Shahjalal University of Science and Technology
Institute of Information and Communication Technology (IICT)
SWE 3rd Year1st Semester Final Examination' Jun 2024 (Session: 2021-22)
Course: SWE 327 (Database Management System)
Credits: 3   Time: 3 hrs   Total Marks: 100

Group A
[Answer all the questions]

1. **Answer any FIVE**   5x2=10
a) Differentiate between DDL and DML commands in SQL.

b) What is the difference between DELETE, TRUNCATE, and DROP statements?
c) What is a weak and strong entity set? Explain with an example.
d) Write the syntax of the CREATE TABLE statement with an example.
e) What is the difference between CHAR and VARCHAR data types?
f) Define primary key, foreign key, and unique key in SQL.
g) What are the transaction properties?.

2. **Answer any FOUR**   4x5=20
a) Discuss the types of users in a DBMS and their roles.
b) Define ACID properties in DBMS and give one real-world example of how each property ensures correctness in a transaction.
c) A hospital records patient information, doctor schedules, and prescriptions. The staff faces difficulty managing duplicate records and inconsistent data.

- Describe the types of users who would interact with the DBMS.
- Explain how the DBMS ensures data consistency and reduces redundancy.

d) A library maintains information about books, members, and issued books. Earlier, the library was using manual files, and now it plans to use a DBMS.

- Identify the potential problems of the manual file system.
- Explain how a DBMS can resolve these problems.

e) What is data independence? Explain the difference between the logical data independence and physical data independence.

3. **Answer the following question.**   2x10=20
a) Assume a database with the following tables and write the SQL for the following queries (**any ten**):

STUDENT (StudentID, Name, Age, DeptID)
DEPARTMENT (DeptID, DeptName)
COURSE (CourseID, CourseName, DeptID)
ENROLLMENT (StudentID, CourseID, Grade)

i.   Write a query to display the names of students along with their department names.
ii.   Update the student name to Tushar Das for the StudentID 2021831999.
iii.   List the CourseName of SWE department.
iv.   Find the list of students enrolled in the course "Database Systems."
v.   Write a query to display all students who have scored grade 'A' in any course.
vi.   Find the average age of students in each department.
vii.   Write a query to find students who are not enrolled in any course.
viii.   Display the top 3 highest-paid employees from an EMPLOYEE table using ORDER BY and LIMIT.
ix.   Write a query to increase the salary of all employees in the "Sales" department by 10%.
x.   Retrieve the second highest salary from the EMPLOYEE table without using LIMIT.
xi.   Write a query to find duplicate email addresses in a USERS table. EMPLOYEE
xii.   Display all departments where the average salary is greater than 50,000.
xiii.   Change the department of all students in the "Physics" department to "Applied Physics."
xiv.   Write a query to find departments where the average age of students is above 22.

Group B
[Answer all the questions]

4. Answer any FIVE   5x2=10

a) Explain the difference between static hashing and dynamic hashing.

b) Explain the four necessary conditions for deadlock (Coffman conditions).

c) Why do we need higher normal forms if 1NF already removes redundancy?

d) What is a multivalued attribute? How is it represented in an ER diagram?

e) Define 1NF, 2NF, and 3NF.

f) What is two-phase locking(2PL)?.

g) What is the difference between a committed transaction and an aborted transaction?

5. Answer any FOUR   4x5=20

a) Compare centralized, client-server, and distributed database architectures. Which one is most suitable for large-scale web applications?

b) Construct a B+ tree for the following sequence of keys:
10, 20, 5, 6, 12, 30, 7, 17 (order = 3).

c) Draw a query equation tree for SELECT * FROM Student S JOIN Course C ON S.DeptID=C.DeptID WHERE C.Credit>3.

d) Consider the relation STUDENT (StudentID, Name, CourseID, CourseName, InstructorID, InstructorName).
   - Identify the anomalies.
   - Normalize the relation up to 3NF.

e) A bank database has transactions:

   - T1: Transfer BDT 100 from Account A to Account B
   - T2: Transfer BDT 50 from Account B to Account C

Show how a system crash in between can affect consistency.

6. Answer any TWO   2x10=20

a. Draw an ER diagram considering the following scenario: 10

A food delivery company wants to build a database system to manage its operations. The company serves customers by connecting them with restaurants, managing food orders, and assigning delivery agents.

Each customer is identified by a unique customer ID and has details such as name, email, phone number, and delivery address. A customer can place multiple food orders over time, but each order must belong to exactly one customer.

The company collaborates with several restaurants. Each restaurant is identified by a unique restaurant ID and is described by its name, location, and contact number. A restaurant prepares many different food items, and each food item belongs to one specific restaurant. Every food item has an item ID, name, price, and category (e.g., Pizza, Burger, Dessert).

When a customer places an order, the system records an order ID, the date of the order, and the total amount. An order may contain multiple food items, and each food item may appear in multiple orders. For this reason, there is a many-to-many relationship between orders and food items. Additionally, for each food item in an order, the system must store the quantity ordered.

The company also employs several delivery agents. Each delivery agent is identified by a unique agent ID and has details such as name, phone number, and vehicle number. An agent can deliver many orders, but each order is assigned to exactly one delivery agent.

b. Convert the ER diagram of above question (6.a) into a relational schema.   10

c. i) What is indexing in DBMS? Why is it used?   3
   ii) What is database architecture? Why is it important in DBMS?   3
   iii) Differentiate between primary index, secondary index, and clustering index.   4

Shahjalal University of Science and Technology
Institute of Information and Communication Technology (IICT)
Software Engineering
3rd Year 1st Semester Final Examination' April 25 (Session: 2021-22)
Course: SWE 321 [Software Architecture and Design Pattern]
Time: 3 hrs   Credits: 3   Total Marks: 100

Group A
[Answer all the questions]

1. **Answer any FIVE**   5x2=10

a) Explain the purpose of a Reverse Proxy.
b) Define Primitive Obsession.
c) Define Bloaters.
d) What is the role of the Director in the Builder design pattern?
e) Explain Data Clumps.
f) Write one scenario where message-queue needs to be used.
g) What problem does the Observer design pattern solve?

2. **Answer any FOUR**   4x5=20

a) What do you understand about Divergent Change? Why does it occur, and how can it be prevented?

b) Analyze the advantages and challenges of the Microservices architectural pattern. In what types of software systems would this pattern be most suitable, and why?

c) What are the differences between Open-Closed Principle and the Dependency Inversion Principle?

d) How does the Extract Method refactoring technique work? Explain with an example.

e) Give an example of Parallel Inheritance Hierarchies. How does this code smell typically occur?

3. **Answer any TWO**   2x10=20

a) Consider a scenario where you need to create a Computer object. The object must be constructed with required components, motherboard and processor, but also has optional components such as ramSize, hardDrive, and graphicsCard.

    Which design pattern is suitable for this scenario? Write the pseudo code for this pattern. Show how to create a Computer object using this pattern.

b) A smart thermostat has states: Cooling, Heating, Idle, and Off. Each state changes the thermostat's behavior automatically based on room temperature.

    Which design pattern suits this system and why? Sketch a class structure for managing state transitions.

c) Consider the following Java class:

```java
public class InvoiceManager {
    public void createInvoice(String customerName, String productName,
    int quantity, double pricePerUnit, boolean isPaid) {

        System.out.println("Creating invoice for: " + customerName);
        double totalAmount = quantity * pricePerUnit;

        if(quantity > 10) {
            System.out.println("Apply bulk discount");
            totalAmount = totalAmount * 0.9;
        }

        if(isPaid) {
            System.out.println("Invoice paid. Generate receipt.");
        } else {
            System.out.println("Invoice pending. Send reminder
            email.");
        }

        sendNotification(customerName, totalAmount, isPaid);
    }

    private void sendNotification(String customerName, double amount,
    boolean isPaid) {
    System.out.println("Notifying " + customerName + " about invoice
    amount: " + amount);
    }
}
```

Identify the code smells in this code., Refactor the code to remove the smells while keeping the same functionality.

Group B
[Answer all the questions]

4. **Answer any FIVE**   5x2=10

a) Define Shotgun Surgery.

b) What is the role of the Adapter in the Adapter design pattern?

c) Explain the concept of Feature Envy.

d) Define Speculative Generality.

e) Explain the purpose of a service bus in microservice architecture..

f) Why is regression testing important for large scale systems?

g) What do you understand about the Dispensables code smell?

5. **Answer any FOUR**   4x5=20

a) What do you understand by the term Technical Debt, and why does it occur?

b) Explain the Liskov Substitution Principle and give an example of its application.

c) What is the difference between vertical scaling and horizontal scaling? Explain with examples.

d) Analyze the advantages and limitations of the Pipe and Filter architectural pattern. In what types of software systems would this pattern be most suitable, and why?

e) With a diagram, explain a web application architecture using the MVC pattern.

6. Answer any TWO

a) You need to create multiple Document objects. Most share the same structure and default content, and creating each from scratch is time-consuming. You want to quickly clone existing documents and modify copies independently.

Which design pattern fits this scenario? Write the pseudo code. Show how to create a Document object using this pattern.

b) A payment system is implemented as follows:

```
class PaymentProcessor {
    public void processPayment(String type, double amount) {
        if(type.equals("CreditCard")) {
            System.out.println("Processing credit card payment of
$" + amount);
        } else if(type.equals("PayPal")) {
            System.out.println("Processing PayPal payment of $" +
amount);
        } else if(type.equals("Bitcoin")) {
            System.out.println("Processing Bitcoin payment of $" +
amount);
        }
    }
}

public class Main {
    public static void main(String[] args) {
        PaymentProcessor processor = new PaymentProcessor();
        processor.processPayment("CreditCard", 100.0);
        processor.processPayment("PayPal", 50.0);
        processor.processPayment("Bitcoin", 0.005);
    }
}
```

Currently, whenever a new payment method is added, the processPayment method must be modified, which can lead to errors and tightly coupled code.

Identify which design principle is violated in this design., Explain why it is violated. Suggest a design approach to fix this violation.

c) A company has a document management system where users can access large confidential PDF files stored on a remote server. Every time a user requests a document, the system downloads the full file, which is slow and consumes a lot of bandwidth. Additionally, access to some documents should be restricted based on user roles.

Which design pattern can solve this problem and why? Explain the approach you would use to implement this pattern in the system.

Shahjalal University of Science and Technology
Institute of Information and Communication Technology
BSc(Engg.) in Software Engineering
3rd year 1st Semester Final Examination— 2024
Course—**Computer Networking (CSE 313W)**

Time—**3 Hours**   Credits— **03**   Total Marks#**100**

Group A
(Answer All the Questions)

1. Answer the following questions (Any Five). $5 \times 2 = 10$

    (a) A computer's IP is 10.20.30.10/15. What are the network's broadcast addresses (limited and directed)?

    (b) Write the IP 10.4.8.8/19 in subnet mask format.

    (c) What is the purpose of loopback addresses?

    (d) Represent the following IPv6 address in shortened form:

    i. 2001:0db8:85a3:0000:0000:8a2e:0370:7334

    ii. 2607:0000:0000:0805:0000:0000:0000:200e

    (e) Explain the concept of a loopback address.

    (f) How do TCP and UDP perform demultiplexing?

    (g) Why is TCP half-close connection termination useful?

    (h) Do we need to manually setup IP all the time?

2. Answer the following questions (Any Four). $4 \times 5 = 20$

    (a) If a IP packet is lost in network and fails to deliver successfully, will it be in the internet infinitely?

    (b) Which protocol is used for troubleshooting in network layers? Name two applications built on that protocol and their working procedures.

    (c) In a scenario where a sender sends packets much faster than the receiver can process them, briefly explain how flow control mechanisms can prevent data loss or buffer overflow.

    (d) Sam visited a new webpage for the first time. After some time, he visited the same webpage again and observed that the second visit required significantly less time to load. Upon investigation, he found many *304 Not Modified* HTTP responses, which reduced the loading time. Explain the process that led to this behavior, using proper explanation and figures.

    (e) In a selective-repeat TCP connection, the client and server have the values and flow as stated in Figure 1.

    i. Calculate the sequence and acknowledgment number of the server's Data Segment 3 sent to the client.

    ii. What are the sequence and acknowledgment number of the acknowledgment segment that the client will send (not shown) after it receives the 5th Data segment?

    (f) You visited the e-commerce website www.ecom.com for the first time and browsed several products. After a few days, you returned to the same website and noticed that it recommended products based on your previous browsing history, even though you did not log in. Explain how this is possible, briefly.

3. Answer the following questions (Any Two). $2 \times 10 = 20$

    (a) Summarize every layers of OSI protocol stack by specifying their respective task, correspondence with TCP/IP protocol stack, addresses.

    (b) You want to set up DNS for your website and mail server correctly. The mail server should use the same domain as the web server (e.g., www.somedomainname.com.bd).   5+5

    i. Explain how you would configure the DNS records to achieve this.

    ii. Illustrate and explain how an iterative DNS query is carried out from the client's side when a user attempts to access your web server after your DNS has been configured

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Institute of Information and Communication Technology
BSc(Engg.) in Software Engineering
3rd year 1st Semester Final Examination— 2024
Course—Computer Networking (CSE 313W)

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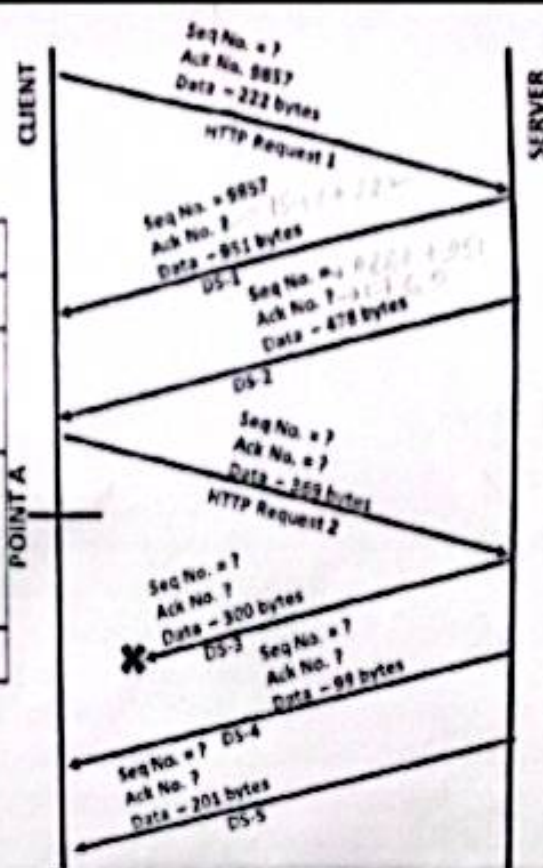|	Client	Server
ISN	1546	9856
Segment Sizes / DS – Data Segment	HTTP Request 1 (Also the third segment of the 3 way handshake) 222 bytes	DS 1: 951 bytes DS 2: 478 bytes
	HTTP Request 2: 369 bytes	DS 3: 300 bytes DS 4: 99 bytes DS 5: 201 bytes
RWND	1684	6599

Figure 1: TCP communication

(c) Suppose the IP of a device in LAN is 10.150.51.110/10.

i. Calculate subnet mask, network address and broadcast address of the network.

ii. For the network address calculated, efficiently calculate the sub-network addresses of all the networks in the topology of Figure 2. Show necessary calculations. **Note:** The host counts provided in the topology exclude the network and broadcast addresses.

820 Hosts

8 Hosts

255 Hosts
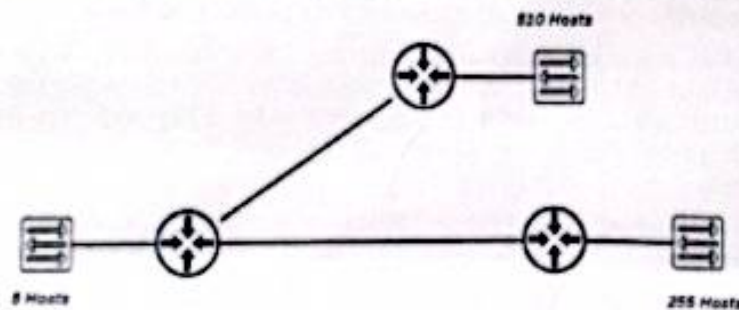
Figure 2: Subnetting

Group B
(Answer All the Questions)

4. Answer the following questions (Any Five). $5 \times 2 = 10$

(a) State the protocols used in each step of mail transfer and reception.

(b) What is Round Trip Time?

(c) What information is stored in an ARP table and in a switch table?

(d) Why was IPv6 introduced even though IPv4 already exists?

(e) Why are switches called self-learning? Explain briefly.

(f) Why are switches referred to as transparent?

(g) How multiple devices on LAN (with private IPs) can communicate with public internet with one public IP simultaneously?

(h) What are the drawbacks of Fixed-Length Subnet Masking (FLSM)?

5. Answer the following questions (Any Four). $4 \times 5 = 20$

(a) List the differences between static routing and dynamic routing.

(b) Explain how **traceroute** program works. And how it helps the source device to calculate the round-trip delays to the destination device.

(c) Why is ARP (Address Resolution Protocol) needed? Explain with examples.

(d) Subnet the network 100.10.10.0/24 using Fixed-Length Subnet Masking (FLSM) for the LANs shown in Figure 3. Note: The host counts provided in the topology include the network and broadcast addresses.
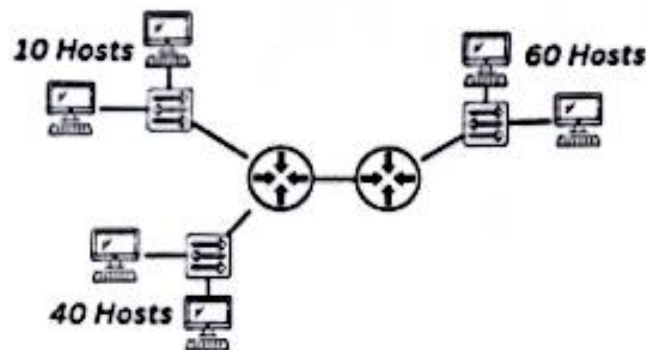
Figure 3: FLSM topology.

(e) List all the functions/services provided by the data link layer.

(f) Due to which features can IPv4 and IPv6 coexist in a network?

6. Answer the following questions (Any Two). $2 \times 10 = 20$

(a) Explain all the steps of the link state routing protocol with an example. How is flooding different from broadcast? $8+2$

(b) Suppose you have three servers in your local network providing web, mail, and API services, but your network has only one public IP address. How can you make all three services accessible from the public internet? 10

(c) Why do routers perform fragmentation, and how do they determine if it is allowed? A router encounters an IP packet with 4000 bytes of data, the DF (Don't Fragment) bit is 0, and ID = 100. If the MTU of the router is 900 bytes, determine the ID, MF (More Fragments) flag, offset, and length of each fragment. Assume header size is 20 bytes. $3+7$

Institute of Information and ... cation Technology (IICT)
Software Engineering
3rd year 1st Semester Final Examination 2024 (Session: 2021-22)
Course Code: SWE 06193123   Credits: 3
Course Title: Artificial Intelligence
Time: 3 hrs   Total Marks: 60

Group A

1. **Answer any FIVE**   5x2=10

a) What is Artificial Intelligence (AI)? State four main goals of AI.

b) What is Turing Test?

c) What is Adversarial search? write the characteristics.

d) Explain Admissible Heuristics.

e) What breakthrough did the Transformer architecture introduce in 2017, and why is it fundamental to large language models?

f) What is the difference between g(n) and h(n) in A*?

2. **Answer any TWO**   2x5=10

a) A smart home system adjusts temperature, lighting, and appliance usage to balance comfort and electricity cost.
i) Which type of intelligent agent architecture is most suitable for this scenario? (2 marks)
ii) Briefly design the architecture by specifying the role of the **Performance measure, Environment, Actuators, Sensors**, and the **Utility function**. (3 marks)

b) Write down the percept sequence for the vacuum cleaner.
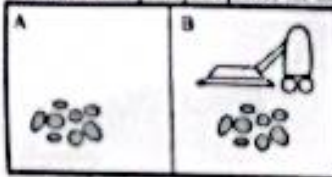
c) Consider the weighted graph below with nodes and edge costs (all positive).
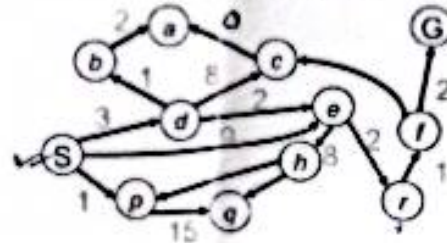
Apply the ... Cost Search (UCS) alg... find ... cost path from start node S to goal node G. Show the order in which nodes are expanded and the frontier at each step.

3. **Answer any ONE**   1x10=10

a)
i. Using Min-max approach, fill up the blank nodes in the given game tree with appropriate values.

ii. Prune the tree using alpha-beta cut-offs.

iii. Is Min-max BFS or DFS? Why?

OR
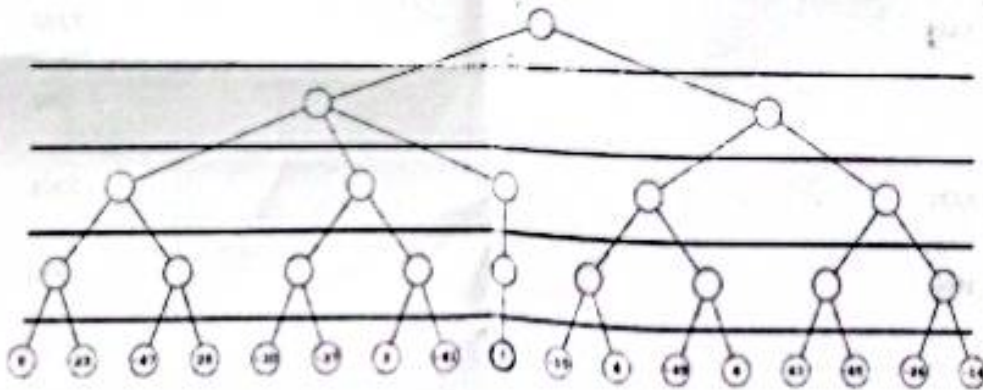
a) What is a heuristic? Design and heuristic function and solve the given 8-puzzle.

1	2	3
8	5	6
4	7	

Initial State

1	2	3
4	5	6
7	8	

Goal State

Group B

**4.** **Answer any FIVE**   5x2=10

a) What is a Constraint Satisfaction Problem (CSP)? How can the Class Scheduling problem be formulated as a CSP?

b) What is heuristics function? what are three approaches to defining f?

c) How Hill Climbing Search works?

d) What is iterative deepening search in game playing?

e) Why are context windows important in LLMs, and how do they differ across models?

f) Name two games where Minimax can be applied.

5. Answer any TWO 2x5=10

a) Suppose there is a population of army personnel of two regions A : B = 1 : 20. Twelve percent of the people from region A and thirty percent of the people from region B get a chance in the UN peace program every year. Now, if we choose a person who got a chance in the UN peace program, what are the chances that he is from region A?

b) Consider the following graph.
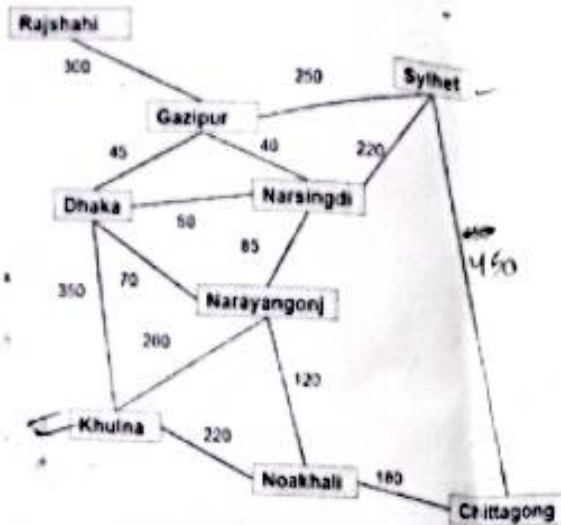
Heuristic h(n)

h (Sylhet) = 530
h (Rajshahi) = 520
h (Gazipur) = 360
h (Dhaka) = 350
h (Narsingdi) = 320
h (Narayangonj) = 260
h (Chittagong) = 2 455
h (Khulna) = 0
h (Noakhali) = 220

Find the most cost-effective path to reach from start state Sylhet to final state Khulna using A* algorithm.

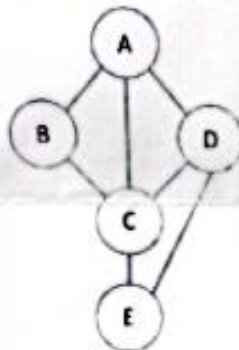c) Construct a 3-ply game tree for tic-tac-toe. Apply the Minimax algorithm and determine the optimal move for X.

6. Answer any ONE 1x10=10

a) Color (RGB) the given graph using "Minimum remaining value heuristics" and "least constraining value heuristics". Show the steps. **5**
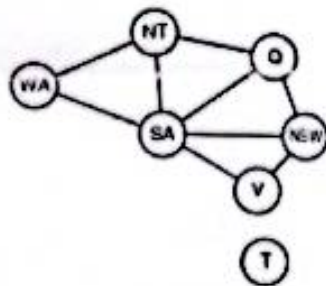

Constraints:
A≠B, A≠C, A≠D,
B≠C,
C≠D, C≠E,
D≠E

b) Color the following map with forward checking algorithm. Show the steps.

Do you think there is any other algorithm faster than forward checking? If yes, show how the algorithm works?

OR

Suppose a genetic algorithm uses chromosomes of the form X = abcdefgh with a fixed length of eight genes. Each gene can be any digit (0-9). The fitness of an individual x is calculated as $f(x) = (a - b) + (c - d) + (e - f) + (g - h)$. The initial population consists of four individuals with the following chromosomes:

X₁ = 65413532
X₂ = 23921285
X₃ = 41852094
X₄ = 87126601

Perform the following crossover operations:
i. Cross the fittest two individuals using one-point crossover at the middle point.
ii. Cross the 2ⁿᵈ and 3ʳᵈ fittest individuals using a two-point crossover (after genes b and f, i.e. abcdefgh).
iii. Has the fitness improved in new generation?
iv. Find the maximum possible fitness score for the given model.