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

SEMESTER FINAL EXAMINATION   WINTER SEMESTER, 2017-2018
DURATION: 3 Hours   FULL MARKS: 150

SWE 4101: Introduction to Software Engineering

Programmable calculators are not allowed. Do not write anything on the question paper.
There are **8 (eight)** questions. Answer any **6 (six)** of them.
Figures in the right margin indicate marks.

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1. a) What are the generic framework activities in a software process model? Give brief descriptions of each activity with proper examples.   10

   b) Write the key ideas and tasks that are associated with each of the framework activities of XP process. Draw a diagram to show the whole XP process.   15

2. a) Draw the **"Failure Rate"** vs **"Time"** graphs for Hardware and Software with proper labelling. Analyze the behavior of the graphs in details with examples.   15

   b) Software engineer Samiul Bashar Anan has the responsibility of developing the **web application** for **IUT virtual banking system**. The students and the staffs of the university will use this system to access different services of IUT and complete the payment for the services. What could be the **unique natures** of the system that Anan should keep in mind?   10

3. Samuel Hahnemann owns a homeopathic medicine company called **Faithhealers**. He sells vitamins and other relatively nonperishable products for those who want choices regarding alternative medicine. Mr. Samuel is developing a new system that would require his staff to be retrained.

Table 1: Task information

Description	Task	Must Follow	Time (Weeks)
Interview executives	A	None	6
Interview staff in order fulfillment	B	None	3
Design input prototype	C	B	2
Design output prototype	D	A, C	3
Write use cases	E	A, C	4
Record staff reactions to prototypes	F	D	2
Develop system	G	E, F	5
Write up training manual	H	B, G	3
Train staff working in order fulfillment	I	H	2

   a) Assume that current time is **15th week** and every task is on time except task G, half of the task G is completed on 15th week. Draw a **Gantt chart** from the given information.   10

   b) From the information in Table 1 make a **PERT diagram** for Mr. Samuel and identify the **critical path**.   10

   c) If Mr. Samuel could find a way to save time on the "write use cases" phase, would it help? Why or why not?   5

4. a) Explain the cost of development with agile process comparing to other process model. Draw the graph that supports your claim. 10

    b) Agile development focuses on the talents and skills of individuals, molding the process to specific people and teams. Write down the key traits that must exist among the people on an agile team and the team itself. 10

    c) "The art of maximizing the amount of work not done – is essential in agile development." - Explain the statement. 5

5. a) Prescriptive process models were originally proposed to bring order to the chaos of software development. Winston Royce proposed the "Waterfall Model" originally. Explain the **Waterfall Process Model** with necessary figures. List the **advantages** and **disadvantages** of using this model. 15

    b) What are the potential problems of Prototyping Process Models and other evolutionary approach? 5+5

6. IUT is planning to start online teaching program. Through this program many knowledge seekers can avail higher level education or professional certificate courses from all over the world remotely. You have been assigned to carry out the feasibility study which will be presented to governing body of IUT. The predicted costs and benefits are as follows:

Table 2: Cost-revenue information

Year	Costs	Revenue
1	$50,000	$5,000
2	$10,500	$10,000
3	$5,000	$15,600
4	$2,000	$15,800
5	$2,000	$18,400
6	$2,500	$20,200

    a) What are the aspects you will look into, at the time of feasibility study? Explain each category of feasibility for the above system. 10

    b) Based on the information in Table 2, create a break even analysis and explain it with the figure indicating **payback period**. 10

    c) Identify the different types of benefits and costs of the proposed system. 5

7. The code in Figure 1 is intended to take an integer number (subject mark) as the input. Assume the given mark is out of 200. The program should print the percentage and appropriate message (Good, Average or Bad student).

```
1.   #include<stdio.h>
2.   Int main()
3.   {
4.      int num, float percentage;
5.      scanf('%d',num);
6.      percentage/=100;
7.      if(percentage>70){
8.        printf("Percentage: %d (Good Student)",percentage);
9.      if(percentage>50)
10.       printf("Percentage: %d (Average Student)",percentage);}
11.     else printf("Percentage: %d (Bad Student)",percentage);
12.     return 0;
13.  }
```

Figure 1

a) Find out all the errors in the Figure 1 and write down all the errors with the category of   12
    error (use the line number).

b) Write the NS diagram for given code (correct form of the code).   8

c) Write the differences between NS diagram, pseudocode and flow chart.   5

8. a) Define each type of operating systems.   6

    b) Write the functions of operating system with proper explanation.   10

    c) Write short notes on the following: 9
        i.   Version Control
        ii.   Stack Exchange
        iii.   Cloud Application

B.Sc. Engg./HD CSE 1st Semester   07 June 2018

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Department of Computer Science and Engineering (CSE)

SEMESTER FINAL EXAMINATION   WINTER SEMESTER, 2017-2018
DURATION: 3 Hours   FULL MARKS: 150

CSE 4105: Computing for Engineers

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There are **8 (eight)** questions. Answer any **6 (six)** of them.
Figures in the right margin indicate marks.

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1. a) A CPU executes each instruction in a series of steps. Explain each of those steps with their functionalities and roles of different registers in those steps.   10

   b) What is the importance of thorough problem analysis before deployment of any software project? Write down the six stages of program development cycle.   4+4

   c) What is cache memory? Draw the hierarchy of different types of memory used in computer system according to speed, capacity, and cost.   2+5

2. a) What is Compiler, Assembler, and Interpreter? Explain them with detailed examples.   6

   b) What are the stages of compiling a standard C program? Explain each of the stages mentioning the output at the end of each of them.   12

   c) Observe the following C code. Find the syntax errors in this code and mention their type.   7

```c
#include <stdio.h>
void Main()
{
    int a, b=1;
    for( a = 10; a>=0; a-- );
    {
        printf(b/a);
        continue;
    }
    if(a=b){
        printf("Equal");
    }
    return 0;
}
```

Figure 1

3. a) Suppose you own a super shop. Your super shop has only 20 items and you know their prices. You need software that will be able to calculate total bill of a customer. It is to be mentioned that there is a VAT (value added tax) of 7% attached with the total bill which is to be paid by the customer. Now write an IPO chart that depicts the input processing and output of the required software.   9

   b) Write an algorithm to calculate the bill of a customer. You can use any of the methods to represent your algorithm.   8

   c) Convert your algorithm into a NS diagram.   8

4. a) What is an operating system? Explain the key role played by operating system for user's interaction with the underlying hardware with appropriate diagram.   2+5+2

   b) What do you understand by Real Time Operating System? Explain Soft real-time and Hard real-time systems with appropriate examples.   2+6

c) Explain the following terms with appropriate examples.   8
    i.   Instruction
    ii.   Program
    iii. Software
    iv.   Process

5. a) Explain the Process Life Cycle with appropriate diagram.   10

   b) In a multiprogramming and time-sharing environment, several users share the system   6+4
      simultaneously. This situation can result in various security problems. Mention two such
      problems. What could be done to solve those problems?

   c) In a batch processing system, most of the time CPU remains idle. – Justify this statement   5
      with appropriate reason.

6. a) What is a register? Explain the purpose of different types of registers in CPU.   2+6

   b) Explain the difference between RISC and CISC architecture.   8

   c) Pipelining improves instruction execution speed by putting the execution steps into parallel.   9
      – Justify this statement with appropriate examples or diagram.

7. a) Observe the following assembly instruction: 8

                    LOAD   R1, A

      Explain the working procedure of this instruction. The contents of registers and buses
      should be clearly mentioned.

   b) There are a number of factors related to CPU that have an effect on the overall speed and   9
      performance of the computer. Explain those factors with appropriate examples.

   c) What do understand by Bus? Explain the function of Data Bus, Control Bus and Address   2+6
      Bus.

8. a) What is a computer network? Explain the basic network criteria.   2+6

   b) What do you understand by network topology? Name the four basic network topologies and   1+8
      cite an advantage of each type.

   c) What do you understand by protocols? Why protocols are needed? Mention key elements   2+6
      of a protocol in terms of computer networks.

B.Sc. Engg. CSE 1st Semester
B:Sc. Engg. SWE 1st Semester

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24 May 2018

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

SEMESTER FINAL EXAMINATION
WINTER SEMESTER, 2017-2018
DURATION: 3 Hours
FULL MARKS: 150

CSE 4107: Structured Programming I

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1. a) Write down the output of the following code: 13

```c
#include<stdio.h>
void change_value(int *q){
    int *p[] = {q+3, q+2, q+1, q};
    int **db_p = p;
    *(*p - 1) = (*p[0])++;
    *p[2] = db_p - p;
    **(p+3) = **db_p + 5;
    return;
}
int main(){
    int arr[5] = {10, 20, 30, 40};
    int i;
    change_value(arr);
    for(i = 0; i < 4; i++){
        printf("%d ", arr[i]);
    }
    return 0;
}
```

Figure 1: Code for Question 1(a)

b) Write a program where the main function takes a string as input from the user. It then passes the string 12
to the user-defined function *int myatoi(char *p)* that converts the string to an integer and returns the
value like the library function *int atoi(char *str)*. The program then prints the returned value.
If the given string starts with a character that is not a number, then the function returns zero. On the
other hand, if the given string starts with a number, then the function will take all the consecutive
numeric characters for conversion until it reaches the end of the string or a non-numeric character is
encountered. Some examples are given below:

Enter string: 123	Enter string: abc123	Enter string: 123abc	Enter string: 12ab34
Output: 123	Output: 0	Output: 123	Output: 12

Figure 2: Sample outputs for Question 1(b)

2. a) The people of Wakanda want to send a secret message to the members of Avengers. But they are 16
fearful that the spies of Thanos will intercept their message and read it. So, they have asked you to
encrypt their message so that the spies cannot understand it.
Now, write a program where a string will be taken as input from the user. Take the 2's complement of
the ASCII code of each of the characters in the string and write it in a file.

b) Discuss the storage type modifiers auto, register and static. 9

3. a) Write a program where the main function takes an integer as input. It then passes the value to a 13
recursive function that prints the binary representation of the number. **Do not use any global
variable.** [Hint: the main task of the recursive function will be to divide the given number by 2]

b) A square matrix is said to be an upper triangular matrix if all the entries below the main diagonal is   12
zero. Two examples of upper triangular matrices are given below:

```
1  3  1  8  4              0  0  0  0
0  3  2  -2 2              0  2  9  1
0  0  7  6  1              0  0  3  2
0  0  0  4  2              0  0  0  7
0  0  0  0  9
```

Figure 3: Examples of upper triangular matrices

Write a program that takes an integer n as input from the user. It then takes a $n \times n$ matrix as input and checks whether it is a upper-triangular matrix or not.

4. a) You have been assigned the task of developing a grading software to calculate the grades of the   10
students. The software will take the mark $m, (0 \leq m \leq 100)$ obtained by a student as input and then print the grade of the student according to the following table. You have also been instructed to only use switch case in the program. The use of if condition will not be accepted by the clients.

Grade	Marks
A	70-100
B	50-69
C	40-49
F	0-39

Figure 4: Table for Question 4(a)

b) Take an integer n as input from the user. Now take a $n \times n$ array as input. Now print the content of the   15
array in a spiral form. An example is given below:

```
Enter Size: 4
Enter Array:
1   2   3   4
5   6   7   8
9   10  11  12
13  14  15  16
Output: 1 2 3 4 8 12 16 15 14 13 9 5 6 7 11 10
```

Figure 5: Sample output for Question 4(b)

5. a) Tapos created a program to write down his and some of his friends' quiz, mid semester and semester   13
final marks in a file using binary stream. The information was stored in the following manner:
At first, he wrote an **integer** that contained a Student ID. Next, he wrote 4 **double** values that were the 4 quiz marks of that person. Then he stored 2 more **double** values where the first one was the mid-semester exam marks and the second one was the semester final exam marks. This was followed by a newline **character** to represent the end of the information for that person.
The information of the next person started immediately after the newline character following the same format.
Tapos now wants to find the average of the mid-semester exam marks all the people in his file. Help Tapos out by writing a program that will perform this task.

b) What is programming language? Discuss the three classes of programming language.   6

c) Differentiate between binary and character stream. List their advantages and disadvantages.   6

6. a) Take two characters as input and perform the three binary bitwise operations on them to create three   15
new characters. Print the number of 1s and 0s in the binary representation of the ASCII code of the new characters.

b) Discuss how the shift operators can be used to perform certain division and multiplication operations   10
with suitable examples.

7. You have been assigned the task of organizing the data of each of the departments of IUT. You will need to store the following data:
For each department you will have to store:
- Name of the department (Maximum 50 characters)
- Number of B.Sc. Students
- Information of the BSc students (Maximum 500 students)

- Number of M.Sc. Students
- Information of the M.Sc. students (Maximum 50 students)
- Number of PhD Students
- Information of the PhD students (Maximum 20 students)

Create a structure called *department* that can store all of these data. Since, there are six departments, you will need an array of this structure type. For each student, the following data must be stored:

- Name of the student (Maximum 50 characters)
- Student ID (Maximum 10 characters)
- Current CGPA

These data will be stored in a structure called *student*. Variables of *student* structure will be used within the *department* structure to hold the information of all the B.Sc., M.Sc. and PhD students.

a) Create the required structures according to the given specifications and create variables so that all the information can be stored.   7

b) Write a function that will print maximum and minimum CGPA of any student in any department of IUT.   8

c) Write a function that will take the name of a department as input and print the name of all of its students (B.Sc., M.Sc. and PhD) **alphabetically**.   10

8.   a) The following codes gives the output '210'. Rewrite the code so that the output is '211'. **Do not change any of the printf() statements.**   7

```
#include<stdio.h>
#define MAX(i, j) i > j ? i : j
int main(){
    printf("%d", MAX(1, 2));
    printf("%d", MAX(1, -1));
    printf("%d", MAX(100 && -1, 0));
    return 0;
}
```

Figure 6: Code for question no. 8(a)

b) Write the output of the following code and also rewrite the code so that the output is: 8

4 5 6 23 24 99

```
#include<stdio.h>
enum colors {blue, orange, purple, cyan, crimson, burgundy};
int main(){
    printf("%d ", blue);
    printf("%d ", orange);
    printf("%d ", purple);
    printf("%d ", cyan);
    printf("%d ", crimson);
    printf("%d ", burgundy);
    return 0;
}
```

Figure 7: Code for Question 8(b)

c) Write a code that takes an integer *n* as input and determines if *n* is a power of 3. [Check if n == 3^a, where a $\geq$ 0].   10

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SEMESTER FINAL EXAMINATION   WINTER SEMESTER, 2017-2018
DURATION: 3 Hours   FULL MARKS: 200

Math 4141: Geometry and Differential Calculus

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There are **8 (eight)** questions. Answer any **6 (six)** of them.
Figures in the right margin indicate marks.

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1. a) Prove that if a function is differentiable then it is continuous. Give an example which shows that converse is not always true.   13.33

   b) Check the continuity and differentiability of the following function at $x = 0$ and $x = 1$ and draw the graph.   20

   $$f(x) = \begin{cases} 1 + x^2 & x < 0 \\ x & 0 \le x \le 1 \\ \dfrac{1}{x} & x > 1 \end{cases}$$

2. a) The amount of water in a tank is $w(t) = 100(t - 15)^2$ gal. t minutes after it has started to drain 15 then find   15
      i.   At what rate is the water running out at the instant 5 minute?
      ii. What is the average rate at which water flows during 1 to 5 minute?

   b) If $f(x) = \begin{cases} \dfrac{1}{x + 2} & x < -2 \\ x^2 - 5 & -2 < x \le 3 \\ \sqrt{x + 13} & x > 3 \end{cases}$ Then find   8.33

      i. $\lim_{x \to -2} f(x)$ ii. $\lim_{x \to 3} f(x)$ iii. $\lim_{x \to 0} f(x)$

   c) Find all points where the following functions fail to be differentiable.   10

      i. $f(x) = x^{\frac{1}{3}}$ ii. $f(x) = |9 - x^2|$

3. a) A dynamic blast blows a heavy rock straight up with a launch velocity of 160 ft/sec. it reaches a height of $s = 160t - 16t^2$ ft after t second.   20
      i.   How high does the rock go?
      ii. What is the acceleration of the rock?
      iii. When does the rock hit the ground again?

   b) Find all points on the curve $f(x) = \tan x$, $-\dfrac{\pi}{2} < x < \dfrac{\pi}{2}$ where the tangent line is parallel to the line $y = 2x$ 8

   c) If $y = x + \sin x$, is there any horizontal tangent line? If so where is it?   5.33

4. a) A 13 ft ladder is leaning against a house when its base starts to slide away, by the time   13.33
        the base is 12 ft from the house, the base is moving at the rate of 5 ft/sec.

        i.   How fast the top of the ladder sliding down the wall?
        ii. At what rate the area of triangle (formed by ladder, wall and ground) changing?
    b) Verify that the following pair of curves meet orthogonally   20

        i. $x^2 + y^2 = 4$, $x^2 = 3y^2$ ii. $x = 1 - y^2$, $x = \frac{1}{3}y^2$

5. a) State and prove Rolle's theorem.   12

    b) Does the function $f(x) = \begin{cases} x^2 + 1 & 0 \le x \le 1 \\ 3 - x & 1 < x \le 2 \end{cases}$ satisfy the hypothesis of Rolle's   12

        theorem on the given interval [0,2]? Give reason for your answer.

    c) Find $\frac{dy}{dx}$ from the followings   9.33

        i. $x + \tan(xy) = 0$ ii. $\frac{1}{\sqrt{x}} + \frac{1}{\sqrt{y}} = 1$

6. a) Find the absolute maximum and minimum of $f(x) = 2x^3 - 15x^2 + 36x$ on the interval   8
        [-1, 5] and determine where these values occur.
    b) Find critical points and identify which critical points are stationary points for   5.33
        $f(x) = \frac{x+1}{x^2 + 3}$
    c) Sketch the graph of the function $f(x) = 3x^4 - 4x^3 + 2$ by showing stationary point,   20
        relative extrema, inflection point and concavity.

7. a) Evaluate the following limits using L' Hospital rule   13.33
        i. $\lim_{x \to 0}(1 + \sin x)^x$ ii. $\lim_{x \to -\infty}(\sqrt{x^2 + x} - x)$

    b) Graph the rational function $f(x) = \frac{2x^2 + x - 1}{x^2 - 1}$ by showing all necessary steps.   20

8. a) Show that the equation of bisectors of angles between the line represented by   10
        $ax^2 + 2hxy + by^2 = 0$ is $\frac{x^2 - y^2}{a - b} = \frac{xy}{h}$.
    b) Show that the equation $6x^2 - 5xy - 6y^2 + 14x + 5y + 4 = 0$ represents a pair of straight   12
        lines. Find their equation, point of intersection, angle between them and equation of
        bisector.
    c) If a straight line makes angle $\alpha, \beta, \gamma, \delta$ with the four diagonals of a cube then show that   11.33
        $\cos^2 \alpha + \cos^2 \beta + \cos^2 \gamma + \cos^2 \delta = \frac{4}{3}$

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

SEMESTER FINAL EXAMINATION   **WINTER SEMESTER, 2017-2018**
DURATION: 3 Hours   **FULL MARKS: 150**

Phy 4141: Physics I

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1. a) State Gauss's law in electrostatics. Define electric flux and flux density. Write down Gauss's law for magnetism, for gravitation, and for an incompressible fluid. **7**

   b) A particle of mass m and charge **q** is placed at rest in a uniform electric field **E** and released. Describe the motion of the electron. Show that the kinetic energy attained by the electron after moving a distance **y** is given by **K=qEy**, where the symbols have their usual meaning. Compare the motion of the electron with that of a falling body under the action of gravity. **10**

   c) The electric field between the plates of a cathode-ray oscilloscope is 1.2×10^4 nt/coul. What deflection will an electron experience if it enters at right angles to the field with a kinetic energy of 2.0 kEV ($1eV = 1.6 \times 10^{-19}$ joule)? The deflecting assembly is 1.5 cm long. **8**

2. a) Discuss Ohm's law. Define resistivity and current density. What do you mean by temperature coefficient of resistivity? **7**

   b) In a metallic conductor the electrons drift opposite to the applied external electric field **E**. Show that the drift velocity of the electrons in the conductor is given by $v_d = j/ne$, where the symbols have their usual meaning. **10**

   c) Show that the power **P** per unit volume transformed into Joule heat in a resistor is given by $P = j^2\rho$ or $P = E^2/\rho$, where the symbols have their usual meaning. **8**

3. a) Name and distinguish ferromagnet, ferrimagnet and antiferromagnetic materials. **7**

   b) What is Hall effect? Define Hall field E_H and Hall voltage V_H. How would you measure these quantities? Show that the Hall field experienced by the conduction electron is given by $E_H = j/ne \, B$, where the symbols have their usual meaning. **10**

   c) A copper strip 2.0 cm wide and 1.0 mm thick is placed in a magnetic field with B=1.5 webers/m². If a current of 200 amp is set up in the strip, what Hall potential difference would appear across the strip? **8**

4. a) Define Capacitance of a capacitor. What is a dielectric material and why is it used in a capacitor? Discuss the mechanism of charge polarization in a dielectric material. **7**

   b) What are free charges and induced charges? Show that the induced surface charge **q'** is always less in magnitude than the free charge **q** and that **q'=0** if no dielectric material is present in the capacitor. **10**

   c) A parallel plate capacitor has plates with area **A** and separation **d**. A battery charges the plates to a potential difference V_0. The battery is then disconnected, and a dielectric slab of thickness **d** is introduced between the plates. Calculate the stored energy both before and after the slab is introduced and account for any difference. **8**

5. a) Discuss interference of light. Describe Young's experiment in a quantitative way assuming that the incident light consists of a single wavelength. 5

   b) In a Young's double slit arrangement the two slits are illuminated with light from a mercury vapor lamp so filtered that only the strong green line ($\lambda = 5400$ Å) is effective. The slits are 0.10 mm apart, and the screen on which the interference patterns appears is 20 cm away calculate 15

      i.   The angular position of the first minimum
      ii. The angular position of the tenth maximum
      iii. The linear distance on screen between adjacent maxima.

   c) Discuss the various uses of MgF2 (n=1.38) as an anti-reflecting glass coating for different optical devices. 5

6. a) Discuss the phenomenon of diffraction of light. State and explain Huygen's principle. 7

   b) A plane wave falling at normal incidence on a long narrow slit of width **a**. Using the optical diagrams show the conditions at the central maximum of diffraction and at the first minimum of the diffraction. 10

   c) A slit of width **a** is illuminated by white light. For what value of **a** will the first minimum for red light ($\lambda = 6000$ Å) fall at $\theta = 30^0$? 8

7. a) Define polarization of light. Discuss with the help of a diagram the mechanism of polarization of light using polarizing sheets. 7

   b) Discuss polarization by double refraction. Describe how a beam of unpolarized light falling on a calcite crystal is split into two beams which are polarized at right angles to each other? What are o-ray and e-ray? 10

   c) Two polarizing sheets have their polarizing directions parallel so that the intensity I_m of the transmitted light is a maximum. Through what angle must either sheet be turned if the intensity is to drop by one-half? 8

8. a) Discuss Einstein's general theory of relativity. Discuss how Einstein related gravity to the structure of space and time? What do you mean by the term "warping of space-time around a body of matter"? 7

   b) Define relativistic mass and relativistic momentum. Derive Einstein's Mass-Energy relation. 10

   c) Solar energy reaches the earth at the rate of about 1.4 kW per square meter of surface perpendicular to the direction of the sun. By how much does the mass of the sun decrease per second owing to this energy loss? The mean radius of the earth's orbit is 1.5×10^{11} m. 8

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
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Department of Computer Science and Engineering (CSE)
SEMESTER FINAL EXAMINATION   WINTER SEMESTER, 2017-2018
DURATION: 3 Hours   **FULL MARKS: 150**

CSE 4173: Introduction to Database Management System

Programmable calculators are not allowed. Do not write anything on the question paper.
There are **8(eight)** questions. Answer any **6 (six)** of them.
Figures in the right margin indicate marks.

1. a) What are levels of abstraction in a Database? Demonstrate with necessary figure.   5
   b) Discuss the ACID properties of transactions that must be maintained by the database   8
      management systems to ensure integrity of data.
   c) Suppose IUT has an Exam Management System that is implemented with several files. The   12
      IUT authority is thinking about changing the system into a Database Management System.
      Give reasons why IUT authority is thinking about changing the system.

2. a) Consider the following two tables: 12

   Table 1: Instructor

inst_id	inst_name	dept_id
111	Nusrat	40
222	Farnia	50
333	Samia	50
444	Tajkia	40
555	Naznin	60
666	Ishrat	10

   Table 2: Department

dept_id	dept_name
10	MCE
20	EEE
30	TVE
40	CSE
50	CEE
60	BTM

   Write down the results after performing the following operations:
   i.   Left Outer Join (instructor ⟕ department)
   ii. Right Outer Join (instructor ⟖ department)
   iii. Full Outer Join (instructor ⟗ department)
   iv. Inner Join (instructor ⋈ department)

   b) Consider the following relational entities (Primary key is underlined)   10
      employee (*employee_name*, *street*, *city*)
      works (*employee_name*, *company_name*, *salary*)
      company (*company_name*, *city*)
      manages (*employee_name*, *manager_name*)
   Write down the following queries in SQL:
   i.   Find the company that has the most employees.
   ii. Find all employees in the database who earn more than each employee of "AB
        Bank".

   c) Consider the *department* table from Question 2(a). Determine the output of the following   3
      queries:
   i.   SELECT * FROM department WHERE dept_name LIKE '%E'
   ii. SELECT * FROM department WHERE dept_name LIKE 'C_E'

3. a) What is the difference between instance and schema? What is Scalar Subquery? 4+2
   b) How can we express natural join using other operations of relational algebra (explain with example)? 9
   c) Convert the following SQL statement into formal relational query language: 5+5

   SELECT name, dept_name, budget
   FROM instructor natural join department
   WHERE salary >= 10000

   Again, convert the following formal relational query statement into a proper SQL statement

   $\Pi_{name,\ course\ id} (\sigma_{instructor.ID\ =\ teaches.ID} ((\sigma_{dept\ name\ =\ "Physics"} (instructor)) \times (teaches)))$

4. a) Write short notes on: 20
      i.   Weak Entity Set
      ii.   Specialization and Generalization
      iii. Disjoint Constraint
      iv.   Overlapping Constraint
   b) Explain different types of attributes of an entity with appropriate examples. 5

5. a) Write down the relational schema from the E-R diagram shown in Figure 1. 12
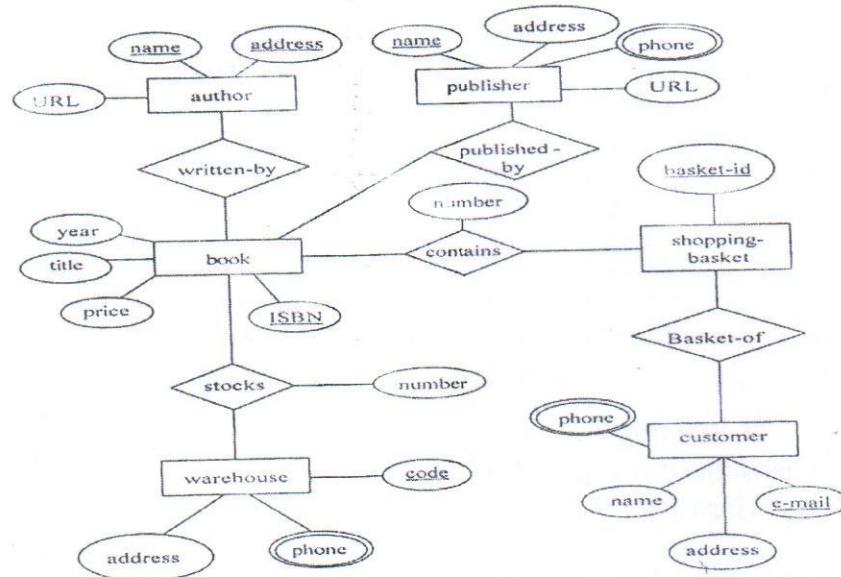
Figure 1: E-R diagram

   b) Write SQL data definition commands to create tables, relations and key constraints that replicate the E-R diagram given in Figure 1. 13

6. a) What is mapping cardinality in E-R model? Describe the mapping cardinalities with appropriate figure. 8

b) You are asked to develop a patient billing system to be marketed to private medical practices in Gazipur. The system is to be called PATMAN (short for PATient billing MANager), and is to run as a remote client-server system. An initial analysis phase of the project has resulted in the following description of the relevant data for PATMAN. **15**

- A practice has a number of patients and doctors.
- Doctors are identified by name.
- Each patient has a number used to identify the patient, a name and an age.
- Each patient is either a male or female.
- Each medical test identified by a test code and has a description and a charging category.
- Each charging category has a value in tk.
- Each patient has a number of billing records, with each billing record recording the medical test, the date on which the test was performed, the examining doctor and some additional comments on the part of the examining doctor.
- Billing records are either outstanding or paid in full.

Draw an ER diagram that represents the PATMAN data.

c) What is total and partial participation in E-R model? **2**

7. a) What do you mean by functional dependency? Explain with example. What is trivial functional dependency and closure of a set of functional dependency? **7**

b) What is meant by normalization? How does each step of normalization reduce anomalies? **8**

c) Figure 2 shows a dependency diagram (Primary keys are underlined) **10**
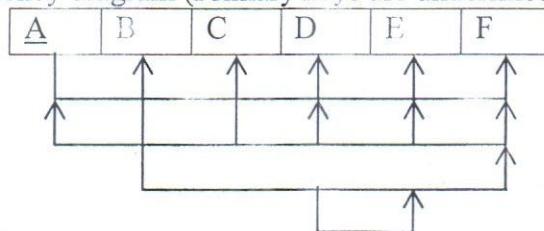
Figure 2: Dependency diagram of a relation for question 7.c)

A → BCDEF
BC → ADEF
B → F
D → E

Create a database whose tables are at least in 3NF. Show the dependency diagram for each table.

8. a) What do you mean by closure of a set of attribute sets? Mention several uses of the attribute closure algorithm. **7**

b) Consider the relational schema R(A, B, C, D, E, F, G) with the following functional dependencies: **10**

A → D
D → C
F → EG
DC → BF

Decompose R into BCNF. Show all the steps.

[Hint: Your answer should consist of a list of table names and attributes and an indication of the keys in each table (underlined attributes).]

c) Explain the Armstrong's axioms. List the additional rules to compute F⁺. **8**

DTE 1st Semester   04 June 2018

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

SEMESTER FINAL EXAMINATION   WINTER SEMESTER, 2017-2018
DURATION: 3 Hours   FULL MARKS: 150

CSE 4175: Computer Programming

Programmable calculators are not allowed. Do not write anything on the question paper.
There are **8 (eight)** questions. Answer any **6 (six)** of them.
Figures in the right margin indicate marks.

---

1. a) Write a function called strcmp406( ). This function is passed two parameters, both of which   20
        are C strings. The function should return:

    - A negative number if the first string is alphabetically before the second string. In C,
      the return value of strcmp( ) returns a number which reflects the difference in the
      ASCII codes for the first 2 letters which are not the same. For example, a call to
      strcmp("programming", "project") returns -3, since 'g' and 'j' in ASCII differ by 3.
    - Zero if the strings are the same
    - A positive number if the second string is alphabetically before the first string. Again,
      the number is the difference in ASCII codes between the first 2 letters which are not
      the same.

    Here are some additional examples:
    - strcmp406("bin", "bag") should return 8
    - strcmp406("computer", "game"); should return -4
    - strcmp406("computer", "computer"); should return 0
    - strcmp406("are", "area"); should return -97, because the '\0' character (at the end of
      "are", and represented by the number 0) is compared with 'a' (ASCII 'a' is 97).

    Your strcmp406( ) function should emulate strcmp( ) in this way, in other words, if the return
    value is not zero, the value of the negative or positive integer should reflect the difference in
    the ASCII encoding of the first differing letters in the two strings.

    b) What is the difference between Run time error and Compile time error? Give examples.   5

2. a) Suppose x is an array of integers and we have just executed the following code: 20
        ```
        for(i=0;i<5;i++)
            x[i] = i*i;
        ```
        Assume that x[0] is stored at address 4500. What is the value of each of the following
        expressions? (Assume integer occupies 2 Bytes of memory).
        i. x
        ii. &x[0]
        iii. *x
        iv. x[1]
        v. &x[1]
        vi. x+2
        vii. *(x+2)
        viii.   *(&x[2]+1)
        ix. *(x+5)
        x. x+x[1]

    b) What are the benefits of using pointers over array?   5

3. a) When will you use 'while loop' over 'for loop'? Explain with example.   6
   b) Discuss the following string related library functions: 15
      i.   strcpy()
      ii. strcat()
      iii. strlen()
   c) What is the purpose of a function prototype?   4

4. a) Determine the output for the following code: 10

```c
#include<stdio.h>
void f1( int *x);
int main( ).{
        int a[5], i;
        for ( i = 0 ; i < 5 ; i++ ){
            a[i] = 2 * i ;
            printf("%d   ",a[i]);
        }
        printf("\n");
        f1 ( a ) ;
        for ( i = 0 ; i < 5 ; i++ )
            printf ( "%d   ", a[i] ) ;
        return 0;
}
void f1 ( int *x){
        int i ;
        for ( i = 0 ; i < 5 ; i++ )
            *( x + i ) += 2 ;
}
```

Figure 1: Code for Question 4(a)

   b) Give two real life examples where structure can be used to store information. Write down the   8
      structure and explain those.
   c) What is *typedef*? Why is it important? What is the difference between *typedef* and *#define*?   7

5. a) Write a program that takes ten numbers from user and reports if any number is repeated.   10
   b) What is the output of the following program?   10

```c
#include <stdio.h>
int f(int n)
{
        int value;
        if (n == 0) value = 1;
        else value = 2 * f(n-1);
        printf("%d\n", value);
        return value;
}
int main()
{
        f(5);
        return 0;
}
```

Figure 2: Code for Question 5(b)

   c) Write code equivalent to the following loop using a C while statement: 5
      for (i = 0; i < N; i += 2) a += i;

6. a) What are the basic data types in C? — 5
   b) Write a program that asks the user for an integer and determines whether it is a prime or not. — 12
   c) Admission to a professional course is subject to the following conditions: — 8
      - Marks in Mathematics >= 60
      - Marks in Physics >=50
      - Marks in Chemistry >= 40
      - Total in all three subjects >=200 or Total in Mathematics and Physics >=150

      Given the marks in the three subjects write a program in C programming language to process the applications to list the eligible candidates.

7. a) Write a function named "calculateVowel()" that takes a string as a parameter and returns the number of vowels used in that string. — 10
   b) Given the declarations — 10
      ```
      int i = 3, j = 5;
      ```
      Find the values of the following expressions and include the values of variables i and j after the expression is evaluated.

      i.   (i/2) + 4
      ii. (j%3) * i
      iii. (i++) - (i--)
      iv. J = (i+ = 2)
   c) What are the relational operators used in C? — 5

8. a) Recently while checking student's database of IUT, it was found that some student's ID was wrong. It is decided that before storing an ID first it will be checked whether it is valid Id or not. Your task is to write a function named validate() that will take an ID as input and will decide whether the ID is valid or not. Function will return 1 if the given ID is valid otherwise it will return 0. A valid ID must meet the following criteria: — 20
      - An ID contains exactly 6 digits
      - First 2 digits of ID can be any number
      - 3rd digit is either 1,2,3,4 or 5
      - 4th digit is either 2,3 or 4
      - Last 2 digit is greater than 00 and less than 90
   b) There are some disadvantages of **switch** over **if** statement in C. There are some tasks those you cannot accomplish with a **switch** statement. Mention those limitations. — 5

B.Sc. Engg. / HD CSE 3rd Semester   **25 May 2018**

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
Department of Computer Science and Engineering (CSE)
SEMESTER FINAL EXAMINATION   **WINTER SEMESTER, 2017-2018**
DURATION: 3 Hours   **FULL MARKS: 150**

CSE 4301: Object Oriented Programming
Programmable calculators are not allowed. Do not write anything on the question paper.
There are **8 (eight)** questions. Answer any **6 (six)** of them.
Figures in the right margin indicate marks.

---

1. a) Your development team at **Led-Labels** are trying to develop a multi-player first person   25
        shooting game. The multi-player feature of the game lets a number of players to connect over
        the network and to work as a team to kill zombies. Keeping up with the spirit of the team-
        work, the cumulative number of bullets that can be fired by the players in a game are fixed.
        There are a number of zombies who the players can shoot bullets at and kill. Moreover, a bullet
        can hit nothing but unimportant objects in the game. Finally, a bullet hitting a fellow player
        will 'kill' the player, forcing her to leave the game. However, a bullet hitting a zombie will get
        rid of it from the game.

        Thus, the game consists of **GameObject**s. There are two specific types of such **GameObject**s,
        namely **Zombie**s and **Player**s. All **Zombie**s and **Player**s have their unique **ID**s represented
        as **integers** along with keeping track of the total number of **ammo**, **Zombie**s and **Player**s
        left in the game.

        Now, your friend John Doe has already created a class called **Bullet** which has a member
        function called **whereDidItHit()**. The method returns **0** if a zombie is hit, **1** if a player is hit
        or **-1** if a generic game object is hit. Moreover, another method of **Bullet** class called
        whoDidItHit() returns the **ID** of the **GameObject** that was hit by the bullet.

        Your job at **Led-Labels** is to at first complete the **GameObject**, **Zombie** and **Player**
        class. Later you need to device a class called **GameManager** which will include a method
        called **fire()**. The method will be called as long as there is ammo left in the game. All
        Zombies and **Player**s in the game will initially subscribe themselves with the **GameManager**
        class by overloading **+=** operator. Each time a **fire()** event is published, all **Zombie**s and
        Players will get notification of where the bullet had hit and if it had hit a specific **Zombie** or
        Player. The **Player**s and **Zombie**s will update the number of ammo, **Zombie**s and **Player**s
        left in the game according the result. If a specific **Zombie** or **Player** was hit by a bullet, they
        will unsubscribe from the **GameManager** by overloading **-=** operator. Finally, if all zombies
        become 'dead', the game will be won. On the other hand, if total ammo becomes depleted or
        only one player remains in the game, the game will be lost.

2. a) Consider the code in Figure 1. Write a code snippet to declare an array of 3 **Employees**.   5

```
class Employee {
  int salary, bonus;
public:
  Employee(int _salary) :salary(_salary), bonus(salary * 10 / 100) {}
  Employee(int _salary, int _bonus) :salary(_salary), bonus(salary*_bonus/10) {}
};
```

Figure 1: Code snippet for Question 2(a)

b) Write short notes on the following topics: 10
   i. Function Overloading
   ii. Virtual Base Class
   iii. Virtual Function
   iv. Abstract Class
   v. Forward Declaration

c) Consider the code snippet in Question 2.(a). Now overload `<<` operator to set **salary** for an 10
Employee. Also, overload `>>` operator to get the **salary** of an **Employee**.

3. a) Create a class called **StudentInfo** where the details of a student's academic records are stored. 20
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.

b) What should be the output of the code snippet in Figure 2? 5

```
#include<iostream>                 int main() {
int x;                                 int& (*fp) ();
int& foo() {                           fp = foo;
    x = 30;                            fp() = fp() + 43;
    return x;                          std::cout << x << "\n";
}                                      return 0;
                                   }
```

Figure 2: Code Snippet for Question 3(b)

4. a) Simon and Garfunkel are software developers. Simon creates a class called **MyString** in 15
MyString.h file. **MyString** class includes a character string as a private property. In the
constructor of the **MyString** class, Simon takes input from the user for the string. Garfunkel
wants to create a class called StringService inside a file called StringService.h. StringService
class checks if a string is palindrome. Garfunkel wants to use the private variable in Simon's
MyString class as test case for StringService class. However, Simon does not trust anyone in
the world other than Garfunkel to give access to the private properties.
Your task is to recreate both these classes and provide Garfunkel access to Simon's private
properties so that no one else can so the same.

b) What would be the output of the following code? 10

```
class Base1{
public:
    Base1(int x){cout << "In Base 1 Constructor. x = " << x << endl;}
    virtual void PrintLine(){cout << "Base1 function\n";}
    ~Base1(){cout << "Destroying Base1\n";}
};
```

```
class Base2{
public:
    Base2(int x){cout << "In Base 2 Constructor. x = " << x << endl;}
    virtual void PrintLine(){
        cout << "Base2 function\n";
        PrintAnotherLine();
    }
    virtual void PrintAnotherLine(){cout << "Another Line in Base\n";}
    ~Base2(){cout << "Destroying Base2\n";}
};

class Derived : public Base2,public Base1{
public:
    Derived() :Base1(10), Base2(20){}
    void PrintAnotherLine(){cout << "Another Line in Derived\n";}
};

int main(){
    Base1 *b1; Base2 *b2; Derived d;
    b1 = &d;
    b1->PrintLine();
    b2 = &d;
    b2->PrintLine();
    return 0;
}
```

Figure 3: Code snippet for Question 4(b)

5. a) **Cake** is a form of sweet dessert that is typically baked. Typical cake ingredients are flour,   15
        sugar, eggs, butter, oil, margarine etc. A cake requires specific amount of all these ingredients.
        It also contains a particular flavor. A **WeddingCake** is a specific type of cake that includes
        multiple tiers stacked one after another. On the other hand, a **BirthdayCake** contains a
        specific number of candles on top of it. A more recent type of cake is called **IUT_Cake** which
        is made every year on the eve of cake party at IUT. **IUT_Cake** contains all the properties of a
        Cake along with having multiple tiers like a **WeddingCake** and has candles on top like a
        BirthdayCake. Apart from these properties, **IUT_Cake** also has a special property – each
        cake is made for each year of fresher students of IUT.

        Now, create four different classes to depict the object-oriented properties of the
        aforementioned types of cakes. What sort of problems are you going to face if you want to
        instantiate a new **IUT_Cake**? How can you solve that problem? Explain at least **two** different
        solutions.

    b) Consider the following code segment: 10

```
class Base{
    int x;
public:
    Base():x(0){cout << "Default Constructor in Base. x = " << x << endl;}
    Base(int x):x(x){cout << "Parameterized Constructor in Base. x = "<<x<<endl;}
    virtual int get_base_X(){return x;}
};
class DerivedA : virtual public Base{
    int x;
public:
    DerivedA(int x,int y):x(x),Base(y){cout << "Constructor in DerivedA.x = " << x <<
endl;}
    virtual int get_base_X(){return x;}
};
class DerivedB : virtual public Base{
    int x;
public:
    DerivedB(int x, int y) :x(x),Base(y){
    cout << "Constructor in DerivedB. x = " << x << endl;}
    virtual int get_base_X(){return Base::get_base_X();}
```

```
};
class DerivedC:public DerivedB, public DerivedA{
   int x;
public:
   DerivedC(int x, int dax, int dbx, int bxa, int bxb) : x(x),DerivedA(dax, bxa),
DerivedB(dbx, bxb){
       cout << "Constructor in DerivedC. x = " << x <<endl;}
    int get_base_X(){return x;}
};
```

Figure 4: Code for Question 5(b)

Now write a main function such that it generates the following output:

```
Constructor in DerivedA. x = 2
Constructor in DerivedC. x = 1
Default Constructor in Base. x = 0
Constructor in DerivedB. x = 30
Constructor in DerivedA. x = 20
Constructor in DerivedC. x = 10
1
10

Parameterized Constructor in Base. x = -4
Constructor in DerivedA. x = -3
-3

Parameterized Constructor in Base. x = -40
Constructor in DerivedA. x = -30
-40
```

Figure 5: Output for Question 5(b)

Note: you can only create objects of the given classes, call different methods of those objects or print new lines in your implementation of main function. You can pass parameters to the objects.

6. a) Consider the following code snippet of a program. What are the reasons for the compilation   5
      errors in the program?

```
class base {          class derived_1 :private base {
    int x;            public:    derived_1() { x = 1; y = 2; z = 3; }
protected:   int y;   };
public: int z;
};                    class derived_2 :public derived_1 {
                      public:    derived_2() { x = 1; y = 2; z = 3; base b;  }
                      };
```

Figure 6: Output for Question 6(a)

   b) What is run-time polymorphism and why is it necessary?   5

   c) In question 2(a), **Employee** class is given. Now overload the **+** operator so that the chain   15
      addition of **Employee** objects and decimal values are possible. Let us assume, we have three
      Employee objects, **ob1**, **ob2** and **ob3**. Now, the overloaded operator should be able to
      execute the following expression: **10 + ob1 + ob2 + 12 + ob3**.
      Note: When a decimal value is added to an **Employee** object, the value should be added to
      both **salary** and **bonus** of the object. On the other hand, when adding two **Employee**
      objects, their corresponding **salary** and **bonus** should be added respectively.

7. a) Consider the following code snippet of a program. The program is incomplete. You have to   20
      complete the program according to the instructions given in the code as comment.

```
class Course{
    int ID;
    string name;
    float GPA, credit_hour;
public:
    Course(){  /*Take input from the users to initialize the properties*/}
```

```
};
class CourseList{
    Course *cp;
    int course_list_size;
public:
    CourseList(){    /*Take the number of courses from user
            Dynamically allocate memory in 'cp'*/    }
    ~CourseList(){/*Release memory of 'cp'*/}
};
class Student{
    int ID;
    float CGPA;
    string name;
    CourseList course_list;
public:
    Student(){/*Take input from the users to initialize the properties*/}
};
```

Figure 7: Code for Question 7(a)

Now implement the following operator overloading:

- i. Overload += operator to add a course to a CourseList
- ii. Overload = operator to set the value of ID for both Student and Course class
- iii. Overload [] operator to get or set the GPA in a specific course from the CourseList based on the index passed as parameter.
- iv. Calculate CGPA of a student by adding the GPAs of all courses and dividing the sum by the total number of courses.

b) Define the key characteristics of OOP.   5

8. a) What are the major bugs in the following code? How can you solve these bugs without 15 changing any datatypes?

```
class Employee {                              int main() {
    int *salary;                                  Employee ob(1);
public:                                           int inp;   cin >> inp;
    Employee(int _salary) {                       if (!inp % 2) {Employee ob1(0);
        this->salary = new int(_salary);              ob1 = ob;
    }                                             }
    ~Employee() {                                 else {Employee ob2(0);
        delete this->salary;                          ob2 = ob;
    }                                             }
};                                                return 0;
                                              }
```

Figure 8: Code for Question 8(a)

b) What is vector in C++. Give examples on how to use the following functions: push_back(), 10 begin(), end(), insert(), erase().

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

SEMESTER FINAL EXAMINATION   WINTER SEMESTER, 2017-2018
DURATION: 3 Hours   FULL MARKS: 150

CSE 4303: Data Structures

Programmable calculators are not allowed. Do not write anything on the question paper.
There are **8 (eight)** questions. Answer any **6 (six)** of them.
Figures in the right margin indicate marks.

---

1. a) Define Complexity. Translate Q into its equivalent postfix expression P using stack.   9
$$Q = (A + B * C / D - E + F / G / (H + I))$$

   b) On each iteration of its outer loop, insertion sort finds the correct place to insert the next item,   4+4
   relative to the ones that are already in sorted order. It does this by searching back through
   those items, one at a time.

   i.   Would insertion sort be speeded up by using binary search to find the correct place to
         insert the next item? Justify your answer.

   ii.   What is the running time for insertion sort when the array is already sorted in
         ascending order and descending order?

   c) Discuss different types of memory allocation techniques with appropriate example.   8

2. a) Assume you have a stack with operations: *push()*, *pop()*, *top()*, *isEmpty()*. How would you   6
   use these stack operations to simulate a queue, in particular, the operations: *enqueue()* and
   dequeue()?

   b) Consider the directed, weighted graph given in Figure 1. Even though the graph has negative   13
   weight edges, step through Dijkstra's algorithm to calculate shortest paths from A to every
   other vertex. Show your steps in a single table. Cross out old values and write in new ones,
   from left to right within each cell, as the algorithm proceeds. Also list the vertices in the order
   which you marked them visited.
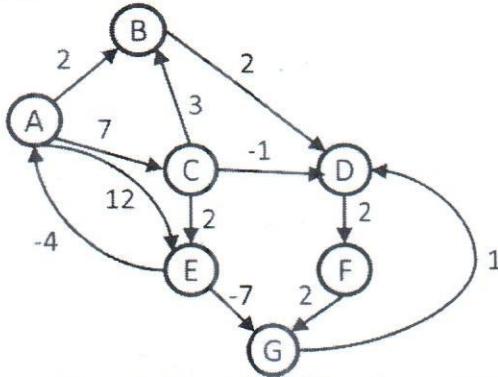
Figure 1: Figure for the Question no. 2 (b)

   i.   Here, Dijkstra's algorithm found the wrong path to some of the vertices. For just the
         vertices where the wrong path was computed, indicate both the path that was
         computed and the correct path.

   ii.   What single edge could be removed from the graph such that Dijkstra's algorithm
         would happen to compute correct answers for all vertices in the remaining graph?

   iii. Determine all strongly connected components for the graph given in Figure 1.

   c) What is garbage collection? Discuss how and when garbage collection takes place.   6

3. a) In the following questions, consider the list of numbers: 12
           62 , 31 , 70 , 91 , 25 , 11 , 9 , 61 , 73 , 6
      i.   Show the resulting tree after inserting the numbers in the same order specified above into an initially empty minimum heap.
      ii. Show the resulting tree after inserting the numbers in the same order specified above into an initially empty binary search tree.
      iii. Use the binary search tree you created in (ii). What are the two possible binary search trees after 62 is deleted.

  b) Draw an AVL Tree containing keys A, B, C, D, E, F, G such that a pre-order traversal visits   7
the nodes in following order "E, C, B, A, D, F, G". Next, insert 'H' and 'I' (Balance the AVL tree if necessary).

  c) Bob writes down a number between 1 and 1,000. Mary must identify that number by asking   6
"yes/no" questions to Bob. Mary knows that Bob always tells the truth. If Mary uses an optimal strategy, then she will determine the answer at the end of exactly how many questions in the worst case.

4. a) Define Load factor in hashing. Write down some properties of a good hash function. Which   8
type of Collision Resolution method is more appropriate when the load factor of the hash table is high?

  b) What is the minimum and maximum number of nodes in a complete and perfect binary tree   5
of height h?

  c) What is hashing? Consider a hash table of size 11 storing entries with integer keys. Suppose   12
the hash function is $h(k) = k \bmod 11$. Insert, in the given order, entries with keys **0, 1, 6, 7, 10, 22, 21** into the hash table to resolve collisions using:
      i.   Separate Chaining
      ii. Linear-Probing with $h_i(k) \Rightarrow (h(k) + i) \bmod 11$, where $f(i) = i$
      iii. Quadratic-Probing with $h_i(k) \Rightarrow (h(k) + i) \bmod 11$, where $f(i) = i^2$
      iv. Double-Hashing with h as the hash function and h_2 as the second hash function $h_i(k) \Rightarrow (h(k) + ih_2(k)) \bmod 11$, where $h_2(k) = 5 - (k \bmod 5)$

5. a) How many strongly connected components does a directed acyclic graph (DAG) of n vertices   7
have? Possible answers are 0, 1, n, or "it depends". Point out one of these answers and fully justify it.

  b) The frequencies of characters used in an arbitrary message are as follows: 10
      A : 7, B : 9, C : 11, D : 14, E : 18, F : 21, G : 27, H : 29, I : 35, J : 40
Show the complete Huffman tree for these characters and represent the values in binary for node A, C, and J of the Huffman tree using Huffman coding. (In Huffman tree, every left branch is coded with 0 and every right branch is coded with 1).

  c) What is the best asymptotic ("big-O") characterization of the following functions: 8
      i. $f(n) = 2^5 + 5n^3 \log(n) + 2^6 n^2 + 100\, n^4$
      ii. $f(n) = 1000n^2 + 16n + 2^n$
      iii. $f(n) = n + (n-1) + (n-2) + \cdots + 3 + 2 + 1$
      iv. $f(n) = 2^{10} + 3^5$

6. a) Let T be a full binary tree with 2011 nodes. How many internal nodes does T have? Suppose   4+4
you want to find the shortest distance from s to some particular vertex (rather than to all vertices reachable from s). What would you do?

  b) Analyze the complexity of bucket sort and radix sort. Briefly mention the limitations of these   4+4
two sorting algorithms.

  c) Perform topological sort on the graph given in Figure 2 and write down the sorted list of   9
nodes. If there is more than one valid topological sort order, write down all of them.
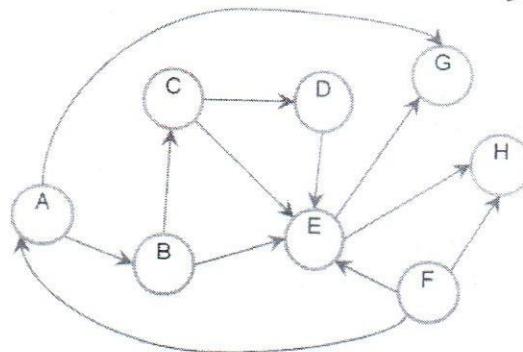
Figure 2: Figure for the Question no. 6 (c)

Next, for Figure 2, list the nodes in the order they would be visited in a depth-first search and breadth-first search of the graph starting at A. When choosing a node to explore next, break ties in favor of the alphabetically least.

7. a) Analyze the following scenarios regarding Prim's and Kruskal's algorithm and justify your answer with "yes/no". You are allowed to do some pre-processing work (like modifying the input values if necessary) before applying the algorithms. But you cannot modify the basic algorithm.   12

    i.   Both algorithms will always return the same Minimum Spanning tree (MST).
    ii. Both algorithms can produce Minimum Spanning Tree with an undirected graph where the weights can be either positive or negative.
    iii. You can compute a maximum spanning tree, namely the spanning tree that maximizes the sum of edge costs.

    b) Analyze the following code of Figure 3 and find out the complexity in terms of Big-O notation step by step. (try to make the upper bound tighter)   5

```
void complexity(){
    int n, val;
    for ( int j = 4; j < n; j = j+2 ){
        val = 0;
        for ( int i = 0; i < j; ++i){
            val = val + i * j;
            for ( int k = 0; k < n; ++k){
                val++;
            }
        }
    }
}
```

Figure 3: Figure for the Question no. 7 (b)

    c) Explain critical path for a directed graph with suitable example. How to check from preorder, inorder or postorder traversal sequence whether a given Binary Tree is BST or not?   4+4

8. a) Write down one basic application and asymptotic run time for the following algorithms, on a graph with n vertices and m edges: 8
    i.   Bellman-Ford algorithm
    ii. Breadth-first search (BFS)
    iii. Depth-First Search (DFS) with Adjacency matrix
    iv. Topological sort with Adjacency list

    b) Use Prim's algorithm starting at node A to compute the Minimum Spanning Tree (MST) of the graph given in Figure 4. In particular, write down the edges of the MST in the order in which Prim's algorithm adds them to the MST. Use the format (node 1; node 2) to denote an edge. Next, write down the edges in the order in which Kruskal's algorithm adds them to the MST.   7+4
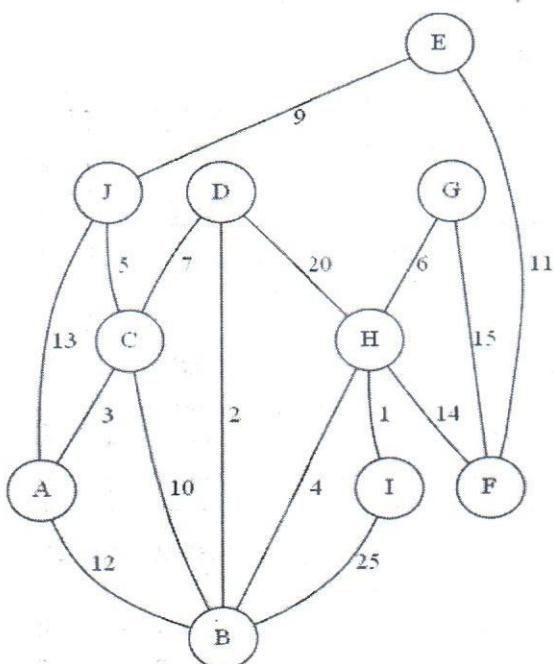
Figure 4: Figure for the Question no. 8 (b)

c) Consider a sorted circular doubly-linked list where the head element points to the smallest   6
   element in the list. Now write down the asymptotic complexity for the followings:
   i.   Finding the smallest element in the list
   ii.   Finding the largest element in the list
   iii. Determining whether a given element e appears in the list
   iv.   Deleting a given element e in the list (not including the cost of finding it)

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

SEMESTER FINAL EXAMINATION   WINTER SEMESTER, 2017-2018
DURATION: 3 Hours   FULL MARKS: 150

CSE 4305: Computer Organization and Architecture
Programmable calculators are not allowed. Do not write anything on the question paper.
There are **8 (eight)** questions. Answer any **6 (six)** of them.
Figures in the right margin indicate marks.

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1. a) Explain the advantages and disadvantages of using a direct mapped cache instead of an 8-way set associative cache.   5

   b) A computer system uses 16-bit memory addresses. It has a 2K-byte cache organized in a direct-mapped manner with 64 bytes per cache block. Assume that the size of each memory word is 1 byte.   6+4

      i.   Calculate the number of bits in each of the tag, index, and offset fields of the memory address.
      ii. Below is a sequence of two binary memory addresses in the order they are used to reference memory. Assume that the cache is initially empty. For each reference, write down the tag and index bits and indicate whether that reference is a hit or a miss

      0000 0000 1000 0000,   0000 0000 1001 0000

   c) Repeat question 1(b), if the cache is organized as a 2-way set-associative cache that uses the LRU replacement algorithm.   6+4

2. a) Define Horizontal and vertical organization of micro instruction. Why is the WMFC step needed when reading from or writing to the main memory?   4+4

   b) Suppose a processor is using the single bus structure for internal datapath. Write the sequence of control steps required for each of the following instructions.   4+4

      i.   *Add (R3), R1*
      ii. *Add R3, R1*

   c) Briefly describe hardwired control and microprogrammed control with proper diagram.   9

3. a) What do you mean by memory interleaving? How can the memory interleaving increase higher average utilization of memory?   7

   b) What is the advantage of using a write-back cache instead of a write-through cache? You find that it would be very inexpensive to implement small, direct mapped cache of 32K bytes with an access time of 30 ns. However, the hit rate would be only about 50%. If the main memory access time is 60 ns, does it make sense to implement the cache?   5+4

   c) The average memory access time for a microprocessor with 1 level of cache is 2.4 clock cycles   9
   If data is present and valid in the cache, it can be found in 1 clock cycle. If data is not found in the cache, 80 clock cycles are needed to get it from off-chip memory. Designers are trying to improve the average memory access time to obtain a 65% improvement in average memory access time, and are considering adding a 2nd level of cache on-chip. This second level of cache could be accessed in 6 clock cycles. The addition of this cache does not affect the first level cache's access patterns or hit times. Off-chip accesses would still require 80 additional CCs. To obtain the desired speedup, how often must data be found in the 2nd level cache?

4. a) What is virtual memory? Explain the concept of virtual memory address translation scheme   2+6
        with paging using necessary diagrams.
    b) What is TLB? Explain (in 4-5 sentences) why TLB is needed for virtual-to-physical address   2+5
        translation.
    c) Explain TLB hit and TLB miss with proper example and diagram.   10

5. a) Briefly explain the difference between page fault and TLB miss with proper example.   7
    b) What do you mean by RAID? List the characteristics of each RAID level with diagram.   8
    c) Write short note on read and write mechanism of magnetic disk.   7
    d) Consider a machine with 64-bit addresses and an 8KB page size. How many bits are   3
        required to represent a page number?

6. a) Consider the following sequence of instructions being processed on the pipelined 5-stage   6x3
        RISC processor
        Load R4, #100(R2)
        Add R5, R2, R3
        Subtract R6, R4, R5
        And R7, R2, R5
        i.   Identify all the data dependencies in the above instruction sequence. For each
              dependency, indicate the two instructions and the register that causes the
              dependency.
        ii.   Assume that the pipeline does not use operand forwarding. Also assume that the only
              sources of pipeline stalls are the data hazards. Draw a diagram that represents
              instruction flow through the pipeline during each clock cycle. How long does it take
              for the instruction sequence to complete?
        iii. Now, assume that the pipeline uses operand forwarding. There are separate
              forwarding paths from the outputs of stage-3 and stage-4 to the input of stage-3.
              Draw a diagram that represents the flow of instructions through the pipeline during
              each clock cycle. Indicate operand forwarding by arrows.
    b) What is dynamic branch prediction? Draw the finite state machine for a 2-bit prediction   2+5
        scheme.

7. a) "Pipelining does not result in individual instructions being executed faster; rather, it is the   7
        throughput that increases" Explain this with necessary example.
    b) Why shouldn't we use a million pipeline stages if an operation can be divided up into a   5
        million steps, even if we can keep the pipeline full?
    c) Briefly describe the different functional units of basic linear pipeline architecture.   6
    d) Consider the execution of a program of 15000 instructions by a linear pipeline processor   3+4
        with a clock rate of 25MHz. Assume that the instruction pipeline has 5 stages and that one
        instruction is issued per clock cycle. The penalties due to branch instructions and out-of-
        sequence executions are ignored
        i.   Calculate the speedup factor as compared with non-pipelined processor
        ii.   What are the efficiency and throughput of this pipelined processor

8. a) What do you mean by Direct Memory Access? Briefly explain how DMA controller can   2+6
        transfer a block of data from an external device to the processor?
    b) Write short notes on the following.   3x3
        i.   Cycle Stealing
        ii.   Memory-mapped I/O
        iii. Interrupt-service routine
    c) One way of receiving a response from a device is to poll it periodically about whether it has   2+6
        any additional information. What is wrong with this technique? Explain the alternative.

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

SEMESTER FINAL EXAMINATION   WINTER SEMESTER, 2017-2018
DURATION: 3 Hours   FULL MARKS: 150

CSE 4307: Database Management Systems

Programmable calculators are not allowed. Do not write anything on the question paper.
There are **8 (eight)** questions. Question **No. 7 and 8 are compulsory** to answer. Answer any **4 (four)** from the remaining questions. Figures in the right margin indicate marks.

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1. a) *"File processing system introduces difficulty in accessing data. It also incurs integrity problem.* 10
   - Place suitable examples to justify these statements.
   b) Write down the main responsibilities of a Database Administrator (DBA). 5
   c) What is relational algebra? Briefly outline its major three operations. What is the basic 10 difference between the relational algebra and query language?

2. a) Consider the following database design: 3×4

   employee (person name, street, city)
   works (person name, company name, salary)
   company (company name, city)

   Give expressions both in the relational algebra and standard SQL to express each of the following queries:

   i. Find the names of all employees who live in city "Dhaka".
   ii. Find the names of all employees whose salary is greater than $60000.
   iii. Find the names of all employees who live in "Dhaka" and whose salary is greater than $60000.

   b) What is the basic difference between DDL and DML? Explain with example. 5
   c) What is the difference between inner join and outer join? Explain left outer join and right outer 8 join with suitable example data.

3. a) Answer the followings: 4+4

   i. Explain DDL and DML with suitable examples.
   ii. Null values introduce a number of problems in arithmetic operations in SQL statements. Justify with suitable example.

   b) Is it possible to add a "where" clause in an SQL statement involving aggregate functions? 5 Justify your opinion with example.
   c) Consider the following relations: 2×6

   (Note: ID is the primary key of each entity. x(FK[r]) indicates x a foreign key referencing entity r)
   persons(ID, Name, DOB, Address)
   schools(ID,Name, Establish_Year)
   companies(ID, Name, Location)
   students(ID,Person_ID (FK[persons], gpa, school_ID(FK[schools]))
   emp(ID, Person_ID(FK[persons]), Salary)

Write the following SQLs:
   i.   List the person Name, ID and Address according to their age (i.e. Oldest will appear first)
   ii. List each student's information as following:
        Student ID, Student Name, Name of School, gpa
   iii. List the school's summary as : School Name, Total Students, average gpa
   iv. List top 5 schools based on the average gpa (as obtained in iii)
   v.   List employees name, his/her company name, salary
   vi. Update each employee salary by 20% for those who currently get less than the average salary of his/her company's employees salary

4. a) Define Super Key, Candidate key, Primary key with example data.   3
    b) What is jdbc? What are essential parameters for making a jdbc connection? Present a brief   6
       example code (only relevant part of the code is expected).
    c) What is a view? What is the basic difference between a table and a view? Can you insert data   7
       into a view? Justify it using suitable examples.
    d) i.   What is cardinality? How do you ensure many-many cardinality? Use example to   3×3
             explain.
        ii. Differentiate between Cartesian product and natural join.
        iii. *"Natural join removes meaningless records."*- Justify with suitable example.

5. a) Name the four integrity constraints on single relation. Create one table involving these   10
       constraints (use standard SQL).
    b) i.   What is a trigger? Mention one scenario where you are advised to use trigger and   10
             another scenario where it is not encouraged to use trigger.
        ii. Consider emp(ID, Name, DOB, address, Retired (yes or no)). You are the dba of the
             company. Whenever any employee finishes his/her job and gets into retirement his/her
             Retired flag is set to YES. And all personal information of that employee should be
             copies to another table for historical reference.

             Write SQL code to perform the above task.
    c) Define entity and attribute. Explain different types of attributes with appropriate examples.   5

6. a) Classify the constraints on generalization or specialization based on the followings: 3×4

        i.   Attribute of higher-level entity determines lower-level entity membership
        ii. The number of branching in its lower-level entity
        iii. Completeness
    b) What is functional dependency? Explain with a suitable example.   5
    c) Explain the conditions of Boyce–Codd normal form (BCNF). State a general rule for   8
       decomposing schema that are not in BCNF.

7. **[Compulsory]**   25

Consider following Library Management System (LMS):
System description: The existing manual Library Management System (LMS) should be replaced
by an automated system. Library stores books on various **major subjects** such as Physics, Computer
Science and so on. Each major subject may have further details such as: Computer Science can be
further detailed (e.g. Networking, Database, AI and so on). Library procures books from different
publishers, it contains information such as publisher name, country and reputation (allowed values
are: excellent, good, bad). The system should store **book**'s basic information such as: title of book,
publisher, year of publish, price. It can store **multiple copies** of the same book and uniquely identify
each book efficiently.

Both **students** and **staffs** can borrow (normal borrow) books. Once a book is issued against a

student or a staff the book is **no longer available** until he/she returns it. After borrowing book he/she must **return** book within 7 days. Apart from normal borrow the system also allows to issue one book against a number of students (e.g. 3 students can take one book) and the number of students is not fixed. This mode of borrowing is called **shared** borrow. In shared borrow multiple students take one book but one student is assigned as **major user** while others are **associate users**. The major user is responsible for any unusual cases such as: book lost or stolen (this module will not deal it).

Required Reports:

- A detail book report with the following information:
  o Book No, Book Title, Publisher Name, Country of Publisher, Date of Purchase
- A summary book report with the following information:
  o Book No, Book Title, Publisher Name, Country of Publisher, Total Copy, Total Copy available
- Given a student ID or staff ID list of books he/she borrowed but yet not returned.
- Given a student ID or staff ID list of books he/she borrowed during the last 30 days.

a) Make E-RD of the system. (You are free to make additional assumption for both entities and attributes)
b) Implement E-RD using proper DDL statements.
c) Write SQL statements for the mentioned reports.

8. a) **[Compulsory]**   10

Mr. X is database designer of very large company containing 20000 employees. As part of the total system design he has done the following in regard to employee's information:

- The total salary of each employee is calculated as follows:
  Total Salary= Basic + 40% of Basic (as house rent)
  Mr. X designed *emp* entity as follows:
  emp(ID,Name, Date of Birth, Join Date, Age, Basic Salary, House Rent, Total Salary)

- In order to make employee ID more informative he designed the ID as follows:
  ID: X-NNN   where X is either S or M or J, NNN is a 3-digit number.
  Here S, M and J stand for Senior, Medium and Junior. An employee has S status if he/she worked more than 10 years, M status if he/she worked more than 3 years and less than 10 years, others are with J status.

Since you have taken the database course in your undergrad, you think Mr. X has some design problems in this context. Your task is to explain the major design problem and at the same time propose an ideal solution to eliminate those problems.

b) Referring the Q.8 a) the business rule for calculating total salary has been changed as follows: 5

Total Salary= Basic + 40% of Basic (as house rent) + 50$ for each child.

Your tasks are:
  i. Modify the DDLs to accommodate the new requirement.
  ii. Write a PL/SQL function that takes employee ID as IN parameter and computes and returns the total salary.

c) Is it possible to declare one attribute as primary key and foreign key (referencing different   5
entity)? Justify your position with a suitable real-life example.

d) Is it possible to declare one attribute as primary key and foreign key (referencing the same   5
entity)? Justify your position with a suitable real-life example.

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

SEMESTER FINAL EXAMINATION   WINTER SEMESTER, 2017-2018
DURATION: 3 Hours   FULL MARKS: 150

Math 4341: Linear Algebra

Programmable calculators are not allowed. Do not write anything on the question paper.
There are **8 (eight)** questions. Answer any **6 (six)** of them.
Figures in the right margin indicate marks.

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1. a) Show that the projection of a vector b on the column space of given matrix A is obtained   7
    from $p = A\hat{x}$. Also derive the value of $\hat{x}$.

    b) Prove that $A^T A$ is invertible if and only if A has linear independent columns.   5
    c) Suppose a plane is spanned by the linear combination of two vectors $(1, 2, -1)^T$ and $(1,0, 1)^T$.   8
       Which vector in this plane is closest to b $= (2, 1, 1)^T$?
    d) Suppose A is the 4 by 4 identity matrix with its last column removed: A is 4 by 3. Project   5
       b$=(1, 2, 3, 4)^T$ onto the column space of A. What shape is projection matrix P and what is P?

2. a) Find the equation $y = mx + c$ of the least-squares line that best fits the data points (2, 1), (5,   20
       2), (7, 3), and (8, 3). What is the magnitude of the error vector?

    b) Given an $m \times n$ matrix A with linearly independent columns, let A=QR be a QR   5
       factorization of A where Q contains orthonormal columns and R is an upper-triangular
       matrix. Then, prove that for each b in $\mathbf{R}^m$ space, the equation Ax=b has a unique least-
       squares solution, given by: $\hat{x} = R^{-1}Q^T b$.

3. a) If A=QR then $A^TA=R^TR$. *Gram-Schmidt* method on A corresponds to elimination on A^TA.   20
       Show that the pivots for A^TA must be the squares of diagonal entries of R. Find Q and R by
       Gram-Schmidt for this matrix A:

       $$A = \begin{bmatrix} -1 & 1 \\ 2 & 1 \\ 2 & 4 \end{bmatrix}$$

    b) Determine whether the following statements are true or false. Give a reason if true or a
       counter example if false:
       i.   The determinant of $I+A$ is 1+det(A).   1
       ii.   The determinant of ABC is |A||B||C|.   1
       iii.   The determinant of $4A$ is 4det(A).   1
       iv.   The determinant of $AB-BA$ is zero. All matrices here are considered square.   2

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

4. a) The n by n determinant A_n has 1's above and below the main diagonal:

    $$A_1 = |0| \qquad A_2 = \begin{vmatrix} 0 & 1 \\ 1 & 0 \end{vmatrix} \qquad A_3 = \begin{vmatrix} 0 & 1 & 0 \\ 1 & 0 & 1 \\ 0 & 1 & 0 \end{vmatrix} \qquad A_4 = \begin{vmatrix} 0 & 1 & 0 & 0 \\ 1 & 0 & 1 & 0 \\ 0 & 1 & 0 & 1 \\ 0 & 0 & 1 & 0 \end{vmatrix}$$

       i.   What are these determinants A_2, A_3, A_4?   3×5
       ii.   By cofactors find the relation between A_n and A_{n-1} and A_{n-2}. Find A_{10}.   5

b) The corners of a triangle are (2, 1) and (3, 4) and (0, 5). Add a corner at (-1, 0) to make a lopsided region (four sides). Find the area of the new region.   5

5. a) Find the eigenvalues for the following matrix A. Calculate the eigenvectors for only nonzero eigenvalues.   20

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

b) Show that if $3I$ is added with a matrix A, then its eigenvalues change but eigenvectors do not.   5

6. a) Factorize the following matrix A in to $S\Lambda S^{-1}$.   7

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

b) The Lucas numbers are like the Fibonacci numbers except they start with $L_1=1$ and $L_2 = 3$. Following the rule $L_{K+2} = L_{K+1} + L_K$ the next Lucas numbers are 4, 7, 11, 18, and so on. Find the Lucas number L_{100}.   18

7. a) List the properties of Markov matrix. Show that the square of a Markov matrix is also a Markov matrix.   2+3

b) Suppose in a city every year 2% of young people become old and 3% of old people become dead. With no births and sudden death of young people, find the steady state for   20

$$\begin{bmatrix} young \\ old \\ dead \end{bmatrix}_{k+1} = [3\times3 \; Markov \; Matrix] \begin{bmatrix} young \\ old \\ dead \end{bmatrix}_{k}$$

Show all necessary calculations.

8. a) Compute the product of the following two matrices using the concepts of column picture of a linear system.   10

$$A = \begin{bmatrix} 1 & 0 & 0 \\ 2 & 1 & 3 \\ 0 & 0 & 1 \end{bmatrix} \quad \text{and} \quad B = \begin{bmatrix} 1 & 1 & 1 \\ 0 & 2 & -2 \\ 1 & 0 & 3 \end{bmatrix}$$

b) Find the inverse of matrix A by the Gauss-Jordan method: 10

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

c) For which values of c and d does the following matrix have a rank of 2? Explain your answer.   5

$$A = \begin{bmatrix} 1 & 2 & 5 & 0 & 5 \\ 0 & 0 & c & 2 & 2 \\ 0 & 0 & 0 & d & 2 \end{bmatrix}$$

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

SEMESTER FINAL EXAMINATION   WINTER SEMESTER, 2017-2018
DURATION: 3 Hours   FULL MARKS: 150

CSE 4501: Operating Systems

Programmable calculators are not allowed. Do not write anything on the question paper.
There are **8 (eight)** questions. Answer any **6 (six)** of them.
Figures in the right margin indicate marks.

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1. a) What is mode of operation in OS? Show the transition with diagram from one mode to another and explain.   1+4+2
   b) Write down advantages and disadvantages of layered approach.   4+4
   c) List the operating system services helpful for the user as well as required for efficient operation of the system itself. (List them separately)   7+3

2. a) Despite having worse hardware, why apple devices perform better than android devices?   5
   b) What is PCB? Describe the process information stored in PCB.   1+7
   c) Consider how to implement a mutex lock using an atomic hardware instruction. Assume that the following structure defining the mutex lock is available: 6+6

   typedef struct {
      int available;
   } lock;

   (available == 0) indicates that the lock is available, and a value of 1 indicates that the lock is unavailable. Using this struct, illustrate how the following functions can be implemented using the test and set() and compare and swap() instructions:
   • void acquire(lock *mutex)
   • void release(lock *mutex)
   Be sure to include any initialization that may be necessary.

3. a) What is a dispatcher? Write down the functionalities of a dispatcher.   1+3
   b) Differentiate (at least three) between Preemptive & Non-preemptive scheduling.   6
   c) How the burst time for the next process is predicted in SJF? Explain with necessary formula and figure.   10
   d) What is multi-level feedback queue? What are the parameters to define such queue?   5

4. a) Define processor affinity & load balancing.   2+4+4
      Differentiate:
         i.   Soft & Hard affinity
         ii.   Push & Pull Migration
   b) Mention one of the major drawbacks of Priority Scheduling, give a real-life example. What is the method used to deal with this problem?   8
   c) What is the thumb rule to determine quantum time for RR scheduling? Can RR be used as FCFS? If yes, describe how with example.   2+5

5. a) Why process scheduling is required?   1

   b)

Process ID	Burst Time	Arrival Time
01	10	3
02	3	0
03	1	1
04	5	4
05	7	5

   Draw process schedule diagram, determine start and finish time, average wait time and   4×6
   average turnaround time for the following scheduling algorithm:
       i.   FCFS
       ii.   Preemptive SJF
       iii.   Non-Preemptive SJF
       iv.   RR(QT = 5)

6. a) What is a thread? Describe single and multi-threaded structure with figures.   2+6
   b) Describe different multi-threading models with figures.   12
   c) List the benefits of multi-threading.   5

7. a) Differentiate among first fit, best fit & worst fit in terms of memory allocation.   12
   b) What is fragmentation? Describe different types of fragmentation with figures. What are the   8
      ways to handle them?
   c) Describe Segmentation. How is it different from paging?   3+2

8. a) List the advantages and disadvantages of paging.   7
   b) Discuss on different program threats and system threats.   10
   c) What are the main ways to allocate disk spaces to files? Briefly describe them.   8

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

SEMESTER FINAL EXAMINATION   WINTER SEMESTER, 2017-2018
DURATION: 3 Hours   FULL MARKS: 150

CSE 4503: Microprocessors and Assembly Language

Programmable calculators are not allowed. Do not write anything on the question paper.
There are **8 (eight)** questions. Answer any **6 (six)** of them.
Figures in the right margin indicate marks.

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1. a) What do you mean by single and multi-core microprocessor systems? Briefly explain the importance of using assembly language in a microprocessor system. — 10

   b) Derive the contents of the Flag (CF, PF, ZF, OF) register of 8086 microprocessor upon executing the following instructions: — 8

      i. CMP AL, FFh   ; Assume AL initially contains FFh.
      ii. TEST AL, FFh ; Assume AL initially contains FFh.

   c) Explain the purpose of DUP operator with an example. — 7

2. a) Derive the contents of the following MOV instructions using its coding template and also show how the contents of the instructions can be stored in memory: — 12

      i.   MOV AL, BL
      ii. MOV FFh[SI], BH
      iii. MOV DX, [ABCDh]

   b) Write short differentiations between the following 8086 assembly language instructions: — 8

      i. ROR and SHR   ii. LEA and OFFSET   iii. NOT and NEG

   c) Write an assembly language program structure to allocate exactly 64 Kbytes of memory for *data segment*, default memory bytes for *stack segment* and also consider that the size for *code segment* may exceed 64 Kbytes. — 5

3. a) Draw the schematic architecture of 8088 microprocessor. Write short notes on *segment registers* of 8086 microprocessor. — 9

   b) Write an assembly language program that takes N as a decimal digit (0 ~ 9) input and shows the summation of *1+2+ ... + N* as output. — 9

   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. — 7

4. a) Drawing the timing diagram, briefly explain the READ and WRITE operations for 8086 microprocessor. — 10

   b) Narrate the function of using 1, 2 and 9 under INT 21h instruction. — 6

   c) Distinguish between the followings: — 9
      i. Polling and Interrupt.
      ii. Memory-mapped I/O and Isolated I/O.

5. a) Find out the similarity between the register sets of 8085 and 8086 microprocessors. 10
   b) Briefly explain the operations of IOPL and NT flags of 80286 microprocessor. 7
   c) To perform MUL and DIV operation, write two assembly language programs each for MUL 8
      and DIV using:
      i. 8086 Data Register Sets
      ii. 8086 Bit Manipulation Instructions

6. a) With an appropriate timing diagram clearly define the following terms: 9
      Clock cycle, *Machine cycle* and *Instruction cycle*.
   b) Differentiate between different 80x86 microprocessors. 9
   c) Derive the contents of the IN AL, FFh using the instruction template and also show how 7
      the contents of this instruction can be stored in memory.

7. a) What is Memory Segment? How is the main memory of 8086 processor segmented? 8
   b) Briefly explain the operations of a Program Counter. 8
   c) Write appropriate assembly language codes to accomplish the following tasks (use as many 9
      as possible arithmetic instructions with less number of registers):
      i.   (30 + 15) * (575 – 225) + 210
      ii. 0Bh * (200 - 225) + 127
      iii. FFFh * 10h + 1111b

8. a) What are real mode, protected mode and virtual mode? Which microprocessor(s) first 10
      implements the virtual mode and how?
   b) Distinguish between the DX and SX version of 80386 microprocessor. 8
   c) Write an assembly language program structure to clearly state the operational differentiation 7
      between LABEL and LOOP?

B.Sc. Engg. / HD CSE 5th Semester   07 June 2018

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

SEMESTER FINAL EXAMINATION   WINTER SEMESTER, 2017-2018
DURATION: 3 Hours   FULL MARKS: 150

CSE 4511: Computer Networks

Programmable calculators are not allowed. Do not write anything on the question paper.
There are **8 (eight)** questions. Answer any **6 (six)** of them.
Figures in the right margin indicate marks.

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1. a) Explain why a minimum frame size is required for Ethernet. For example, standard   6+3
        (10Base) Ethernet impose a minimum frame size constraint of 64 bytes. Now suppose that
        the distance between two ends of an Ethernet LAN is d. Derive a formula to find the
        minimum frame size needed for an Ethernet packet.

    b) A sender sends a series of packets to the same destination using *Go-Back-N ARQ'*. If the   6
        header of the frame allows 4 bit sequence number that starts with 0, what is the sequence
        number after sending 100 packets? If the sender uses 'Stop-and-Wait ARQ' protocol for
        flow control then what should be the sequence number after sending 100 packets.

    c) Write short notes on any two of the followings: 2×5
              i.   Cheapernet
              ii. Fast Ethernet
              iii. Vulnerable Time

2. a) What is the significance of D (Duration) field in an IEEE 802.11 frame? What is the   4+4
        significance of contention window(CW) in CSMA/CA?

    b) Can RTS-CTS hand-shaking completely eliminate the hidden station problem? If YES,   7
        then justify how the RTS-CTS hand-shaking avoids the collision from hidden nodes. If
        NO, then draw a frame exchange scenario where a collision occurs due to hidden nodes.

    c) Consider a system of four LANs (L_1 to L_4) interconnected by five bridges (B_1 to B_5). The   10
        bridges connect the LANs as follows:
              i.   B1 connects L1 and L2
              ii.   B2 connects L1 and L3
              iii. B3 connects L1, L3 and L4
              iv.   B4 connects L3 and L4
              v.   B5 connects L1, L2, and L4
        Assume B_1 as the root bridge. Show the forwarding and the blocking ports after applying
        the spanning tree algorithm.

3. a) Name three ICMPv4 query message and three error-reporting messages. What is the   4+4
        purpose of including the IP header and the first 8 bytes of datagram data in the error
        reporting ICMPv4 messages?

    b) What is the main role of Address Resolution Protocol (ARP) in the network layer of   3+5
        TCP/IP protocol suite? Briefly explain how ARP is used to create subnetting effect.

c) Which fields of the IPv4 header are mutable, that means change from router to router? Name the fields in IPv4 herder those are necessary to handle the fragmentation of packets. In IPv6, mandatory base header contains no fields related to fragmentation. Briefly explain how fragmentations of packets are implemented in IPv6.   2+2+5

4. a) What is the difference between routing and forwarding? What is the advantage of net specific routing over host specific routing?   2+3

   b) An ISP is granted a block of addresses starting with 130.15.0.0/16. The ISP wants to distribute these blocks to 320 customers as follows: 12
   i. The first group has 64 customers; each needs 256 addresses
   ii. The second group has 128 customers; each needs 128 addresses
   iii. The third group has 128 customers; each needs 64 addresses
   Design the sub blocks and show the address allocation and distribution by the ISP. Find out how many addresses are still available after these allocations.

   c) What is IP address space depletion? Briefly explain different measures to handle IP address depletion   2+6

5. a) Briefly explain the working principle of link state routing. Consider the network shown in Figure 1, and assume that each node initially knows the costs to each of its neighbors. Consider the distance-vector algorithm and show the distance vector/table entries at node V that is shared with its neighbors. How does the scenario change if we use link state algorithm instead of distance-vector algorithm?   7+6

Figure 1: Network for Question 5.a)

   b) With necessary diagrams explain the C2I (counting to infinity) problem of distance-vector routing protocols. Mention some of the methods to eliminate the C2I (counting to infinity) problem of distance-vector routing.   9+3

6. a) A TCP client opens a connection using an initial sequence number (ISN) of 14,534. The TCP server opens the connection with an ISN of 21,732.   4+6
   i. Show the three TCP segments during the **three-way handshaking** connection establishment.
   ii. Show the contents of the segments during the connection termination using **four-way handshaking with half-close**.
   (Use timeline in y-axis for each side to show the **states** and the relative duration of the client and the server.)

   b) Name different flags used in a TCP segment. Briefly explain the significant role of Persistence timer and TIME-WAIT timer in TCP.   3+7

   c) What is **SYN flooding attack**? Mention some strategies to alleviate the effect of a SYN flooding attack.   5

7. a) A TCP source sends segments of equal size, and maintains the sequence number for each segment (i.e., the TCP protocol is segment-oriented instead of byte-oriented). Assume that the sequence number of the first data segment is 35. The size of the receiver window (*rwnd*) is always larger that the congestion window (*cwnd*). For the first data segment, assume that the value of the *cwnd* is 1, and the value of the slow start threshold (*ssth*) is 65000.

   You are asked to draw a timing diagram, where y-axis shows the time, and two parallel lines in the y-axis represent the events (sending and receiving of data and ACK segments, *cwnd* values, etc.) at the source and destination TCP.

   Assume that the source always tries to send as many data segments as it is allowed to.

   Draw the diagram considering the followings:
   - The successful transmission of segments from sequence number 35 to 55.

   - Segment 42 is lost, and the source identifies this by triple duplicate acknowledgments.
   - Segment 49 is lost (assume subsequent segments are also lost), and the source indentifies this by a timeout.
   - At the left side of the source TCP timeline, show the value of *cwnd* and *ssth*, whenever they are updated.
   - Identify the slow start, congestion avoidance, congestion detection region in the source TCP timeline.

   b) The UDP protocol does not provide any of the important services of the transport layer, namely reliability, flow control, and congestion control. Explain why we still use UDP, and what applications are suitable for UDP.   5

8. a) From a service perspective, how does symmetric key cryptography differ from asymmetric key cryptography? Can you 'decrypt' a hash of a message to get the original message? Explain your answer.   4+4

   b) Briefly explain the cryptographic strength of the Vigenere cipher over the Caesar cipher. Using the Playfair cipher encrypt the word "committee" using the key 'thief'.   4+4

   c) Suppose Alice wants to communicate with Bob using symmetric key cryptography using a session key K_S. The trusted third party (TTP) is a server that shares a unique secret symmetric key with each registered user. For Alice and Bob, denote these keys by $K_{A\text{-}TTP}$ and $K_{B\text{-}TTP}$. Design and explain a scheme that uses the TTP to distribute K_S to Alice and Bob. Your scheme should use at least three messages to distribute the session key: a message from Alice to the TTP; a message from the TTP to Alice; and finally a message from Alice to Bob. Your scheme should provide mutual authentication and should avoid the reflection attack as well as replay attack.   9

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

SEMESTER FINAL EXAMINATION   WINTER SEMESTER, 2017-2018
DURATION: 3 Hours   FULL MARKS: 150

CSE 4513: Software Engineering and Object Oriented Design

Programmable calculators are not allowed. Do not write anything on the question paper.
There are **8 (eight)** questions. Answer any **6 (six)** of them.
Figures in the right margin indicate marks.

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1. a) Briefly describe prototyping software process model.   7
   b) Elaborate the role of Software Requirement Specification (SRS) in Software Testing.   8
   c) ISO 9001 provides guidelines for different aspects of software development process. One of   10
      the guidelines for Management is as follows:

   ```
   Management Responsibility:
      -  Management must have an effective quality policy.
      -  The responsibility and authority of all those whose work
         affects quality:
            -  must be defined and documented.
      -  Responsibility of the quality system:
            -  independent of the development process,
            -  can work in an unbiased manner.
      -  The effectiveness of the quality system:
            -  must be periodically by audited.
   ```

   What SQA steps can an organization assume to fulfill the management requirements of ISO
   9001?

2. a) Observer is a pattern used in software design when there are multiple views of a single data/   8
      subjects. Briefly describe the observer pattern.
   b) What are the other patterns in distributed environment that have similar characteristics as   7
      observer pattern? Mention two such patterns and discuss their implementation issues?
   c) Design pattern is a proven solution to a well-researched problem. However, the pattern is   10
      applied to a particular context. In your software development project, you might have used
      some of the design patterns. Briefly explain how (in which context) you used **any one** of
      these patterns in your software project: **Adapter/factory/façade**.

3. a) Agile processes are normally customized in the software organizations to tune for the best   8
      productivity considering their situations. In the software development project, what agile
      process did you adapt for the development? List the number of customizations you made and
      explain the reasons for that.
   b) Briefly explain SCRUM agile process.   7
   c) Prepare a Risk Information Sheet (RIS) for the following risk: 'A personality feature will be   10
      added to the software for better user experience' which has a risk probability of 80% and will
      cost $20,000 dollars.
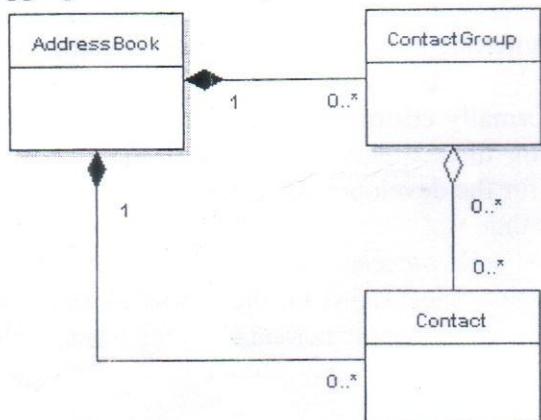
4. a) Briefly explain the use case based project size/ cost estimation technique.   7

   b) Soft skill is very important for achieving individual and group success. What are the soft   6
      skills did you practice during the project work on software development?

   c) Explain driver and stub code for software testing. Write a driver code for testing the   6
      following code snippet. Do you feel if any stub code will be necessary to write? If yes, the
      write the stub code also.

```
class GPS{
    public point3D adjustGPS(){
        Point3D gpsVal= System.getGPS();
        gpsVal.adjustXYZ(5,10,0);
        return gpsVal;
    }
}
```
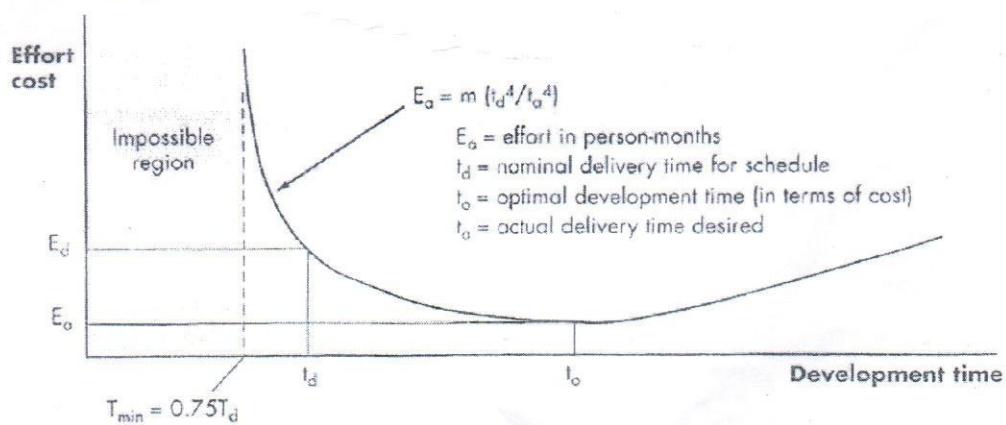
   d) White box testing introduces a metric called code coverage which measures how much code   6
      is covered by a set of test cases. Consider the following decisions statements (e.g. if, switch,
      while, for etc.) and write appropriate test cases so that each side of the decisions are covered
      at least once.

```
int x, y;
x = c.readInt ();
y = c.readInt ();

if (y == 0)
    c.println ("y is zero");
else
    if (x == 0)
        c.println ("x is zero");
    else
    {
        for (int i = 1; i <=x ; i++)
        {
            if (i % y == 0)
                c.println (i);
        }
    }
```

5. a) Briefly describe Service Oriented Architecture (SOA).   7

   b) Testing is a never ending activity and hence a testing strategy is needed to restrict the testing   6
      effort within the budget. One of the strategies can be: 'to find the vital few and test them'.
      Discuss the role of 'Cyclomatic Complexity', 'Call Graph', 'No of functions in a class'
      Metrics in finding the 'vital few'. How do you even define the 'vital few'?

   c) Describe the following aggregration and composition relationship :   6

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

6. a) What is a 'critical path' in PERT/CPM ? How is it calculated? **7**

   b) Explain the following Babich's equation for company A with respect to its rivals B and C. **6**

   $$A_{t+1} = A_t(1 - x) + B_t y \left[\frac{A_t}{A_t + C_t}\right] + C_t z \left[\frac{A_t}{A_t + B_t}\right] + G \left[\frac{A_t}{A_t + B_t + C_t}\right]$$

   c) Define Error Index (EI). Why is it defined as a quality metric? **6**

   d) What is a test case? Given the following state diagram, enumerate a number of test cases to verify all the possible states of the system. **6**

7. a) Briefly describe waterfall model. When can waterfall process model be more productive even over agile process models? **10**

   b) What are cohesion and coupling? What are their impacts on the modularity and extendibility of software? **7**

   c) Write a short note on class diagram and object diagram. **8**

8. a) Briefly explain the architecture of a web application and explain how the input from a HTML form are propagated and processed in the server. **10**

   b) 'Islands of Automation' is a proven anti-pattern that arises from finding isolated solutions to different problems of a big system. Briefly explain the Islands of Automation with its architecture. How can the anti-pattern be corrected with its architecture and technologies? **8**

   c) Explain the following graph that shows the relationship between effort and delivery time in project scheduling. **7**

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)

Department of Computer Science and Engineering (CSE)

SEMESTER FINAL EXAMINATION   WINTER SEMESTER, 2017-2018
DURATION: 3 Hours   FULL MARKS: 150

CSE 4531: E-Commerce and Internet Security

Programmable calculators are not allowed. Do not write anything on the question paper.
There are **8 (eight)** questions. Answer any **6 (six)** of them.
Figures in the right margin indicate marks.

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1. Dhaka is one of the fastest growing megacity in the world. Every year millions of properties (flats, apartments, offices, open spaces etc.) are rented for various purposes in this city. Usually two parties are involved in a rental contact, owner of the property and a renter who desires to have temporary possession of the property.
   a) Propose an E-Business plan which will help to handshake between interested parties mentioned above. Also propose a domain name for your proposed E-Business.   8
   b) Which business models can be used to describe your proposed business plan? If there is multiple model, name all with proper explanation.   6
   c) Discuss all possible ways to generate revenue from your proposed E-Business.   8
   d) Will you implement all possible revenue generating methods for your site? – Justify your answer.   3

2. a) Discuss the general requirements of an E-Payment system to be accepted widely.   9
   b) What are the drawbacks of using Credit Card payment on an E-Commerce site? Discuss on some non-credit card e-payment systems.   8
   c) Does your proposed E-Commerce site (from Question 1) need any online payment processing? If needed which payment method will you implement? – Discuss in detail.   8

3. a) What are the advantages of E-Marketing over traditional marketing? Explain in detail.   8
   b) Discuss various marketing strategies for an E-Business.   9
   c) Which marketing/advertising strategy will you follow to publicize your E-Commerce site (from Question 1)?   8

4. a) Discuss direct, indirect and aggregate metrics of a website along with examples.   13
   b) Explain how various site metrics can help a business entrepreneur to take decisions about his business.   4
   c) Considering the scenario described in Question 1, which metrics you will study to understand your site visitor's behavior? Will it be helpful to show some of the metrics to the visitors/clients of your site? If so, which metrics can be show to which level of users?   8

5. a) Draw the block diagram of an E-Commerce enabled Supply Chain Management (SCM) system. Discuss on its various components.   9
   b) Discuss the major ways to optimize inventory in a smart SCM.   8
   c) What is M-Commerce? For which products/services M-Commerce can be enabled? – discuss in detail.   8

6. a) Discuss the risk management issues for an E-Business.   8
   b) Define Firewall. What are the benefits of Internet Firewall?   3
   c) Write down the name and functions of various Firewall components.   9
   d) As a webserver administrator what measures will you take to protect your sites from DDoS Attacks.   5

7. a) What is cybercrime? Discuss various types of cybercrimes.   8

   b) What is ethical hacking? Classify and define various types of hackers.   8

   c) Write short notes on the followings-   9
     Brute force attack, dictionary attack, Spoofing.

8. a) How SEO might help to grow E-Business? How will a web admin take full potential of   9
     SEO to extend his business?

   b) Discuss the steps to carryout Cyber Forensic investigation.   8

   c) Write short notes on the followings-   8
     Creaser Cipher, Public Key Encryption.

B.Sc. Engg. / HD CSE 5th Semester   30 May 2018

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

SEMESTER FINAL EXAMINATION   **WINTER SEMESTER, 2017-2018**
DURATION: 3 HOURS   **FULL MARKS: 150**
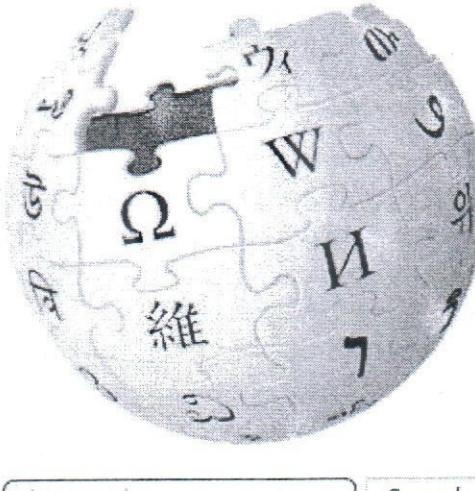
CSE 4539: Web Programming

Programmable calculators are not allowed. Do not write anything on the question paper.
There are **8 (eight)** questions. Question **No. 2 and 3 are mandatory.** Answer any **4 (four)** from the
remaining questions. Figures in the right margin indicate marks.

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1. a) Write the necessary HTML and CSS codes to build the following webpage: 20

WIKIPEDIA

The Free Encyclopedia

| wiki search | Search

Read Wikipedia in your language

Instructions:
- i.   The name of the image is 'wikipedia.jpg'.
- ii.   The background color of the bottom text is 'light grey' , name of the font is 'Verdana' and size is 15px.
- iii. Make proper use of margins, padding, and borders if necessary.

b) What is COOKIE in the context of web development? Explain its use with a practical example.   5

2. [Mandatory]
   a) Write the necessary HTML codes for creating the following page. (Give proper names to each   10
      input fields so that they can be later accessed easily for validation.)

   ## Sign Up
   It's free and always will be.

   | First Name | Last Name |

   | Your Email |

   | Re-enter Email |

   | New Password |

   Birthday

   Month ▼   Day ▼   Year ▼   Why do I need to provide my birthday?

   ○ Female   ○ Male

   By clicking Sign Up, you agree to our Terms and that you have read our Data Use Policy, including our Cookie Use.

   [**Sign Up**]

   b) Consider the webpage created in Question 2(a). Using JavaScript show an alert message in each   15
      of the following cases:

      i.   If the user forgets to put value for any of the fields.
      ii.   If the user enters an invalid password. The password can not only be consisting of
            numbers. It can contain any characters from A-Z or a-z. The password can be
            minimum 8 and maximum 20 characters long.
      iii. If the entered Email does not match in both cases.

3. [Mandatory]
   a) Mr. X wants to build a simple website showing the details of his friends. The information about   20
      his friends is currently saved in a MySQL database named 'myFriends' which contains a table
      called 'friendInfo' having 4 columns such as: roll, name, age, address.
      The requirements of Mr. X are:

      i.   When anyone will open the website, he/she will see a table containing all the friend
            records. Beside each row, there will be options for deleting the particular friend's
            information and for viewing a particular friend's information in a dedicated page.
      ii.   When the delete button will be clicked, that particular row will be deleted and the
            homepage will be automatically updated.
      iii. When the view button will be clicked, it will open a new webpage containing only
            the detail of that particular friend. The page will have a button for going to the
            homepage.

   Write necessary codes to build Mark's desired website using the information saved in his
   database.

b) Name some of the reasons for which you would like to use PHP in your webpage. 5

4. a) Create a simple HTML from for taking file as input with a submit button. Then write the necessary codes to do the following validations: 3+14

    i.   The form will not accept any other files than 'PDF' type.

    ii.   The size of the file can be maximum 1MB.

    iii.   You have to handle the filename properly so that it doesn't conflict with any existing file in the 'Document' folder.

    iv.   If every requirement is fulfilled, then upload this file to the 'Document' folder. Other you must show error message showing the reason for which the file can't be uploaded now.

b) Write the output of the following code: 8

```
<!DOCTYPE html>
<html>
<body>
        <p id="demo"></p>
        <script>
                var x = 5;
                var y="10";
                var z;
                var c =.["red","green","blue"];
                document.getElementById("demo").innerHTML =
                                (x == 8)+"<br>"+
                                typeof "" +"<br>"+
                                (y === "10")+"<br>"+
                                typeof c +"<br>"+
                                (x>=5 && y<15)+"<br>"+
                                (y!=10)+"<br>"+
                                (x!=="5")+"<br>"+
                                z;
        </script>
</body>
</html>
```

5. a) Mr. Y wants to build a simple webpage which has two webpages. The first one will be the Homepage which will show some information about the website along with information about the current date and time. The second webpage will contain some user information which he only wants to show a user if he is logged in. Otherwise if anyone will try to access the second webpage, it will be automatically redirected to the first one. Even after a user logs in, if he is logged out, the system will understand this and prevent him from accessing the second webpage until he logs in again. 17

As a new web developer Mr. Y needs your help. Write the necessary codes for creating all the required pages.

b) Write necessary codes which will generate 20 random numbers from 1-1000 range. Then find out the average, the highest 5 numbers and lowest 5 numbers. You can use either PHP or JavaScript to solve this problem. 8

3L4

6. a) Write the necessary HTML and CSS code for building the following webpage: 20

Mike's Coffe shop

Choose your favourite coffe. Hope you'll enjoy!

Home

Menu

Order

About us

Instructions:
  i.   The name of the image is 'coffee.jpg'
  ii.   Make proper use of margins,padding and borders if necessary.
  iii. The left section (Home, Menu, Order, About us) is an unordered list and each of the elements is containing links.

b) Write the output of the following code: 5

```php
<?php
    $name="Peter";
    $age=20;
    $height=5.9;
    $maritalStatus= false;
    $hobbies= array("Book reading", "Gardening");
    var_dump($name); echo "<br>";
    var_dump($age); echo "<br>";
    var_dump($height); echo "<br>";
    var_dump($maritalStatus); echo "<br>";
    var_dump($hobbies); echo "<br>";
?>
```

7. a) Write the necessary PHP codes to store the following data (name, address) in a variable. 10

Thor	Asgard
Iron Man	USA
Black Panther	Wakanda

Then write the necessary code which will show the following output:
  "Hello *name*! You live in *address*."
[Example: "Hello Thor! You live in Asgard."]

b) What are the differences between GET method and POST method in PHP? Explain where to use and where not to use each one of these methods with examples. 9

c) Explain Box Model in CSS with appropriate example. 6

8. a) Mention two different ways of accessing global variables in PHP with examples.   5
   b) Compare the use of 'INCLUDE' and 'REQUIRE' keywords in PHP.   5
   c) Create an input field which will take the user's name as input. There will be a submit button   3+4×3
      beside the input field. If the user clicks the submit button, the system will do some analysis on
      the name and write some comments in a paragraph (id="p1") under the input field.
      The analysis will be doing the following tasks:

      i.   Check where the name is a palindrome or not. (A word is considered as palindrome
         if it is the same if we read backward or forward).
      ii.   Separate all the characters of the name and save in an array.
      iii. Count the number of Vowels and Consonants in the name.
      iv. Find out the average of the ASCII values of all the characters in the name.

      Write the necessary JavaScript codes to perform the above mentioned tasks.

Required Library Functions

JS	JS	PHP	PHP
slice()	charcodeat()	strlen()	var_dump()
substring()	split()	str_word_count()	isset()
replace()	indexof()	strrev()	mysqli_connect()
touppercase()	lastindexof()	strops()	mysqli_query()
tolowercase()	number()	str_replace()	mysqli_fetch_assoc()
concat()	parseint()	sort()	pathinfo()
cahrat()	parsefloat	rsort()	file_exists()
innan()	math.min()	asort()	move_uploaded_file()
tostring()	math.max()	ksort()	document.location.href
toexponential()	math.random()	arsort(()	htmlspecialchars()
tofixed()	math.round()	krsort()	trim()
toprecision()	math.pow()	count()	stripslashes()
math.ceil()	math.sqrt()	rand()	header()
math.floor()	math.abs()	session_start()	session_destroy()

B.Sc. Engg. CSE 5th Semester   30 May 2018

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

SEMESTER FINAL EXAMINATION   **WINTER SEMESTER, 2017-2018**
DURATION: 3 Hours   **FULL MARKS: 150**

CSE 4549: Simulation and Modeling

Programmable calculators are not allowed. Do not write anything on the question paper.
There are **8 (eight)** questions. Answer any **6 (six)** of them.
Figures in the right margin indicate marks.

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1. Jobs arrive at a single-CPU computer facility with interarrival times that are IID exponential random variables with mean 1.5 minutes. Each job specifies upon its arrival the maximum amount of processing time it requires, and the maximum times for successive jobs are IID exponential random variables with mean 1.1 minutes. However, if *m* is the specified maximum processing time for a particular job, the actual processing time is distributed uniformly between 0.77*m* and 1.04*m*. The CPU will never process a job for more than its specified maximum; a job whose required processing time exceeds its specified maximum leaves the facility without completing service. You are asked to develop simulation program to study the computer facility until 5000 jobs have left the CPU assuming that jobs in the queue are ranked in increasing order of their specified maximum processing time.
   The system is studied to compute the average and maximum delay in the queue of jobs, the proportion of jobs that are delayed in the queue more than 4 minutes.
   a) What are the state variable(s) and output variable(s) for this simulation model?   6
   b) Identify the set of events for this simulation model. Assume that the simulation terminates   5
      by a terminating event.
   c) Write down the state equations for this simulation model.   6
   d) Write down the state space for this simulation model.   3
   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 jobs showing the change of the state variable(s)   15
      over time.
   b) Draw separate flow charts of the event routines (i.e. the event handler functions) for any   10
      two of the system events.

3. A manufacturing system contains *m* machines, each subject to randomly occurring breakdowns. A machine runs for an amount of time that is an exponential random variable with mean 8 hours before breaking down. There are *s* (where *s* is fixed, positive integer) repairmen to fix broken machines, and it takes one repairmen an exponential amount of time with mean 1.5 hours to complete the repair of one machine; no more than one repairmen can be assigned to work on a broken machine even if there are other idle repairmen. If more than *s* machines are broken down at a given time, they form a FIFO 'repair' queue and wait for the first available repairmen. Further, a repairmen works on a broken machine until it is fixed, regardless of what else is happening in the system. Assume that it costs the system $40 for each hour that each machine is broken down and $20 an hour to employ each repairmen. (The repairmen are paid an hourly wage regardless of whether they are actually working.) Assume that *m = 3*, but the simulation model might accommodate a value of *m* as high as 20 by changing an input parameter.

The system is studied for 500 hours for each of the employment policies $s = 1, 2,$ and 3 to determine which policy results in the smallest expected average cost per hour. Assume that at time 0 all the machines have just been freshly repaired.

a) Write down the goals and objectives of the simulation.   3

b) What are the state variable(s) and output variable(s) for this simulation model?   6

c) Identify the set of events for this simulation model. Assume that the simulation terminates by a terminating event.   4

d) Write down the state equations for this simulation model.   6

e) Write down the output equations for this simulation model.   6

4.
a) Mention few potential application areas of simulation.   5

b) Compare and contrast *Input-output modeling* and *State Space modeling*.   6

c) Describe the properties of *Discrete Event Systems* along with few example scenarios   7

d) Discuss the fundamental limitation of the *Midsquare* method as a random-number generator with appropriate example.   7

5.
a) Consider the multiplicative congruential generator under the following circumstance: 10
$$a = 11, m = 16, X_0 = 7$$
Generate enough values to compute a cycle. What inferences can be drawn? Is maximum period/cycle achieved?

b) Without actually computing any Z_i's, determine which of the following mixed linear congruential generator (LCGs) have the full period: 15

i. $Z_i = (13 Z_{i-1} + 13)(mod\ 16)$

ii. $Z_i = (4951 Z_{i-1} + 247)(mod\ 256)$

6.
a) When the basketball player Wilt Chamberlain shot two free throws, each shot was equally likely either to be good (g) or bad (b). Each shot that was good was worth 1 point. Let X denote the number of points that he scored.   15

i.   What is the probability mass function of random variable X?

ii.   Find and sketch the cumulative distribution function of random variable X.

iii.   What is the expected value of random variable X?

iv.   What is the variance of random variable X?

b) Suppose that 7.3, 6.1, 3.8, 8.4, 6.9, 7.1, 5.3, 8.2, 4.9 and 5.8 are 10 observations from a distribution with unknown mean μ. Approximate the 95 percent confidence interval for μ.   10

7.
a) Develop a random variate generator using the composition method for a random variable with the following distribution: 10
$$f(x) = \begin{cases} 2 - a - 2(1-a)x, & 0 \le x \le 1 \\ 0, & Otherwise. \end{cases}$$

b) Develop a random variate generator using the acceptance-rejection method for a random variable with the following distribution: 10
$$f(x) = 20x(1-x)^3, \quad 0 < x < 1$$

c) Generate 3 random variates using this generator. Following random numbers are available   5
0.964, 0.152, 0.759, 0.365, 0.462, 0.785, 0.218, 0.763, 0.568, and 0.631

8. Assume that the numbers of items demanded per day from an inventory on different days are IID random variables and the data in the following Table are those demand size on 45 different days. Analyze the data performing the following steps:

0	5	4	1	3
3	2	3	6	7
1	2	1	6	1
3	3	2	2	3
1	2	5	4	5
3	2	2	6	3
4	2	3	2	2
2	4	2	1	5
1	3	6	0	8

a) Find the following summary statistics of data – coefficient of variation and skewness. Also from the summary statistics comment on the possible distribution. 8

b) Make the histogram of the data. 7

c) From the histogram determine the fitted distribution of the data. 5

d) Find the parameter value(s) of the fitted distribution. 5

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

SEMESTER FINAL EXAMINATION   WINTER SEMESTER, 2017-2018
DURATION: 3 Hours   FULL MARKS: 150

CSE 4551: Computer Graphics and Multimedia

Programmable calculators are not allowed. Do not write anything on the question paper.
There are **8 (eight)** questions. Answer any **6 (six)** of them.
Figures in the right margin indicate marks.

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1. a) Draw the basic mechanism of a 24-bit color frame buffer in raster CRT graphics device.   10
        What is the role of shadow mask in this mechanism?
    b) Discuss the basic structure of a Scanline polygon fill algorithm. Mention some of the   7
        exceptional cases where we need to add more instruction points.
    c) Classify different styles to represent a curve in computer graphics. Mention different   8
        properties of Bezier curve and B-spline curve.

2. a) Illustrate the working strategy of Cyrus-Beck line clipping algorithm with suitable example.   10
    b) Write the mechanism of an LCD monitor. How will an LCD monitor be better than a CRT   8
        monitor?
    c) Given a display with the following characteristics, how much memory is required to store the   7
        pixmap?
        i.   1024 X 768 addressable pixels
        ii. 24-bit color
        iii. 60 Hz refresh rate

3. a) What are the problems of Digital Difference Analyzer (DDA) line drawing algorithm? How   10
        can Bresenham's line algorithm improve the performance of line drawing? Derive necessary
        equations to justify your answers.
    b) Derive all the necessary equations to establish an efficient midpoint *ellipse* scan conversion 10
        algorithm.
    c) What is axonometric projection? Is an isometric projection can be a type of axonometric   5
        projection? Justify your answer.

4. a) Write down the pseudocode of Bresenham's circle drawing algorithm.   7
    b) Indicate which pixel coordinates would be chosen by mid-point circle drawing algorithm   10
        when scan-converting a circle. Consider the center of the circle is (1, 1) and radius is 12.
    c) What is the difference between flood filling and boundary feeling algorithms? Describe   8
        different methodologies to implement these algorithms with necessary figures.

5. a) Show the *front*, *rear*, *left-side* and *top* views of a cube given in Figure 1, which can be   12
        obtained by the orthographic projection. The vertices of the cube are A(4,0,0), B(4,4,0),
        C(4,4,8), D(4,0,4), E(0,0,0), F(0,4,0), G(0,4,8) and H(0,0,4).
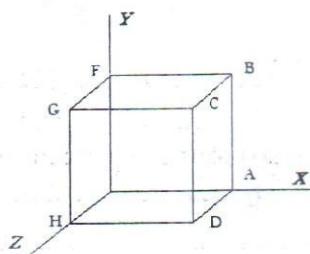
Figure 1: A cube.

    b) When is the order of matrix multiplication not important in the transform of objects?   4
    c) Define the following terms with suitable figures: 9
        i.   Projector
        ii. Center of projection
        iii. Direction of projection

6. a) Use *Lempel Ziv (LZ)* encoding to compress the following text: **blaaabadbadcalad**. How LZ   10
        algorithm is better than Huffman encoding in some cases?
    b) Draw the basic block diagram of JPEG compression.   5
    c) For a 3D object, its rotation about the x-axis is followed by a rotation about the y-axis.   10
        Answer the following questions;
        i.   Calculate the composite transformation matrix
        ii. Does the order of performing the rotation matter? Justify your answer.

7. a) What is planner projection? Define cavalier and cabinet projection.   7
    b) What is perspective projection? Describe different types of perspective projections with   8
        appropriate figure.
    c) What are the differences between lossless and lossy data compression method? Discus the   10
        MPEG encoding technique for video compression.

8. a) Write the pseudocode implementing z-buffer algorithm for hidden surface removal.   7
    b) What is polygon surface? In how many ways can we represent a 3D object? Describe with   8
        proper example and classifications.
    c) Define the following terms: 10
        i.   Hypermedia
        ii. Hypertext
        iii. Multimedia Synchronization
        iv. Flicker Effect

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

SEMESTER FINAL EXAMINATION   WINTER SEMESTER, 2017-2018
DURATION: 3 HOURS   FULL MARKS: 150

CSE 4581: Web Programming

Programmable calculators are not allowed. Do not write anything on the question paper.
There are **8 (eight)** questions. Question **No. 2 and 3 are mandatory.** Answer any **4 (four)** from the
remaining questions. Figures in the right margin indicate marks.

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1. a) Write the necessary HTML and CSS codes to build the following webpage: 20

WIKIPEDIA

The Free Encyclopedia

wiki search   Search

Read Wikipedia in your language

Instructions:
  i.   The name of the image is 'wikipedia.jpg'.
  ii.   The background color of the bottom text is 'light grey' , name of the font is
        'Verdana' and size is 15px.
  iii. Make proper use of margins, padding, and borders if necessary.

  b) What is COOKIE in the context of web development? Explain its use with a practical example.   5

2. [Mandatory]
   a) Write the necessary HTML codes for creating the following page. (Give proper names to each input fields so that they can be later accessed easily for validation.)   10

   ## Sign Up
   It's free and always will be.

   First Name   Last Name

   Your Email

   Re-enter Email

   New Password

   Birthday

   Month ▾ Day ▾ Year ▾   Why do I need to provide my birthday?

   ○ Female ○ Male

   By clicking Sign Up, you agree to our Terms and that you have read our Data Use Policy, including our Cookie Use.

   Sign Up

   b) Consider the webpage created in Question 2(a). Using JavaScript show an alert message in each of the following cases: 15

      i.   If the user forgets to put value for any of the fields.
      ii.   If the user enters an invalid password. The password can not only be consisting of numbers. It can contain any characters from A-Z or a-z. The password can be minimum 8 and maximum 20 characters long.
      iii. If the entered Email does not match in both cases.

3. [Mandatory]
   a) Mr. X wants to build a simple website showing the details of his friends. The information about his friends is currently saved in a MySQL database named 'myFriends' which contains a table called 'friendInfo' having 4 columns such as: roll, name, age, address.   20
      The requirements of Mr. X are:

      i.   When anyone will open the website, he/she will see a table containing all the friend records. Beside each row, there will be options for deleting the particular friend's information and for viewing a particular friend's information in a dedicated page.
      ii.   When the delete button will be clicked, that particular row will be deleted and the homepage will be automatically updated.
      iii. When the view button will be clicked, it will open a new webpage containing only the detail of that particular friend. The page will have a button for going to the homepage.

   Write necessary codes to build Mark's desired website using the information saved in his database.

b) Name some of the reasons for which you would like to use PHP in your webpage. 5

4. a) Create a simple HTML from for taking file as input with a submit button. Then write the necessary codes to do the following validations: 3+14

    i.   The form will not accept any other files than 'PDF' type.

    ii.   The size of the file can be maximum 1MB.

    iii.   You have to handle the filename properly so that it doesn't conflict with any existing file in the 'Document' folder.

    iv.   If every requirement is fulfilled, then upload this file to the 'Document' folder. Other you must show error message showing the reason for which the file can't be uploaded now.

b) Write the output of the following code: 8

```
<!DOCTYPE html>
<html>
<body>
        <p id="demo"></p>
        <script>
                var x = 5;
                var y="10";
                var z;
                var c = ["red","green","blue"];
                document.getElementById("demo").innerHTML =
                        (x == 8)+"<br>"+
                        typeof "" +"<br>"+
                        (y === "10")+"<br>"+
                        typeof c +"<br>"+
                        (x>=5 && y<15)+"<br>"+
                        (y!=10)+"<br>"+
                        (x!=="5")+"<br>"+
                        z;
        </script>
</body>
</html>
```

5. a) Mr. Y wants to build a simple webpage which has two webpages. The first one will be the Homepage which will show some information about the website along with information about the current date and time. The second webpage will contain some user information which he only wants to show a user if he is logged in. Otherwise if anyone will try to access the second webpage, it will be automatically redirected to the first one. Even after a user logs in, if he is logged out, the system will understand this and prevent him from accessing the second webpage until he logs in again. 17

As a new web developer Mr. Y needs your help. Write the necessary codes for creating all the required pages.

b) Write necessary codes which will generate 20 random numbers from 1-1000 range. Then find out the average, the highest 5 numbers and lowest 5 numbers. You can use either PHP or JavaScript to solve this problem. 8

6. a) Write the necessary HTML and CSS code for building the following webpage: 20

> # Mike's Coffe shop

Choose your favourite coffe. Hope you'll enjoy!

Home

Menu

Order

About us

Instructions:
  i.   The name of the image is 'coffee.jpg'
  ii. Make proper use of margins, padding and borders if necessary.
  iii. The left section (Home, Menu, Order, About us) is an unordered list and each of the elements is containing links.

b) Write the output of the following code: 5

```php
<?php
    $name="Peter";
    $age=20;
    $height=5.9;
    $maritalStatus= false;
    $hobbies= array("Book reading", "Gardening");
    var_dump($name); echo "<br>";
    var_dump($age); echo "<br>";
    var_dump($height); echo "<br>";
    var_dump($maritalStatus); echo "<br>";
    var_dump($hobbies); echo "<br>";
?>
```

7. a) Write the necessary PHP codes to store the following data (name, address) in a variable. 10

Thor	Asgard
Iron Man	USA
Black Panther	Wakanda

Then write the necessary code which will show the following output:
            "Hello *name*! You live in *address*."
[Example: "Hello Thor! You live in Asgard."]

b) What are the differences between GET method and POST method in PHP? Explain where to use and where not to use each one of these methods with examples. 9

c) Explain Box Model in CSS with appropriate example. 6

8. a) Mention two different ways of accessing global variables in PHP with examples.   5
    b) Compare the use of 'INCLUDE' and 'REQUIRE' keywords in PHP.   5
    c) Create an input field which will take the user's name as input. There will be a submit button   3+4×3
        beside the input field. If the user clicks the submit button, the system will do some analysis on
        the name and write some comments in a paragraph (id="p1") under the input field.
        The analysis will be doing the following tasks:

        i.   Check where the name is a palindrome or not. (A word is considered as palindrome
                if it is the same if we read backward or forward).
        ii.   Separate all the characters of the name and save in an array.
        iii.   Count the number of Vowels and Consonants in the name.
        iv.   Find out the average of the ASCII values of all the characters in the name.

    Write the necessary JavaScript codes to perform the above mentioned tasks.

Required Library Functions

JS	JS	PHP	PHP
slice()	charcodeat()	strlen()	var_dump()
substring()	split()	str_word_count()	isset()
replace()	indexof()	strrev()	mysqli_connect()
touppercase()	lastindexof()	strops()	mysqli_query()
tolowercase()	number()	str_replace()	mysqli_fetch_assoc()
concat()	parseint()	sort()	pathinfo()
cahrat()	parsefloat	rsort()	file_exists()
innan()	math.min()	asort()	move_uploaded_file()
tostring()	math.max()	ksort()	document.location.href
toexponential()	math.random()	arsort(()	htmlspecialchars()
tofixed()	math.round()	krsort()	trim()
toprecision()	math.pow()	count()	stripslashes()
math.ceil()	math.sqrt()	rand()	header()
math.floor()	math.abs()	session_start()	session_destroy()

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

SEMESTER FINAL EXAMINATION   WINTER SEMESTER, 2017-2018
DURATION: 3 Hours   FULL MARKS: 150

CSE 4585: Computer Networks

Programmable calculators are not allowed. Do not write anything on the question paper.
There are **8 (eight)** questions. Answer any **6 (six)** of them.
Figures in the right margin indicate marks.

---

1. a) Explain why a minimum frame size is required for Ethernet. For example, standard   6+3
        (10Base) Ethernet impose a minimum frame size constraint of 64 bytes. Now suppose that
        the distance between two ends of an Ethernet LAN is d. Derive a formula to find the
        minimum frame size needed for an Ethernet packet.

    b) A sender sends a series of packets to the same destination using *Go-Back-N ARQ'*. If the   6
        header of the frame allows 4 bit sequence number that starts with 0, what is the sequence
        number after sending 100 packets? If the sender uses 'Stop-and-Wait ARQ' protocol for
        flow control then what should be the sequence number after sending 100 packets.

    c) Write short notes on any two of the followings: 2×5
        i.   Cheapernet
        ii. Fast Ethernet
        iii. Vulnerable Time

2. a) What is the significance of D (Duration) field in an IEEE 802.11 frame? What is the   4+4
        significance of contention window(CW) in CSMA/CA?

    b) Can RTS-CTS hand-shaking completely eliminate the hidden station problem? If YES,   7
        then justify how the RTS-CTS hand-shaking avoids the collision from hidden nodes. If
        NO, then draw a frame exchange scenario where a collision occurs due to hidden nodes.

    c) Consider a system of four LANs (L_1 to L_4) interconnected by five bridges (B_1 to B_5). The   10
        bridges connect the LANs as follows:
        i.   B1 connects L1 and L2
        ii. B2 connects L1 and L3
        iii. B3 connects L1, L3 and L4
        iv. B4 connects L3 and L4
        v.   B5 connects L1, L2, and L4
        Assume B_1 as the root bridge. Show the forwarding and the blocking ports after applying
        the spanning tree algorithm.

3. a) Name three ICMPv4 query message and three error-reporting messages. What is the   4+4
        purpose of including the IP header and the first 8 bytes of datagram data in the error
        reporting ICMPv4 messages?

    b) What is the main role of Address Resolution Protocol (ARP) in the network layer of   3+5
        TCP/IP protocol suite? Briefly explain how ARP is used to create subnetting effect.

c) Which fields of the IPv4 header are mutable, that means change from router to router? Name the fields in IPv4 herder those are necessary to handle the fragmentation of packets. In IPv6, mandatory base header contains no fields related to fragmentation. Briefly explain how fragmentations of packets are implemented in IPv6. 2+2+5

4. a) What is the difference between routing and forwarding? What is the advantage of net specific routing over host specific routing? 2+3

   b) An ISP is granted a block of addresses starting with 130.15.0.0/16. The ISP wants to distribute these blocks to 320 customers as follows: 12
      i.   The first group has 64 customers; each needs 256 addresses
      ii. The second group has 128 customers; each needs 128 addresses
      iii. The third group has 128 customers; each needs 64 addresses
      Design the sub blocks and show the address allocation and distribution by the ISP. Find out how many addresses are still available after these allocations.

   c) What is IP address space depletion? Briefly explain different measures to handle IP address depletion 2+6

5. a) Briefly explain the working principle of link state routing. Consider the network shown in Figure 1, and assume that each node initially knows the costs to each of its neighbors. Consider the distance-vector algorithm and show the distance vector/table entries at node V that is shared with its neighbors. How does the scenario change if we use link state algorithm instead of distance-vector algorithm? 7+6

Figure 1: Network for Question 5.a)

   b) With necessary diagrams explain the C2I (counting to infinity) problem of distance-vector routing protocols. Mention some of the methods to eliminate the C2I (counting to infinity) problem of distance-vector routing. 9+3

6. a) A TCP client opens a connection using an initial sequence number (ISN) of 14,534. The TCP server opens the connection with an ISN of 21,732. 4+6
      i.   Show the three TCP segments during the **three-way handshaking** connection establishment.
      ii. Show the contents of the segments during the connection termination using **four-way handshaking with half-close**.
      (Use timeline in y-axis for each side to show the **states** and the relative duration of the client and the server.)

   b) Name different flags used in a TCP segment. Briefly explain the significant role of Persistence timer and TIME-WAIT timer in TCP. 3+7

   c) What is **SYN flooding attack**? Mention some strategies to alleviate the effect of a SYN flooding attack. 5

7. a) A TCP source sends segments of equal size, and maintains the sequence number for each   20
        segment (i.e., the TCP protocol is segment-oriented instead of byte-oriented). Assume that
        the sequence number of the first data segment is 35. The size of the receiver window
        (*rwnd*) is always larger that the congestion window (*cwnd*). For the first data segment,
        assume that the value of the *cwnd* is 1, and the value of the slow start threshold (*ssth*) is
        65000.
        You are asked to draw a timing diagram, where y-axis shows the time, and two parallel
        lines in the y-axis represent the events (sending and receiving of data and ACK segments,
        cwnd values, etc.) at the source and destination TCP.

        Assume that the source always tries to send as many data segments as it is allowed to.

        Draw the diagram considering the followings:
        - The successful transmission of segments from sequence number 35 to 55.

        - Segment 42 is lost, and the source identifies this by triple duplicate
          acknowledgments.
        - Segment 49 is lost (assume subsequent segments are also lost), and the source
          indentifies this by a timeout.
        - At the left side of the source TCP timeline, show the value of *cwnd* and *ssth*,
          whenever they are updated.
        - Identify the slow start, congestion avoidance, congestion detection region in the
          source TCP timeline.

    b) The UDP protocol does not provide any of the important services of the transport layer,   5
        namely reliability, flow control, and congestion control. Explain why we still use UDP,
        and what applications are suitable for UDP.

8. a) From a service perspective, how does symmetric key cryptography differ from asymmetric   4+4
        key cryptography? Can you 'decrypt' a hash of a message to get the original message?
        Explain your answer.

    b) Briefly explain the cryptographic strength of the Vigenere cipher over the Caesar cipher.   4+4
        Using the Playfair cipher encrypt the word "committee" using the key 'thief'.

    c) Suppose Alice wants to communicate with Bob using symmetric key cryptography using a   9
        session key K_S. The trusted third party (TTP) is a server that shares a unique secret
        symmetric key with each registered user. For Alice and Bob, denote these keys by K_{A-TTP}
        and K_{B-TTP}. Design and explain a scheme that uses the TTP to distribute K_S to Alice and
        Bob. Your scheme should use at least three messages to distribute the session key: a
        message from Alice to the TTP; a message from the TTP to Alice; and finally a message
        from Alice to Bob. Your scheme should provide mutual authentication and should avoid
        the reflection attack as well as replay attack.

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

SEMESTER FINAL EXAMINATION   WINTER SEMESTER, 2017-2018
DURATION: 3 Hours   FULL MARKS: 150

CSE 4701: Artificial Intelligence and Expert Systems

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There are **8 (eight)** questions. Answer any **6 (six)** of them.
Figures in the right margin indicate marks.

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1. a) Assume we want to write an automated planner for a very simple video game: we have a world of 10 different locations, arranged horizontally as shown below. There is a game agent that wants to end up in location 10.

   Table 1: Grid View of the video game world

   1 2 3 4 5 6 7 8 9 10

   There can be a monster in each of positions 3 and 9, and the agent cannot move to these locations when there is a monster there. The agent has a weapon that is either charged or uncharged, and there are new charges at locations 1 and 4. The following actions are available to the agent:

   - The action "move right" increases our agent's location by 1 (up to 10),
   - The action "move left" decreases the location by 1 (down to 1).
   - The action "pickup" allows the agent to pick up a charge if it is at the charge's location. This will charge the agent's weapon and remove the charge from its location.
   - The action "fire" removes every monster whose location differs from the agent's current location by 1 and discharges the agent's weapon.

   i.   Define the STRIPS features (variables) and their domains for this problem. The agent needs to keep track of where it is, whether locations 3 and 9 are free, whether the agent's weapon is charged, and whether each of the two charges is available.   4

   ii. Give the STRIPS representation of the actions for location 4 ("move right4", "move left4", pickup4, and fire4).   5

   iii. Suppose that the agent's goal is to be in location number 10, and its start state is at location 8, with monsters occupying locations 3 and 9, the weapon charged, and charges in locations 1 and 4. Draw a part of the search space that includes the optimal plan (i.e. the optimal solution path from start state to a goal state)   10

   b) What is a good admissible heuristic for the planning goal in 1(a)? (Note that this is a domain-dependent heuristic since you take into account how the video game works.) To get full marks, you must also provide an explanation of why your proposed heuristic is good and is admissible.   4

   c) What does ignore-delete list mean when it comes to coming up with heuristics?   2

2. a) Suppose we want to diagnose the errors school students make when adding multi-digit *binary* numbers. We will only consider adding two two-digit numbers to form a three-digit number. That is, we will consider problems of the form as shown in Figure 1:

$$
\begin{array}{ccc}
 & A_1 & A_0 \\
+ & B_1 & B_0 \\
\hline
C_2 & C_1 & C_0 \\
\end{array}
$$

Figure 1: A sample binary addition

Here A_i, B_i and C_i are all binary digits. Suppose we want to model the process of adding two digit numbers by modeling the following mechanisms: 1) whether the student knows single-digit binary addition and 2) whether the student knows how to carry. For example, performing, the above addition would require - First adding A_0 and B_0 and finding the carry of this addition, $Carry_0$ - Then adding A1 and B1 and the carry from the previous addition. As part of the process, we need to model the following findings - If students know both single-digit binary addition and how to carry, they usually get the right answer, but sometimes make mistakes. - For each mechanism, if they don't know how to do it correctly, they just pick the result at random.

Draw a Bayesian Network keeping in mind the aforementioned dependencies [Hint: try to specify dependencies in the causal direction, also think about what things particularly effects the addition result.]

13

b) For Question 2(a), assume that 80% of the students know binary addition and 50% know how to carry. Further assume that students make mistakes with a probability of 5% (in either addition or carry) even if they know the underlying mechanism. Also, the probability of encountering any digit for addition is 0.5 i.e. [$P(A_0=0) = P(A_0=1) = ... = P(B_0=0) = P(B_0=1) = 0.5$]. Give the conditional probability tables for your network.

12

3. a) Students have to make decisions about how much to study for each course. Suppose students first have to decide how much to study for the midterm. They can study a lot, study a little, or not study at all. Whether they pass the midterm depends on how much they study and on the difficulty of the course. As a first-order approximation, they pass if they study hard or if the course is easy and they study a bit. After receiving their midterm grade, they have to decide how much to study for the final exam. Again, the final exam result depends on how much they study and on the difficulty of the course. Their final grade depends on which exams they pass; generally, they get an A if they pass both exams, a B if they only pass the final, a C if they only pass the midterm, or an F if they fail both. Of course, there is a great deal of noise in these general estimates [E.g. if someone only passes the midterm they might get some grade other than C with a small probability].
Suppose that their final utility depends on their total effort and their final grade. Suppose the total effort is obtained by adding the effort in studying for the midterm and the final.

    i.   Draw a decision network for the above story.   8

    ii.   What is the domain of each variable?   3

    iii.   Give an appropriate utility function for a student who just wants to pass (not get an F).   4

    iv.   Give an appropriate utility function for a student who wants to do really well.   4

b) Given the following joint probability table over 4 variables, compute the conditional probability distribution P (W, Y |X = true, Z = false). Write this down in a similar format as the table below.

6

Table 2: Joint Probability Distribution of the given variables

W	X	Y	Z	P (W, X, Y, Z)
true	true	true	true	0.1
true	true	true	false	0.2
true	true	false	true	0
true	true	false	false	0
true	false	true	true	0.05
true	false	true	false	0.05
true	false	false	true	0.05
true	false	false	false	0.05
false	true	true	true	0.05
false	true	true	false	0.05
false	true	false	true	0
false	true	false	false	0
false	false	true	true	0.1
false	false	true	false	0.1
false	false	false	true	0.1
false	false	false	false	0.1

4. a) In 1942, Anthony S. Filipiak made a 10-block sliding puzzle called the Traffic Cop Tangle. The point of this puzzle is to swap the positions of the blocks labeled `A' and `B', by sliding around the pieces into the empty space (the unlabeled space between the A and the B). [N.B: Picture is to scale, so, both A and B blocks are twice the area of 3 and 6; 3 and 6 have twice the area of 1 and 2]

10
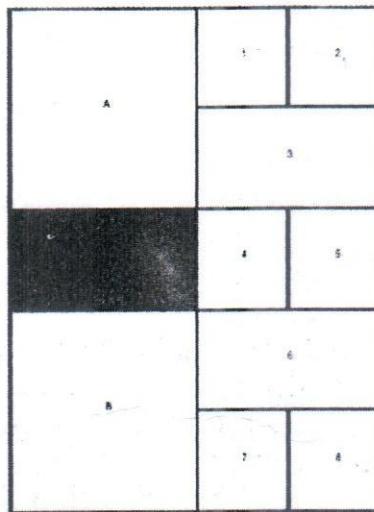
Figure 2: Traffic Cop Tangle Puzzle

Considering the puzzle to start at the given configuration as above, provide your insights of the following with respects to this problem: What is a state? An action? A goal-state? What is a solution?

b) Consider a CSP defined as follows. There are four variables, {A, B, C, D}. The domain for each variable is {1, 2, 3, 4, 5}. The following constraints hold between the variables: A>B, C − A = 1, C>D, D = A, and |D − B| = 1

   i. Draw the constraint network for this CSP; you do not have to include the domains in the picture

5

   ii. Assume arc consistency first considers the edges between variable A and all of its neighbors in the constraint graph. Which values are removed from A's domain in those steps of arc consistency, and why?

4

c) Differentiate between top down and bottom up proof procedure.

6

5. a) You are working at a popular marina where a number of yachts are parked in berths. Each berth can either be vacant or have exactly one yacht parked in it. Any yacht can be parked in any berth. There is only one vacant berth in the marina. Your marina has 10 berths numbered 1 to 10 and houses 9 yachts labeled y_1 to y_9.

y2 ▶ 1	10 ◀ y5
y4 ▶ 2	9
y3 ▶ 3	8 ◀ y7
y1 ▶ 4	7 ◀ y8
y9 ▶ 5	6 ◀ y6

Figure 3: Current state of the marina

Figure 2 shows the current state of the marina in which 9 is the initial vacant berth. The yachts were originally assigned to the berth with the same number, y_1 to berth 1, y_2 to berth 2 etc. Your customers are clearly misbehaving! The marina manager has asked you to put each yacht back to its originally assigned berth. You will only be able to move one boat at a time and you are not allowed to take yachts out of the marina. Also, because of some strange liability issues, you can only move boats from a berth b to a vacant berth b_v if one is a multiple of the other or if both are prime. You would like to find a sequence of yacht-moves such that each yacht is back in its originally assigned berth

    i.   Represent the marina problem as a search problem. Includes what would count as node, start state, goal state, arcs etc.   **5**

    ii.   Draw the first two levels (counting the root as level 1) of the search tree.   **8**

b) Consider the following search problem:
- the set of states S = $\{s_0, s_1, s_2, s_3, s_4, s_5\}$
- successors of s_0 are $\{s_0, s_1, s_2\}$
- successors of s_1 are $\{s_1, s_2, s_3\}$
- successors of s_2 are $\{s_2, s_3\}$
- successors of s_3 are $\{s_0, s_3, s_4\}$
- successors of s_4 are $\{s_4, s_5\}$
- successors of s_5 are $\{s_2, s_3, s_5\}$
- objective function f is as follows: $f(s_0) = 0$, $f(s_1) = 3$, $f(s_2) = 2$, $f(s_3) = 4$, $f(s_4) = 1$, and $f(s_5) = 5$

    i.   Which (if any) states are local maxima and global maxima?   **4**

    ii.   Trace hill climbing search starting in state s_0 (indicate which state is considered at each iteration, and which solution is returned when the search terminates). Does it return the optimal solution?   **8**

6. a) A university has asked you to write a program to help them determine whether or not to accept students who have applied for admission. There are 3 basic pathways for a student to be accepted. If a student is returning to the university after a time away and is in good academic standing with no outstanding fees, they are accepted. Students who submit a complete application and are qualified are also accepted. Students are qualified if they have high SAT scores as well as good high-school transcripts. The university also has a legacy program, wherein children of former graduates are qualified (though these students must still submit a complete application).   **20**

For *brevity*, let's only talk about 3 individuals: Sam is a former graduate and Chris is his son. Chris has good high-school transcripts and he submitted a complete application. Laura is a returning student in good academic standing.

Give the knowledge base representing this problem, using unary predicates accepted [1], returning [1], goodStanding [1], clearBalance [1], appComplete [1], qualified [1], legacyStudent [1], highSAT [1], goodHS [1], and graduate [1], as well as the binary predicate child [2]. The university admissions officials should be able to provide queries such as accepted(chris) and get a true or false answer.

b) Run the top-down derivation of the query accepted(chris) applied to your KB.

5

7. a) Explain minimal models and use that to prove that bottom up proof procedure is sound

15

10

b) You are given the following top-down derivation for a knowledge base KB.

yes ← a.
yes ← b ∧ f.
 yes ← b ∧ g ∧ h.
yes ← c ∧ d ∧ g ∧ h.
yes ← d ∧ g ∧ h.
yes ← g ∧ h.
yes ← h.
yes ←.

Figure 4: Top down derivation

Derive the bottom up derivation of this top down derivation.

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8. a) Consider the following belief network:
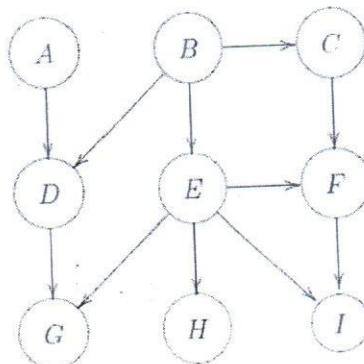
Figure 5: Belief Network

Use the variable elimination algorithm to derive algebraic expressions for the probabilities listed below. (Observe that no numbers are given, so you will be unable to give a numerical answer, i.e. the expression would be shown as factors.) *You will have to show your work*. Name factors that you create f_0, f_1, etc., make sure to follow the naming conventions that go with naming factors. *State the size* (number of variables involved) of the largest factor that you create. (It will be helpful if you choose a variable ordering that makes this quantity as small as you can, though you won't be penalized if you don't find the smallest quantity.) *You can prune any irrelevant nodes.*

    i.   P(E)
    ii.   P(A)
    iii.   P(A|G)
    iv.   P(I)

b) The following picture shows some people who are sitting at a table.

Figure 6: Position of people sitting around a table

You are given a knowledge base with the following facts where sits_right_off (a, b) means b sits at the right of a

```
sits_right_of (k, r).
sits_right_of (r, h).
sits_right_of (h, u).
sits_right_of (u, l).
sits_right_of (l, n).
sits_right_of (n, s).
sits_right_of (s, t).
sits_right_of (t, k).
```

Figure 7: Given facts

i.   Write additional rules for the following that only uses the *facts* given above, i.e. you are not allowed to add any more facts.
- sits_left_of (X, Y) should be true if X is to the left of Y
- are_neighbors_of (X, Y, Z) should be true if X is to the left of Z and Y is to the right of Z
- next_to_each_other (X, Y) should be true if X is next to Y.

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

SEMESTER FINAL EXAMINATION

WINTER SEMESTER, 2017-2018

DURATION: 3 Hours

FULL MARKS: 150

CSE 4703: Theory of Computing

Programmable calculators are not allowed. Do not write anything on the question paper.
There are **8 (eight)** questions. Answer any **6 (six)** of them.
Figures in the right margin indicate marks.

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

   b) What is the language recognized by the NFA of Figure 1? Show the computation of the NFA   3+6
   that makes the input 1011 be accepted.
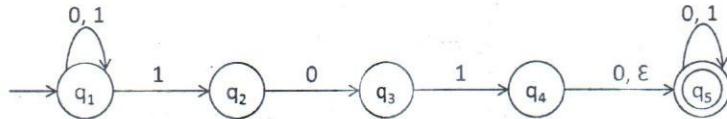
Figure 1: State diagram of an NFA for Question 1.b)

   c) Design NFA's for the following languages. Try to use ϵ-transitions to simplify your design.   2×6
      i. The set of strings consisting of zero or more a's, followed by zero or more b's, followed by zero or more c's over the alphabet $\{a, b, c\}$.
      ii. The set of all strings that consist of either 01 repeated one or more times or 010 repeated one or more times over the alphabet $\{0, 1\}$.

2. a) What is the difference between empty string and empty language?   2
   b) Explain the differences among Σ, Σ^0 and Σ^1.   3
   c) Consider the following ϵ-NFA.   3+3

Table 1: Transition table of an ϵ-NFA for Question 2.c)

	ϵ	a	b	c
$\rightarrow p$	$\{q, r\}$	$\emptyset$	$\{q\}$	$\{r\}$
q	$\emptyset$	$\{p\}$	$\{r\}$	$\{p, q\}$
$* r$	$\emptyset$	$\emptyset$	$\emptyset$	$\emptyset$

   i. Compute the ϵ-closure of each state
   ii. Give all the strings of length three or less accepted by the automaton

   d) Write the regular expressions for the following languages: 2×7
      i. $L = \{ w \mid w \in \{0, 1\}$ and $|w|$ is multiples of 3$\}$
      ii. $L = \{ w \mid w \in \{0, 1\}$ and no two consecutive 0's$\}$

3. a) Convert the regular expression $(0 + 10)^*010(0 + 1)^*$ to NFA.　　　6

b) Consider the following transition table for a DFA.　　　3×4

Table 2: Transition table of a DFA for Question 3.b)

	0	1
→ q_1	q_2	q_1
q_2	q_3	q_1
* q_3	q_3	q_2

Give all the regular expressions of $R_{ij}^{(0)}$, $R_{ij}^{(1)}$, $R_{ij}^{(2)}$.

(Note: $R_{ij}^{(k)} = R_{ij}^{(k-1)} + R_{ik}^{(k-1)}\left(R_{kk}^{(k-1)}\right)^* R_{ij}^{(k)}$. Think of state q_i as if it were the state with integer number i.)

c) Construct the transition diagram for the DFA of Table 2 and give a regular expression for its language using state elimination technique.　　　7

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

b) Using pumping lemma for regular language, show that the language $L = \{0^n10^n \mid n \geq 1\}$ is not regular.　　　10

c) Suppose h is the homomorphism from the alphabet $\{a, b, c, d\}$ to the alphabet $\{0, 1\}$ defined by:　　　10

$h(a) = 0 = h(b)$
$h(c) = 00$
$h(d) = 11$

Now consider the following language:
$L = \{11, 011, 110, 111, 0011\}$

What is $h^{-1}(L)$?

5. a) Consider the set of all strings of balanced parentheses of two types, round and square. An example of where these strings come from is as follows. If we take expressions in C, which use round parentheses for grouping and for arguments of function calls, and use square brackets for array indexes, and drop out everything but the parentheses, we get all strings of balanced parentheses of these two types. For example,　　　10

```
f(a[i]*(b[i][j], c[g(x)]), d[i])
```

Figure 2: Example code for Question 5.a)

The code of Figure 2 becomes the balanced-parentheses string `([]([][][()])[])`. Design a grammar for all and only the strings of round and square parentheses that are balanced.

b) Consider the grammar:　　　3×3
$E \to +EE \mid * EE \mid - EE \mid x \mid y$
Find the following from the grammar for the string "$+ * -xyxy$":
　i.　Left most derivation
　ii.　Right most derivation
　iii.　Parse tree

c) Show that the following grammar is ambiguous on the string "ibtibtaea"　　　6
$S \to iCtS \mid iCtSeS \mid a$
$C \to b$

6. a) Explain the 6 tuple definition of Pushdown Automata (PDA). When can we define a PDA with 6 tuple?   7

b) Describe the languages accepted by PDA.   4

c) Design a PDA to accept the following languages. Draw the transition diagram for the constructed PDA.   2×7

    i. $L = \{ w \mid w \in \{0, 1\}$ and w has equal number of 0's and 1's $\}$

    ii. $L = \{ a^n b^{2n} \mid n \geq 1 \}$

7. a) Explain the working of a PDA with diagram.   5

b) Suppose the PDA $P = (\{q, p\}, \{0,1\}, \{Z_0, X\}, \delta, q, Z_0, \{p\})$ has the following transition function: 8

    1. $\delta(q, 0, Z_0) = \{(q, XZ_0)\}$

    2. $\delta(q, 0, X) = \{(q, XX)\}$

    3. $\delta(q, 1, X) = \{(q, X)\}$

    4. $\delta(q, \epsilon, X) = \{(p, \epsilon)\}$

    5. $\delta(p, \epsilon, X) = \{(p, \epsilon)\}$

    6. $\delta(p, 1, X) = \{(p, XX)\}$

    7. $\delta(p, 1, Z_0) = \{(p, \epsilon)\}$

Starting from the initial ID (q, w, Z_0), show all the reachable ID's when the input is 0011

c) Obtain PDA equivalent to the following grammar: 2×6

    i. $E \rightarrow E + E \mid E * E \mid id$

    ii. $S \rightarrow aABC$

        $A \rightarrow aB \mid a$

        $B \rightarrow bA \mid b$

        $C \rightarrow a$

8. a) What is ambiguous grammar? Explain with example.   3

b) Begin with the grammar: 3×4

$S \rightarrow aAa \mid bBb \mid \epsilon$

$A \rightarrow C \mid a$

$B \rightarrow C \mid b$

$C \rightarrow CDE \mid \epsilon$

$D \rightarrow A \mid B \mid ab$

    i.   Eliminate ϵ productions

    ii.   Eliminate any unit productions in the resulting grammar

    iii.   Eliminate any useless symbols in the resulting grammar

c) What is Chomsky Normal Form (CNF)? Convert the following CFG to CNF: 10

$S \rightarrow aSb \mid ab \mid Aa$

$A \rightarrow aab$

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B.Sc. Engg. CSE 7th Semester

07 June 2018

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

SEMESTER FINAL EXAMINATION   WINTER SEMESTER, 2017-2018
DURATION: 3 Hours   FULL MARKS: 150

Hum 4705: Accounting

Programmable calculators are not allowed. Do not write anything on the question paper.
There are **8 (eight)** questions. Answer any **6 (six)** of them.
Figures in the right margin indicate marks.

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1. a) "Accounting is the language of business". Discuss on this statement.   5
    b) Describe the cost principle and entity concept with examples. What is Generally Accepted Accounting   5 +5
       Principles (GAAP)?
    c) Who are the internal and external users of accounting information? Draw a diagram showing the users of   5+5
       accounting information.

2. a) What is journal? Why do we record transactions?   5 + 20
    b) Mr. Khalid established a business named Khalid & Co. on January 1, 2017. The following transactions
       were completed during the month.

January 2016	Transactions
1	Khalid invested Tk. 20,000 cash and deposited with the bank in the name of business.
2	Paid Tk. 3000 cash for January office rent
3	Purchased office equipment for Tk. 4,500 cash
4	Incurred Tk. 1000 of advertising costs in the The Daily Star, on account
5	Paid Tk. 1500 cash for office supplies
6	Earned Tk. 10,000 for services rendered: Cash of Tk. 2,000 is received from customers, and the balance of Tk. 8,000 is billed to customers on account.
7	Withdrew Tk. 500 cash for personal use.
9	Paid employees' salaries. Tk. 1,200
10	Received Tk. 8,000 in cash from customers who have previously been billed in transaction dated January 6.

Journalize the above transaction.

3. Prepare ledger balances using the following journal entries.   25

Journal

Date		Particulars	Dr. Amount Tk.	Cr. Amount Tk.
2017				
January	1	Cash Account	3,00,000	
		Capital Account		3,00,000
	2	Bank Account	50,000	
		Cash Account		50,000
	5	Furniture Account	30,000	
		Cash Account		30,000
	5	Purchase Account	40,000	
		Cash Account		40,000

9	Cash Account	16,000	
	Sales Account		16,000
14	Computer Account	40,000	
	Payable for Computer		40,000
25	Account Receivable	24,000	
	Sales Account		24,000
27	Wages Account	10,000	
	Cash Account		10,000
27	Rent Account	20,000	
	Cash Account		20,000
28	Salaries Account	50,000	
	Cash Account		50,000
30	Cash Account	20,000	
	Bank Account		20,000
30	Account Receivable	10,000	
	Sales Account		10,000
30	Cash Account	30,000	
	Account Receivable		30,000

4. a) What is meant by trial balance? What are the limitations of the trial balance? 5
   b) Prepare a trail balance form the following ledger balances of the Y Ltd on 31 Dec 2017 20

SL	Items	Tk.
1	Capital	90,000
2	Salaries	46,455
3	Wages	18,291
4	Carriage inward	2,787
5	Carriage outward	6,012
6	Sales	3,48,738
7	Sales returns	23,463
8	Purchase	1,54,374
9	Purchase Returns	4,038
10	Land & Buildings	60,000
11	Drawings	30,000
12	Accounts payable	31,203
13	Loan	28,500
14	Interest on Loan	900
15	Goodwill	15,000
16	Cash at Bank	7,665
17	Cash in Hand	150
18	Accounts receivables	60,300
19	Reserve for bad debts	2,130
20	Rent	6,000
21	Opening stock	14,517
22	Machineries	24,000
23	Bad Debts	1,575
24	Dividend received	750
25	Notes receivables	5,400
26	Gas & water	2,160
27	Insurance premium	513
28	Advertisement	9,792
29	Bills payable	16,341
30	Trade expenses	10,467
31	Investments	23,499
32	Discount paid	1,680
33	Discount received	3,300

5. Write short notes: (Any five)   5×5
      a) Conservatism principle;   b) Suspense Accounts;   c) Debit and credit balance;   d) Fixed and current assets;   e) Job Costing;   f) Cost Centre;   g) Product costing;   h) Opportunity Cost i) Cost of Capital;   k) Normal and Abnormal loss

6. a) "Process costing is a type of operation costing which is used to ascertain the cost of a product at each   5
process or stage of manufacture" – Discuss on this statement.

   b) Jammy Ltd is a manufacturing organization with two processes. Information for the period ended   20
31 July 2017 is as follows:

	Process 1	Process 2
Opening WIP	Nil	200kg
Costs for the period:		
Material 1000kg costing	Tk. 25,650	Nil
Labour	Tk. 12,750	Tk.6950
Overheads	Tk. 5,950	Tk.3475
Transferred to Process 2	700kg	—
Transferred to Finished Goods	—	800kg
Closing WIP	200kg	150kg

Normal losses are expected to be 5% of input for each process. Losses in Process 1 have no scrap value, whilst losses in Process 2 can be sold for Tk. 10 per kg. Losses are deemed to arise at the end of the process.

Opening WIP is 60% complete with regard to Labour and Overheads. Closing WIP in Process 1 is 100% complete with regard to Material and 50% complete for Labour and Overheads. Closing WIP in Process 2 is 50% complete with regard to Labour and Overheads.
Prepare the Process Accounts for each process.

7. a) What is time value of money? Does it exist in the real world?   10
   b) A person deposits Tk.5000 with a bank at an interest rate is 10% which is compounded annually.   5
What will be the amount after 2 years? What will be the amount after 2 years if the interest is compounded semi-annually and quarterly?
   c) A person is supposed to get throughout the next three years (Year 1, Year 2, and Year 3) Tk.2000,   5
Tk.3000 and Tk. 3500 respectively. What will be the present value of this inflow of fund if the discounting rate is 10% and compounded annually?
   d) Suppose you deposit Tk.4000 on Jan 1 of each year for next four years at an interest rate of 10%   5
and compounded annually. What will be the terminal value of the annuity? What will be the terminal value if he deposits money on 31 Dec?

8.   Prepare an Income Statement (Trading and Profit Loss Account) and Balance Sheet from Mr.   25
Hasan's book.

M/S Sattar & Co. Provides the following trail balance at the end of Dec 31,
2017.

Trail Balance: dated 31 Dec., 2017

SL	Items	L.F	Dr. Tk.	Cr. Tk.
1	Capital			55,000.00
2	Cash in hand		10,000.00	
3	Bank Overdraft			7,000.00
4	Goodwill		10,000.00	
5	Leasehold property (for 10 years)		30,000.00	
6	Furniture		7,000.00	
7	Drawings		3,000.00	
8	Opening Stock		10,000.00	
9	Accounts Receivable		20,000.00	
10	Accounts payable			20,000.00
11	Wages		3,000.00	
12	Salaries		5,000.00	
13	Insurance		4,000.00	
14	Purchase		40,000.00	
15	Sales			70,000.00
16	Freight		1,000.00	
17	Purchase discount			1,000.00
18	Investment		10,000.00	
19	Travelling expenses		500.00	
20	Apprenticeship received			1,500.00
21	Bad Debts		500.00	
22	Office Expenses		1,000.00	
25	Reserve for bad debts			500.00
			155,000.00	**155,000.00**

Adjustments

1   Closing stock: Cost Price Tk. 30,000.00 and market price Tk. 25,000.00.
2   Unpaid wages and salaries Tk. 500.00 and Tk. 600.00 respectively.
3   Insurance premium paid in advance Tk.1,000.00.
4   Tk. 500.00 has been proved as bad and create 5% reserve for bad debts.
5   Interest on investment to be calculated at 5%.
6   Depreciate 10% on Furniture.

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

SEMESTER FINAL EXAMINATION   WINTER SEMESTER, 2017-2018
DURATION: 3 Hours   FULL MARKS: 150

Math 4707: Probability and Stochastic Processes

Programmable calculators are not allowed. Do not write anything on the question paper.
There are 8 **(eight)** questions. Answer any 6 **(six)** of them.
Figures in the right margin indicate marks.

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1. a) Select integrated circuits, test them in sequence until you find the first failure, and then stop. Let N denote the number of tests. All tests are independent with probability of failure $p = 0.1$. Consider the condition $B = [N > 20]$. Find $P_{N|B}(n)$, the conditional PMF of N given that there have been 20 consecutive tests without a failure.
   Find $P_{N|B}(n)$, the conditional PMF of N given that there have been 20 consecutive tests without a failure.   7

   b) A business trip is equally likely to take 2, 3, or 4 days. After a d-day trip, the change in the traveler's weight, measured as an integer number of pounds, is uniformly distributed between $-d$ and d pounds. For one such trip, denote the number of days D and the change in weight by W. Find the joint PMF $P_{DW}(d, w)$.   9

   c) A man invites his fiancée to an elegant hotel for a Sunday banquet. They decide to meet in the lobby of the hotel between 11:30 am and 12 noon. If they arrive at random times during this period, what is the probability that the first person to arrive has to wait at least 12 minutes.   9

2. a) A machine produces photo detectors in pairs. Tests show that the first photo detector is acceptable with probability $\frac{3}{5}$. When the first photo detector is acceptable, the second photo detector is acceptable with probability $\frac{4}{5}$. If the first photo detector is defective, the second photo detector is acceptable with probability $\frac{2}{5}$.

      i. Find the probability that exactly one photo detector of a pair is acceptable.   7
      ii. Find the probability that both photo detectors in a pair are defective.   8

   b) An urn contains five red and three blue chips. Suppose that four of these chips are selected at random and transferred to a second urn, which was originally empty. If a randomly selected chip from the second urn is blue, find the probability that two red and two blue chips were transferred from the first urn to the second urn.   10

3. a) Let the joint probability mass function of X and Y be given by   10

$$P_{XY}(x, y) = \begin{cases} \frac{1}{15}(x + y), & x = 0, 1, 2, \quad y = 1, 2 \\ 0, & \text{otherwise} \end{cases}$$

   Find $P_{X|Y}(x|y)$ and $P[X = 0|Y = 2]$.

   b) An unbiased die is successively rolled. Let X and Y denote, respectively, the number of rolls necessary to obtain a six and a five.

      i. Find the expected value of $X, E[X]$.   8
      ii. Find conditional expectation of $X, E[X|Y = 1]$ and $E[X|Y = 5]$.   7

4. a) A student's final exam grade depends on how close the student sits to the center of the classroom during lectures. If a student sits r feet from the center of the room, the grade is Gaussian random variable with expected value $80 - r$ and standard deviation r. If r is a sample value of random variable R, and X is the exam grade, then find $f_{X|R}(x|r)$.   9

b) First a point Y is selected at random from the interval $(0,1)$. Then another point is selected at random from the interval $(Y,1)$. Find the probability density function of X.   9

c) Random variables X and Y have the joint PMF   7

$$P_{XY}(x,y) = \begin{cases} cxy, & x = 1,2,4, y = 1,3, \\ 0, & \text{otherwise.} \end{cases}$$

Find $P[Y < X]$.

5. A sequence of Bernoulli trials consists of choosing components at random from a batch of components. A selected component is classified as either defective or non-defective. A non-defective component is considered as success, while a defective component is considered as a failure. If the probability that a selected component is non-defective is 0.8, determine the probabilities of the following events.

a) The first success occurs on the fifth trial.   5

b) The third success occurs on the eighth trial.   5

c) There are 4 successes by the tenth trial, and there are 10 successes by the eighteenth trial (of which the first four successes occur by the 10th trial).   10

d) Find the expected number of trials required to get the 4th success.   5

6. a) A computer device can be either in a busy mode (state 1) processing a task, or in an idle mode (state 2), where there are no tasks to process. Being in a busy mode, it can finish a task and enter an idle mode any minute with the probability 0.2. Being in an idle mode, it receives a new task any minute with the probability 0.1 and enters a busy mode. Assume the scenario is set up as a discrete time Markov chain.

    i. Find the n-th step transition probability matrix of the chain for $n = 4$.   10

    ii. Find the steady state transition probability vector for the chain.   10

    iii. If the initial state of the chain is idle, then find the probability that the chain will be in idle state after 4 transitions.   5

7. a) A node in a computer network sends data packet to another node one after another. Each packet is successfully sent with probability 0.75 and is dropped with probability 0.25. What is the probability that 5 packets are dropped before 10 packets are successfully sent?   10

b) Passengers are making reservations for a particular flight on a small commuter plane 24 hours a day at a Poisson rate of 3 reservations per 8 hours. If 24 seats are available for the flight, find the probability that by the end of the second day all the plane seats are reserved.   7

c) A doctor has five patients with migraine headaches. He prescribes for all five a drug that relieves the headaches of 82% of such patients. What is the probability that the medicine will not relieve the headaches of two of these patients?   8

8. a) In test of stopping distance for automobiles, cars traveling 30 miles per hour before the brakes were applied tended to travel distances that appeared to be uniformly distributed between two points a and b. Find the following probabilities:

    i. One of these automobiles, selected at random, stops closer to a than to b.   5

    ii. One of these automobiles, selected at random, stops at a point where the distance to a is more than 9 times the distance to b.   5

    iii. If three automobiles (which behave independently) are used in the test, then one of the three travels past the midpoint between a and b.   8

b) A point is selected at random on a line segment of length l. What is the probability that none of two segment is smaller than $\frac{l}{3}$?   7

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	$P_X(x) = \begin{cases} \binom{n}{x}p^x(1-p)^{n-x} & x = 1, \ldots, n \\ 0 & otherwise \end{cases}$	$E[X] = np$	$Var[X] = np(1-p)$
Pascal	$P_X(x) = \begin{cases} \binom{x-1}{k-1}p^k(1-p)^{x-k} & x = k, k+1, \ldots \\ 0 & otherwise \end{cases}$	$E[X] = k/p$	$Var[X] = k(1-p)/p^2$
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)	$P_X(x) = \begin{cases} \dfrac{1}{b-a+1}, & x = a, a+1, a+2, \ldots, b \\ 0, & otherwise \end{cases}$	$E[X] = \dfrac{a+b}{2}$	$Var[X] = \dfrac{(b-a)(b-a+2)}{12}$
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)	$f_X(x) = \begin{cases} \dfrac{1}{b-a}, & a \leq x < b \\ 0, & otherwise \end{cases}$	$E[X] = \dfrac{a+b}{2}$	$Var[X] = \dfrac{(b-a)^2}{12}$

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SEMESTER FINAL EXAMINATION   WINTER SEMESTER, 2017-2018
DURATION: 3 Hours   FULL MARKS: 150

CSE 4731: Internet Engineering

Programmable calculators are not allowed. Do not write anything on the question paper.
There are **8 (eight)** questions. Answer any **6 (six)** of them.
Figures in the right margin indicate marks.

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1. a) Compare and contrast the *Packet Switched Network* and *Circuit Switched Network* in brief.   8

   b) 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 $R1$ = 1500 kbps, $R2$ = 2 Mbps, and $R3$ = 1 Mbps. Assuming no other traffic in the network, what is the throughput for the file transfer?   5

   c) Suppose users share a 5 Mbps link. Also suppose each user requires 190 kbps when transmitting, but each user only transmits 15% of the time.   8
      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 140 users. Find the probability that at any given time, 80 users are transmitting simultaneously.

   d) What is the difference between end-to-end delay and packet jitter?   4

2. a) Consider the network shown in Figure 1, and assume that each node initially knows the costs to each of its neighbors. Consider the distance-vector algorithm and show the distance table entries at node *z*.   5
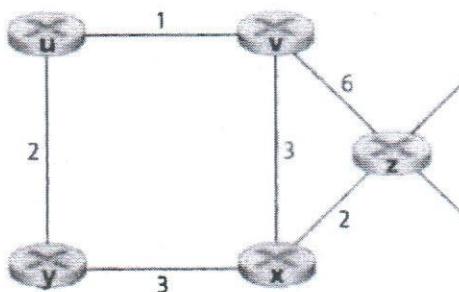
   Figure 1: Network for Question 2 (a)

   b) Discuss how a hierarchical organization of the Internet has made it possible to scale to millions of users.   8

   c) A router *D* using *RIP* (*Routing Information Protocol*) has the routing table shown in Table-1.   12

   Table 1: Routing table for router *D* in Question 2 (c)

Destination	Cost	Next Router
Net1	4	B
Net2	2	C
Net3	1	F
Net4	5	G

      i. Show the RIP response message sent by this router.
      ii. Consider router *D* receives a RIP response message from router *C*, which is summarized as: (Net1, 2), (Net2, 1), (Net3, 3), (Net4, 7).
   Now, show the updated routing table for router *D*.

3. a) How does the *OSPF* (Open Shortest Path First) execute its routing efficiently and in timely manner?   7

   b) In Figure 2, the reachability lists of router *R1, R2, and R3* in path-vector routing are depicted. Draw the stabilized routing tables of each router considering each ASs has already shared their reachability list with each other.   7
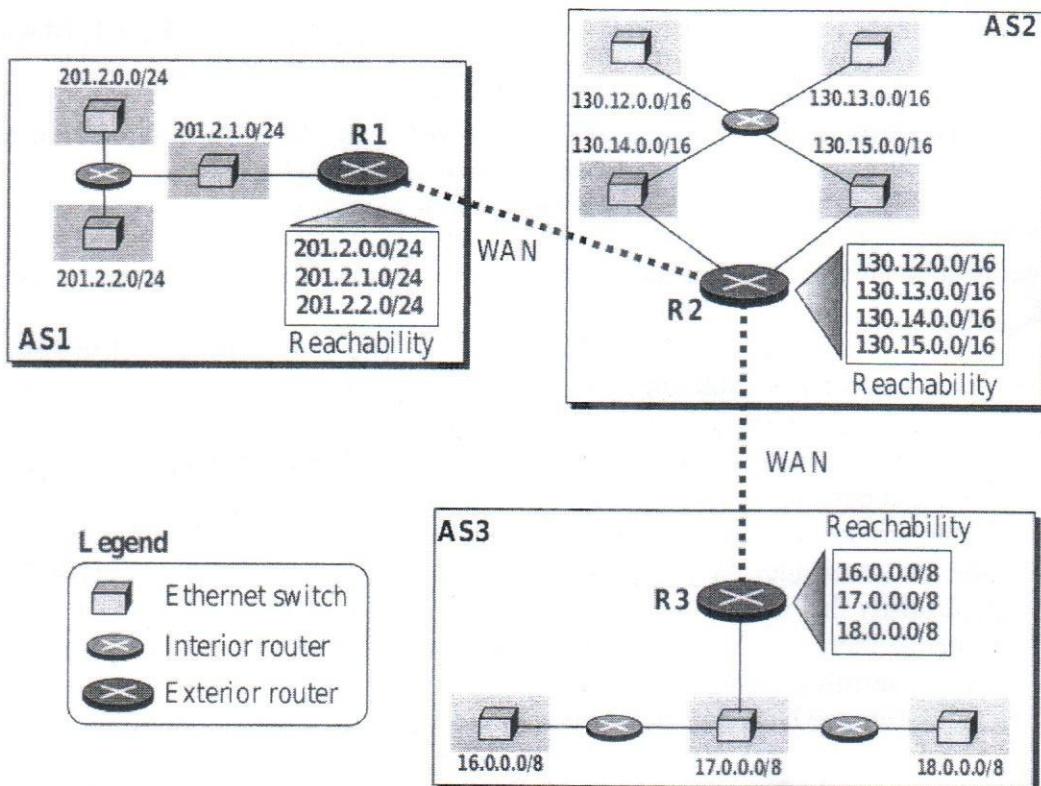
Figure 2: Network for Question 3 (b)

   c) Write short note on *BGP* update message.   4

   d) Consider an autonomous system named *AS1*, where *RIP* is utilized as its interior routing protocol. The routing table in a particular router *R1* of *AS1* has 20 entries. It does not receive information about five routers for 200s. How many *RIP timers* are running at this time?   7

4. a) Multicasting can be emulated using multiple unicasting. What are the potential problems of doing so? Justify your answer with necessary diagrams.   6

   b) In Figure 3, the routing table for R1 is constructed using source-based tree. Find the multicast routing tables for routers R2, R3, and R4. What is the main problem of using source-based tree?   6
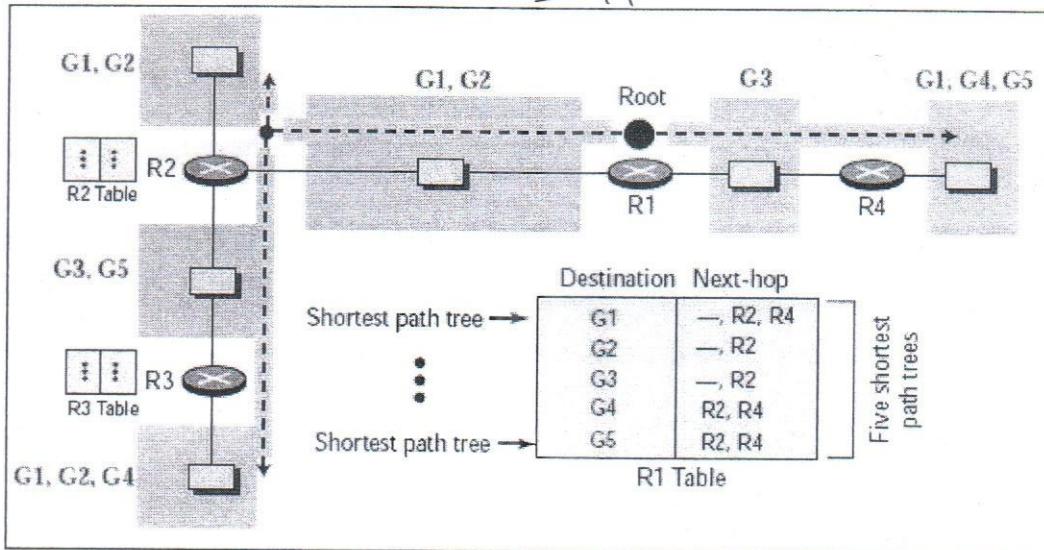
Figure 3: Network for Question 4 (b)

c) Multicast distance vector routing protocol (MDVRP) uses source-based trees, but any 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 its use (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 one by one and show how each strategy can improve the shortcomings of the previous one.   **13**

5. a) What is IP address space depletion? Briefly explain different measures to handle IP address depletion.   **8**

   b) What are the IPv4-compatible address and IPv4-mapped address for 119.254.254.254?   **3**

   c) Discuss the working principle of *Automatic Tunneling* and *Configured Tunneling* strategies for transition from IPv4 to IPv6.   **8**

   d) Suppose an ISP owns the block of addresses of the form 120.117.40.64/26. 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?   **6**

6. a) Consider the Figure 4 for answer the followings: **10**
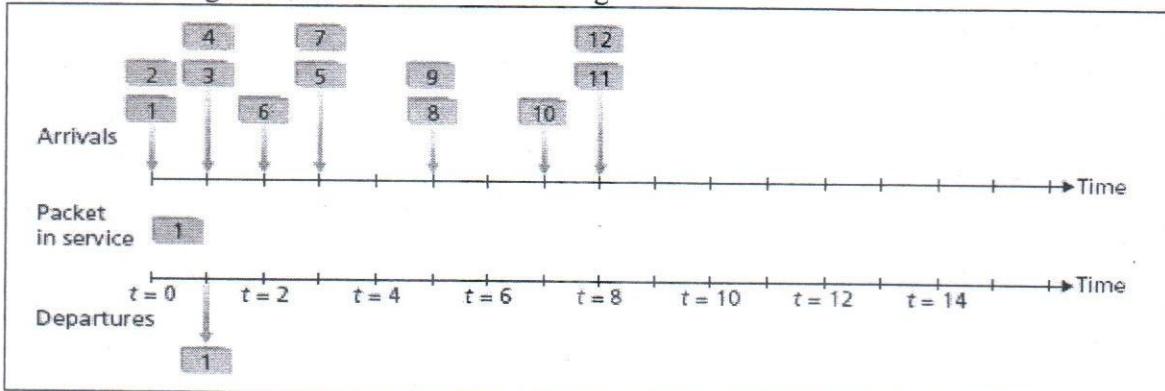
Figure 4: Figure for Question 6 (a)

   i. Assuming first in first out (FIFO) service, indicate the time at which packets 2 through 12 each leave the queue. For each packet, what is the delay between its arrival and the beginning of the slot in which it is transmitted? What is the average of this delay over all 12 packets?

   ii. Now assume a priority service, and assume that odd-numbered packets are high priority, and even-numbered packets are low priority. Indicate the time at

which packets 2 through 12 each leave the queue. For each packet, what is the delay between its arrival and the beginning of the slot in which it is transmitted? What is the average of this delay over all 12 packets?

    iii.   What do you notice about the average delay in these two cases (FIFO, and priority)?

b)   What is the difference between a permanent address and a care-of address? Who assigns a care-of address?   5

c)   Describe the indirect routing to a mobile node?   8

d)   What is the purpose of loopback address?   2

7. a)   "Stream control transmission protocol (SCTP) is a message-oriented reliable protocol that combines the good features of UDP and TCP" – Justify the claim.   6

b)   List the three major components of the Internet e-mail system. With the aid of a diagram depict the high-level view of the Internet e-mail system.   7

c)   What are the roles played by the Internet Group Management Protocol (IGMP) protocol and a wide area multicast routing protocol?   6

d)   Clarify the role of a Firewall in ensuring operational security inside any organization network.   6

8. a)   What are the differences between message confidentiality and message integrity? Can you have confidentiality without integrity? Justify your answer.   6

b)   Consider an 8-block cipher. How many possible input blocks does this cipher have? How many possible mapping are there? If we view each mapping as a key, then how many possible keys does this cipher have?   6

c)   In what way does a hash provide a better message integrity check than a checksum?   8

d)   What is the difference between a virus, a worm, and a Trojan horse?   5

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Department of Computer Science and Engineering (CSE)
SEMESTER FINAL EXAMINATION   WINTER SEMESTER, 2017-2018
DURATION: 3 Hours   FULL MARKS: 150

CSE 4733: Digital Image Processing

Programmable calculators are not allowed. Do not write anything on the question paper.
There are **8 (eight)** questions. Answer any **6 (six)** of them.
Figures in the right margin indicate marks.

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1. a) Differentiate between the Additive and Subtractive color systems with examples.   5
   b) Write short notes on the following color models: 5×2
      i.   HSI
      ii. RGB safe color
   c) Suppose John and Joe both carried out an image smoothing operation on the same color   7
      image. John applied the box filter directly on the RGB color vector values, whereas Joe
      separated each color channels and applied the filter individually on each channel. Will John
      and Joe get the same output? Explain your answer mathematically.
   d) Why do we need a separate Black channel along with the CMY color model?   3

2. a) Draw the general shape of the transformation functions used to correct excessive contrast in   10
      the RGB color space. Explain how that transformation function will reduce excessive
      contrast.
   b) Suppose the color values of your image are corrupted by separately adding Gaussian noise of   9
      zero mean and σ variance with each RGB color channels. Now if the same image is analyzed
      using HSI components, which channels will show more or less color degradation levels.
      Explain why.
   c) How can you implement the Highboost filtering operation for color image?   6

3. a) Describe the working principle of the following morphological operations: 4×2
      i.   Opening for Binary image
      ii. Closing for Gray-scale image
   b) Sketch the result of applying the hit-or-miss transform to the image and structuring element   7
      shown in Figure 1. Indicate clearly the origin and border you selected for the structuring
      element.

Image   Structuring element
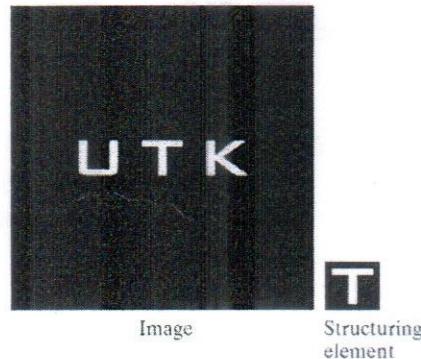
Figure 1.

   c) Opening or Closing with circular structuring element (SE) produces round corners which   5+5
      were sharp beforehand. Describe when and why these inward and outward sharp corners are
      rounded.

4. a) How were the weight coefficients chosen for the Prewitt Gradient masks? 5
   b) Describe the Hough Transform for detecting shapes represented with parameter equations. 10
   c) Explain when and why the Hough mapping of a single point in an image will produce a straight line at $\rho=0$ for all values of θ in the $\rho\theta$-accumulation space. 10

5. a) What does the preprocessing step do before a filtering operation in the Fourier Domain? 5
   b) Why do you observe ripple or ringing effects in the output image for Ideal Filters? 5
   c) Write short notes on the following filters: 5×2
      i. Gaussian Highpass Filter (IHPF)
      ii. Butterworth Lowpass Filter (BLPF)
   d) If the text in the image given in Figure 1 shift their position vertically up by n pixels, what changes would you see in its spectrum values at different frequency components? 5

6. a) Show that subtracting the Laplacian from an image is proportional to unsharp mask. Use the definition for the Laplacian with a center coefficient of negative sign. 10
   b) How is unsharp masking similar or dissimilar to image sharpening with Laplacian filter? 5
   c) Give a 3×3 mask for performing unsharp masking in a single pass through an image. Assume that the average image is obtained using the box filter. 10

7. a) Why does a gray-scale image always have an average intensity of mid-range after histogram equalization (HE)? 5
   b) Exponentials of the form $e^{-\alpha r^2}$, with α a positive constant are useful for constructing smooth intensity transformation functions. Start with this basic function and construct or define transformation function $T(r)$ having the general shape shown in Figure 2. The constants shown are input parameters, and your proposed transformations must include them in their specification. 10

$$s = T(r)$$
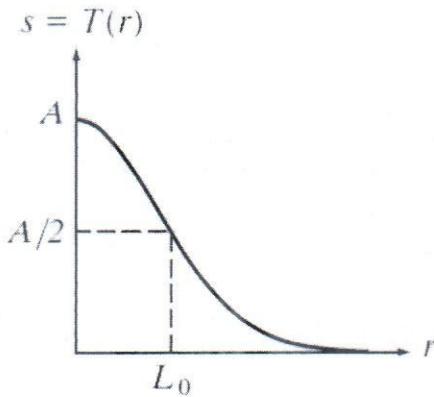
Figure 2.

   c) How is HE adapted for local enhancement? Why can it bring out more details than its global counterpart? 10

8. a) Develop an algorithm for converting a one-pixel-thick 8-path to a 4-path. 10
   b) What is isotropic filter? Prove that Gradient mask is not isotropic. 2+5
   c) In an 8-bit grey scale image, a specific bit-plane values been forcefully inverted. How can you find out which bit-plane has been inverted? 8

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SEMESTER FINAL EXAMINATION   WINTER SEMESTER, 2017-2018
DURATION: 3 Hours   FULL MARKS: 150

CSE 4739: Human Computer Interaction

Programmable calculators are not allowed. Do not write anything on the question paper.
There are **8 (eight)** questions. Answer any **6 (six)** of them.
Figures in the right margin indicate marks.

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1. a) What do you mean by multimodal interaction? Describe the aspects of human-computer interaction (HCI) in designing a multimodal system with an example. **15**

   b) High-quality printers generate output with 600 dots per inch (dpi). How many dots are there per degree of visual angle, assuming a reading distance of 12 inches? **5**

   c) Two symbols appear on the computer terminal. If the second symbol matches the first, the user presses "Yes" and presses "No" otherwise. What is the time between the second signal and response? **5**

2. a) Read carefully the text below: **10**

   "A Windows typical user is exposed to a Unix environment for the first time. He has to type a document on Emacs as opposed to his favorite windows text editor. The user makes a typo and without hesitating presses, his fingers on the 'Control' and the 'Z' buttons since these are the keys he always used as a keyboard shortcut for UNDO command. The user gets frustrated as the Emacs editor completely disappears from the screen and he got back to the Unix prompt with no single notification message."

   Answer the followings:
   i. Decide if this type of user error is a mistake or a slip. Justify your answer.
   ii. Find a possible way to fix this situation and specify the interaction style that you intend to use for this remedy.

   b) Suppose you want to design an Augmented Reality (AR)/Virtual Reality (VR)-based educational software for the children (age group, 7-14). Explain how you are going to analyze the translation problems to minimize 'gulf of execution' and 'gulf of evaluation' which is basically the translation problem between human and machine. **15**

3. a) Do the use of different colors in Microsoft office word ribbon menu will increase user experience (UX)? If yes, then how would you use colors for better UX. If no, then why? **8**

   b) Write the definition of interaction design. Explain the following usability goals with examples: **7**
   i. Effective to use
   ii. Efficient to use
   iii. Safe to use

   c) Describe the conceptual models based on activities and explain how a mental model is communicated to the user with example. **10**

4. a) What do you mean by persona? Why do you need to create personas? Explain the relationships among persona, scenario, and goals with a real-life example. **12**

   b) What is affinity diagram? Describe the process of creating affinity diagram. **8**

   c) Do you need to apply card sorting algorithm to create affinity diagram? Explain. **5**

5. a) To support the design of interfaces, Star lifecycle model was proposed by Hartson and Hix   15
        that follows the user-centered design principle. Elaborate how you will use this model to
        design the system described in Question 6.
    b) Briefly explain the four basic activities of interaction design. How are the interaction   10
        design and user-centered design related to each other?

6. Children with Down Syndrome (DS) may suffer from the intellectual disability as well as
    physical and social disability. Physical disability falls into two categories, fine motor skill (e.g.
    picking, grasping, holding small objects - that use the small muscles of the fingers, toes, wrists,
    lips, and tongue) and gross motor skill (e.g. walking, kicking, jumping, and climbing stairs -
    that use the large muscles in the arms, legs, torso, and feet) deficiency.

    Research shows that Game Therapy has a positive effect on improving motor skills of children
    with DS. Suppose you have to conduct research and design a game therapy system for the
    children with DS to improve gross motor skills.
    a) Describe how you are going to identify the list of requirements of the system. Which   8
        technique will you follow? Give example.
    b) Describe different types of requirement for the system.   10
    c) How will you represent those requirements to your teammates for analysis? Give example.   7

7. a) Write the differences between sketching and prototyping with an example.   6
    b) Suppose you have to construct prototypes for the system described in Question 6. Which   13
        prototyping technique will you follow? Explain with example prototypes considering at
        least two alternative design.
    c) Write the differences between "evolutionary" prototyping and "throw-away" prototyping.   6
        Under what conditions might one be preferred over the other?

8. a) What is experimental design? Identify the independent, dependent, random, control, and   12
        confounding variables to evaluate the system described in Question 6. List the variables
        including proper justifications.
    b) Suppose you have to perform the cognitive walkthrough to evaluate your designed system   13
        as described in Question 6. Answer the followings:
        i.   What are the usability attributes/test conditions/tasks that you will focus on the
              evaluation?
        ii.   Who will be involved in the evaluation process? Explain.
        iii. How will you perform the cognitive walkthrough? Give example for any one of the
              selected tasks.

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DURATION: 3 Hours   FULL MARKS: 150

CSE 4741: Bioinformatics

Programmable calculators are not allowed. Do not write anything on the question paper.
There are **8 (eight)** questions. Answer any **6 (six)** of them. Figures in the right margin indicate marks.

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1. a) Two biological sequences of length five and six respectively are needed to be aligned both   10
   locally and globally. It has been decided that *Smith-Waterman algorithm* will be used for local
   alignment and *Needleman-Wunsch algorithm* will be used for global alignment.

   Show Initialized scoring matrix for both of the methods. Explain how the difference(s) of the
   initial scoring matrices impact on the final outcomes.

   b) Four RNA sequences are given as follows-

   Seq 1: ACGCATTGAATGATGATAAT
   Seq 2: ACGCGTTGGGCGATGGCAAC
   Seq 3: ACACATTGAGTGATAATAAT
   Seq 4: ACGCGTTGGGCGACGGTAAT

        i.   Build distance matrix for the sequences.   4
        ii.   Using Fitch-Margoliash algorithm to build a phylogenetic tree for the sequences.   11

2. a) Discuss the steps of translation process in *Central Dogma*.   5
   b) Explain various theories about how multi-translation takes place from a single mRNA.   11
   c) Write short notes on the followings-   3x3
   Poly Adenylation, mRNA Degradation, mRNA Half-Life

3. a) Along with a graphical presentation name various types of RNA secondary structures.   7
   b) Discuss basic principles and advantages of MFE-folding algorithm for RNA structure   6
   prediction.
   c) State *Projection Algorithm* for Motif search. Define various terms used in the algorithm.   8+4

4. a) Discuss in detail how the propensity values can be calculated for Chow-Fasman algorithms.   8
   b) Write down the Chow-Fasman algorithms to predict protein secondary structures (alpha helix,   5x3
   beta strand, beta turn) for an amino acid chain.
   c) How to resolve conflicts between outcomes of Chow-Fasman algorithms?   2

5. a) For an experiment you are needed to calculate a proximity matrix for a set of gene clusters.   12
   Each cell $M(i,j)$ of the proximity matrix represents similarity between cluster(i) and cluster(j).
   Discuss various possible attributes to calculate cluster similarity in this context.
   b) Mention one of the major drawback of K-means algorithm. Discuss a method to overcome this   1+5
   drawback. Write down the modified K-means algorithm as per discussion.   +7

6. a) Compare divisive and agglomerative clustering methods.   6

    b) What is the importance of SSE (Sum of Squared Error) in the field of clustering? How SSE can   5+2
        be calculated?

    c) Classify various types of RNAs and discuss their functions.   9

    d) How RNAs are different then DNAs?   3

7. a) What is RNA editing? How it is different than gene evolution? Explain.   8

    b) *Cephalopods have something really strange in their genes* - discuss on this topic.   12

    c) What is *DNA microarray*? Discuss its importance in the field of bioinformatics.   5

8. a) What do you mean by gene expression? Discuss control regions of a gene.   2+4

    b) Discuss the mechanism of gene regulation process.   9

    c) Define Boolean Network. Explain how Boolean Network can be used to model a gene   10
        regulatory network.

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

SEMESTER FINAL EXAMINATION   WINTER SEMESTER, 2017-2018
DURATION: 3 Hours   FULL MARKS:150

CSE 4773: Internetworking Protocols

Programmable calculators are not allowed. Do not write anything on the question paper.
There are **8 (eight)** questions. Answer any **6 (six)** of them including **Question no. 7**
[Question no. 7 is compulsory].
Figures in the right margin indicate marks.
[**N.B.** Diagrams will carry 50% of the marks assigned to a Question if applicable]

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1. a) What is a Protocol? What are access networks? Name some of them.   2+3
   b) Compare between Packet Switched Networks and Circuit Switched Networks. Explain the   4+6
      Store and Forward Mechanism in Packet Switched Networks with appropriate diagram.
   c) Write short notes on the following: 5×2
      i.   Transmission delay
      ii.   Propagation delay
      iii. Throughput
      iv.   IP spoofing
      v.   Bandwidth flooding

2. a) What is meant by Congestion Control? Explain how TCP handles network congestion with   2+10
      proper example and figure.
   b) 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 in the channel are respectively $0, 1$ and the stations
      C, D remain silent. Then with the help of CDMA find the following:
      i.   The orthogonal sequence of data on the channel.   4
      ii.   Prove that a receiving station can get the data sent by a specific sender if it   4
            multiplies the entire data on the channel by the sender's chip code and then
            divides it by the number of stations.
   c) A network using CSMA/CD has a bandwidth of 10Mbps. If the maximum propagation time   5
      is $25.6\mu s$, what is the minimum size of the frame?

3. a) Explain with proper diagram the three node instability in Distance Vector Routing. Explain   3+6
      the solutions to two node instability in Distance Vector Routing.
   b) A routing table has 30 entries. It does not receive information about 5 routes for 200 s.   3
      How many timers are running at this time?
   c) What is meant by a Feasible Successor? Explain with the help of an FSM how EIGRP   2+11
      deploys DUAL algorithm.

4. a) Show the taxonomy of common Multicast Routing Protocols. With the help of a table, show   4+4
      the values of corresponding Link Identification and Link Data fields for different types of
      links in OSPF.
   b) Explain the techniques of RPB and RPM in DVMRP with proper diagram.   5+5
   c) Explain the timers in IGRP. Compare between IGRP and EIGRP.   4+3

5. a) Consider the following scenarios:

    Scenario – 1:

    Suppose in a wireless network, there are two hosts, **A** and **B**. Host **A** prefers to search for a router itself, while on the other hand, host **B** prefers that it will receive advertisements from the router itself and then establish connection.

    Scenario – 2:

    Consider another host **C** joins the network in Scenario – 1, such that neither **A** is aware of the fact that **C** exits nor **C** is aware of the fact that **A** exists. Only B knows that **A** and **C** exist.

    Based on these scenarios answer the following questions:
    i.   What is an Access Point(AP)? How are AP and SSID related?   2+2
    ii.   What is a beacon frame? According to Scenario – 1, what are the scanning   2+6
          methods used by hosts **A** and **B**? Explain them with proper diagram.
    iii. According to Scenario – 2, what problem will the network face if both **A** and **C**   1+7
          attempt to send packets to host **B**? How can the problem be resolved? Explain
          with appropriate diagrams.
    b) Why do wireless networks follow CSMA/CA and not CSMA/CD?   5

6. a) Write short notes on the following: 3×2
    i.   Home Agent
    ii.   Anchor Foreign Agent
    iii. Triangle Routing Problem
    b) Explain the process of handoff with common MSC in GSM architecture with proper   9
        diagram.
    c) What are the new network layer functionalities that are required to support indirect routing?   4
    d) What are the possible methods that a mobile IP node can implement to discover an agent in   6
        a foreign network? Explain.

[Compulsory]

7. a) With the help of a diagram, show the architecture of a satellite communication system.   4
    b) Explain with proper diagram, how indirect routing to a mobile node is performed.   9
    c) With proper diagram show how the Care of Address for a mobile IP node is registered with   12
        a home agent using Agent Solicitation.

8. a) Write short notes on the following: 4×2
    i.   Piconet
    ii.   Scatternet
    iii. SCO link
    iv.   ACL link
    b) What is Bluetooth? What are its advantages and disadvantages?   1+4
    c) Mention two IEEE standards for Wireless Personal Area Network and compare between   1+3
        them.
    d) What are softphones? What are the threats associated with VoIP?   2+6

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

SEMESTER FINAL EXAMINATION   WINTER SEMESTER, 2017-2018
DURATION: 3 Hours   FULL MARKS: 150

CSE 4775: Introduction to Data Mining

Programmable calculators are not allowed. Do not write anything on the question paper.
There are **8 (eight)** questions. Answer any **6 (six)** of them.
Figures in the right margin indicate marks.

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1. a) What is data mining? Describe the steps involved in data mining when viewed as a process of knowledge discovery. — 10

   b) Suppose that the data for analysis includes the attribute age. The age values for the data tuples are (in increasing order): — 10
   13, 15, 16, 16, 19, 20, 20, 21, 22, 22, 25, 25, 25, 25, 30, 33, 33, 35, 35, 35, 35, 36, 40, 45, 46, 52, 70.
   Using the data provided here perform smoothing by bin means and by bin boundaries to smooth these data, using a bin depth of 5. Illustrate your steps.

   c) Differentiate *Range* from *Midrange*. — 5

2. a) Why is Data Transformation important for data mining? What are the common strategies used in data transformation? — 4+6

   b) Why Data Integration is important? Discuss issues to consider during data integration. — 10

   c) List all the complex data types used in data mining. — 5

3. Suppose that a data warehouse for Big_University consists of the four dimensions student, course, semester, and instructor, and two measures count and avg_grade. At the lowest conceptual level (e.g., for a given student, course, semester, and instructor combination), the avg_grade measure stores the actual course grade of the student. At higher conceptual levels, avg_grade stores the average grade for the given combination.

   a) Draw a snowflake schema diagram for the data warehouse. — 9

   b) Starting with the base cuboid [student, course, semester, instructor], what specific OLAP operations (e.g., roll-up from semester to year) should you perform in order to list the average grade of CS courses for each Big University student? — 8

   c) If each dimension has five levels (including all), such as "student < major < status < university < all", how many cuboids will this cube contain (including the base and apex cuboids)? — 8

4. a) What is Metadata? What information should a metadata repository contain when used in a data warehouse? — 10

   b) Define *Dimension* and *Fact*. — 5

   c) Define OLAP and OLTP? Differentiate these two from the viewpoint of user, system orientation, data contents, DB design, view and access patterns. — 10

5. Suppose a hospital tested the age and body fat data for 18 randomly selected adults with the result in Table 1:

Table 1: data for question 5

age	23	23	27	27	39	41	47	49	50
%fat	9.5	26.5	7.8	17.8	31.4	25.9	27.4	27.2	31.2
age	52	54	54	56	57	58	58	60	61
%fat	34.6	42.5	28.8	33.4	30.2	34.1	32.9	41.2	35.7

a) Find mean and standard deviation for both of the attributes (age, fat).　　　12

b) Normalize these two attributes based on *z-score normalization*.　　　13

6. A survey was performed in Facebook group "*Pavilion de IUT*", where group members chose their five-a-side football team. Result of that survey is listed in Table 2.
   Let min_sup = 40% and min_conf = 80%.

Table 2: *Five-a-side* teams for question 6

Team ID	Team Players
T1	{Buffon, Messi, Ronaldo, Ramos, Iniesta}
T2	{Neuer, Hazard, Ronaldo, Ramos, Kroos}
T3	{Neuer, Messi, Neymar, Pique, Xavi}
T4	{Buffon, Messi, Ronaldo, Ramos, Modric}
T5	{De Gea, Neymer, Ronaldo, Hummels, Lampard}
T6	{Buffon, Messi, Ronaldo, Ramos, Iniesta}
T7	{Ederson, Coutinho, Neymer, Thiago Silva, Firmino}
T8	{Neuer, Messi, Neymar, Pique, Xavi}
T9	{De Gea, Neymer, Messi, Hummels, Lampard}
T10	{ De Gea, Messi, Ronaldo, Hummels, Coutinho}
T11	{Romero, Messi, Dybala, Aguero, Mascherano}
T12	{De Gea, Messi, Ronaldo, Hummels, Modric}
T13	{Neuer, Messi, Firmino, Pique, Modric}
T14	{Neuer, Messi, Neymar, Pique, Xavi}
T15	{Buffon, Messi, Ronaldo, Ramos, Modric}
T16	{De Gea, Neymer, Ronaldo, Hummels, Lampard}
T17	{Ederson, Coutinho, Neymer, Thiago Silva, Firmino}
T18	{Neuer, Messi, Neymar, Pique, Xavi}
T19	{De Gea, Neymer, Messi, Hummels, Lampard}
T20	{ De Gea, Messi, Ronaldo, Hummels, Coutinho}
T21	{Neuer, Hummels, Ozil, Reus, Muller}
T22	{De Gea, Pique, Iniesta, Xavi, Costa}
T23	{Hart, Cahill, Alli, Kane, Lampard}
T24	{Buffon, Chiellini, Veratti, Belotti, Marchisio}
T25	{De Gea, De Vrij, Dybala, Messi, Hazard}

a) Find all frequent sets of players using Apriori algorithm.　　　18

b) List all the strong association rules (with support s and confidence c) matching the following meta rule, where X is a variable representing group member, and $Player_i$ denotes variables representing Players (e.g., "Messi," "Ronaldo"):　　　7

   $\forall x \in Team, choose(X, Player_1) \wedge choose(X, Player_2) => choose(X, Player_3)\ [s,c]$

7. a) Why is correlation important in finding strong association rule? Propose a method for finding correlation between two objects.　　　4+4

   b) Evaluate the association rules found in question 6(b) using correlation.　　　12

   c) Describe apriori property with example.　　　5

8. a) Briefly outline how to compute the dissimilarity between objects described by the following: 3×5
    i. Nominal attributes
    ii. Asymmetric binary attributes
    iii. Numeric attributes

   b) Given two objects represented by the tuples (22, 1, 42, 10) and (20, 0, 36, 8):   10
    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. Compute the *supremum distance* between the two objects.

CSE 6123: Computer Networks

Programmable calculators are not allowed. Do not write anything on the question paper.
There are **8 (eight)** questions. Answer any **6 (six)** of them.
Figures in the right margin indicate marks.

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1. a) List the layers of OSI model. How does TCP/IP protocol suite differ from OSI model?   5+5

   b) What do you mean by vulnerable time? With the aid of diagrams, explain the vulnerable time of slotted CSMA protocol.   10

   c) Write a short note on network allocation vector (NAV).   5

2. a) Explain different persistence methods used in CSMA protocol.   10

   b) "The RTS-CTS hand-shaking can be a solution to the hidden station problem but it cannot help for the exposed station problem"- explain with the aid of necessary diagrams.   10

   c) Neatly sketch the frame structure of IEEE 802.3 MAC protocol.   5

3. a) What is the difference between routing and forwarding? What is the advantage of net specific routing over host specific routing?   5

   b) Briefly explain different functionalities of ICMP protocol.   10

   c) Briefly explain how Address Resolution Protocol (ARP) is used to create subnetting effect. Why is an ARP query sent within a broadcast frame and an ARP response sent within a frame with specific MAC address?   10

4. a) Find the class and mask of the following IP addresses: 6

      i.   11000001.00000010.11111110.00000000
      ii.   01000001.00000010.11111110.00000000
      iii. 255.255.10.65

   b) What is the main purpose of using subnet mask? Mention the default subnet mask of class A IP addresses.   2+2

   c) A University is granted the address block 18.15.40.0/24, which contains 256 addresses. The university has six departments and needs to divide the addresses into six sub blocks of 128, 64, 32, 16, 8, and 8 addresses. Design the sub blocks and give the slash notation for each sub block that are assigned to different departments. Answer the following questions: 3×5
      i.   What are the valid subnets?
      ii.   What are the broadcast addresses for each subnet?
      iii. What are the valid hosts in each subnet?

5. a) Neatly sketch the structure of *IPv4* datagram. Name the fields that are necessary to handle the fragmentation of packets.   5+3

   b) In an *IPv4* datagram, the M-bit is 0, the value of HLEN is 5, the value of total length is 200, and the fragment offset value is 200. What is the number of the first byte and number of the last byte in this datagram? Is this the last fragment, the first fragment, or a middle fragment?   7

   c) Mention the advantages of *IPv6* over *IPv4*.   10

6. a) Briefly explain the 'counting to infinity' problem of distance vector routing with possible solutions.   8

   b) With the aid of necessary diagrams briefly explain the working principal of link state routing protocols.   9

   c) Compare and contrast distance vector routing with link state routing.   8

7. a) With the aid of diagrams, explain the connection establishment and connection termination of TCP.   7+7

   b) TCP opens a connection using an initial sequence number (ISN) of 14534. The other party opens the connection with an ISN of 21732. Show the three TCP segments during three-way handshaking of connection establishment.   6

   c) Write a short note on 'SYN flooding attack'.   5

8. a) Compare and contrast TCP with UDP as a transport layer protocol.   8

   b) Briefly explain the congestion control mechanism of TCP.   14

   c) Name different control flags in a TCP segment.   3

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

SEMESTER FINAL EXAMINATION   WINTER SEMESTER, 2017-2018
DURATION: 3 Hours   FULL MARKS: 150

CSE 6391: Advanced Human Computer Interaction

Programmable calculators are not allowed. Do not write anything on the question paper.
There are **8 (eight)** questions. Answer any **6 (six)** of them.
Figures in the right margin indicate marks.

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1. a) Explain how human sensory systems, perception, attention, memory, and decision-making   10
        impact interaction with computer.

    b) Suppose you have to design a virtual reality application for the diagnosis of a patient suffering
        from body muscle pain. The patient will pinpoint the location of the pain in particular part of
        the body through a virtual human model. You have identified the interaction tasks like, virtual
        object interaction, navigations, and system control.

        i.   What interaction style(s) would be appropriate for this application? Justify your   7
             answer.
        ii. Which framework will you use to analyze translation problems in the interaction?   8
             Explain your answer with example tasks.

2. a) Briefly explain the effect of depth cues on visual search on smartphone-based interfaces.   9

    b) An understanding of how human memory works is very useful in designing HCI interfaces.   9
        Describe the design implications based on the following points:
        i.   Reduced working memory load
        ii. Recognition is better than recall
        iii. Graphical user interface is better than text-based interface

    c) Suppose you want to count voting by the attendees in a classroom to evaluate the class   7
        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 colors for interaction?

3. a) In a smartphone-based Quran app, interactive menus show a lot of options to navigate which   9
        supports discoverability. With example drawing sketches, show and explain how you will
        apply the following Norman's design principles in designing such menus:
        i.   Affordance
        ii. Visibility
        iii. Mapping

    b) What do mean by usability engineering? Explain the relationship between usability and user   6
        experience goals with example.

    c) What possible high-level conceptual models and metaphors are good for the following   10
        applications:
        i.   Sensor enabled wheel-chair control system using hand gloves
        ii. Virtual reality-based patient body pain management system

4. a) Consider that you are a usability engineer. For the system described in Question 3. (a), you set   12
        an explicit goal of avoiding 'menu lostness'; the extent to which the user gets irredeemably
        lost in a menu hierarchy. On each menu there is the ability to 'bail out' and return to the

highest level menu. If a user bails out like this without invoking some functionality then we assume that they have failed to find what they are looking for and become lost. Answer the followings:

    i.   Suggest the possible usability specifications to measure the problem of 'menu lostness'

    ii.   Considering the usability specifications you have given, suggest some solutions to this problem.

b)   To support the design of interfaces, Star lifecycle model was proposed by Hartson and Hix   13
that follows the user-centered design principle. Explain how users are involved in different stages of this model with a real life example.

5.   You have been asked to design a rehabilitation system to improve body balance condition of a patient with cervical neuropathy; Is the damage to nerve roots in the cervical area causes pain and the loss of sensation along the nerve's pathway into the arm and hand. First you need to assess the patient's current condition and then decide therapeutic interventions in different sessions. Each session may be conducted for 2-3 hours. You, as an interaction designer along with your teammates have got the opportunity to visit a rehabilitation center in Dhaka, named, 'Centre for the Rehabilitation of the Paralyzed (CRP)'.

  a)   Describe how you are going to identify a list of requirements for the system. Which technique   5
you will follow? Justify your answer.

  b)   What are the different types of requirements you will find and how will you establish a final   8
list of requirements?

  c)   How will you perform the requirement engineering task?   5

  d)   How will you represent those requirements to your teammates for analysis?   7

6.   a)   What is affinity diagram? When should you apply affinity diagraming process?   6

  b)   What are the differences between the followings: 10

    i.   Sketching and prototyping

    ii.   Low-fidelity and high-fidelity prototyping

  c)   With real life examples explain the following prototyping techniques: 9

    i.   Card-based prototyping

    ii.   'Wizard-of-Oz'

7.   a)   What do mean by experimental design? Design an experiment to test whether a doctor   15
wearing an Arduino Lilly-pad in his/her arm can control a surgical instrument in the operation theatre accurately. Identify your hypothesis, participants group, independent and dependent variables, between-subject or within-subject, task and task analysis approach.

  b)   Briefly explain the four principles of contextual inquiry (Context, Partnership, Interpretation,   10
and Focus) in respect to the problem description.

8.   a)   What do you mean by inspection-based evaluation? Describe the different stages of heuristic   15
evaluation process with example.

  b)   Write the design implications of Fitt's law. With an example explain how Fitt's law can be   10
applied to evaluate a system.

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

SEMESTER FINAL EXAMINATION   WINTER SEMESTER, 2017-2018
DURATION: 3 Hours   FULL MARKS:150

CSE 6197: Parallel and Distributed Computing

Programmable calculators are not allowed. Do not write anything on the question paper.
There are **8 (eight)** questions. Answer any **6 (six)** of them.
Figures in the right margin indicate marks.

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1. a) What is mounting? How can a foreign name space be mounted in a distributed system? Explain with the example of NFS.   10

    b) Explain the difference between iterative name resolution and recursive name resolution with an example.   8

    c) Briefly describe the home based approach for locating mobile entities.   7

2. a) What is a conit? Calculate numerical deviation and order deviation for replica A and B given on Figure 1.   8
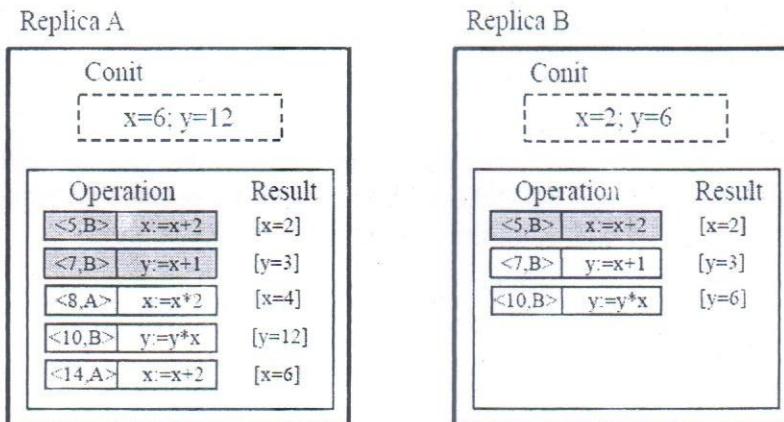

Figure 1: An example of keeping track of consistency deviations

    b) Briefly explain sequential consistency and causal consistency with proper diagram.   10

    c) Replicating a shared remote object may lead to consistency problem. Briefly explain the approaches to solve this problem.   7

3. a) Consider a Web server that is placed in New York. Normally, this server can handle incoming requests quite easily, but it may happen that over a couple of days, a sudden burst of requests come in from an unexpected location far from the server. In that case, How the server will resolve it? Explain with example.   10

    b) Suppose in a structured peer-to-peer communication there can be at most 30 machines. If they implement Chord System to track all the machines as well as the resources, let's assume that the 9 machines online have the following IDs: 1, 4, 9, 11, 14, 18, 20, 21, 28. Also assume that the length of finger table is 5.   10+5

    i. Develop finger tables for each node and describe the process for locating a resource with key 26.

    ii. Assume that node 7 has just joined the network. What would its finger table be and would there be any changes to other finger tables?

4. a) Lamport defined a notion of virtual time based on event ordering – the "happened before" relation. Show how a global total ordering of events can be achieved based on this notion of Lamport's logical clocks.   10

b) Consider three processes p1, p2, and p3 with the following pattern of communication given in Figure 2. Label each event with a normal Lamport timestamp and a vector timestamp.   10
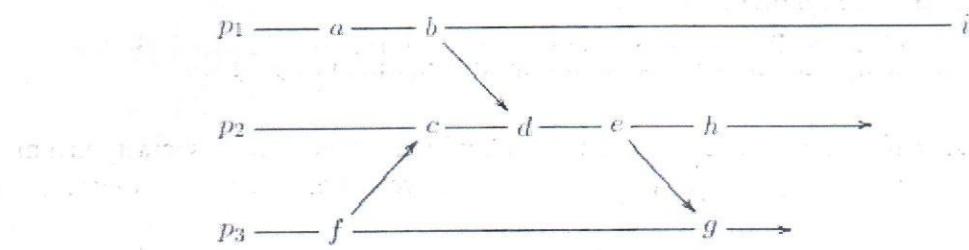

Figure 2: Four Processes P1, P2, P3 run events to send and receive messages

c) Briefly explain ring algorithm for electing a coordinator with proper diagram and example.   5

5. a) What is mutual exclusion? Briefly explain the distributed algorithm of mutual exclusion with proper diagram.   10

b) Suppose 10 nodes are connected in a network and different resources are shared among them. Calculate the number of message per entry/exit and delay before entry if distributed algorithm is used for mutual exclusion.   5

c) In the bully algorithm, a recovering process starts an election and will become the new coordinator if it has a higher identifier than the current incumbent. Is this a necessary feature of the algorithm? Explain.   10

6. a) What do you mean by parallel computing? Briefly explain the Flynn's Classical Taxonomy of parallel computing architecture.   10

b) Briefly explain hybrid distributed-shared memory architecture with necessary figures.   7

c) A benchmark program containing 234,000 instructions is executed on a processor having a cycle time of 0.15ns The statistics of the program is given in Table 1.   8

Table 1: Program statistics

Instruction Type	Instruction mix	Processor Cycles	Memory Cycles
Arithmetic	58 %	2	2
Branch	33 %	3	1
Load/Store	9 %	3	2

Each memory reference requires 3 CPU cycles to complete. Calculate MIPS rate & throughput for the program.

7. a) Consider the following pipelined processor in Figure 3. Answer the following questions associated with using this pipeline with an evaluation time of six pipeline clock periods.   10

L: latch   C: clock
S_i: the ith stage
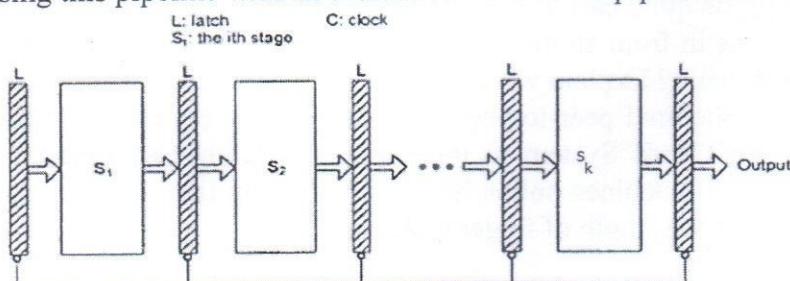
Figure 3: Linear pipeline with k stages

i. Briefly describe the different functional units of given pipeline architecture.
ii. Suppose k=4. Draw a reservation table for the evaluation of a function on five inputs.

b) What is data hazard? How to solve it? Explain with example.   7

c) Consider the execution of a program of 15000 instructions by a linear pipeline processor with a clock rate of 25MHz. Assume that the instruction pipeline has 5 stages and that one instruction is issued per clock cycle. The penalties due to branch instructions and out-of-sequence executions are ignored.   8

    i.   Calculate the speedup factor as compared with non-pipelined processor.

    ii.   What are the efficiency and throughput of this pipelined processor?

8. a) Define cloud computing? Suppose you are assigned with a project where security is a major concern. Which kind of cloud deployment model will you prefer for the project? Justify your answer.   8

b) What do you mean by Cloud-in-a-Box? Describe different service models of cloud computing.   10

c) The IoT differs from the traditional Internet in many ways. Identify their differences and describe their distinctions in connecting entities, infrastructure, networking and application domains.   7

Ph.D/M.Sc. Engg. CSE   01 June 2018

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

SEMESTER FINAL EXAMINATION   WINTER SEMESTER, 2017-2018
DURATION: 3 Hour   FULL MARKS: 150

CSE 6249: Data Warehousing and Mining

Programmable calculators are not allowed. Do not write anything on the question paper.
There are **8 (eight)** questions. Answer any **6 (six)** of them.
Figures in the right margin indicate marks.

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1. a) Define the following terms with examples: 6
      i) Ordinal attribute
      ii) Interval-based attribute
      iii) Ratio-scaled attribute

   b) Given two objects represented by the tuples (23, 4, 42, 10) and (18, 0, 35, 7):   3x4
      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. Compute the supremum distance between the two objects.

   c) Euclidean, Manhattan and Minkowski distances are used for computing the dissimilarity of   7
      objects with numeric attributes. But they often fail in the case where the number of attribute
      is very large such as frequencies of a particular word in a large document. Justify it with
      suitable example. Propose a suitable measure of similarity in this scenario.

2. a) How can we compute the dissimilarity between objects of mixed attribute types? First   10
      discuss the steps involved and then explain with a suitable example.

   b) There are a number of methods to deal with missing values in data preprocessing phase.   5
      Briefly describe them.

   c) Consider the following Term-Frequency Vector between document 1 and document 2:   10

Doc No.	Term-Frequency						
	Coach	Win	Penalty	Sponsor	Fixing	Season	Soccer
Document 1	4	0	2	0	0	1	0
Document 2	0	0	5	0	1	0	0

   Based on the document property select a suitable measure of similarity. Calculate to what
   extent they are similar.

3. a) Data quality can be assessed in terms of several issues including accuracy, completeness   10
      and consistency. For each of the above three issues, discuss how data quality assessment
      can depend on the intended use of the data, giving examples. Propose two other dimensions
      of data quality.

   b) Why do we need normalization in data mining algorithm?   2+
      Consider the following group of data: 3x2

      200, 300, 400, 600, 1000

Now use the following methods to normalize them.
   i.   Min-max normalization by setting min = 0 and max = 1
   ii.   z-score normalization
   iii. Normalization by decimal scaling

c) Explain the concept of Entity Identification Problem with a suitable example.   7

4. a) Consider the following scenario: 15

Bangladesh Government wants to make a survey on the issue of the impact of geographic locations in regard to severity of different diseases. Location should be designed in a hierarchical fashion. For the simplicity we do not consider any symptom of disease to determine it. Every disease is already well identified. You are free to take necessary Fact and Dimension Tables with attributes.

Person A is assigned to design a data warehouse using his favorite schema model. And he uses star schema. Persons B is also assigned with same task and he selects snowflake schema.

Do the design parts on behalf of both A and B. And comment on your own choice.

b) Normally data cube is considered as *3-D* geometric structure, but in the context of data warehouse and mining it is *n-dimensional*. Justify this statement with suitable example.   5

c) Define base cuboid and apex cuboid. What is a concept hierarchy?   5

5. a) Radio-frequency identification is commonly used to trace object movement and perform inventory control. An RFID reader can successfully read an RFID tag from a limited distance at any scheduled time. Suppose a company wants to design a data warehouse to facilitate the analysis of objects with RFID tags in an online analytical processing manner. The company registers huge amounts of RFID data in the format of (RFID, at location, time), and also has some information about the objects carrying the RFID tag, for example, (RFID, product name, product category, producer, date produced, price).   8+7

i) Which multidimensional data model will you use to model the above system? Justify your selection. Finally build the essential entities for it.

ii) The RFID data may contain lots of redundant information. Discuss a method that maximally reduces redundancy during data registration in the RFID data warehouse.

b) What are the major OLAP operations? Explain them.   10

6. a) What is the major challenge in mining frequent itemsets from a large data set? Explain it with a suitable example and propose a solution in the regard.   5

b) Define closed frequent itemset and maximal frequent itemset. In pattern mining the concept of closed frequent itemset and maximal frequent itemset have been introduced to overcome some difficulty. Explain the difficulty and show how these newly introduced concepts can reduce it.   10

c) Sometimes strong association rules may be misleading. Justify it with a suitable example. Specially highlight the origin of the misinterpretation in your example. Also propose a suitable measure to tackle this weakness.   10

7.   Consider the following transactions: 25

ABDFG
ABDF
CDE
AFGF
ACDF
BCDFG

Assume the support is 3 and confidence is 70%.

Apply Apriori Algorithm to deduce:
   i.   The representative sets
   ii.   The representative rules

8. a) What is attribute selection measure? How is it related to classification? Define the   10
        following attribute selection measures:
            i.   Information Gain
            ii.   Gain Ratio
            iii. Gini Index
    b) Why is naïve Bayesian classification called "naïve"? Briefly outline the major ideas of   10
        naïve Bayesian classification.
    c) Why is tree pruning useful in decision tree induction? What is a drawback of using a   5
        separate set of tuples to evaluate pruning?

PhD / M.Sc. Engg. CSE   05 June 2018

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

SEMESTER FINAL EXAMINATION   WINTER SEMESTER, 2017-2018
DURATION: 3 Hours   FULL MARKS: 150

CSE 6263: Advanced Optimization Techniques
Programmable calculators are not allowed. Do not write anything on the question paper.
There are **7 (seven)** questions. Answer any **6 (six)** of them.
Figures in the right margin indicate marks.

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1. Use the branch-and-bound method to solve the following Integer Program: 25

    $$\max z = 5x_1 + 2x_2$$
    $$s.t. \quad 3x_1 + x_2 \leq 12$$
    $$x_1 + x_2 \leq 5$$
    $$x_1, x_2 \geq 0; \quad x_1, x_2 \text{ integer}$$

    Note: You do not need to find the optimum solutions of the LP relaxation sub-problems. Instead, use the graphical method to find the approximate solutions of the LP relaxation sub-problems.

2. Coach Night is trying to choose the starting lineup for the basketball team. The team consists of seven players who have been rated (on a scale of $1 = poor$ to $3 = excellent$) according to their ball-handling, shooting, rebounding, and defensive abilities. The positions that each player is allowed to play and the player's abilities are listed in the following Table.

Player	Position	Ball-Handling	Shooting	Rebounding	Defense
1	G	3	3	1	3
2	C	2	1	3	2
3	G-F	2	3	2	2
4	F-C	1	3	3	1
5	G-F	3	3	3	3
6	F-C	3	1	2	3
7	G-F	3	2	2	1

    The five-player starting lineup must satisfy the following restrictions:
    a) At least 4 members must be able to play guard, at least 2 members must be able to play   5
        forward, and at least 1 member must be able to play center.
    b) The average ball-handling, shooting, and rebounding level of the starting lineup must be at   5
        least 2.
    c) If player 3 starts, then player 6 cannot start.   5
    d) If player 1 starts, then players 4 and 5 must both start.   5
    e) Either player 2 or player 3 must start.   5

    Given these constraints, Coach Night wants to maximize the total defensive ability of the starting team. Formulate an IP that will help him choose his starting team.

3. Consider the following linear programming problem.

    $$\text{maximize} \quad z = 3x_1 + 2x_2$$
    $$s.t. \quad 2x_1 + x_2 \geq 10$$
    $$-3x_1 + 2x_2 \leq 6$$

$$x_1 + x_2 \geq 6$$

and $\qquad x_1, x_2 \geq 0$

a) Using the Big M method, construct the complete first simplex tableau for the simplex method and identify the corresponding initial (artificial) BF solution. Also, identify the initial entering basic variable and leaving basic variable. $\qquad$ 15

b) Work through the simplex method step-by-step in the tableau found in Question 3(a) to solve the problem. $\qquad$ 10

4. Consider the linear programming problem given in Question 3.

a) Using the two-phase method, construct the complete first simplex tableau for phase 1 and identify the corresponding initial (artificial) BF solution. Also identify the initial entering basic variable and the leaving basic variable. $\qquad$ 7

b) Work through phase 1 step by step. $\qquad$ 6

c) Construct the complete first simplex tableau for phase 2. $\qquad$ 6

d) Work through phase 2 step by step to solve the problem. $\qquad$ 6

5. Consider the following linear programming problem: $\qquad$ 25

$$\begin{aligned}
\text{maximize} \quad & Z = -x_1 - 2x_2 + x_3 \\
\text{subject to} \quad & x_1 + x_2 + x_3 \leq 4 \\
& -x_1 + 2x_2 - 2x_3 \leq 6 \\
& 2x_1 + x_2 \qquad \leq 5
\end{aligned}$$

and $\qquad x_1, x_2, x_3 \geq 0$

Solve the linear programming problem using the revised simplex method. Your solution should include all the steps in each iteration of the revised simplex method.

6. Sugarco can manufacture three types of candy bar. Each candy bar consists totally of sugar and chocolate. The compositions of each type of candy bar and the profit earned from each candy bar are shown in the following Table.

Bar	Amount of Sugar (Ounces)	Amount of Chocolate (Ounces)	Profit (Cents)
1	1	2	3
2	1	3	7
3	1	1	5

Fifty oz of sugar and 100 oz of chocolate are available. After defining x_i to be the number of Type i candy bars manufactured, Sugarco should solve the following LP:

$$\begin{aligned}
\text{maximize} \quad & Z = 3x_1 + 7x_2 + 5x_3 \\
\text{subject to} \quad & x_1 + x_2 + x_3 \leq 50 \\
& 2x_1 + 3x_2 + 3x_3 \leq 100 \\
& x_1, x_2, x_3 \geq 0.
\end{aligned}$$

After adding slack variables s_1 and s_2, the optimal tableau is as shown in following Table. Using this optimal tableau, answer the following questions:

z	x_1	x_2	x_3	s_1	s_2	rhs	Basic Variable
1	3	0	0	4	1	300	$z = 300$
0	$\frac{1}{2}$	0	1	$\frac{3}{2}$	$-\frac{1}{2}$	25	$x_1 = 25$
0	$\frac{1}{2}$	1	0	$-\frac{1}{2}$	$\frac{1}{2}$	25	$x_2 = 25$

a) For what values of Type 1 candy bar profit does the current basis remain optimal? If the profit for a Type 1 candy bar were 7¢, what would be the new optimal solution to Sugarco's problem? **7**

b) For what values of Type 2 candy bar profit would the current basis remain optimal? If the profit for a Type 2 candy bar were 13¢, then what would be the new optimal solution to Sugarco's problem? **6**

c) For what amount of available sugar would the current basis remain optimal? **6**

d) Suppose a Type 1 candy bar used only 0.5 oz of sugar and 0.5 oz of chocolate. Should Sugarco now make Type 1 candy bars? **6**

7. Consider the following problem.

maximize $\quad Z = 6x_1 + 8x_2$

subject to $\quad 5x_1 + 2x_2 \leq 20$

$\qquad\qquad x_1 + 2x_2 \leq 10$

$\qquad\qquad x_1, x_2 \geq 0.$

a) Construct the dual problem for this primal problem. **5**

b) Solve both the primal problem and the dual problem graphically. **12**

c) Identify the CPF solutions and corner-point infeasible solutions for both problems. Calculate the objective function values for all these solutions. **8**

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SEMESTER FINAL EXAMINATION   WINTER SEMESTER, 2017-2018
DURATION: 3 Hours   FULL MARKS: 150

CSE 6273: Cloud Computing

Programmable calculators are not allowed. Do not write anything on the question paper.
There are **8 (eight)** questions. Answer any **6 (six)** of them.
Figures in the right margin indicate marks.

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1. a) Explain the difference between cloud and traditional datacenters.   5
    b) Briefly describe how grid computing evolved to cloud computing.   10
    c) Describe the scheduling schemes of grid and cloud computing. Should there be essentially any   10
       difference between their scheduling schemes? Describe briefly.

2. a) Public cloud vendors like facebook provide popular social networking services, yet corporations   10
       buy or install their own cloud services into their own premises. As a cloud service provider,
       explain the business opportunities in this scope.
    b) What are the scopes of cloud computing in the education systems of Bangladesh? Briefly   15
       describe.

3. a) How is cloud computing related to mobile computing? Describe the evolutions of cloud services   12
       in the mobile computing.
    b) One of the enabling technologies of cloud computing is virtualization. Hardware assisted   13
       virtualization provides easier and quicker opportunities in managing virtual machines (VMs).
       Discuss on Intel-VT technology to virtualize CPU and memory for facilitating hardware
       virtualization.

4. a) How much scalability can/do the public clouds provide? To scale beyond the offers of the   15
       commercial vendors, what measures can you take to increase the scalability of your platform/
       application?
    b) With the introduction of cloud, peta bytes of data are being generated and managed regularly and 10
       the information business is now at the top of any other business. Discuss the characteristics of
       information business and how they are being monopolized by the big vendors.

5. a) Explain the concept of map-reduce with an example. What is it considered as a paradigm shift in   10
       computation?
    b) Describe server architecture (master and worker) for facilitating the map-reduce computing.   10
    c) Why is map-reduce done in Hadoop Files System (HDFS) or similar file systems? How can map-   5
       reduce be done on a single computation node even?

6. a) Briefly describe the characteristics of HDFS.   15
       Distributed lock is an essential part of any scalable file system. Describe an implementation   10
       mechanism of distributed lock with a real life example.

7. a) What are the virtual machine (VM) related security issues in cloud computing. Explain their   10
       characteristics and preventive measures.
    b) The cloud cube business model takes an initiative to describe the business scopes of different   15
       types of clouds in an organized manner. Briefly describe the cube model.

8. a) Why and how RPC evolved to Web Services? Briefly describe the roadmap with technical   13
       details.
    b) Network virtualization is an enabling technology for cloud computing. Describe the different   12
       forms of network virtualization possible/ needed in cloud computing.

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

SEMESTER FINAL EXAMINATION   WINTER SEMESTER, 2017-2018
DURATION: 3 Hours   FULL MARKS: 150

CSE 6275: Advanced Human Computer Interaction

Programmable calculators are not allowed. Do not write anything on the question paper.
There are **8 (eight)** questions. Answer any **6 (six)** of them.
Figures in the right margin indicate marks.

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1. a) Explain how human sensory systems, perception, attention, memory, and decision-making   10
       impact interaction with computer.
    b) Suppose you have to design a virtual reality application for the diagnosis of a patient suffering
       from body muscle pain. The patient will pinpoint the location of the pain in particular part of
       the body through a virtual human model. You have identified the interaction tasks like, virtual
       object interaction, navigations, and system control.
       i.   What interaction style(s) would be appropriate for this application? Justify your   7
            answer.
       ii. Which framework will you use to analyze translation problems in the interaction?   8
            Explain your answer with example tasks.

2. a) Briefly explain the effect of depth cues on visual search on smartphone-based interfaces.   9
    b) An understanding of how human memory works is very useful in designing HCI interfaces.   9
       Describe the design implications based on the following points:
       i.   Reduced working memory load
       ii.   Recognition is better than recall
       iii. Graphical user interface is better than text-based interface
    c) Suppose you want to count voting by the attendees in a classroom to evaluate the class   7
       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 colors for interaction?

3. a) In a smartphone-based Quran app, interactive menus show a lot of options to navigate which   9
       supports discoverability. With example drawing sketches, show and explain how you will
       apply the following Norman's design principles in designing such menus:
       i.   Affordance
       ii.   Visibility
       iii. Mapping
    b) What do mean by usability engineering? Explain the relationship between usability and user   6
       experience goals with example.
    c) What possible high-level conceptual models and metaphors are good for the following   10
       applications:
       i.   Sensor enabled wheel-chair control system using hand gloves
       ii.   Virtual reality-based patient body pain management system

4. a) Consider that you are a usability engineer. For the system described in Question 3. (a), you set 12
       an explicit goal of avoiding 'menu lostness'; the extent to which the user gets irredeemably
       lost in a menu hierarchy. On each menu there is the ability to 'bail out' and return to the

highest level menu. If a user bails out like this without invoking some functionality then we assume that they have failed to find what they are looking for and become lost. Answer the followings:

    i.   Suggest the possible usability specifications to measure the problem of 'menu lostness'

    ii.   Considering the usability specifications you have given, suggest some solutions to this problem.

b)   To support the design of interfaces, Star lifecycle model was proposed by Hartson and Hix   13
    that follows the user-centered design principle. Explain how users are involved in different stages of this model with a real life example.

5.   You have been asked to design a rehabilitation system to improve body balance condition of a patient with cervical neuropathy; Is the damage to nerve roots in the cervical area causes pain and the loss of sensation along the nerve's pathway into the arm and hand. First you need to assess the patient's current condition and then decide therapeutic interventions in different sessions. Each session may be conducted for 2-3 hours. You, as an interaction designer along with your teammates have got the opportunity to visit a rehabilitation center in Dhaka, named, 'Centre for the Rehabilitation of the Paralyzed (CRP)'.

   a)   Describe how you are going to identify a list of requirements for the system. Which technique   5
    you will follow? Justify your answer.

   b)   What are the different types of requirements you will find and how will you establish a final   8
    list of requirements?

   c)   How will you perform the requirement engineering task?   5

   d)   How will you represent those requirements to your teammates for analysis?   7

6.   a)   What is affinity diagram? When should you apply affinity diagraming process?   6

   b)   What are the differences between the followings: 10

      i.   Sketching and prototyping

      ii.   Low-fidelity and high-fidelity prototyping

   c)   With real life examples explain the following prototyping techniques: 9

      i.   Card-based prototyping

      ii.   'Wizard-of-Oz'

7.   a)   What do mean by experimental design? Design an experiment to test whether a doctor   15
    wearing an Arduino Lilly-pad in his/her arm can control a surgical instrument in the operation theatre accurately. Identify your hypothesis, participants group, independent and dependent variables, between-subject or within-subject, task and task analysis approach.

   b)   Briefly explain the four principles of contextual inquiry (Context, Partnership, Interpretation,   10
    and Focus) in respect to the problem description.

8.   a)   What do you mean by inspection-based evaluation? Describe the different stages of heuristic   15
    evaluation process with example.

   b)   Write the design implications of Fitt's law. With an example explain how Fitt's law can be   10
    applied to evaluate a system.