CSE408 MCQs – Design and Analysis of Algorithm

Unit – IV

Sure, here are 20 multiple-choice questions (MCQs) on the topic of Dynamic Programming and Greedy Techniques along with their answers:

1. Which of the following is a characteristic of Dynamic Programming?
   - A) Overlapping Subproblems
   - B) Optimal Substructure
   - C) Greedy Choice Property
   - D) Both A and B
   - Answer: D

2. In the Rod Cutting Problem, what is the goal?
   - A) To maximize the number of pieces
   - B) To minimize the number of cuts
   - C) To maximize the profit
   - D) To minimize the length of the rod
   - Answer: C

3. Which technique is typically used to solve the Coin Change Problem?
   - A) Divide and Conquer
   - B) Greedy Algorithms
   - C) Dynamic Programming
   - D) Backtracking
   - Answer: C

4. In the 0/1 Knapsack Problem, what does the "0/1" signify?
   - A) You can take fractional amounts of items
   - B) Items can either be included or excluded
   - C) Items must be included in pairs
   - D) Items are either 0 or 1 units in weight

- Answer: B

5. When does the Optimal Substructure property fail?
   - A) When a problem can be divided into subproblems
   - B) When overlapping subproblems are not present
   - C) When the optimal solution to the problem does not include optimal solutions to subproblems
   - D) When there is a greedy choice property
   - Answer: C

6. Which of the following problems is typically solved using Dynamic Programming?
   - A) Huffman Coding
   - B) Longest Common Subsequence
   - C) Dijkstra's Algorithm
   - D) Prim's Algorithm
   - Answer: B

7. What is Memorization in Dynamic Programming?
   - A) Storing solutions to subproblems to avoid recomputation
   - B) Memorizing the algorithm steps
   - C) Writing the solution in a memo
   - D) Forgetting previously computed solutions
   - Answer: A

8. In the Coin Changing Problem, what is the goal?
   - A) To find the minimum number of coins for a given amount
   - B) To find the maximum number of coins for a given amount
   - C) To use a fixed number of coins
   - D) To find the total value of the coins
   - Answer: A

9. Which of the following properties is necessary for a problem to be solved by a Greedy Algorithm?

- A) Optimal Substructure
- B) Greedy Choice Property
- C) Overlapping Subproblems
- D) Both A and B
- Answer: D

10. In Greedy Interval Scheduling, what is the goal?
    - A) To minimize the number of intervals
    - B) To maximize the number of non-overlapping intervals
    - C) To maximize the total length of the intervals
    - D) To minimize the start time of the intervals
    - Answer: B

11. Which problem can be optimally solved by a Greedy Algorithm?
    - A) 0/1 Knapsack Problem
    - B) Coin Changing Problem
    - C) Fractional Knapsack Problem
    - D) Longest Common Subsequence
    - Answer: C

12. What is the purpose of Huffman Coding?
    - A) To encrypt data
    - B) To create a prefix-free binary code for data compression
    - C) To sort data
    - D) To search data
    - Answer: B

13. Which of the following statements is true about Huffman Codes?
    - A) Huffman Codes are not prefix codes
    - B) Huffman Codes are optimal for data compression
    - C) Huffman Codes are based on dynamic programming

- D) Huffman Codes are used in search algorithms
- Answer: B

14. Why do Huffman Codes provide optimal data compression?
    - A) They minimize the average code length
    - B) They use dynamic programming to compress data
    - C) They use a fixed-length code for each character
    - D) They sort the data before compressing it
    - Answer: A

15. In Dynamic Programming, what does the term "overlapping subproblems" refer to?
    - A) Subproblems that have common subsubproblems
    - B) Subproblems that can be solved independently
    - C) Subproblems that have the same solution
    - D) Subproblems that are solved multiple times
    - Answer: A

16. What is the main difference between Greedy Algorithms and Dynamic Programming?
    - A) Greedy Algorithms use recursion
    - B) Dynamic Programming builds up solutions using previously computed solutions
    - C) Greedy Algorithms always find the global optimum
    - D) Dynamic Programming does not require optimal substructure
    - Answer: B

17. Which of the following problems does not typically use Greedy Algorithms?
    - A) Huffman Coding
    - B) Fractional Knapsack Problem
    - C) Prim's Algorithm
    - D) Longest Common Subsequence
    - Answer: D

18. What is the primary objective of the Longest Common Subsequence (LCS) problem?

- A) To find the longest subsequence common to all given sequences
- B) To find the shortest common supersequence
- C) To find the longest substring common to all given sequences
- D) To find the longest common prefix
- Answer: A

19. In the context of the Coin Changing Problem, which approach is most efficient in terms of computational complexity?

- A) Brute Force
- B) Greedy Algorithm
- C) Dynamic Programming
- D) Backtracking
- Answer: C

20. What is the purpose of proving the optimality of Huffman Codes?

- A) To show that they are unique
- B) To demonstrate that they provide the best possible compression
- C) To compare them with other coding schemes
- D) To establish their time complexity
- Answer: B

Unit – V

Sure, here are 20 multiple-choice questions (MCQs) on the topic of Approximation Algorithms along with their answers:

1. What is the primary goal of approximation algorithms?
   - A) To find an exact solution to a problem
   - B) To find a near-optimal solution in polynomial time
   - C) To solve problems with unlimited computational resources
   - D) To simplify problem statements
   - Answer: B

2. Which of the following problems is commonly solved using approximation algorithms?
   - A) Sorting
   - B) Matrix Multiplication
   - C) Job Shop Scheduling
   - D) Binary Search
   - Answer: C

3. What is the approximation ratio of an algorithm?
   - A) The ratio of the running time to the input size
   - B) The ratio of the cost of the approximation solution to the cost of the optimal solution
   - C) The ratio of the number of variables to the number of constraints
   - D) The ratio of the input size to the output size
   - Answer: B

4. What is Job Shop Scheduling primarily concerned with?
   - A) Minimizing job completion time
   - B) Allocating resources to jobs in a way that minimizes total processing time
   - C) Maximizing the number of jobs processed
   - D) Minimizing the number of machines used
   - Answer: B

5. Which of the following is an application of the Travelling Salesman Problem (TSP)?

- A) Sorting algorithms
- B) Network design
- C) Job scheduling
- D) Data compression
- Answer: B

6. Why is TSP considered NP-hard?

- A) Because it has a polynomial-time solution
- B) Because verifying a given solution is difficult
- C) Because no polynomial-time algorithm is known to solve it
- D) Because it can be transformed into any other NP problem
- Answer: C

7. What is the goal of the Vertex Cover problem?

- A) To cover all edges in a graph using the minimum number of vertices
- B) To cover all vertices in a graph using the minimum number of edges
- C) To find the shortest path between two vertices
- D) To find the maximum independent set
- Answer: A

8. In approximation algorithms, what is meant by "performance guarantee"?

- A) The algorithm always runs in polynomial time
- B) The algorithm provides a bound on how far the solution can be from the optimal
- C) The algorithm always finds the optimal solution
- D) The algorithm has the best possible performance
- Answer: B

9. Which technique is often used in designing approximation algorithms for the Maximum Satisfiability Problem?

- A) Greedy algorithms
- B) Dynamic programming
- C) Linear programming relaxation
- D) Divide and conquer
- Answer: C

10. What is the significance of the PTAS (Polynomial Time Approximation Scheme) for a problem?
- A) It provides a polynomial-time algorithm for the exact solution
- B) It offers a way to solve the problem optimally in exponential time
- C) It provides a polynomial-time algorithm that can get arbitrarily close to the optimal solution
- D) It transforms the problem into a simpler one
- Answer: C

11. Which approximation ratio is guaranteed by the 2-approximation algorithm for the Vertex Cover problem?
- A) 1
- B) 1.5
- C) 2
- D) 3
- Answer: C

12. In the context of Job Shop Scheduling, what is typically the objective of the approximation algorithm?
- A) To minimize the total number of jobs
- B) To maximize the idle time of machines
- C) To minimize the makespan
- D) To minimize the number of machines used
- Answer: C

13. Which of the following is true about NP-hard problems?
- A) They have known polynomial-time solutions
- B) They can be solved in polynomial time for special cases

- C) They cannot be solved in polynomial time
- D) They can be reduced to NP-complete problems
- Answer: C

14. Which of the following is an example of a problem with a known Polynomial Time Approximation Scheme (PTAS)?

- A) Travelling Salesman Problem with triangle inequality
- B) General Travelling Salesman Problem
- C) Maximum Independent Set
- D) Vertex Cover
- Answer: A

15. What is the key idea behind the Greedy Algorithm for the Vertex Cover problem?

- A) Select vertices randomly
- B) Select the vertex with the highest degree at each step
- C) Select edges randomly
- D) Select the vertex with the lowest degree at each step
- Answer: B

16. What is the hardness of approximating the general TSP without any restrictions?

- A) It can be approximated within any constant factor
- B) It can be approximated within a logarithmic factor
- C) It cannot be approximated within any constant factor unless P=NP
- D) It can be solved exactly in polynomial time
- Answer: C

17. Which of the following approaches is commonly used to analyze approximation algorithms?

- A) Experimental analysis
- B) Worst-case analysis
- C) Best-case analysis
- D) Average-case analysis

- Answer: B

18. What is the goal of the Maximum Satisfiability Problem (Max-SAT)?

- A) To satisfy all clauses of a Boolean formula
- B) To maximize the number of satisfied clauses in a Boolean formula
- C) To minimize the number of satisfied clauses in a Boolean formula
- D) To find a solution in polynomial time
- Answer: B

19. Why is proving the hardness of approximation important?

- A) It helps in finding the exact solutions
- B) It provides insights into the efficiency of polynomial-time algorithms
- C) It shows the limitations of what can be achieved with approximation algorithms
- D) It demonstrates the existence of approximation schemes
- Answer: C

20. Which property of TSP with triangle inequality allows for better approximation algorithms?

- A) The distances between points form a complete graph
- B) The sum of the lengths of any two sides of a triangle is greater than or equal to the length of the third side
- C) The problem can be solved exactly in polynomial time
- D) The problem has a unique solution
- Answer: B

Unit – VI

Certainly! Here are 20 multiple-choice questions (MCQs) on the topic of Introduction to Intractability (NP-completeness) and Solving Optimization Problems, along with their answers:

1. What is a decision problem in the context of computational complexity?
   - A) A problem with a numeric output
   - B) A problem with a yes or no answer
   - C) A problem involving multiple choices
   - D) A problem solved by quantum computers
   - Answer: B

2. What is meant by a language in the context of computational theory?
   - A) A programming language
   - B) A set of strings over an alphabet
   - C) A human language
   - D) A sequence of numbers
   - Answer: B

3. Which of the following best describes Polynomial Time Problems (P)?
   - A) Problems that can be solved in exponential time
   - B) Problems that can be solved in logarithmic time
   - C) Problems that can be solved in polynomial time
   - D) Problems that cannot be solved
   - Answer: C

4. What does NP stand for in computational complexity theory?
   - A) Non-polynomial
   - B) Non-deterministic Polynomial time
   - C) Not Polynomial
   - D) Non-physical
   - Answer: B

5. Which of the following statements is true about NP problems?
   - A) All NP problems are also P problems
   - B) All P problems are also NP problems
   - C) NP problems cannot be verified in polynomial time
   - D) NP problems are easier than P problems
   - Answer: B

6. What is an NP-complete problem?
   - A) A problem that is in NP and can be reduced to any other NP problem
   - B) A problem that can be solved in polynomial time
   - C) A problem that is in NP and every NP problem can be reduced to it in polynomial time
   - D) A problem that cannot be solved
   - Answer: C

7. What is a polynomial-time reduction?
   - A) Transforming one problem into another in constant time
   - B) Transforming one problem into another in polynomial time
   - C) Solving a problem using polynomial space
   - D) Transforming one problem into another using exponential time
   - Answer: B

8. Which of the following is an example of an NP-complete problem?
   - A) Sorting
   - B) Travelling Salesman Problem (TSP)
   - C) Matrix Multiplication
   - D) Binary Search
   - Answer: B

9. What is the significance of proving a problem is NP-complete?
   - A) It shows that the problem is easy to solve

- B) It shows that the problem is hard to solve
- C) It shows that every problem in NP can be reduced to it
- D) It shows that the problem is in P
- Answer: C

10. What does the Cook-Levin theorem state?
    - A) Every problem in P is also in NP
    - B) Every problem in NP is NP-complete
    - C) The Boolean satisfiability problem (SAT) is NP-complete
    - D) The Travelling Salesman Problem is NP-complete
    - Answer: C

11. What is the relationship between NP and P if P ≠ NP?
    - A) NP problems are harder than P problems
    - B) P problems are harder than NP problems
    - C) All NP problems are P problems
    - D) NP problems can be solved in polynomial time
    - Answer: A

12. What is the significance of qubits in quantum computing?
    - A) They are the basic unit of classical information
    - B) They can represent and store information as 0s or 1s simultaneously
    - C) They are used to perform classical computations
    - D) They are slower than classical bits
    - Answer: B

13. What does Bell's Inequality test?
    - A) The efficiency of classical algorithms
    - B) The existence of quantum entanglement
    - C) The speed of classical computers
    - D) The performance of polynomial-time algorithms

- Answer: B

14. What is Grover's Search Algorithm used for?
    - A) To solve NP-complete problems in polynomial time
    - B) To search unsorted databases quadratically faster than classical algorithms
    - C) To perform matrix multiplication
    - D) To sort data efficiently
    - Answer: B

15. What is an example of a problem that Grover's algorithm can speed up?
    - A) Sorting a list of numbers
    - B) Searching an unsorted database
    - C) Multiplying matrices
    - D) Finding the shortest path in a graph
    - Answer: B

16. Which of the following is true about the relationship between NP and NP-complete problems?
    - A) NP-complete problems are easier to solve than NP problems
    - B) Every NP problem can be reduced to an NP-complete problem
    - C) NP-complete problems are a subset of P problems
    - D) NP problems cannot be reduced to NP-complete problems
    - Answer: B

17. What is the purpose of reductions in the context of NP-completeness?
    - A) To simplify the problem-solving process
    - B) To prove that one problem is as hard as another
    - C) To convert problems to polynomial time
    - D) To improve the efficiency of algorithms
    - Answer: B

18. What does it mean if a decision problem is in the class NP?

- A) It can be solved in polynomial time
- B) It can be verified in polynomial time given a solution
- C) It cannot be solved or verified
- D) It can only be solved in exponential time
- Answer: B

19. What does the class P represent in computational complexity?
- A) Problems solvable in polynomial time
- B) Problems verifiable in polynomial time
- C) Problems unsolvable in polynomial time
- D) Problems solvable in exponential time
- Answer: A

20. Which of the following best describes the concept of quantum entanglement?
- A) Qubits that operate independently
- B) Qubits that are correlated in such a way that the state of one qubit can depend on the state of another
- C) The process of measuring qubits
- D) The method of encoding classical bits into qubits
- Answer: B