   Mention any useful properties that this rotation matrix possess.

3. a) Suppose T1, T2 and T3 are three different matrices which represent different kinds of   5
   transformation in three dimensional space. Now if these matrices are applied in the following
   sequences on Figure 1, will the final transformed image be the same for both cases? Justify
   your answer mathematically.

   Sequence 1: T1, T3, T2
   Sequence 2: T2, T1, T3
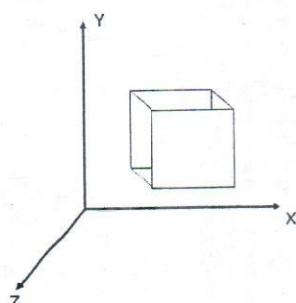
Figure 1: A 3D object. (2D).

b) Derive the sequence of transformation matrix required to transform the object in Figure 2(a)   12
into the object in Figure 2(b).
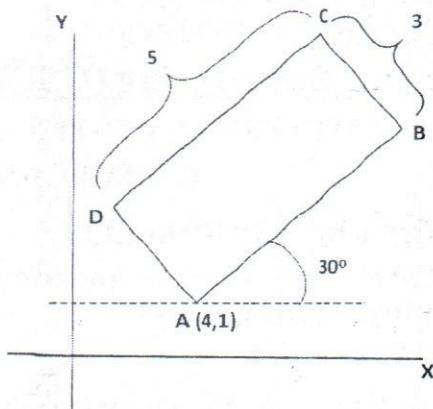

Figure 2(a): Original object (2D).   Figure 2(b): Transformed object
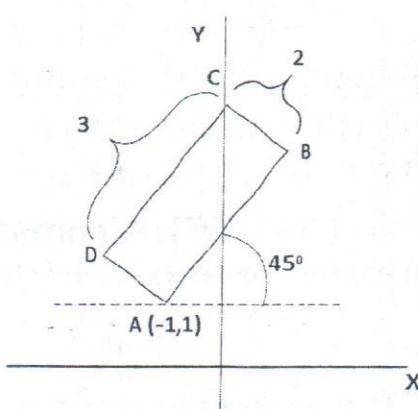
c) Write short notes on: 8
   i.   Resolution
   ii.   Bandwidth of a display
   iii. Phosphorescence
   iv.   Shadow mask

4. a) Write down the pseudo code of Cohen-Southerland algorithm to clip a line which is partially   8
      inside viewing window. Also mention the weakness with this algorithm if there any.
   b) Let W be the rectangular window in Figure 3 whose lower-left corner is at A(-3,-2) and   10
      upper-right corner is at B(6,7).
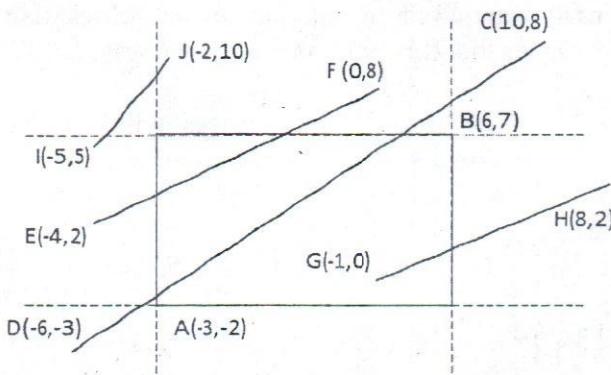
Figure 3: Rectangular window with arbitrary lines.

Answer the following questions:
   i.   Calculate the TBRL codes for the endpoints of all the lines. Find out which of these
         points will be trivially accepted and rejected.
   ii.   Use the Cohen-Southerland algorithm to clip the line segments in Figure 3 (Show all
         the steps).
   c) Define **affine transformation**. What is **homogeneous co-ordinate system**? Why do we   7
      need this co-ordinate system in computer graphics?

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ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
Department of Computer Science and Engineering (CSE)

MID SEMESTER EXAMINATION   WINTER SEMESTER, 2017-2018
DURATION: 1 Hour 30 Minutes   FULL MARKS: 75

CSE 4573: Microprocessor and Assembly Language Programming
Programmable calculators are not allowed. Do not write anything on the question paper.
There are **4 (four)** questions. Answer any **3 (three)** of them.
Figures in the right margin indicate marks.

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1. a) Briefly describe odd and even addressed byte and word transfer of 8086 with the help of odd   8
   and even address space and appropriate examples.
   b) Write an assembly language program that will prompt the user to give two numbers as input   10
   and display the summation of the numbers in the next line. Assume that the summation will
   not exceed 9.
   Sample Execution:
   ```
   Enter the first number: 2
   Enter the second number: 3
   Answer: 5
   ```
   c) What is memory model? Describe different types of memory models.   7

2. a) Draw the internal block diagram of an 8086 microprocessor and briefly explain different   15
   components of independent functional parts.
   b) How does a processor determine that overflow has occurred? Consider both signed and   7
   unsigned overflow. Explain with examples.
   c) What is the purpose of FLAGS register? Why is it beneficial for a microprocessor?   3

3. a) What is the main purpose of the LEA instruction? Why do we need to initialize the DS   5
   register at the beginning of a program for displaying a string?
   b) Draw a diagram to depict the read and write bus cycle executed sequentially by a   10
   microprocessor.
   c) Describe different types of addressing modes of 8086 microprocessor.   10

4. a) For each of the following instructions, give the new setting of CF, SF, ZF, PF, OF and   15
   briefly explain the reasons. Suppose that the flags are initially 0.
   i.   CMP BX, CX ;[BX=0009H, CX=00FFH]
   ii.   INC AX ;[AX=00FFH]
   iii.   NEG DX ;[DX=8000H]
   b) What are the functionalities of the following 8086 pins?   10
   $\overline{BHE}$, $MN/\overline{MX}$, ALE, $\overline{TEST}$, $HOLD$

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Department of Computer Science and Engineering (CSE)

MID SEMESTER EXAMINATION   WINTER SEMESTER, 2017-2018
DURATION: 1 Hour 30 Minutes   FULL MARKS: 75

CSE 4701: Artificial Intelligence

Programmable calculators are not allowed. Do not write anything on the question paper.
There are **4 (four)** questions. Answer any **3 (three)** of them.
Figures in the right margin indicate marks.

---

1. a) Consider the following generic search pseudo-code: 5

```
Procedure Search(G,S,goal)
          Inputs
                    G: graph with nodes N and arcs A
                    S: set of start nodes
                    goal: Boolean function of states
          Output
                    path from a member of S to a node for
which goal is true
                    or ⊥ if there are no solution paths
          Local
                    Frontier: set of paths
          Frontier ←{⟨s⟩: s∈S}
          while (Frontier ≠{})
                    select and remove ⟨s0,...,sk⟩ from Frontier
                    if ( goal(sk)) then
                              return ⟨s0,...,sk⟩
                    Frontier ←Frontier ∪{⟨s0,...,sk,s⟩: ⟨sk,s⟩∈A}
          return ⊥
```

Figure 1: Code listing 1

Imagine that this generic algorithm was used as the basis for an implementation of depth-first search and of breadth-first search. Which line or lines of the pseudocode above must have different implementations? Briefly, how would those implementations differ?

  b) IUT has been expanding for the last couple of years. Assume that IUT has acquired a new   12
site in BoardBazar as part of the expansion project. You have to place a dormatory, a new
academic building, a recreational area and an administration building. The area for
development can be represented as 3x3 grid (three rows 0,1,2 and three columns 0,1,2) and
you need to place each development in one cell of the grid. Unfortunately, there are some
practical constraints on the problem that you need to take into account. In the following, A is
close to B if A is in a cell that shares an edge with B (sharing a corner does not make two
objects close). The constraints are as follows:

  • There is a garbage dump in cell 0,0.
  • There is a lake in cell 1,2.

- The dormatory and the new academic building should not be close to the garbage dump.
- The recreational area should be close to the lake.
- The dormatory and the new academic building should be close to the recreational area.
- The dormatory and the new academic building should not be close to the administration building.

Represent this problem as a CSP. Do not forget some basic constraints that are inherent in allocating objects in space but are not listed above.

c) Draw a constraint graph for this problem. If a constraint/domain is too long to fit easily in the graph, use a label in the graph instead, and indicate which constraint/domain the label refers to.   8

2. a) Consider a scenario in which there are: two block X and Y and a flat surface. The two blocks   9
can be both on the surface, the top of the box is clear (i.e. clearX and clearY is true). When X is stacked on Y, clearX is true and clearY is false and vise versa when Y is stacked on X. Assume there is a robot that can perform 3 actions, stack X on top of Y, Stack Y on top of X, unstack the two blocks. A block can be stocked on the other if and only if both blocks are clear [i.e. nothing stacked on them]. Notice that unstack can be executed at any state. If unstack is performed, when the two blocks are already on the surface, nothing happens.

Provide a STRIPS representation for the actionsin this planning scenario. Please use sensible names for the actions.

b) If the robot is in a state in which clear Y is true and clearX is false, find a plan by forward   6
planning for achieving the goal state in which clearY is false and clearX is true. Show your work i.e. draw the search space from source to desired destination

c) Prove that if A* selects a path to the goal, it selects the optimal i.e. lowest cost path.   10

3 a) Peg Solitaire is a board game for one player involving movement of pegs on a board with   16
holes. The standard game fills the entire board with pegs except for the central hole. The objective is to empty the entire board except for a solitary peg in the central hole, by making valid moves. A valid move is to jump a peg orthogonally [up, down, left and right] over an adjacent peg into a hole two positions away and then to remove the jumped peg. Let the Figure 2 be a representation of a standard peg solitaire board where letters of the english alphabet represent pegs on the board and x in the middle is the initial blank spot from which the game begins.
Represent peg solitaire as a search problem.

  i.   How would you represent a node/state?
  ii.   What is the goal node?
  iii. What are the arcs?
  iv.   How many possible board states are there? [Note: this is not the same as the number of "valid" or "reachable" game states, which is a much more challenging problem.]

```
        a       b       c

        d       e       f

g   h   i   j   k   l   m

n   o   p   x   A   B   C

D   E   F   G   H   I   J

        K   L   M

        N   O   P
```
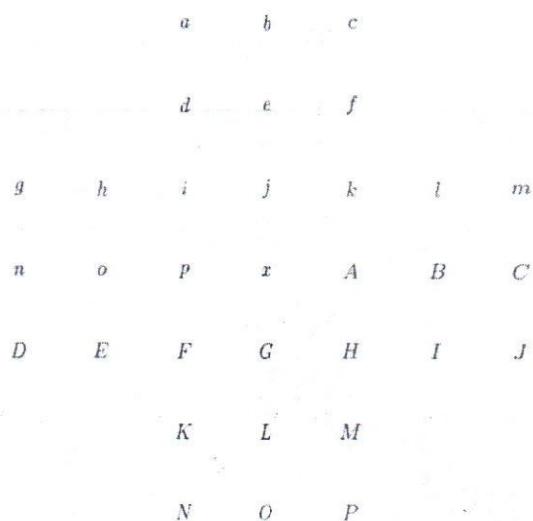
Figure 2: Representation of a peg solitaire board

b) Write out the first three levels (counting the root as level 1) of the search tree based on the labels in Figure 2. (Only label the arcs; not the nodes). What can you say about the length of the solution(s)?   9

4. a) What is a key limitation of stochastic local search and what is a key advantage? Consider two local search algorithms, A and B. A solves 25% of a given problem if it is given upto 100 minutes. B solves 35% of the problems it is given upto 55 minutes. Is one algorithm always better than the other? If not, which algorithm would you use in which conditions?   6

   b) Prove that the run-time complexity of IDS is the same as DFS or BFS.   9
   c) Consider the directed graph at figure 4(c)where a is the start node and k and n are both goal nodes, the true cost function is given by the edge labels, and h is an admissible heuristic function, the values for each node are shown in Table 1.   10

Table 1: Heuristic values for the graph at 4(c)

| node	h(node)
a	16
b	16
c	11
d	20
e	18
k	0
m	2
n	0
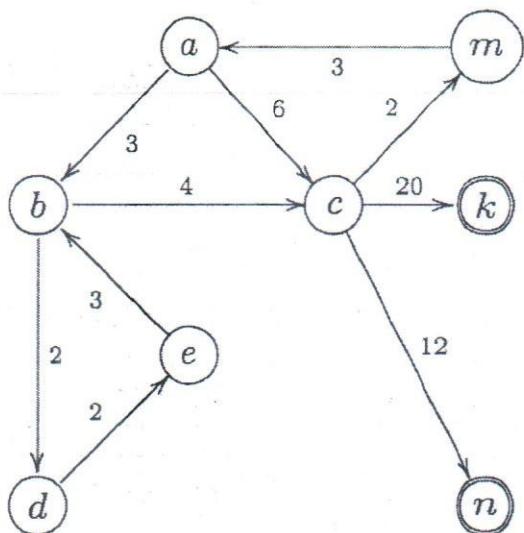
Figure 3: Directed graph for 4.(c)

Answer the following question for a case where you use Branch-and-bound search with cycle checking, in which neighbors are expanded according to f [evaluation function]. Assume that ties are broken alphabetically.

i. What sequence of paths are expanded (or considered for expansion) by branch-and-bound? (If you like, you can describe each path just by giving the last node in the path.

ii. What path is returned?

iii. What is the cost of the path?

iv. If you have to use either DFS or BFS for this problem, which one would you use and why?

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
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Department of Computer Science and Engineering (CSE)

MID SEMESTER EXAMINATION   WINTER SEMESTER, 2017-2018
DURATION: 1 Hour 30 Minutes   FULL MARKS: 75
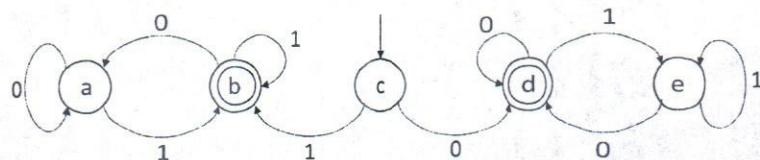
CSE 4703: Theory of Computing
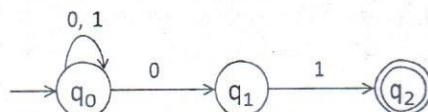
Programmable calculators are not allowed. Do not write anything on the question paper.
There are **4 (four)** questions. Answer any **3 (three)** of them.
Figures in the right margin indicate marks.

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1. a) Consider a finite automaton $A = (Q, \Sigma, \delta, q_0, F)$. Explain the meaning of the elements of the 5-tuple. Explain δ for both DFA and NFA.   6

   b) Identify the elements of A from the following state diagram.   5

   c) Explain the language of the automaton of above diagram.   4

   d) Design an NFA to recognize *abc*, *abd* and *aacd* over the alphabet {*a, b, c, d*}.   10

2. a) State the differences between a DFA and an NFA.   4

   b) Give DFA of the set of strings that either begin or end (or both) with 01.   6

   c) What are the operators of regular expression? Mention the order of precedence followed by the operators.   3+2

   d) The following diagram is an NFA accepting all strings that end in 01. Describe the states the NFA is in during the processing of input sequence 00101 (with diagram).   10

3. a) Define Regular Expression.   2

   b) What is the difference between the strings and the words of a language?   3

   c) Convert the regular expression (0+1)01 to an NFA.   6

   d) Convert the following NFA to a DFA and informally describe the language it accepts.   14

	0	1
→ p	{q, s}	{q}
*q	{r}	{q, r}
r	{s}	{p}
*s	0	{p}

4. a) Give formal description of the following regular expressions.   2×4
        i. $\Sigma*001\Sigma*$
        ii. $(0*1*)*000(0+1)*$
    b) Write a regular expression for the set of strings over alphabet $\{a, b, c\}$ containing at least one   5
        a and at least one b.
    c) Convert the following DFA to a regular expression, using the state elimination technique.   12

	0	1
→ * p	s	p
q	p	s
r	r	q
s	q	r

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
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Department of Computer Science and Engineering (CSE)

MID SEMESTER EXAMINATION   WINTER SEMESTER, 2017-2018
DURATION: 1 Hour 30 Minutes   FULL MARKS: 75

Math 4707: Probability and Stochastic Processes

Programmable calculators are not allowed. Do not write anything on the question paper.
There are **4 (four)** questions. Answer any **3 (three)** of them.
Figures in the right margin indicate marks.

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1. A computer network consists of several stations connected by various media (usually cables). There are certain instances when no message is being transmitted (i.e., the channel is free). At such "suitable instances," each station will send a message with probability p independently of the other stations. However, if two or more stations send messages in a single "suitable instance," a collision will corrupt the messages and they will be discarded. These messages will be retransmitted until they reach their destination. Note that the probability p of sending a message by a station is assumed irrespective of the fact that the packet can be either a new one or a retransmitted one. Suppose that the network consists of N stations.

    a) Find the probability that at a "suitable instance" a message is initiated by one of the stations   10
        and will go through without a collision.

    b) Show that, to maximize the probability of a message going through with no collisions, exactly   10
        one message, on average, should be initiated at each "suitable instance."

    c) Find the limit of the maximum probability obtained in Question 1(b) as the number of stations   5
        of the network grows to infinity (∞).

2. The simplest error detection mechanism used in data communication is *parity checking*. Usually messages sent consist of characters, each character consisting of a number of bits (a *bit* is the smallest unit of information and is either 1 or 0). Assume that the number of bits in a character is 7. In parity checking, a 1 or 0 is appended to the end of each character at the transmitter to make the total number of 1's even (and the parity checking mechanism is known as even parity).

    The receiver checks the number of 1's in every character received, and if the number of 1's is odd it signals an error. Suppose that each bit in a character is received correctly with probability 0.999, independently of other bits of the characters.

    a) Find the probability that character is received in error, but the error is not detected by the   10
        parity check mechanism.

    b) Find the probability that the parity check mechanism detects the error, if one or more bits are   8
        incorrectly received.

    c) Suppose that a message consisting of six characters is transmitted. Find the probability that   7
        the message is erroneously received (at least one character is erroneously received), but none
        of the errors is detected by the parity check mechanism.

3. a) Suppose that the loss in a certain investment, in thousands of dollars, is a continuous random
        variable X with the following probability density function
        $$f_X(x) = \begin{cases} k(2x - 3x^2), & -1 < x < 0 \\ 0, & \text{otherwise.} \end{cases}$$
        Calculate the value of k and find the probability that the loss is at most \$500.   10

    b) A point is selected at random on a line segment of length l. Find the probability that the   8
        longer segment is at least twice as long as the shorter segment.

c) Every week the average number of wrong number phone calls received by a certain office is 7. If the number of wrong phone calls received is Poisson distributed, find the probability that it will receive   7

    i.   Exactly two wrong phone calls tomorrow.

    ii.   At least one wrong call by tomorrow.

4. a) Let X be a random variable with probability density function   10

$$f_X(x) = \begin{cases} \frac{1}{2}e^{-|x|}, & -\infty < x < \infty \\ 0, & \text{otherwise.} \end{cases}$$

Calculate $E[X]$ and $Var[X]$.

b) Voice calls cost 20 cents each and data calls cost 30 cents each. Let C is the cost of one telephone call. The probability that a call is voice call is $P[V] = 0.6$, and the probability that a call is data call is $P[D] = 0.4$. Find $P_C(c)$ and $E[C]$.   7

c) The probability mass function of a discrete random variable X is given by   8

$$P_X(x) = \begin{cases} \frac{x}{15}, & x = 1, 2, ..., 5 \\ 0, & \text{Otherwise.} \end{cases}$$

Find the expected value and the variance of the derived random variable $Y = X(6 - X)$.

Appendix A: PMF/PDF and the expected values of some Random Variables

Distribution	PMF/PDF	Expected value	Variance
Bernoulli	$P_X(x) = \begin{cases} 1-p & x = 0 \\ p & x = 1 \\ 0 & otherwise \end{cases}$	$E[X] = p$	$Var[X] = p(1-p)$
Geometric	$P_X(x) = \begin{cases} p(1-p)^{x-1} & x \geq 1 \\ 0 & otherwise \end{cases}$	$E[X] = 1/p$	$Var[X] = (1-p)/p^2$
Binomial	$P_X(x) = \begin{cases} \binom{n}{x}p^x(1-p)^{n-x} & x = 1, \dots, n \\ 0 & otherwise \end{cases}$	$E[X] = np$	$Var[X] = np(1-p)$
Pascal	$P_X(x) = \begin{cases} \binom{x-1}{k-1}p^k(1-p)^{x-k} & x = k, k+1, \dots \\ 0 & otherwise \end{cases}$	$E[X] = k/p$	$Var[X] = k(1-p)/p^2$
Poisson	$P_X(x) = \begin{cases} \dfrac{(\lambda T)^x e^{-(\lambda T)}}{x!} & x \geq 0 \\ 0 & otherwise \end{cases}$	$E[X] = \alpha$ $\alpha = \lambda T$	$Var[X] = \alpha$
Uniform (Discrete)	$P_X(x) = \begin{cases} \dfrac{1}{b-a+1}, & x = a, a+1, a+2, \dots, b \\ 0, & otherwise \end{cases}$	$E[X] = \dfrac{a+b}{2}$	$Var[X] = \dfrac{(b-a)(b-a+2)}{12}$
Exponential	$f_X(x) = \begin{cases} ae^{-ax} & x \geq 0 \\ 0 & otherwise \end{cases}$	$E[X] = 1/a$	$Var[X] = 1/a^2$
Gaussian	$f_X(x) = \begin{cases} \dfrac{1}{\sqrt{2\pi}\sigma}e^{\frac{-(x-\mu)^2}{2\sigma^2}} & \sigma > 0 \\ 0 & otherwise \end{cases}$	$E[X] = \mu$	$Var[X] = \sigma^2$
Uniform (Continuous)	$f_X(x) = \begin{cases} \dfrac{1}{b-a}, & a \leq x < b \\ 0, & otherwise \end{cases}$	$E[X] = \dfrac{a+b}{2}$	$Var[X] = \dfrac{(b-a)^2}{12}$

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
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Department of Computer Science and Engineering (CSE)

MID SEMESTER EXAMINATION   WINTER SEMESTER, 2017-2018
DURATION: 1 Hour 30 Minutes   FULL MARKS: 75

CSE 4731: Internet Engineering

Programmable calculators are not allowed. Do not write anything on the question paper.
There are **4 (four)** questions. Answer any **3 (three)** of them.
Figures in the right margin indicate marks.

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1. a) What advantage does a circuit-switched network have over a packet-switched network? 7
   b) Do the routers in both datagram networks and virtual-circuit networks use forwarding tables? 4
   c) What is the difference between routing and forwarding? 5
   d) Suppose users share a 3 Mbps link. Also suppose each user requires 150 kbps when transmitting, but each user only transmits 10% of the time. 9
      i. When circuit-switching is used, how many users can be supported?
      ii. For the remainder of this problem, suppose packet-switching is used. Find the probability that a given user is transmitting
      iii. Suppose there are 120 users. Find the probability that at any given time, 90 users are transmitting simultaneously.

2. a) How does a newly arriving host in a subnet get an IP address automatically? 6
   b) What is the difference between routing and forwarding? 5
   c) Suppose Alice and Bob are sending packets to each other over a computer network. Suppose Trudy positions herself in the network so that she can capture all the packets sent by Alice and send whatever she wants to Bob; she can also capture all the packets sent by Bob and send whatever she wants to Alice. List some of the malicious things Trudy can do from this position. 7
   d) Suppose Host A wants to send a large file to Host B. The path from Host A to Host B has three links, of rates R1 = 500 kbps, R2 = 2 Mbps, and R3 = 1 Mbps. 7
      i. Assuming no other traffic in the network, what is the throughput for the file transfer?
      ii. Suppose the file is 4 million bytes. Roughly how long will it take to transfer the file to Host B?

3. a) Describe how a botnet can be created, and how it can be used for a DDoS attack. 6
   b) What is the key distinguishing difference between a tier-1 and tier-2 ISP? 5
   c) Suppose an application generates chunks of 40 bytes of data every 20 msec, and each chunk gets encapsulated in a TCP segment and then an IP datagram. What percentage of each datagram will be overhead, and what percentage will be application data? 6
   d) Consider sending a 2400-byte datagram into a link that has an MTU of 700 bytes. Suppose the original datagram is stamped with the identification number 422. How many fragments are generated? What are the values in the various fields in the IP datagram(s) generated related to fragmentation? 8

4. a) Compare and contrast link-state and distance-vector routing algorithms. 7
   b) How long does it take a packet of length 1,000 bytes to propagate over a link of distance 2,500 km, propagation speed 2.5*10^8 m/s, and transmission rate 2 Mbps? Does this delay depend on transmission rate? 5
   c) Suppose an ISP owns the block of addresses of the form 128.119.40.64/26. Suppose it wants to create four subnets from this block, with each block having the same number of IP addresses. What are the network and broadcast addresses (of form a.b.c.d/x) for the four subnets? 7

d) Suppose you purchase a wireless router and connect it to your cable modem. Also suppose   6
that your ISP dynamically assigns your connected device (that is, your wireless router) one IP
address. Also suppose that you have five PCs at home that use 802.11 to wirelessly connect to
your wireless router. How are IP addresses assigned to the five PCs? Does the wireless router
use NAT? Why or why not?

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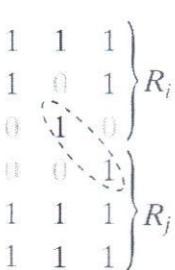
MID SEMESTER EXAMINATION   **WINTER SEMESTER, 2017-2018**
DURATION: 1 Hour 30 Minutes   **FULL MARKS:75**

CSE 4733: Digital Image Processing
Programmable calculators are not allowed. Do not write anything on the question paper.
There are **4 (four)** questions. Answer any **3 (three)** of them.
Figures in the right margin indicate marks.

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1. a) Define the following terms: 2×5
      i.   Digital Image
      ii.   Luminance
      iii.   Intensity Resolution
      iv.   Spatial Resolution
      v.   False Contouring

   b) Describe a simple image formation model in the 2D spatial domain.   5

   c) In order to generate digital images from sensed data, *sampling* and *quantization* are two   10
   important processes. How do these two operations affect the size and color information of
   an image?

2. a) When and how do you use *bicubic interpolation* in digital image processing?   8

   b) Consider the two sub-regions in an image, R_i and R_j, shown in Figure 1. For $V = \{1\}$,   9
   determine whether these two subsets are (i) 4-adjacent, (ii) 8-adjacent, or (iii) m-adjacent.
   Explain your answers.

$$
\begin{array}{ccc}
1 & 1 & 1 \\
1 & 0 & 1 \\
0 & 1 & 0 \\
0 & 0 & 1 \\
1 & 1 & 1 \\
1 & 1 & 1
\end{array}
$$

$\left. \begin{array}{c} \\ \\ \end{array} \right\} R_i$ $\left. \begin{array}{c} \\ \\ \end{array} \right\} R_j$

Figure 1.

   c) When is an operation H called linear? Show that the median operator is not linear.   8

3. a) What conditions should an intensity transformation function $T()$ fulfill? What happens if   3+4
   they fail?

   b) Draw a single intensity transformation function for spreading the intensities of a gray-scale   4+4
   image so the lowest intensity is *0* and the highest is *(L-1)*. Here L is the number of
   intensities possible. Give the mathematical definition of your transformation function.

   c) Explain with appropriate figures, why the discrete histogram equalization technique does   10
   not, in general, yield a flat histogram.

4. a) Give the mathematical equation representing the convolution of a filter $w(x,y)$ with an   10
   image $f(x,y)$. Show the results of applying a weighted average filter on an image of size
   5×5 pixels. Explain some of the convolution responses with that filter.

b) What is high-boost filtering and why is this filter used? Can you change this filter to perform exactly as unsharp masking? Explain the working principle of unsharp masking. 10

c) How was the Sobel mask designed for computing the gradient of an image? 5

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ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
Department of Computer Science and Engineering (CSE)

MID SEMESTER EXAMINATION   WINTER SEMESTER, 2017-2018
DURATION: 1 Hour 30 Minutes   FULL MARKS: 75

CSE 4739: Human Computer Interaction

Programmable calculators are not allowed. Do not write anything on the question paper.
There are **4 (four)** questions. Answer any **3 (three)** of them.
Figures in the right margin indicate marks.

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1. a) Detecting fake post in the social networking sites is one of the major challenges for the researchers. What are the interrelated aspects of Human-Computer Interaction that the researchers should consider in this case? Explain briefly.   13

   b) You are employed by a software company that develops games for tablet computers (e.g., Apple's iPad). The senior developer has tasked you to help with the development of the tablet version of the classic Whac-A-Mole game. In the game, the screen will show a number of holes, and moles will pop up from the holes at random. Players will, using touch, hit the moles in the head to force them back into their holes as fast as possible to maximize their score. The development team needs your help particularly in designing the behaviors of the moles.   12

   Briefly describe the memories, processors, and operators that will determine how much delay should be added between each mole popping up, based on the Model Human Processor

2. a) Describe the Fitts's law. Based on the scenario described in Question 1. (b), make a calculation applying Fitts's law to provide your team with a rough estimate of the time it will take the player to respond to each mole along with any assumptions you make.   9

   b) Suppose you want count voting by the attendees in a classroom to evaluate the class performance. You have to track different color amount with intensities and transfer them in a system that will perform data visualization. How do you apply different color for interaction?   8

   c) Briefly explain with example the articulation, performance, presentation, and observation analysis from the interaction framework given in Figure 1.   8
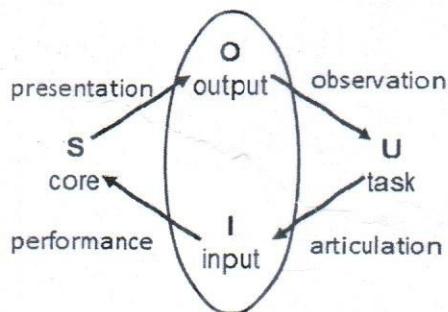

Figure 1: An interaction framework

3. a) What do you mean by 'gulf of execution' and 'gulf of evaluation' while doing interaction   10
        through computers? Explain with example.
    b) Briefly describe four different interaction styles used to accommodate the dialog between   8
        user and computer.
    c) Explain human ergonomics and design implications with example.   7

4. a) Suppose you want to design a communication tool for an autistic child. An autistic child may   10
        have articulation, performance, presentation, and observation problems. But this tool will
        help the child to communicate with others. Do the followings:
        i.   List the usability and user experience goals of the system.
        ii.   Sketch a prototype of the communication tool.
    b) What is interaction design? Briefly explain the four basic activities of interaction design.   5
    c) Explain Norman's design principles with examples.   10

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
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Department of Computer Science and Engineering (CSE)

MID SEMESTER EXAMINATION

WINTER SEMESTER, 2017-2018

DURATION: 1 Hour 30 Minutes

FULL MARKS: 75

CSE 4741: Bioinformatics

Programmable calculators are not allowed. Do not write anything on the question paper.
There are **4 (four)** questions. Answer any **3 (three)** of them.
Figures in the right margin indicate marks.

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1. a) *"The size of the genome (base pair count) and the number of genes in the genome of a lifeform does not represent the complexity of that lifeform"* – Justify this statement. 10
   b) What is sequence alignment? Discuss the importance of sequence alignment. 10
   c) Briefly describe the transcription process of central dogma. 5

2. a) Compare DNA and a computer program. 10
   b) During translation process Codons are mapped to Amino Acids to form proteins. But, number of different Codons and number different Amino Acids in living being are not equal. Discuss the effect of this scenario on lifeforms. 10
   c) Discuss on insert, delete and align operation during pairwise sequence alignment. 5

3. a) State the constraints to form RNA secondary structures. 5
   b) Write down Nussinov folding algorithm to predict RNA secondary structures. 5
   c) Using Nussinov folding algorithm predict secondary structure of the following RNA sequence. 15
      GGGAAUUCC

4. a) Discuss on RNA editing and its impact in cephalopods. 10
   b) Following 5 sequences are needed to be aligned using ClustalW method. 5+10

      S1: AGGCTATG
      S2: TGCCTTAG
      S3: GTTGCTTA
      S4: ATGCTTAG
      S5: CTGCTCAG

      i. Build the distance matrix D for the sequences.
      ii. Step by step build the rooted guide-tree using UPGMA approach.

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Department of Computer Science and Engineering (CSE)

MID SEMESTER EXAMINATION   WINTER SEMESTER, 2017-2018
DURATION: 1 Hour 30 Minutes   FULL MARKS: 75

CSE 4773: Internetworking Protocols

Programmable calculators are not allowed. Do not write anything on the question paper.
There are **4 (four)** questions. Answer any **3 (three)** of them.
Figures in the right margin indicate marks.

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1. a. What advantage does a circuit-switched network have over a packet-switched network? What advantages does **TDM** have over **FDM** in a circuit-switched network?   4+2

   b. What is the difference between nodal delay and end-to-end delay? Derive a formula for the end-to-end delay of sending one packet of length, **L** over **N** links, each having a transmission rate of **R**. Generalize this formula for sending **P** such packets back-to-back over **N** links.   3+2+4
   [Consider the queuing, processing and propagation delays as negligible]

   c. Consider two hosts, **A** and **B**, connected by a single link of rate **R** bps. Suppose the two hosts are separated by **m** meters and suppose the propagation speed along the link is **s** meters/sec. Host **A** is to send a packet of size **L** bits to host **B**.   5×2
      i. Determine the transmission time of the packet, d_{trans}, in terms of **L** and **R**.
      ii. Suppose host **A** begins to transmit the packet at time, t=0. At time, $t = d_{trans}$, where is the last bit of the packet?
      iii. Suppose d_{prop} is less than d_{trans}. At time $t = d_{trans}$, where is the first bit of the packet?
      iv. Suppose $s = 2.5 \times 10^8, L = 120\ bits$ and $r = 56\ kbps$. Find the distance **m** so that d_{prop} equals d_{trans}.
      v. Suppose d_{prop} is greater than d_{trans}. At time $t = d_{trans}$, where is the first bit of the packet?

2. a. Write down the taxonomy of common multicast routing protocols. Give a comparative analysis between multicasting and multiple unicasting with proper diagram.   4+5

   b. Multicast distance vector routing uses source-based trees, but the router never actually makes a routing table. When a router receives a multicast packet, it forwards the packet as though it is consulting a routing table. We can say that the shortest path tree is evanescent. After a packet is forwarded the table is destroyed. To accomplish this, the multicast distance vector algorithm uses a process based on four decision-making strategies. Each strategy is built on its predecessor. Briefly explain each of the strategy and show how each strategy can improve the shortcomings of the previous one.   12

   c. Mention at least two differences between **DVMRP** and **CBT**.   4

3. a. What is meant by Congestion Control? Explain how TCP handles network congestion with proper example and figure.   2+9

   b. A network transmits **300 bit** frames on a shared channel of **300 kbps**. Compare the throughput of pure ALOHA and slotted ALOHA in percentage, if the system (all stations together) produces **1500 frames per second**. What should be the maximum number of frames per frame transmission time, in order to get maximum throughput in pure ALOHA.   3+3

   c. Consider you have four stations **A, B, C** and **D**; which transmit the data using a shared channel. If the data sent by stations **A, B, C** in the channel are respectively **0, 0, 1** and the station **D** remains silent. Then with the help of CDMA find out the orthogonal sequence   4+3+1

of data on the channel. Also show how station *D*, which is listening to station *B*, will extract the data sent by *B* from the data in the channel. Depict the scenario with proper diagram and values.

4. a. How can the problem of counting to infinity be solved in case of two node instability in Distance Vector Routing Protocol?   4

b. Compare among *RIPv1*, *RIPv2* and *IGRP*. Explain the timers in *IGRP*.   3+4

c. Explain how *EIGRP* calculates alternate backup route using *DUAL* Finite State Machines.   6

d.   8
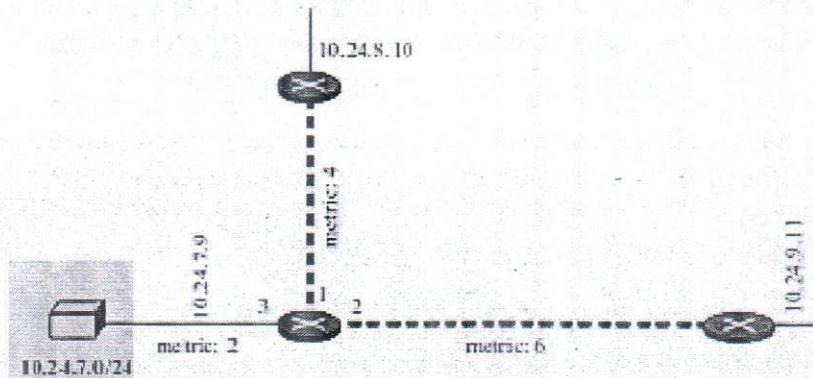
Figure - 1

Using the network topology in Figure - 1, generate the router link LSA sent by the router 10.24.7.9.

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
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Department of Computer Science and Engineering (CSE)

MID SEMESTER EXAMINATION   WINTER SEMESTER, 2017-2018
DURATION: 1 Hour 30 Minutes   FULL MARKS: 75

CSE 4775: Introduction to Data Mining

Programmable calculators are not allowed. Do not write anything on the question paper.
There are **4 (four)** questions. Answer any **3 (three)** of them.
Figures in the right margin indicate marks.

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1. a) Describe three challenges to data mining regarding data mining methodology and user interaction issues.   10

   b) Present an example where data mining is crucial to the success of a business. What data mining functionalities does this business need   9

   c) What are the characteristics for a pattern to be interesting?   6

2. a) Suppose that the data for analysis includes the attribute age. The age values for the data tuples are (in increasing order):   4x4
   13, 15, 16, 16, 19, 20, 20, 21, 22, 22, 25, 25, 25, 25, 25, 30, 33, 33, 35, 35, 35, 35, 36, 40, 45, 46, 52, 70, 82, 86.
      i.   Compute the mode and the median of the data.
      ii.   Give the five-number summary of the data.
      iii.   Is there any outlier here? What are those?
      iv.   Show a boxplot of the data.

   b) What is the difference between *Quantile* and *Quartile*?   4

   c) What is *Interquartile Range*? How IQR is used for outlier analysis?   5

3. a) "Manhattan distance and Euclidean distance are variations of Minkowski distance." – Justify this statement.   8

   b) Table 1 shows the data about the results of different tests for disease detection. All the attributes are symmetric binary. Find the dissimilarity matrix for the data of table 1.   12

Table 1: Patient report for different tests

Patients	Test 1	Test 2	Test 3	Test 4	Test 5	Test 6	Test 7	Test 8
P1	Positive	Negative	Positive	Negative	Positive	Positive	Negative	Positive
P2	Negative	Positive	Positive	Negative	Positive	Negative	Positive	Negative
P3	Negative	Positive	Negative	Positive	Negative	Negative	Negative	Negative

   c) What is the difference between Interval-Scaled Attributes and Ratio-Scaled Attributes?   5

4. a) There are multiple factors comprising data quality. Describe those factors in brief.   10

   b) *iFashion* is a renowned fashion brand in Bangladesh which has several outlets in different cities. They have a central database to store all the information of their sales and customers. This year they are planning to start loyalty program by giving special offers to their loyal customers. For classifying the customer they hired you to analyze *iFashion* sales and customer data. What steps will you follow to perform the task?   10

   c) What is noise in data? What are the techniques used for removing noise?   5

L9L

M.Sc. CSA 3rd Semester   16 March 2018 (Afternoon)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
Department of Computer Science and Engineering (CSE)

MID SEMESTER EXAMINATION   WINTER SEMESTER, 2017-2018
DURATION: 1 Hour 30 Minutes   FULL MARKS: 75

CSE 6123: Computer Networks

Programmable calculators are not allowed. Do not write anything on the question paper.
There are **4 (four)** questions. Answer any **3 (three)** of them.
Figures in the right margin indicate marks.

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1. a) Mention the necessary criteria for an effective and efficient network. Name the four basic network topologies. — 3+2

   b) Draw the OSI Internet model and mention two major functionalities of each of the layers. — 10

   c) Draw the send and receive window for *'Go-Back-N ARQ'* protocol. How does *'Selective Repeat ARQ'* protocol differ from *'Go-Back-N ARQ'* protocol? — 6+4

2. a) With the aid of a flowchart briefly explain the medium access procedure of pure ALOHA. — 8

   b) What do you mean by vulnerable time? With the aid of diagrams, explain the vulnerable time of CSMA protocols. — 2+8

   c) What is slot time in CSMA/CD? How does slot time is related to maximum network length? — 2+5

3. a) Neatly sketch the frame structure of IEEE 802.3 MAC protocol. An Ethernet MAC sublayer receives 1540 bytes of data from the upper layer. Can the data be encapsulated in one frame? If not, how many frames need to be sent? What is the size of the data in each frame? — 3+5

   b) Briefly explain different persistent methods used in CSMA protocol. — 9

   c) Briefly explain the hidden station problem of IEEE 802.11 with one possible solution to eliminate the problem. — 8

4. a) What is the significance of D (Duration) field in IEEE 802.11 frame? What does it signify when both the *To DS* and *From DS* flags of the Frame Control (FC) field of IEEE 803.11 frame represent 1? — 4+4

   b) How does a bridge differ from a router? — 4

   c) With the aid of necessary diagrams briefly explain the learning process of a transparent bridge. Demonstrate the major problem of a transparent bridge. — 6+7

M.Sc. TE
13 March 2018 (Afternoon)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
Department of Computer Science and Engineering (CSE)

MID SEMESTER EXAMINATION
WINTER SEMESTER, 2017-2018
DURATION: 1 Hour 30 Minutes
FULL MARKS: 75

CSE 6197: Parallel and Distributed Computing

Programmable calculators are not allowed. Do not write anything on the question paper.
There are **4 (four)** questions. Answer any **3 (three)** of them.
Figures in the right margin indicate marks.

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1. a) Briefly describe the architecture of a message queuing system. What is the role of a message broker in a message queuing system? — 7+2

    b) With an example explain the process of parameter marshaling in a remote communication through RPC. — 8

    c) What is Quality of Service (QoS). Suppose one single packet contains multiple sequential audio and video frames. While transmitting the packet is lost. What problem will occur in this case? How to solve this problem? — 8

2. a) Scalability can be achieved by applying different techniques. What are these techniques? Explain briefly. — 8

    b) Suppose you are tasked to create a distributed system for a fast food chain restaurant which provides tasty foods all over the world from various outlets. To order food from these outlets, consumers have to insert the first name and email along with the security PIN into a client's machine at every outlet. They will also have to insert the foods they want to order. Unlike most restaurants, here the users refill their accounts with monetary transactions, similar to a prepaid system and then they can order food using credits stored in their accounts. Design the system in such a way that the Authentication server and Menu Information server are different. How can you put a middleware so that each transaction is processed by single request/reply message from/to the clients' end? — 8

    c) Consider a chain of processes $P_1, P_2,...., P_n$ implementing a multi-tiered client-server architecture. Processes P_i is client of process P_{i+1} and P_i will return a reply to process P_{i-1} only after receiving a reply from P_{i+1}. What are the main problems with this organization when taking a look at the request-reply performance at process P_1? — 4

    d) Write the differences between Cloud and Grid computing as the distributed computing systems. — 5

3. a) Mention the role of virtualization in distributed system. Explain the architecture of process virtual machine and virtual machine monitor. — 2+5

    b) Suppose a web document consists of an HTML file containing plain text along with a collection of images, icons, etc. To fetch each element of a web document, the browser has to set up a TCP/IP connection, read the incoming data and passes it to a display component. Setting up a connection as well as reading incoming data is inherently blocking operations. When dealing with long-haul communication, the time for each operation to complete may be relatively long. Briefly explain how to improve the performance of the system? — 5

    c) What is client stub and server stub? Briefly describe the process of client server binding in Remote Procedure Call (RPC). — 2+5

    d) What are ACID properties? Describe the ACID properties for performing successful transaction in a distributed system. — 6

4. a) What do you mean by horizontal distribution in a decentralized architecture? Briefly explain   2+6
   how a distributed hash table (DHT) is used to organize such type of architecture.

   b) What is Berkley Sockets? What are the different primitives of Berkley Sockets? Explain the   5+4
   connection-oriented communication pattern using Berkley Sockets.

   c) Figure 1 demonstrates the alternative client-server organization of multi-tiered architecture   8
   for distributed systems. Explain its different types with appropriate example.
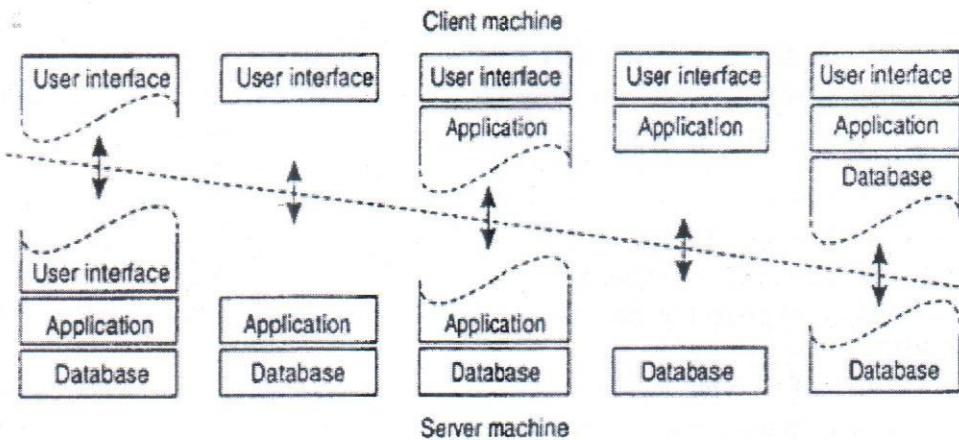
Figure 1: Alternative client-server organization

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Department of Computer Science and Engineering (CSE)

MID SEMESTER EXAMINATION   **WINTER SEMESTER, 2017-2018**
DURATION: 1 Hour 30 Minutes   **FULL MARKS: 75**

CSE 6249: Data Warehousing and Mining

Programmable calculators are not allowed. Do not write anything on the question paper.
There are **4 (four)** questions. Answer any **3 (three)** of them.
Figures in the right margin indicate marks.

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1. a) What is transactional data? Explain with example.   4

    b) Present the definition of data warehouse given by William H. Inmon. The definition leads to a number of key components of data warehouse. Briefly discuss them.   6

    c) Briefly explain the different types of OLAP operations with suitable diagram. For each operation also present an example of its equivalent SQL statement.   10

    d) *"Boxplots are a popular way of visualizing data distribution"*. First define boxplot and then place an example to justify the argument.   5

2. a) Define Data Objects and Attributes. What is nominal attribute? *"Mean, median and mode of nominal attribute data have no meaningful interpretation."* Justify your position with suitable example.   8

    b) Explain the main difference between ordinal and interval-scaled attribute.   3

    c) Although the mean is the singlemost useful quantity for describing a data set, it is not always the best way of measuring the center of the data. A major problem with the mean is its sensitivity to extreme (e.g., outlier) values. Even a small number of extreme values can corrupt the mean. Place example to explain this fact. To reduce this problem "trimmed mean" is used. Explain it.   6

    d) Given two objects represented by the tuples (12, 4, 42, 10) and (20, 2, 36, 8):   8

        i. Compute the Euclidean distance between the two objects.
        ii. Compute the Manhattan distance between the two objects.
        iii. Compute the Minkowski distance between the two objects, using $q = 3$.
        iv. iv. Compute the supremum distance between the two objects.

3. a) What is the purpose of using *Jaccard coefficient*? Place example in this regard.   5

    b) Both Manhattan and Euclidean distance satisfy a number of mathematical properties. Briefly mention them.   7

    c) *"Traditional distance measures do not work well for sparse numeric data."* - Justify with a suitable example. Also propose and explain a suitable measure to handle such data.   8

    d) In real-world data, tuples with missing values for some attributes are a common occurrence. Describe various methods for handling this problem.   5

4. a) What is the main purpose of normalization? Define the following normalization methods with examles?   8

        i. min-max normalization.
        ii. z-score normalization.
        iii. z-score normalization using the mean absolute deviation instead of standard deviation.
        iv. normalization by decimal scaling.

b) Suppose that the Statistical Bureau of Bangladesh (SBB) wants to build its own data warehouse for a number of purposes.

SBB is interested to analyze the correlation between the followings:
- Income of people and their geographic location
- Children education level and their financial status
- Results of Higher Secondary Examination or equivalent and College

    i.   Explain and draw a star schema diagram for the data warehouse.
   ii.   Also propose the snowflake schema diagram for the same data warehouse.
  iii.   Finally highlight the comparative strength and weakness of both approaches.

c) Measures can be organized into three categories such as distributive, algebraic and holistic. Briefly explain them.   7

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Department of Computer Science and Engineering (CSE)

MID SEMESTER EXAMINATION   WINTER SEMESTER, 2017-2018
DURATION: 1 Hour 30 Minutes   FULL MARKS: 75

CSE 6273: Cloud Computing

Programmable calculators are not allowed. Do not write anything on the question paper.
There are **4 (four)** questions. Answer any **3 (three)** of them.
Figures in the right margin indicate marks.

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1. a) How did the concept of cloud computing evolve from traditional computing concept? What services does cloud computing offer? — 6
   b) Enumerate three security threats to IaaS and SaaS each. Describe the ways to block these security threats of cloud. — 9
   c) How does cloud computing saves IT expenditures for a small or medium size business organization? — 10

2. a) Briefly describe the architecture of Remote Procedure Call (RPC). Why did RPC evolved to XML-RPC and then to Web Services? — 10+5
   b) What is a mobile cloud? How is the concept of mobile cloud redefined by today's research? — 5
   c) Why is there always a business model with a cloud service? How do SaaS providers typically generate revenue in their businesses? — 5

3. a) What is map-reduce? Elaborate the concept by citing the example of word count. — 10
   b) Briefly describe the characteristics of Hadoop Files System (HDFS). — 10
   c) What are WORM file systems? Which types of applications provide the scope or constraint to use WORM file system? — 5

4. a) What services can you provide with education cloud? — 10
   b) How does Facebook scale perfectly to accommodate millions of users? — 10
   c) What do you understand by horizontal scaling and vertical scaling? — 5

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ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
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Department of Computer Science and Engineering (CSE)

MID SEMESTER EXAMINATION   WINTER SEMESTER, 2017-2018
DURATION: 1 Hour 30 Minutes   FULL MARKS: 75

CSE 6391: Advanced Human Computer Interaction
Programmable calculators are not allowed. Do not write anything on the question paper.
There are **4 (four)** questions. Answer any **3 (three)** of them.
Figures in the right margin indicate marks.

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1. a) Suppose you have a requirement to design a word-processing software for an amputee (i.e. a person having no upper-limb, e.g. hand). It has to support the standard set of word-processing tasks. Which combination of input and output devices would be suitable to support the intended interaction? You need to describe typical users' characteristics and identify how the devices are chosen to support these people in their tasks. Explain the major problems that the input and output devices solve. Describe your answer based on different aspects of Human-Computer Interaction (HCI).   **10**

   b) Consider that a user is texting a friend and is entering the word 'hello' on a mobile phone using predictive text entry (T9). After entering 4 (GHI), 3 (DEF), 5 (JKL), 6 (MNO), a word appears on the display. There are two possible responses. If the word is 'hello', it matches the word in the user's mind and the user presses 0 (space) to accept the word. This is the YES response. If the display shows some other word, a collision has occurred, meaning there are multiple responses in the key sequence. The user presses * (next) to display the next word in the ambiguous set. This is due to NO response.

      i.   Model this scenario using Model Human Processor to find out the Reaction time by two type of users, 'slow-typer' and 'fast-typer'.   **8**

      ii. Map this scenario with human information processing steps and write your comments.   **4**

      iii. Explain how human performance may vary if this text-entry task in interleaved with another task (e.g. spell check) in the mobile phone.   **3**

2. a) One of the most important factors of Fitts' law is the distance between where the mouse pointer currently is and where it needs to be. Consider the interface in Figure 1, where interface elements are grouped based on similar elements. Comments on the button 'New Invoice' based on Fitts' law in action.   **8**
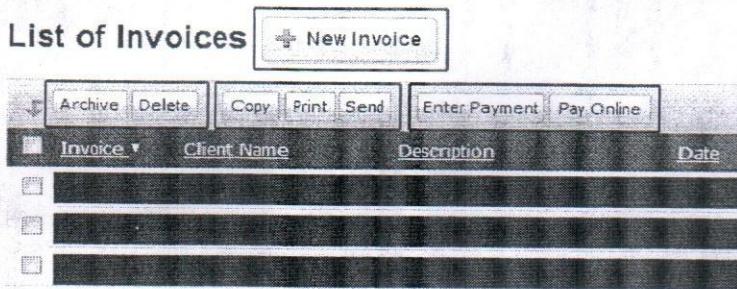

   Figure 1: An interface

   b) In an interface, some UI elements are interactive (buttons, input fields, scrolling) and some are non-interactive. The visual cues including depth cues should be properly utilized to differentiate between two. Such visual features can resolve the ambiguity while performing the interaction. Explain how the visual cues can be applied to improve the visibility, affordance, feedback, constraints of the UI elements.   **10**

   c) Suppose you want to count voting by the attendees in a classroom to evaluate the class performance. You have to track different color amount with intensities and transfer them in a system that will perform data visualization. How do you apply different color for interaction?   **7**

3. a) What do you mean by 'gulf of execution' and 'gulf of evaluation' while doing interaction   8
        through computers? Consider the interaction framework in Figure 2.
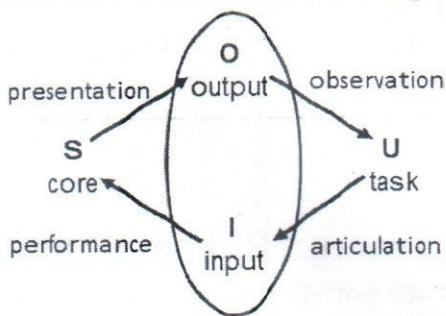

Figure 2: An interaction framework

Answer the followings:
    i.   Redraw the framework indicating two gulfs (show in the figure) in a user
          interface.
    ii.   In windows paint software, mention some poor mappings of articulation,
          performance, presentation, and observation.

    b) 'Recognition is better than recall' – is the principle to reduce memory load. However, in few   12
        of the cases, the interaction designer needs to consider both of them. An example of such
        case could be to remember passwords to access the phone-banking system by the rural users.
        Propose an idea to merge memory recall and memory recognition techniques to remember
        passwords by the rural users.

    c) Briefly explain human ergonomic factors with an example.   5

4. You are asked to design interaction dialogs using the right hand gesture. Deliberate pointing
    movement through finger can be considered as an input modality. Your design should utilize a set
    of gestures to control menu-driven interface. There are different types of menu such as selection
    menu, pop-up/pop-in menu, pull-down menu, pie menu, etc.
    a) What are the design considerations for menu-driven interface?   8
    b) Suggest a set of gesture-based interaction dialogue to control such menu-driven interface.   12
    c) Comments on the usability issues if you merge mouse-pointer-based menu and gesture-based   5
        menu to support multimodality as input.