University of Dhaka

Department of Computer Science and Engineering

Second Year Second Semester Incourse Examination -2022

CSE-2202: Design and Analysis of Algorithms – I

Time: 1.10 Hours Total Marks: 25

Name: **Class Roll:**

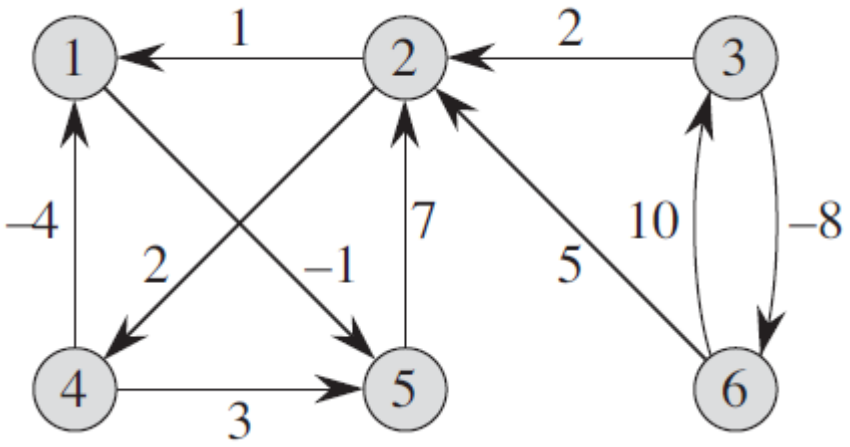
[Answer all the following questions]

1. There is a hypothesis that the algorithm for finding strongly connected components would be simpler if it used the original (instead of the transpose) graph in the second depth-first search and scanned the vertices in the order of increasing finishing times. [4+2]

   Does this simpler algorithm **always** produce the correct results? Defend your answer with a sample graph of three nodes (A, B, C) and three directed edges. You need to show all the steps.

   How can the number of strongly connected components of a graph change if a new edge is added?

2. Use Floyd Warshall Algorithm to find the shortest path distance between every pair of vertices. Initial three steps have been provided for your convenience. [3+3+1]



$$\begin{pmatrix} 0 & \infty & \infty & \infty & -1 & \infty \\ 1 & 0 & \infty & 2 & 0 & \infty \\ \infty & 2 & 0 & \infty & \infty & -8 \\ -4 & \infty & \infty & 0 & -5 & \infty \\ \infty & 7 & \infty & \infty & 0 & \infty \\ \infty & 5 & 10 & \infty & \infty & 0 \end{pmatrix}$$

$$\begin{pmatrix} 0 & \infty & \infty & \infty & -1 & \infty \\ 1 & 0 & \infty & 2 & 0 & \infty \\ 3 & 2 & 0 & 4 & 2 & -8 \\ -4 & \infty & \infty & 0 & -5 & \infty \\ 8 & 7 & \infty & 9 & 0 & \infty \\ 6 & 5 & 10 & 7 & 5 & 0 \end{pmatrix}$$

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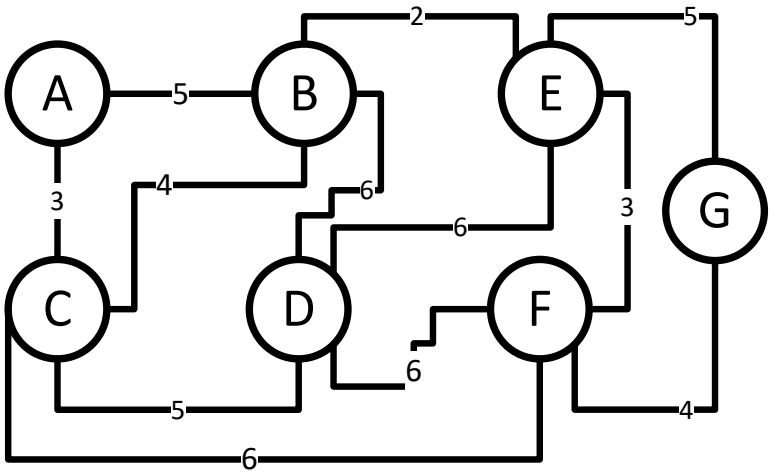
Given that the Floyd-Warshall algorithm provides a solution for the all-pairs shortest path problem with a time complexity of **$O(V^3)$**, it is reported that Johnson's algorithm, which leverages two single-source shortest path algorithms, offers a computationally more efficient approach for certain graph structures. Given this context, determine the computational complexity of Johnson's algorithm when applied to a dense graph. You need to specifically discuss the complexity of each step of the algorithm to generate the final worst case complexity.

In any case, mention the necessity of correct reweighting technique.

3. In the realm of graph algorithms, consider the challenges faced by two travel enthusiasts, Emily and Harry. Emily aims to cross every bridge in a city only once and return to her starting point, emulating an Eulerian circuit. Harry, conversely, aspires to visit every city in a country exactly once, representing a Hamiltonian path. [3+3]

Now, relate the problems faced by Emily and Harry to their corresponding graph algorithms, providing the formal algorithmic complexities for each.
Which traveller faces a more computationally complex task, and why?



Consider the above undirected graph, which of the following is/are not the sequence of edges added to the minimum spanning tree using Kruskal's algorithm? Provide justification for your selection(s) and rejection(s). Finally, use any of the valid sequences to produce a minimum spanning tree.

(i) (B,E), (E,F), (A,C), (B,C), (F,G), (C,D)
(ii) (B,E), (E,F), (A,C), (F,G), (B,C), (C,D)
(iii) (B,E), (A,C), (E,F), (B,C), (F,G), (C,D)
(iv) (B,E), (E,F), (B,C), (A,C), (F,G), (C,D)

4. In the context of algorithm design, the greedy approach is often recommended for its efficiency and simplicity. However, it is not universally applicable. Describe three algorithmic conditions or scenarios where greedy algorithms might not be the most suitable or might fail to deliver an optimal solution. Each of the three points should include suitable real-world applications. [6]

Dept. of Computer Science & Engineering
University of Dhaka
Mid-Term Examination 2022
CSE2203: Data Communications

Time: 75 minutes | Full Marks: 25

1. We need to upgrade a channel to a higher bandwidth. Answer the following question: 2
   i) How is the rate improved if we double the bandwidth?
   ii) How is the rate improved if we double the SNR?

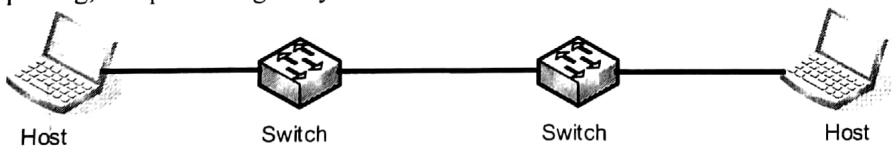
2. Define *baseband* and *broadband* transmissions. Give an examples of both transmission systems. 2

3. A composite signal is given by the following function $f(t) = (1 + 0.1\cos 10t)\sin 100t$ 4
   Find the amplitude, phase, and frequency of that signal and represent it in frequency domain.
   [$2\sin x \cos x = \sin(x+y)+\sin(x-y)$]

4. Distinguish between *distortion* and *noise*. 2

5. Encode the bit pattern 1010110011100011001 using Differential Manchester, Pseudo Ternary, and AMI schemes. 3

6. In modern packet-switched networks, including the Internet, the source host segments long, application-layer messages (for example, an image or a music file) into smaller packets and sends the packets into the network. The receiver then reassembles the packets back into the original message. Consider a message that is 8×10^6 bits long that is to be sent from source to destination in the figure below. Suppose each link in the figure is 2 Mbps. Ignore propagation, queuing, and processing delays. 2



   Now suppose that the message is segmented into 800 packets, with each packet being 10,000 bits long. Keeping in mind that each switch uses store-and-forward packet switching, how long does it take to move the first packet from source host to the first switch? When the first packet is being sent from the first switch to the second switch, the second packet is being sent from the source host to the first switch. At what time will the second packet be fully received at the first switch?

7. Suppose that a digitized TV picture is to be transmitted from source that uses a matrix of 480x500 picture elements (pixels), where each pixel can take on one of 32 intensity values. Assume that 30 pictures are sent per second. Assume that the TV picture is to be transmitted over channel with 4.5 Mhz bandwidth and a 35 dB signal-to-noise ratio. Find the capacity of the channel (bps). 2

8. Is it possible to change the phase of a signal without changing the instantaneous frequency and vice versa? Justify your answer. 2

9. Differentiate between the operations of physical layer and data link layer in the context of OSI model. 2

10. A signal generator is producing a square wave with a period of 1ms. What happens (show illustrations with possible reasons) when it is passed through: 4
    i) a lowpass filter with a cutoff frequency of 3KHz
    ii) a highpass filter with a cutoff frequency of 3KHz
    (note the cutoff frequency of a filter is the frequency at which the signal power is attenuated by 3dB)

University of Dhaka
Department of Computer Science and Engineering
2nd Year, 2nd Semester, 2023
CSE 2204: Computer Architecture and Organization

Total Mark: 30 **Total Time: 1 Hour 30 Minutes**

Answer any Five (5) of the Following Questions

1. What is the advantage of non-restoring division algorithm? Write down the steps needed to find the result of dividing 13 by 3. For each step you should mention the rule used. 2+4=6

2. What are the advantages of using a carry save adder? Discuss the concept of carry save addition using W = 10110110, X = 11001010 and Y = 1111 0101. Compare it with the traditional addition using the same example. 2+4=6

3. Write down the steps needed to compute 5 × 6 using Booth's multiplication algorithm. For each step you should mention the rule used. 6

4. Discuss the concept of spatial expansion of an ALU. Draw a 1-bit ALU supporting AND, OR, NOR, Addition, Subtraction and set on less than instruction. Finally draw the 32-bit ALU supporting the above-mentioned operations. Discuss how each operation is implemented with the explanation of control input. 2+4=6

5. Write on PC-relative and pseudo-direct addressing. 3+3=6

   Write the MIPS instructions for the following code segment:

```
i=0;
k=3;

while(i<4)
{
   save [i] = k+save[i];
   i++;
   k+=5;
}
```

6. Show the MIPS instruction format for each of the following instruction and then derive the decimal representation: 4+2=6

   (1) add $s1, $s2, $s3 [opcode = 0 and funct = 32]
   (2) sw $t0, 300 ($t1) [opcode = 43]
   (3) bne $s1, $s2, 300 [opcode = 4]

   For (2) and (3) mention how memory address is calculated.

7. Discuss the necessity of normalization and bias in floating point representation. Find the normalized binary representation of the following number using IEEE -754 32 bit floating point format.

   -23.875_{10}
   You should explain each step explicitly.

Department of Computer Science and Engineering
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In-course Examination, September 2023

Course # CSE 2201. Title: Database Management Systems

Duration: 90 minutes

Answer all questions.

1 a) One of the primary purposes of Database Management Systems (DBMS) is to keep data consistent. Explain with proper examples when data becomes inconsistent. 3

b) "A database management system provides tools for avoiding data inconsistency; however, a bad design may invite inconsistent data even in an ideal DBMS"-Justify the statement. Prepare a checklist for a database designer in order to reduce inconsistency in a database. 4

2 Consider a hospital where patients come for treatments when they feel sick or get injured. The hospital has a set of doctors and a set of enlisted external consultants for the patients. The doctors and consultants examine the patients physically, recommends different types of medical test based on their sickness (eg. General disease, cardiology, neurology, urology etc.), and prescribe medicines accordingly. Except for emergency cases, the patients can select their doctors from the panel of doctors and consultants.
Suppose the hospital wants to develop a database application to keep track of patients, their treatments based on their sickness, and the prescribed medicines. The hospital authority has appointed you to design the database for the hospital. The hospital authority has no idea about DBMS or how it works. They can explain the information they would like to get from the database. Some of such requirements are:

i) The most prescribed medicine by doctors and consultants
ii) The medicine names that are prescribed for how many different sickness types
iii) The patients' preference in selecting the doctor/consultant for a sickness type
iv) The medical tests that a doctor/consultant recommends for each sickness type.
v) The list of patients and doctors that have appointment tomorrow (or, on a particular date)

a) For the hospital described above, design a database with the required tables and their attributes. Just write down the table schema for a table and mention the primary/unique key of the tables. You have the full freedom in choosing the tables and attributes; however, your design must comply to the requirements i) to v) mentioned above. 4

b) Do you like to use any foreign key in your design? If yes, list the table and column names with the referring table and column and justify why you like to use that key. 2

c) Write down the SQL statements to create the tables in your design. 3

3 a) For your database design in answering the question 2(a), write relational algebra expressions and SQL statement to find the following:

I. List the doctor's name, patient name, patient age, and patient telephone number of each patient that have an appointment tomorrow (12-SEP-2023). 2

II. List of medicines that have been prescribed for "Dengu fever". 2

III. List of patients who visited the hospital last month and have no appointment this month. 4

b) Write SQL statements to find the following requirements from your designed database

i) Find the most prescribed medicine by doctors and consultants
ii) Find medicine names that are prescribed for how many different sickness types
iii) Find The patients' preference in selecting the doctor/consultant for a sickness type 6

Good Luck!

CT-2022 CSE 2205 Marks : 25 time : 1.5 hour

1. Why Mechatronics is called an Interdisciplinary subject? 2.5
2. What are the basic elements of a Mechatronics System? 2.5
3. What is meant by Mechanics? Show the classification of Engineering Mechanics. 3.5
4. Define a gear. 4.5

   Consider a gear train consists of a 15/45 gear and 45/90 gear. If I rotate the 15-tooth driver gear 6 times how many times would the 90-tooth driven gear rotate?
5. Consider a potentiometer whose internal resistances are 1 kΩ and 2 kΩ. 3

   If the input voltage is 11 volt, calculate the load voltage if

   i) load resistance is 3 kΩ ii) load resistance is 200 kΩ
6. What is a Flow Sensor? Mention practical applications of it. 2.5
7. What are the three standard systems of measurements? 1.5
8. With diagram explain the basic operation of a closed loop control system. 5