27. An AI research team is developing a robot that can adapt its strategies based on environmental changes and previous outcomes using a genetic algorithm. The researchers are debating over the best way to represent the robot's strategy choices in the genetic algorithm. Which of the following encoding strategies is most likely to hinder the genetic algorithm's ability to effectively explore a diverse range of solutions?  
(1) Binary encoding, which simplifies crossover and mutation operations.  
(2) Permutation encoding, suitable for ordering and sequencing problems.  
(3) Direct encoding of strategy parameters as floating-point numbers.  
(4) Hierarchical encoding that rigidly defines parent-child relationships in strategy components.  
Answer Key: 4  
Solution:  
• (Correct): Binary encoding is versatile and makes genetic operations straightforward, often enhancing the GA's exploration capabilities.  
• (Correct): Permutation encoding is particularly effective in problems where the order matters, such as routing or scheduling, allowing the GA to explore permutations efficiently.  
• (Correct): Direct encoding allows for a direct manipulation of parameters, providing a fine-grained control over the solution space, beneficial for continuous optimization.  
• (Incorrect): Hierarchical encoding can impose constraints on how components interact and evolve, potentially limiting the genetic algorithm’s ability to generate diverse and innovative solutions across generations.  
Hence, Option (4) is the right answer.  
  
36. In a distributed database system, a deadlock situation occurred involving four transactions across different nodes. Each transaction was awaiting a resource held by another, forming a circular wait. The system architect plans to implement a solution that involves preemption of resources, transaction rollbacks, and a priority-based resource allocation mechanism.   
Which of the following methods would be least effective in addressing the deadlock situation described?  
(1) Using a timeout mechanism to detect deadlocks and roll back transactions based on priorities.  
(2) Implementing a deadlock avoidance algorithm, such as Banker's Algorithm, which preempts and reallocates resources dynamically.  
(3) Enabling a deadlock detection system that periodically checks for cycles in the resource allocation graph and resolves them by transaction rollback.  
(4) Applying a strict two-phase locking (2PL) protocol which might intensify the deadlock situation by increasing the number of lock conversions.  
Answer Key: 2  
Solution:  
• (Correct): A timeout mechanism is a simple yet effective way to break deadlocks by determining which transactions to rollback based on their priorities and how long they have been waiting.  
• (Incorrect): While the Banker's Algorithm is effective in preventing deadlocks by ensuring that resource allocation never enters an unsafe state, it might not be suitable in a distributed environment where resource states can change dynamically and unpredictably.  
• (Correct): Deadlock detection systems that identify cycles in the resource allocation graph can effectively resolve deadlocks by selectively rolling back transactions involved in the deadlock.  
• (Correct): Two-phase locking can cause more deadlocks as it requires transactions to hold on to all locks acquired in the first phase until all operations are completed, thereby increasing the risk of circular waits.  
Hence, Option (2) is the right answer.  
  
4. Given below are two statements, one is labelled as Assertion (A) and the other is labelled as Reason (R).  
Assertion (A): The problem of determining if there exists a subset of numbers that sums up to a given number is NP-complete.  
 Reason (R): NP-complete problems are those for which no polynomial-time algorithm is known and for which a solution can be verified quickly.  
 Answer Key: 1  
 Solution:  
 • (Assertion is Correct): The subset sum problem is a classic example of an NP-complete problem, meaning it is hard to solve but easy to verify a solution.  
 • (Reason is Correct): The definition of NP-complete aligns with the characteristics described in the reason, including the verification of solutions in polynomial time.  
 Hence, Option (1) is correct.  
  
1. Given below are two statements, one is labelled as Assertion (A) and the other is labelled as Reason (R).  
Assertion (A): The worst-case time complexity of an optimized merge sort algorithm is O(n log n).  
Reason (R): Merge sort is a divide-and-conquer algorithm that divides the input array into two halves, sorts them separately, and then merges them in a linear traversal, which ensures minimum time complexity for sorting operations.  
In light of the above statements, choose the most appropriate answer from the options below:  
(1) Both Assertion and Reason are correct, and Reason is the correct explanation of Assertion.  
(2) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.  
(3) Assertion is correct, but Reason is incorrect.  
(4) Assertion is incorrect, but Reason is correct.  
Answer Key: 3  
Solution:  
• (Assertion is Correct): The worst-case time complexity for merge sort, even when optimized, remains O(n log n) due to the nature of its divide-and-conquer approach.  
• (Reason is Incorrect): Although the description of merge sort is correct, the claim that this ensures minimum time complexity for sorting operations is not accurate, as "minimum" implies it is the best possible among all sorting algorithms, which isn't necessarily true.  
Hence, Option (3) is the right answer.  
  
37. A network administrator is configuring a corporate network that includes various devices and services across multiple subnets. The configuration involves assigning IP addresses, setting up DNS for name resolution, and implementing VLANs for departmental segmentation. The administrator must also ensure communication across different network layers and between heterogeneous network protocols.  
Which aspect of the network setup does not directly contribute to inter-layer communication and protocol interoperability?  
(1) Assigning IP addresses to ensure proper logical addressing within the network.  
(2) Utilizing the OSI model to guide the setup and integration of network protocols.  
(3) Implementing VLANs to segment the network according to departmental needs.  
(4) Configuring routers to perform network address translation between subnets.  
Answer Key: 2  
Solution:  
• (Correct): IP addresses are crucial for logical addressing and routing across the network, facilitating layer 3 (Network Layer) activities.  
• (Incorrect): While the OSI model provides a theoretical framework for understanding and implementing layered network architectures, it does not directly involve the configuration tasks needed for protocol interoperability or actual data flow.  
• (Correct): VLANs are primarily used for segmenting a physical network into multiple logical networks at layer 2 (Data Link Layer), which affects intra-layer communication but not inter-layer communication.  
• (Correct): Routers, especially when configured for network address translation, play a critical role in managing traffic between different subnets and facilitating layer 3 communications.  
Hence, Option (2) is the right answer.  
  
3. Given below are two statements, one is labelled as Assertion (A) and the other is labelled as Reason (R).  
In a computer architecture course, students are tasked with developing an assembler that translates assembly language programs into machine code. The project includes handling symbolic labels, translating mnemonics to opcodes, and managing storage directives. The students also need to implement error detection for syntax and semantic errors in the assembly programs.  
Which of the following tasks is least associated with the core functions of an assembler?  
(1) Translating assembly language mnemonics into corresponding machine code opcodes.  
(2) Resolving addresses for symbolic labels used in the assembly program.  
(3) Generating a detailed listing file that includes the original assembly code and corresponding machine code.  
(4) Creating a user interface for the assembler program to facilitate code editing and debugging.  
\*\*Answer Key: 4\*\*  
\*\*Solution:\*\*  
• (Correct): Translating mnemonics to opcodes is a fundamental task of an assembler, directly involved in the conversion from assembly to machine language.  
• (Correct): Resolving symbolic labels to their respective addresses is crucial for correct code generation and is a primary function of an assembler.  
• (Correct): Generating a listing file is helpful for debugging and verifying the assembly to machine code translation, thus integral to the assembler’s functionality.  
• (Correct): While a user interface enhances the usability of the assembler, it is not directly related to the core computational functions of translating assembly code or handling storage directives.  
Hence, Option (4) is the right answer.

2. Given below are two statements, one is labelled as Assertion (A) and the other is labelled as Reason (R).  
Assertion (A): In a distributed system, achieving consensus among multiple nodes often requires complex algorithms.  
Reason (R): Consensus in distributed systems is necessary to ensure that all nodes agree on a single data value, which is critical for maintaining the integrity of operations across the system.  
In light of the above statements, choose the most appropriate answer from the options below:  
(1) Both Assertion and Reason are correct, and Reason is the correct explanation of Assertion.  
(2) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.  
(3) Assertion is correct, but Reason is incorrect.  
(4) Assertion is incorrect, but Reason is correct.  
Answer Key: 2  
Solution:  
• (Assertion is Correct): Consensus algorithms, such as Paxos or Raft, are indeed complex due to the need to ensure reliability and agreement despite potential node failures or network issues.  
• (Reason is Correct): The purpose of achieving consensus is crucial for data consistency and integrity, particularly in operations that involve multiple nodes.  
Hence, Option (2) is the right answer.  
  
39. In a computer architecture course, students are tasked with developing an assembler that translates assembly language programs into machine code. The project includes handling symbolic labels, translating mnemonics to opcodes, and managing storage directives. The students also need to implement error detection for syntax and semantic errors in the assembly programs.  
Which of the following tasks is least associated with the core functions of an assembler?  
(1) Translating assembly language mnemonics into corresponding machine code opcodes.  
(2) Resolving addresses for symbolic labels used in the assembly program.  
(3) Generating a detailed listing file that includes the original assembly code and corresponding machine code.  
(4) Creating a user interface for the assembler program to facilitate code editing and debugging.  
Answer Key: 1  
Solution:  
• (Incorrect): Translating mnemonics to opcodes is a fundamental task of an assembler, directly involved in the conversion from assembly to machine language.  
• (Correct): Resolving symbolic labels to their respective addresses is crucial for correct code generation and is a primary function of an assembler.  
• (Correct): Generating a listing file is helpful for debugging and verifying the assembly to machine code translation, thus integral to the assembler’s functionality.  
• (Correct): While a user interface enhances the usability of the assembler, it is not directly related to the core computational functions of translating assembly code or handling storage directives.  
Hence, Option (1) is the right answer.  
  
5. Given below are two statements, one is labelled as Assertion (A) and the other is labelled as Reason (R).  
Given below are two statements, one is labelled as Assertion (A) and the other is labelled as Reason (R).  
Assertion (A): SQL injection is a code injection technique that exploits a security vulnerability occurring in the database layer of an application.  
Reason (R): The vulnerability is exploited by manipulating SQL commands through the input data from the client to the application.  
In light of the above statements, choose the most appropriate answer from the options below:  
(1) Both Assertion and Reason are correct, and Reason is the correct explanation of Assertion.  
(2) Both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.  
(3) Assertion is correct, but Reason is incorrect.  
(4) Assertion is incorrect, but Reason is correct.  
\*\*Answer Key: 1\*\*  
\*\*Solution:\*\*  
• (Assertion is Correct): SQL injection indeed exploits vulnerabilities primarily in the database layer of an application, where SQL commands can be executed.  
• (Reason is Correct): The manipulation of SQL commands through client-supplied data is a key method by which SQL injection attacks are carried out.  
Hence, Option (1) is the right answer.  
  
38. A computer engineering student is designing a microprocessor as part of their thesis. The design includes specifying microoperations for arithmetic calculations, memory access, and control signal generation. The student plans to implement complex instruction set computing (CISC) architecture, which includes a variety of specialized instructions.  
Which aspect of microprocessor design is least related to defining and implementing microoperations for arithmetic and control?  
(1) Choosing register transfer language (RTL) to specify the exact sequence of control signals for each operation.  
(2) Deciding on the bus architecture to facilitate data transfers between registers and memory units.  
(3) Implementing a hardware multiplier to speed up arithmetic operations involving multiplication.  
(4) Selecting a suitable set of machine instructions that allow for versatile programming and application development.  
Answer Key: 1  
Solution:  
• (Incorrect): Register transfer language is directly related to microoperations as it defines the precise control and timing of data transfers and operations within the CPU.  
• (Correct): While the bus architecture is crucial for data movement across different parts of the microprocessor, it does not directly influence the specific microoperations performed during arithmetic and control tasks.  
• (Correct): A hardware multiplier is an essential component for efficient arithmetic microoperations, especially in CISC architectures where multiple arithmetic tasks need to be accelerated.  
• (Correct): The choice of machine instruction set impacts the overall flexibility and capability of the processor, influencing how effectively it can perform a wide range of tasks, including microoperations.  
Hence, Option (2) is the right answer.  
  
34. A logistics company uses a centralized planning system to manage its supply chain. The system incorporates various planning techniques to optimize route schedules and inventory levels. Considering the complexity of handling multiple warehouses and transportation modes, which planning model might introduce inefficiencies in adapting to sudden changes in supply chain demands?  
(1) Linear planning focused on cost minimization through straightforward linear relationships.  
(2) Goal stack planning, which organizes tasks in a LIFO manner to address goal conflicts.  
(3) Hierarchical planning, which decomposes problems into subproblems and solves them sequentially.  
(4) Partial order planning that allows for flexibility in the sequence of actions.  
Answer Key: 1  
Solution:  
• (Incorrect): Linear planning is efficient for problems with direct, predictable relationships but may not adapt well to dynamic environments with complex, non-linear interactions typical in a multi-modal supply chain.  
• (Correct): Goal stack planning effectively resolves goal conflicts by prioritizing tasks, useful in dynamic environments.  
• (Correct): Hierarchical planning helps in managing complexity by breaking down the supply chain into manageable segments, though it may sometimes be slow to adapt to sudden changes.  
• (Correct): Partial order planning offers flexibility by not enforcing a strict order of operations, suitable for dynamic adjustments.  
Hence, Option (1) is the right answer.  
  
33. In the context of implementing virtual machines within a corporate data center, an IT specialist is considering the impact of different virtualization techniques on system performance and management. Which virtualization approach might complicate the management and monitoring of virtual machines due to its inherent complexity and overhead?  
(1) Full virtualization that completely simulates hardware, allowing unmodified guest OS to run.  
(2) Paravirtualization where the guest OS is aware of the virtualization and is optimized accordingly.  
(3) OS-level virtualization, which allows for multiple isolated user-space instances.  
(4) Hardware-assisted virtualization that leverages CPU features to enhance performance.  
Answer Key: 4  
Solution:  
• (Correct): Full virtualization provides a high level of isolation and compatibility, but may introduce performance overhead due to complete emulation of hardware.  
• (Correct): Paravirtualization reduces overhead by allowing the guest OS to interact with the host, simplifying management.  
• (Correct): OS-level virtualization offers efficient resource use and simpler management by avoiding full emulation of hardware.  
• (Incorrect): Hardware-assisted virtualization improves performance by utilizing specific CPU extensions; however, it can introduce complexity in setup and monitoring, especially when integrating with existing systems without these capabilities.  
Hence, Option (4) is the right answer.  
  
40. During a computer science seminar, a discussion arises about the application of artificial intelligence in strategic game playing. The conversation focuses on advanced algorithms used in games like chess and Go, particularly those involving heuristic evaluations and decision trees. A new algorithm is proposed that combines deep learning with traditional min-max strategies to enhance predictive accuracy and speed.  
Which of the following considerations is least relevant to improving the performance of AI algorithms in game playing?  
(1) Enhancing the heuristic function to provide deeper analysis of possible moves.  
(2) Optimizing the search algorithm to prune irrelevant branches and reduce computational load.  
(3) Incorporating real-time player feedback to adjust AI strategies during the game.  
(4) Implementing alpha-beta cutoff techniques to minimize the number of nodes evaluated in the search tree.  
Answer Key: 4  
Solution:  
• (Correct): Improving the heuristic function directly impacts the AI’s ability to evaluate and prioritize moves, essential for strategic depth.  
• (Correct): Optimizing search algorithms, such as implementing effective pruning strategies, is crucial for managing the complexity and enhancing the speed of AI decision-making processes.  
• (Incorrect): While real-time player feedback can be useful in interactive applications, it is generally irrelevant in the context of AI algorithms designed for autonomous strategic game playing, where decisions are precomputed based on possible game states rather than player input.  
• (Correct): Alpha-beta pruning is a well-known technique in game theory that significantly reduces the search space, thereby improving the efficiency of the AI’s decision-making process.  
Hence, Option (3) is the right answer.  
  
36. During the design phase of a new cloud-based application, a software architect is evaluating different cloud services to ensure efficient resource management, scalability, and compliance with the service level agreement (SLA). Which of the following scenarios would likely pose the greatest challenge in meeting the SLA requirements?  
(1) Utilizing a public PaaS solution for rapid development and deployment.  
(2) Employing a private IaaS cloud to maintain control over physical hardware resources.  
(3) Outsourcing database storage to a cloud service with elastic scalability.  
(4) Relying solely on virtual servers for dynamic resource allocation and scaling.  
Answer Key: 4  
Solution:  
• (Correct): Public PaaS provides managed services that can speed up development and handle many operational aspects, aiding in SLA compliance.  
• (Correct): Private IaaS gives the organization control over physical resources, potentially enhancing security and performance consistency, aligning with SLA specifics.  
• (Correct): Cloud databases that offer elastic scalability can quickly adjust resources to meet varying loads, thus supporting SLA adherence.  
• (Incorrect): Virtual servers offer flexibility, but relying solely on them without integrating other scalability and redundancy measures such as load balancing or multi-region deployments may fall short in meeting SLA requirements during peak loads or failover scenarios.  
Hence, Option (4) is the right answer.  
  
29. Consider a social networking platform that has implemented a variety of NoSQL storage systems to manage different types of data such as user profiles, connections, posts, and messages. Given the diverse nature of queries, ranging from simple lookups to complex aggregations and graph traversals, which of the following approaches would be least effective in optimizing query performance across these varied data models?  
(1) Implementing a polyglot persistence architecture that uses the most appropriate data model for each type of query.  
(2) Using a single NoSQL system that supports secondary indexing to handle all types of data uniformly.  
(3) Applying denormalization and embedding documents where possible to reduce the need for joins.  
(4) Leveraging data partitioning and sharding techniques to distribute queries and data across multiple servers.  
Answer Key: 2  
Solution:  
• (Correct): Polyglot persistence tailors the database technology to the specific needs of each data type and query, optimizing performance.  
• (Incorrect): While secondary indexing helps in improving the performance of some queries, relying solely on one type of NoSQL system for diverse data types and queries can lead to suboptimal performance, as not all systems are equally efficient for all kinds of operations.  
• (Correct): Denormalization and embedding can significantly enhance read performance by eliminating the need for complex joins, which are costly in NoSQL systems.  
• (Correct): Sharding and partitioning effectively distribute data and workload across several nodes, thereby improving query responsiveness and scalability.  
Hence, Option (2) is the right answer.