2. Consider the following statements related to distributed databases and client-server architectures:
Statement I: In a distributed database, data is stored in multiple locations, and the system appears as a single database to the user, enhancing data availability and reliability.
Statement II: Client-server architectures inherently support distributed databases by separating database functionality between client machines and servers, thus optimizing performance and resource allocation.
(1) Both Statement I and Statement II are correct
(2) Both Statement I and Statement II are incorrect
(3) Statement I is correct but Statement II is incorrect
(4) Statement I is incorrect but Statement II is correct
Answer Key: 4
Solution:
? Statement I(Incorrect): While it's true that distributed databases store data in multiple locations and aim to appear as a single system, this does not inherently enhance data availability and reliability without additional mechanisms like replication and failover strategies.
? Statement II(Correct): Client-server architectures do not inherently support distributed databases. They separate the processing between clients and servers, which can lead to performance benefits, but this separation alone does not equate to the support for distributed database functionalities.
Hence, Option (4) is the right answer.

3. Analyze the following statements about database systems:
Statement I: Data independence refers to the capacity to change the schema at one level of a database system without having to alter the schema at the next higher level.
Statement II: The three-schema architecture involves only two levels of abstraction to separate user views and the physical storage.
(1) Both Statement I and Statement II are correct
(2) Both Statement I and Statement II are incorrect
(3) Statement I is correct but Statement II is incorrect
(4) Statement I is incorrect but Statement II is correct
Answer Key: 2
Solution:
? Statement I (Correct): Data independence is a key feature of database architecture, allowing changes in the schema at one level (physical or logical) without affecting other levels, thereby providing flexibility and ease of maintenance.
? Statement II (Incorrect): The three-schema architecture actually includes three levels of abstraction: the internal level (physical storage), the conceptual level (logical structure), and the external level (user views). This structure helps achieve data independence and provides a clear separation between how data is stored and how it is perceived by users.
Hence, Option (2) is the right answer.

2. Consider the following statements regarding software requirements:
Statement I: Functional requirements define the fundamental actions that must occur in the system in order for it to behave correctly.
Statement II: Non-functional requirements are not crucial for the system operation but define system attributes such as performance, usability, and reliability.
(1) Both Statement I and Statement II are correct
(2) Both Statement I and Statement II are incorrect
(3) Statement I is correct but Statement II is incorrect
(4) Statement I is incorrect but Statement II is correct
Answer Key: 2
Solution:
? Statement I (Correct): Functional requirements indeed specify what the system should do and include detailed behaviors or functions.
? Statement II (Incorrect): Non-functional requirements are crucial and often impact the system's operation

significantly. They define how the system performs certain operations, not just peripheral attributes. They are essential for ensuring the system meets its intended quality standards and user expectations.
Hence, Option (2) is the right answer.

Match the following 2-D geometrical transformations with their matrix operations:
1. Transformations Matrix Operations
I. Translation A. Multiplication by a matrix with cos and sin terms corresponding to the angle of rotation
II. Scaling B. Addition of a constant vector to coordinates
III. Rotation C. Multiplication by a diagonal matrix with scaling factors
IV. Reflection D. Multiplication by a matrix with values ±1 on the diagonal
Choose the correct answer from the options given below:
(1) I-B, II-C, III-A, IV-D
(2) I-C, II-A, III-D, IV-B
(3) I-A, II-D, III-B, IV-C
(4) I-D, II-B, III-C, IV-A
Answer Key: 1
Solution:
? Translation: This involves adding a constant vector to the coordinates of each point in the object, effectively moving it in space.
? Scaling: Involves multiplying coordinates by a diagonal matrix where each diagonal element represents the scaling factor for that dimension.
? Rotation: This transformation is accomplished by multiplying the coordinates by a rotation matrix, which includes cosine and sine of the rotation angle.
? Reflection: This can be represented by a matrix with diagonal entries of ±1, reflecting the object across specific axes depending on the sign and placement of these entries.
Hence, Option (1) is the right answer.

1. Consider the following two statements about the simplex method and integer programming in optimization:
Statement I: In the simplex method, if the solution space is unbounded, there exists at least one feasible solution that will maximize or minimize the objective function without bound.
Statement II: Integer programming problems can be solved using the simplex method by introducing additional constraints to ensure all variables take integer values.
(1) Both Statement I and Statement II are correct
(2) Both Statement I and Statement II are incorrect
(3) Statement I is correct but Statement II is incorrect
(4) Statement I is incorrect but Statement II is correct
Answer Key: 4
Solution:
? Statement I(Incorrect): While the simplex method can indicate an unbounded solution space, this does not guarantee the existence of a feasible solution that optimizes the objective function without bound, especially if no feasible solutions satisfy all constraints.
? Statement II(Correct): Integer programming generally requires specific algorithms like Branch and Bound or cutting planes because the simplex method alone cannot enforce integer constraints merely by adding additional constraints; the simplex method deals with continuous variables.
Hence, Option (4) is the right answer.

Match the following concepts in complexity theory with their appropriate explanations:
1. Concept Explanation
I. P Class Problems A. Problems where solutions can be verified quicker than they can be solved
II. NP Class Problems B. Problems solvable in polynomial time given a deterministic machine
III. NP-Completeness C. Subset of problems in NP that are as hard as any problem in NP
IV. Reducibility D. The ability to reduce one problem to another, demonstrating equivalency in computational difficulty

Choose the correct answer from the options given below:
(1) I-B, II-A, III-C, IV-D
(2) I-C, II-D, III-A, IV-B
(3) I-B, II-C, III-A, IV-D
(4) I-A, II-C, III-B, IV-D
Answer Key: 3
Solution:
? P Class Problems: Known for being solvable within a polynomial time frame on a deterministic machine.
? NP Class Problems: Characterized by the property that their solutions can be verified in polynomial time, even if finding the solution might be more complex.
? NP-Completeness: Represents a critical concept in computational theory where a problem in NP is also as hard as the hardest problems in NP.
? Reducibility: Important for proving NP-completeness, it involves showing that one problem can be transformed into another, preserving the computational challenge.
Hence, Option (3) is the right answer.

Match the following types of virtual machines with their primary function or characteristic:
1. Virtual Machine Types Function/Characteristic
I. System VM A. Offers a separate operating environment within the same physical hardware
II. Process VM B. Provides system-level virtualization, including hardware and network resources
III. Hardware VM C. Designed for running specific programs and can support multiple execution environments
IV. Application VM D. Simulates entire hardware systems, useful for hosting multiple OS environments
Choose the correct answer from the options given below:
(1) I-B, II-A, III-D, IV-C
(2) I-D, II-C, III-A, IV-B
(3) I-C, II-B, III-D, IV-A
(4) I-A, II-D, III-B, IV-C
Answer Key: 2
Solution:
? System VM: Provides a complete system-level environment that simulates the underlying hardware, often used for running multiple operating systems.
? Process VM: Each process VM can offer a separate execution environment for computer programs, allowing a single host to run multiple guest processes simultaneously.
? Hardware VM: This type of virtual machine emulates complete hardware systems, such as computers, which can be very useful in complex computing environments and data centers.
? Application VM: Primarily focused on running specific applications, ensuring that the application can operate across different operating systems.
Hence, Option (2) is the right answer.

2. Consider these statements about 3-D object representation and transformations:
I. A Bezier curve is defined by its control points, and any change in a control point alters the entire shape of the curve.
II. The Viewing Pipeline includes transformation from world coordinates to normalized device coordinates.
III. Quadric surfaces can only represent shapes like spheres and cylinders but not free-form surfaces.
Which of the following is correct?
(1) I and II only
(2) I and III only
(3) II and III only
(4) All of the above
Answer Key: 2
Solution:
? Statement I(Correct): Bezier curves are indeed defined by control points, and adjustments to these points

affect the whole curve, illustrating a global control characteristic.
? Statement III(Correct): Quadric surfaces are limited to representing simple geometric forms such as spheres, cylinders, cones, and paraboloids, and do not support more complex or free-form surfaces.
? Statement II(Incorrect): The Viewing Pipeline indeed involves transformations, but it transforms coordinates from world coordinates to view coordinates, then to projection coordinates, and finally to normalized device coordinates, not directly as stated.
Hence, Option (2) is the right answer.

1. Consider the following two statements related to the analysis and performance of algorithms:
Statement I: The worst-case time complexity of QuickSort is O(n^2), but with proper pivot choice, it can be optimized to O(n log n) on average.
Statement II: The recurrence relation T(n) = 2T(n/2) + n represents the time complexity of the MergeSort algorithm, which consistently performs at O(n log n) in the worst case.
In light of the above statements, choose the correct answer from the options given below:
(1) Both Statement I and Statement II are correct
(2) Both Statement I and Statement II are incorrect
(3) Statement I is correct but Statement II is incorrect
(4) Statement I is incorrect but Statement II is correct
Answer Key: 3
Solution:
? Statement I (Correct): QuickSort's worst-case time complexity is indeed O(n^2), typically occurring when the smallest or largest element is always chosen as the pivot. However, with a randomized pivot, the average time complexity becomes O(n log n).
? Statement II (Incorrect): The given recurrence relation T(n) = 2T(n/2) + n indeed describes a divide and conquer algorithm like MergeSort, but the description of its worst-case performance as O(n log n) applies universally to MergeSort due to its structure and not specifically to this recurrence without further context.
Hence, Option (3) is the right answer.

3. Evaluate the following statements regarding microprogrammed control units:
I. Microprogramming involves a sequence of microinstructions stored in control memory to generate control signals.
II. Control memory can be implemented using ROM, which stores fixed microprograms or RAM for dynamic alteration.
III. Address sequencing complicates the control unit design but allows for more flexibility and sophisticated control logic.
Which of the following is correct?
(1) I and II only
(2) I and III only
(3) II and III only
(4) All of the above
Answer Key: 4
Solution:
? Statement I(Correct): Microprogramming is indeed the process where microinstructions are stored in control memory to direct the control unit in generating the necessary control signals for operation.
? Statement II(Correct): Control memory can be implemented using either ROM, for unchangeable microprograms, or RAM, which allows for modifications and updates in microprograms.
? Statement III(Correct): Address sequencing indeed introduces complexity in the design of control units but is necessary for implementing conditional and iterative control structures, thereby providing enhanced flexibility and control.
Hence, Option (4) is the right answer.

Match the following Internet technologies with their primary function:
1. Technology Function

I. DNS A. Transfers files between systems
II. SMTP B. Resolves domain names to IP addresses
III. FTP C. Manages email communications
IV. IMAP D. Enables email retrieval from a server
Choose the correct answer from the options given below:
(1) I-B, II-D, III-A, IV-C
(2) I-C, II-A, III-B, IV-D
(3) I-B, II-C, III-A, IV-D
(4) I-A, II-B, III-C, IV-D
Answer Key: 1
Solution:
? DNS: The Domain Name Service is essential for translating human-readable domain names into machine-readable IP addresses.
? SMTP: Simple Mail Transfer Protocol is used primarily for sending email between servers.
? FTP: File Transfer Protocol is utilized for the transferring of files across networks.
? IMAP: Internet Message Access Protocol allows users to retrieve and manage their email from a server.
Hence, Option (1) is the right answer.

2. Consider the following three statements related to Assembly Language and Machine Language:
I. Assembly language uses mnemonic codes while machine language consists of binary codes.
II. An assembler converts high-level programming into machine code.
III. Subroutines in assembly language improve modularity and code reuse but do not assist in reducing program execution time.
Which of the following is correct?
(1) I and II only
(2) I and III only
(3) II and III only
(4) All of the above
Answer Key: 4
Solution:
? Statement I (Correct): Assembly language simplifies the coding process by using mnemonic codes (e.g., ADD, SUB) which are easier for humans to remember, unlike machine language that uses binary codes directly understandable by the machine.
? Statement II (Incorrect): An assembler specifically converts assembly language into machine code, not high-level programming languages, which are instead handled by compilers or interpreters.
? Statement III (Correct): While subroutines in assembly language indeed improve modularity and code reuse, they also can optimize and reduce program execution time by avoiding code duplication and allowing repeated use of code blocks efficiently.
Hence, Option (4) is the right answer.

Match the following learning types with their associated neural network models:
1. Learning Type Model
I. Supervised Learning A. Hopfield Network
II. Unsupervised Learning B. Single Perceptron
III. Reinforcement Learning C. Multi Layer Perceptron
IV. Competitive Learning D. Self Organizing Maps
Choose the correct answer from the options given below:
(1) I-C, II-D, III-B, IV-A
(2) I-C, II-A, III-D, IV-B
(3) I-B, II-C, III-A, IV-D
(4) I-A, II-B, III-C, IV-D
Answer Key: 2
Solution:

? Supervised Learning: Typically uses Multi Layer Perceptrons where the network is trained using a known set of inputs and outputs.
? Unsupervised Learning: Self Organizing Maps are a prime example where the network learns to classify input without external outputs.
? Reinforcement Learning: Typically associated with models like Q-learning that adjust actions based on rewards, not directly applicable to the given options but closest is Multi Layer Perceptron by elimination.
? Competitive Learning: Involves networks like Hopfield Networks where nodes compete to become active, forming part of memory and pattern recognition systems.
Hence, Option (2) is the right answer.

Match the following graph concepts with their correct definitions:
1. Graph Concepts Definition
I. Eulerian Paths A. A path that visits every vertex exactly once
II. Bipartite Graphs B. A graph that can be colored with two colors such that no two adjacent vertices have the same color
III. Spanning Trees C. A cycle that uses every edge of a graph exactly once
IV. Hamiltonian Circuits D. A tree that includes all the vertices of the graph
Choose the correct answer from the options given below:
(1) I-C, II-B, III-D, IV-A
(2) I-D, II-A, III-B, IV-C
(3) I-A, II-C, III-D, IV-B
(4) I-B, II-D, III-A, IV-C
Answer Key: 1
Solution:
? Eulerian Paths: It refers to a cycle that utilizes every edge of a graph exactly once, indicating that it must return to the starting vertex.
? Bipartite Graphs: These can be colored using two different colors for adjacent vertices, ensuring no two connected vertices share the same color.
? Spanning Trees: It is a subset of Graphs, which includes all the vertices and is a tree, meaning it has no cycles and connects all the vertices with the minimum number of edges.
? Hamiltonian Circuits: These are a type of circuit that visits every vertex of the graph exactly once and returns to the origin point.
Hence, Option (1) is the right answer.

1. Consider the following statements regarding the Relational Database Model:
I. Update anomalies can occur when multiple copies of the same data are not updated simultaneously.
II. Relational Calculus is a procedural query language.
III. Codd's 12th rule states that the database must support online backup and recovery.
Which of the following is correct?
(1) I and II only
(2) I and III only
(3) II and III only
(4) All of the above
Answer Key: 1
Solution:
? Statement I (Correct): Update anomalies are a common issue in database systems where the same data exists in multiple places; if all copies are not updated simultaneously, inconsistencies occur.
? Statement II (Incorrect): Relational Calculus is actually a non-procedural query language, allowing users to specify what data to retrieve without having to specify how to retrieve it.
? Statement III (Incorrect): Codd's 12th rule actually refers to the requirement for non-subversion, which means that if a system provides a low-level (record-at-a-time) interface, then that interface cannot be used to subvert the system, e.g., bypassing security rules and constraints.
Hence, Option (1) is the right answer.

1. Analyze the following statements regarding the OSI Reference Model and TCP/IP protocol suite:
I. OSI model?s transport layer ensures end-to-end communication between hosts and provides error recovery.
II. In the TCP/IP suite, the Internet Protocol (IP) is responsible for logical addressing, which ensures data packets are routed across multiple networks.
III. The Data Link layer in the OSI model is equivalent in function and operation to the Network Interface layer in the TCP/IP suite.
Which of the following is correct?
(1) I and II only
(2) I and III only
(3) II and III only
(4) All of the above
Answer Key: 2
Solution:
? Statement I(Correct): The transport layer in the OSI model indeed provides end-to-end communication and is responsible for error recovery and flow control.
? Statement III(Correct): The Data Link layer of the OSI model aligns closely with the Network Interface layer of the TCP/IP suite, both handling framing, physical addressing, and can control access to the media.
? Statement II(Incorrect): While IP handles logical addressing, it does not ensure data packets are routed across networks on its own; this task involves multiple protocols within the Internet layer of the TCP/IP suite, including IP but also others like ICMP and ARP for full routing functionality.
Hence, Option (2) is the right answer.

3. Consider the following statements about network layer delivery and routing protocols:
Statement I: Direct network layer delivery occurs when the source and destination hosts are on the same network, requiring no intermediate router.
Statement II: Routing algorithms like OSPF and BGP utilize the shortest path first technique to determine the most efficient route, regardless of the network topology and administrative preferences.
(1) Both Statement I and Statement II are correct
(2) Both Statement I and Statement II are incorrect
(3) Statement I is correct but Statement II is incorrect
(4) Statement I is incorrect but Statement II is correct
Answer Key: 2
Solution:
? Statement I(Correct): Direct delivery is indeed used when the source and destination are on the same network, which means packets are sent directly without routing through an intermediate.
? Statement II(Incorrect): OSPF uses a shortest path first approach based on Dijkstra's algorithm, tailored for intradomain routing in IP networks. BGP, however, uses a path vector protocol that considers policy-based routing decisions, not just the shortest path, particularly important for interdomain routing.
Hence, Option (2) is the right answer.

3. Evaluate the following statements concerning Digital Logic Circuits:
I. A multiplexer can route multiple input lines into a single line.
II. Boolean algebra is used to simplify the expressions of logic circuits, not to design them.
III. Memory units in digital circuits are typically built using sequential circuits.
Which of the following is correct?
(1) I and II only
(2) I and III only
(3) II and III only
(4) All of the above
Answer Key: 4
Solution:

? Statement I (Correct): Multiplexers are designed to take several input signals and by using select lines, route one of them to a single output line. This is essential in reducing the number of data paths needed in circuit design.
? Statement II (Incorrect): Boolean algebra is both used to simplify the expressions and design of logic circuits. It provides a formal way to express and manipulate logical statements and configurations, which is fundamental in the design process.
? Statement III (Correct): Memory units are typically built using sequential circuits because these circuits use past input states to determine future outputs. This property is essential for creating storage mechanisms in digital circuits.
Hence, Option (4) is the right answer.