DEPARTMENT OF COMPUTER SCIENCE

18PCS102 -Design and Analysis of Computer Algorithms

K1 Level

Unit-I

1. There are _____steps to solve the problem

A. Seven

B. Four

C. Six

D. Two

2. _____is the first step in solving the problem

A. Understanding the Problem

B. Identify the Problem

C. Evaluate the Solution

D. None of these

3. _____is the last step in solving the problem

A. Understanding the Problem

B. Identify the Problem

C. Evaluate the Solution

D. None of these

4. Following is true for understanding of a problem

A. Knowing the knowledgebase

B. Understanding the subject on which the problem is based

C. Communication with the client

D. All of the above

5. _____ Solution requires reasoning built on knowledge and experience

A. Algorithmic Solution

B. Heuristic Solution

C. Random Solution

D. None of these

6. While solving the problem with computer the most difficult step is _____.

A. describing the problem

B. finding out the cost of the software

C. writing the computer instructions

D. testing the solution

7. The correctness and appropriateness of _____solution can be checked very easily.

A. algorithmic solution

B. heuristic solution

C. random solution

D. none of these

8. Naming convention for variable is followed in company because _____.

A. it enhances readability

B. it allows to work without conflicts

C. it enhances the efficiency

D. all of the above

9. The main measure for efficiency algorithm are-

A. Processor and Memory

B. Complexity and Capacity

C. Data and Space

D. Time and space

10. What does the algorithmic analysis count?

A. The number of arithmetic and the operations that are required to run the program

B. The number of lines required by the program

C. The number of seconds required by the program to execute

D. None of these

Unit-II

11. What is the worst case complexity of binary search using recursion?

a) O(nlogn)

b) O(logn)

c) O(n)

d) $O(n^2)$

12. What is the average case time complexity of binary search using recursion?

a) O(nlogn)

b) O(logn)

c) O(n)

d) $O(n^2)$

13. What are the applications of binary search?

a) To find the lower/upper bound in an ordered sequence

b) Union of intervals

c) Debugging

d) All of the mentioned

14. Binary Search can be categorized into which of the following?

a) Brute Force technique

b) Divide and conquer

c) Greedy algorithm

d) Dynamic programming

15. In quick sort, the number of partitions into which the file of size n is divided by a selected record is

a. n

b. n - 1

c. 2

d. n/2

16. The worst-case time complexity of Quick Sort is_____.

A. O(n2)

B. O(log n)

C. O(n)

D. O(n logn)

17. **The worst-case time complexity of Merge Sort is_____.**

A. O(n2)

B. O(log n)

C. O(n)

D. O(n logn)

18. Which of the following is false in the case of a spanning tree of a graph G?

a) It is tree that spans G

b) It is a subgraph of the G

c) It includes every vertex of the G

d) It can be either cyclic or acyclic

19. Consider a complete graph G with 4 vertices. The graph G has ____ spanning trees.

a) 15

b) 8

c) 16

d) 13

20. Dijkstra's Algorithm is used to solve _____ problems.

a) All pair shortest path

b) Single source shortest path

c) Network flow

d) Sorting

Unit-III

21. Which of the following is/are property/properties of a dynamic programming problem?

a) Optimal substructure

b) Overlapping subproblems

c) Greedy approach

d) Both optimal substructure and overlapping subproblems

22. In dynamic programming, the technique of storing the previously calculated values is called _____

a) Saving value property

b) Storing value property

c) Memoization

d) Mapping

23. Which of the following problems is NOT solved using dynamic programming?

a) 0/1 knapsack problem

b) Matrix chain multiplication problem

c) Edit distance problem

d) Fractional knapsack problem

24. Which of the following is false about a binary search tree?

a) The left child is always lesser than its parent

b) The right child is always greater than its parent

c) The left and right sub-trees should also be binary search trees

d) None of the mentioned

25. What is the speciality about the inorder traversal of a binary search tree?

a) It traverses in a non increasing order

b) It traverses in an increasing order

c) It traverses in a random fashion

d) None of the mentioned

26. What are the worst case and average case complexities of a binary search tree?

a) O(n), O(n)

b) O(logn), O(logn)

c) O(logn), O(n)

d) O(n), O(logn)

27. The Knapsack problem is an example of _____

a) Greedy algorithm

b) 2D dynamic programming

c) 1D dynamic programming

d) Divide and conquer

28. What is the time complexity of the above dynamic programming implementation of the Knapsack problem with n items and a maximum weight of W?

a) O(n)

b) O(n + w)

c) O(nW)

d) $O(n^2)$

29. Project scheduling is an example of

a) greedy programming

b) dynamic programming

c) divide and conquer

d) none of the above.

30. Which of the following problems should be solved using dynamic programming?

a) Mergesort

b) Binary search

c) Longest common subsequence

d) Quicksort

Unit-IV

31. From the following which is not return optimal solution

a. Dynamic programming

b. Backtracking

c. Branch and bound

d. Greedy method

32. Which of the problems cannot be solved by backtracking method?

a) n-queen problem

b) subset sum problem

c) hamiltonian circuit problem

d) travelling salesman problem

33. Backtracking algorithm is implemented by constructing a tree of choices called as?

a) State-space tree

b) State-chart tree

c) Node tree

d) Backtracking tree

34. What happens when the backtracking algorithm reaches a complete solution?

a) It backtracks to the root

b) It continues searching for other possible solutions

c) It traverses from a different route

d) Recursively traverses through the same route

35. In what manner is a state-space tree for a backtracking algorithm constructed?

a) Depth-first search

b) Breadth-first search

c) Twice around the tree

d) Nearest neighbour first

36. In how many directions do queens attack each other?

a) 1

b) 2

c) 3

d) 4

37. Where is the n-queens problem implemented?

a) carom

b) chess

c) ludo

d) cards

38. The problem of finding a path in a graph that visits every vertex exactly once is called?

a) Hamiltonian path problem

b) Hamiltonian cycle problem

c) Subset sum problem

d) Turnpike reconstruction problem

39. A _____ is a round trip path along n edges of G that visits every vertex once and returns to its starting position.

a. MST

b. TSP

c. Multistage Graph

d. Hamiltonian Cycle

40. Who coined the term ‘backtracking’?

a) Lehmer

b) Donald

c) Ross

d) Ford

Unit-V

41. Who published the eight queens puzzle?

a) Max Bezzel

b) Carl

c) Gauss

d) Friedrich

42. When was the Eight Queen Puzzle published?

a) 1846

b) 1847

c) 1848

d) 1849

43. Who published the first solution of the eight queens puzzle?

a) Franz Nauck

b) Max Bezzel

c) Carl

d) Friedrich

44. Apriory algorithm analysis does not include

a) Time Complexity

b) Space Complexity

c) Program Complexity

d) None of the above

45. What is the objective of the knapsack problem?

a) To get maximum total value in the knapsack

b) To get minimum total value in the knapsack

c) To get maximum weight in the knapsack

d) To get minimum weight in the knapsack

46. Time complexity of fractional knapsack problem is _____

a) O(n log n)

b) O(n)

c) $O(n^2)$

d) O(nW)

47. The main time taking step in fractional knapsack problem is _____

a) Breaking items into fraction

b) Adding items into knapsack

c) Sorting

d) Looping through sorted items

48. Which of the following methods can be used to solve n-queen's problem?

a) greedy algorithm

b) divide and conquer

c) iterative improvement

d) backtracking

49. How many possible solutions exist for an 8-queen problem?

a) 100

b) 98

c) 92

d) 88

50. What is the domination number for 8-queen's problem?

a) 8

b) 7

c) 6

d) 5

K2 Level

18PCS102-Design and Analysis of Computer Algorithms

1. What is an algorithm?

Informally, an algorithm is any well-defined computational procedure that takes some value, or set of values, as input and produces some value, or set of values, as output. An algorithm is thus a sequence of computational steps that transform the input into the output.

2. In what areas do data structures are applied?

Data structures are essential in almost every aspect where data is involved. In general, algorithms that involve efficient data structure is applied in the following areas: numerical analysis, operating system, A.I., compiler design, database management, graphics, and statistical analysis, to name a few.

3. What is LIFO?

LIFO is a short form of Last In First Out. It refers how data is accessed, stored and retrieved. Using this scheme, data that was stored last should be the one to be extracted first. This also means that in order to gain access to the first data, all the other data that was stored before this first data must first be retrieved and extracted.

4. What is a stack?

A stack is a data structure in which only the top element can be accessed. As data is stored in the stack, each data is pushed downward, leaving the most recently added data on top.

5. Explain Binary Search Tree

A binary search tree stores data in such a way that they can be retrieved very efficiently. The left subtree contains nodes whose keys are less than the node's key value, while the right subtree contains nodes whose keys are greater than or equal to the node's key value. Moreover, both subtrees are also binary search trees.

6. What is the difference between a PUSH and a POP?

Pushing and popping applies to the way data is stored and retrieved in a stack. A push denotes data being added to it, meaning data is being "pushed" into the stack. On the other hand, a pop denotes data retrieval, and in particular, refers to the topmost data being accessed.

7. Explain what is an algorithm in computing?

An algorithm is a well-defined computational procedure that take some value as input and generate some value as output. In simple words, it's a sequence of computational steps that converts input into the output.

8. What is a graph?

A graph is one type of data structure that contains a set of ordered pairs. These ordered pairs are also referred to as edges or arcs and are used to connect nodes where data can be stored and retrieved.

9. Explain what is a recursive algorithm?
Recursive algorithm is a method of solving a complicated problem by breaking a problem down into smaller and smaller sub-problems until you get the problem small enough that it can be solved easily. Usually, it involves a function calling itself.

10. Compare DFS and BFS

Comparing BFS and DFS, the big advantage of DFS is that it has much lower memory requirements than BFS, because it's not necessary to store all of the child pointers at each level. Depending on the data and what you are looking for, either DFS or BFS could be advantageous.

11. What is Merge sort?

Merge sort takes a divide-and-conquer approach to sorting data. In a sequence of data, adjacent ones are merged and sorted to create bigger sorted lists. These sorted lists are then merged again to form an even bigger sorted list, which continuous until you have one single sorted list.

12. Give the general plan for divide-and-conquer algorithms.
The general plan is as follows
A problems instance is divided into several smaller instances of the same problem, ideally about the same size. The smaller instances are solved, typically recursively.
If necessary the solutions obtained are combined to get the solution of the original problem

13. List the advantages of Divide and Conquer Algorithm
Solving difficult problems, Algorithm efficiency, Parallelism, Memory access, Round off control.

14. List the Steps in Merge Sort

1. Divide Step: If given array A has zero or one element, return S; it is already sorted. Otherwise, divide A into two arrays, A1 and A2, each containing about half of the elements of A.

2. Recursion Step: Recursively sort array A1 and A2.

3. Conquer Step: Combine the elements back in A by merging the sorted arrays A1 and A2 into a sorted sequence

15. List out Disadvantages of Divide and Conquer Algorithm
Conceptual difficulty
Recursion overhead
Repeated subproblems

16. Define Quick Sort
Quick sort is an algorithm of choice in many situations because it is not difficult to implement, it is a good \"general purpose\" sort and it consumes relatively fewer resources during execution.
17. List out the Advantages in Quick Sort
It is in-place since it uses only a small auxiliary stack.
It requires only n log(n) time to sort n items.

It has an extremely short inner loop

This algorithm has been subjected to a thorough mathematical analysis, a very precise statement can be made about performance issues.

18. How many edges does a minimum spanning tree has?
A minimum spanning tree has (V – 1) edges where V is the number of vertices in the given graph.

19. Explain what is Quick Sort algorithm?

Quick Sort algorithm has the ability to sort list or queries quickly. It is based on the principle of partition exchange sort or Divide and conquer. This type of algorithm occupies less space, and it segregates the list into three main parts

- Elements less than the Pivot element
- Pivot element
- Elements greater than the Pivot element

20. Explain how binary search works?

In binary search, we compare the key with the item in the middle position of the array. If the key is less than the item searched then it must lie in the lower half of the array, if the key is greater than the item searched than it should be in upper half of the array.

21. Explain what is heap sort?

Heap-sort can be defined as a comparison based sorting algorithm. It divides its input into the unsorted and sorted region, until it shrinks the unsorted region by eliminating the smallest element and moving that to the sorted region.

22. Explain what is Space complexity of insertion sort algorithm?

Insertion sort is an in-place sorting algorithm which means that it requires no extra or little. storage. For insertion sort, it requires only single list elements to be stored out-side the initial data, making the space-complexity 0(1).

23. Explain what is the difference between best case scenario and worst case scenario of an algorithm?

- Best case scenario: Best case scenario for an algorithm is explained as the arrangement of data for which the algorithm performs best. For example, we take a binary search, for which the best case scenario would be if the target value is at the very center of the data you are searching. The best case time complexity would be 0 (1)
- Worst case scenario: It is referred for the worst set of input for a given algorithm. For example quicksort, which can perform worst if you select the largest or smallest element of a sublist for the pivot value. It will cause quicksort to degenerate to O (n2).

24. What is time complexity of Binary Search?
Time complexity of binary search is O(Logn).

25. Can Binary Search be used for linked lists?
Since random access is not allowed in linked list, we cannot reach the middle element in O(1) time. Therefore Binary Search is not possible for linked lists.

26. If a problem can be broken into subproblems which are reused several times, the problem possesses _____ property.

Overlapping subproblems

27. In dynamic programming, the technique of storing the previously calculated values is called _____

Memoization

28. When a top-down approach of dynamic programming is applied to a problem, it usually _____

Decreases the time complexity and increases the space complexity

29. Some famous Dynamic Programming algorithms are:

- Unix diff for comparing two files
- Bellman-Ford for shortest path routing in networks
- TeX the ancestor of LaTeX
- WASP - Winning and Score Predictor

30. Backtracking algorithm is implemented by constructing a tree of choices called as?
State-space tree

31. What happens when the backtracking algorithm reaches a complete solution?

It continues searching for other possible solutions

33. In general, backtracking can be used to solve?

Combinatorial problems

34. The problem of finding a list of integers in a given specific range that meets certain conditions is called?

Constraint satisfaction problem

35. The problem of finding a subset of positive integers whose sum is equal to a given positive integer is called as?

subset sum problem

36.Define Hamiltonian circuit.

A Hamiltonian circuit is defined as a cycle that passes through all the vertices of the graph exactly

37. Define mergesort:

Mergesort sorts a given array A[0..n-1] by dividing it into two halves a[0..(n/2)-1] and A[n/2..n-1] sorting each of them recursively and then merging the two smaller sorted arrays into a single sorted one.

38.What is minimum spanning tree?

Minimum spanning tree of a weighted, connected graph G: a spanning tree of G of the minimum total weight

39. Define Backtracking

Backtracking is used to solve problems with tree structures. Even problems seemingly remote to trees such as a walking a maze are actually trees when the decision \'back-left-straight-right\' is considered a node in a tree.

40.What is the traveling salesman problem?

The problem can be modeled as a weighted graph, with the graph‘s vertices representing the cities and the edge weights specifying the distances.

41.What is meant by n-queen Problem?

The problem is to place n queens on an n-by-n chessboard so that no two queens attack each other by being in the same row or in the same column or in the same diagonal.

42.What is graph coloring algorithm?

Graph coloring problem is to assign colors to certain elements of a graph subject to certain constraints.

43. Define Branch and Bound?

A counter-part of the backtracking search algorithm which, in the absence of a cost criteria, the algorithm traverses a spanning tree of the solution space using the breadth-first approach.

44.Define Traveling Salesman Problem?

Given a complete undirected graph G=(V, E) that has nonnegative integer cost c(u, v) associated with each edge (u, v) in E, the problem is to find a hamiltonian cycle (tour) of G with minimum cost.

45.Define Subset-Sum Problem?

This problem find a subset of a given set S={s1,s2,……,sn} of n

positive integers whose sum is equal to a given positive integer d.

46.Define Non-Promising Node?

A node in a state-space tree is said to be nonpromising if it backtracks to the node‘s parent to consider the nest possible solution for its last component.

47.What is a state space tree?

The processing of backtracking is implemented by constructing a tree of choices being made. This is called the state-space tree

48.What is a feasible solution and what is an optimal solution?

In optimization problems, a feasible solution is a point in the problem‘s search space that satisfies all the problem‘s constraints, while an optimal solution is a feasible solution with the best value of the objective function.

49. List out the steps of Greedy algorithms for the Knapsack Problem

a) Compare the value to weight ratio

b) Sort the items in nonincreasing order of the ratios

c) If the current item on the list fits into the knapsack place it in the knapsack; otherwise proceed to the next.

50. If an optimal solution can be created for a problem by constructing optimal solutions for its subproblems, the problem possesses _____ property.

Optimal substructure

K3 Level

Unit-I

1. Explain the properties of an algorithm with an example.
2. Give the algorithm for matrix multiplication and find the time complexity of the algorithm using step – count method.
3. What are the characteristics of an algorithm?
4. Compare time complexity with space complexity?
5. Write the pseudo code for expressing algorithms.
6. What is Amortized analysis? Explain
7. What are the Asymptotic notations? And give its properties.
8. What are the features of an efficient algorithm? Explain with an example.
9. Compare BFS and DFS algorithm with an example graph and denote its time complexities.
10. List the applications of trees.

Unit-II

1. Explain the logic of Merge Sort with its algorithm. Also give its complexity analysis.
2. . Define breadth-first search and depth first search algorithm. Give the pseudo code for each.
3. What is meant by Divide – and – Conquer approach?
4. Write Divide – And – Conquer recursive Merge sort algorithm and derive the time complexity of this algorithm.
5. Write the General method of Divide – And – Conquer approach.
6. State the Greedy Knapsack? Find an optimal solution to the Knapsack instance n=3, m=20, (P1, P2, P3) = (25, 24, 15) and (W1, W2, W3) = (18, 15, 10).
7. What is a Spanning tree? Explain Prim's Minimum cost spanning tree algorithm with suitable example. [8M] 5 a) Draw an Optimal Binary Search Tree
8. Differentiate between greedy method and dynamic programming.

9. Write and explain recursive binary search algorithm. [8M] b) Derive the time complexity of merge sort.

10. Write a greedy algorithm for sequencing unit time jobs with dead lines and profits.

Unit-III

1. Compare the time complexities of solving the All Pairs Shortest Path problem using Floyds algorithm and using the Dijkstra's algorithm by varying the source node
2. Write a program to to implement the concept of Heap Sort
3. Write a program to solve Knapsack Problem using Greedy Method
4. Explain the greedy technique for solving the Job Sequencing problem.
5. What is the principle difference between the divide and conquer technique and dynamic programming technique?
6. Explain the Travelling sales man problem
7. Write a program to find shortest paths to other vertices using Dijkstra's algorithm
8. Write the algorithm to compute 0/1 Knapsack problem using dynamic programming and explain it.
9. Explain the Optimal Binary Search Tree with an example.
10. Write a program to to implement the concept of Minimum Cost Spanning Tree

Unit-IV

1. Explain backtracking concept. Illustrate N queens problem using back tracking to solve 4 queens problem.

2. Solve subset sum problem for the following example , s={3,5,6,7} and d=15.construct a state space tree.

3. What is the central principle problem of back tracking? Apply backtracking to solve the below instance of sum of subset problem s= {5,10,12,13,15,18} d=30

4. Give the solution to the 8-queens problem using backtracking

5. Write the Control Abstraction of iterative Backtracking method.

6) Write an algorithm to determine the Hamiltonian cycle in a give graph using backtracking.

7. Explain the solution to the graph coloring problem using backtracking.

8. . State and explain the subset sum problem with an example

9. Explain the basic principle of Backtracking and list the applications of backtracking.

10. Using backtracking technique solve the following instance for the subset problem s=(1,3,4,5) and d=11.

Unit-V

1. Explain FIFO Branch and Bound solution.
2. Explain 0/1 Knapsack problem with respect to branch and bound method
3. What are the differences between backtracking and branch and bound solutions?
4. Explain the LC branch and bound algorithm.
5. State the concept of branch and bound method and also list its applications.
6. Solve the Travelling Salesman problem using branch and bound algorithms
7. What are the searching techniques that are commonly used in branch and bound method?
8. What is LC – Search? Discuss LC – Search algorithm.
9. Write the Control Abstraction of Least – Cost Branch and Bound.
10. Define : i) State Space tree ii) E – Node and iii) Dead Node.

K4 Level

Unit-I

1. List the various representations of graph? 8. What are the two algorithms to find minimum spanning tree?
2. What are the draw backs of using sequential storage to represent stacks and queues?
3. Write an algorithm for postfix expression, evaluate it and show the contents of stack for the following postfix expression + * 2 $ 3 + 3 8 2/ – +6 2 3
4. Explain array implementation of Priority queues and list implementation of Priority queues.
5. Illustrate the traversal algorithms and node representation of binary trees with examples. Or (b) Explain Huffman's algorithm with example

Unit-II

1. Explain the basic principle of Divide and Conquer method.
2. Define Minimum Cost Spanning tree and list its applications
3. Show the result of running Merge sorting technique on the sequence 38,27,43,3,9,82,10
4. Derive the Best, Worst and Average time complexities of Merge sorting technique.
5. Explain the general principle of Greedy method and also list the applications of Greedy method.

Unit-III

1. Write a program to to implement the concept of All pairs shortest path
2. Write with an example of Prim's algorithm.
3. Explain Optimal Binary Search tree.
4. Solve the following instance of 0/1 Knapsack problem using Dynamic programming n = 3; (W1, W2, W3) = (3, 5, 7); (P1, P2, P3) = (3, 7, 12); M = 4.

5. Write about 0/1 knapsack problem.

Unit-IV

Write a program to implement N Queen's problem using Back Tracking.

12. Write about the constraints and criterion function used in backtracking.

13. Relate Hamiltonian cycle with travelling sales person problem and also give the backtracking solution vector that finds all Hamiltonian cycles for any directed or undirected graph.

14. Draw the portion of state space tree generated by recursive backtracking algorithm for sum of subsets problem with an example.

15. Explain how backtracking is used for solving n- queens problem. Show the state space tree.

Unit-V

1. What are the differences between FIFO and LC branch and bound solutions?
2. State the difference between FIFO and LC branch and bound algorithms
3. State the concept of branch and bound method and also list its applications.
4. Solve the Travelling Salesman problem using branch and bound algorithms.
5. Distinguish between backtracking and branch – and bound techniques.

K5 Level

Unit-I

1. Illustrate the linked list representation of list.
2. Explain about Techniques for Binary Tree
3. Discuss about sets and disjoint set union
4. How do you do a performance analysis?
5. Discuss about circular Queue

Unit-II

1. Explain the greedy technique for solving the Job Sequencing problem.
2. What is the principle difference between the divide and conquer technique and dynamic programming technique?
3. Explain the basic methodology of divide and conquer algorithm. List the advantages of divide and conquer algorithm.
4. Explain the principle of Binary search technique with an example and also List the drawbacks of it.
5. What is Minimum cost spanning tree? Explain an algorithm for generating minimum cost spanning tree and list some applications of it.

Unit-III

1. Explain the methodology of Dynamic programming. List the applications of Dynamic programming.
2. What is the solution generated by function Job Sequencing algorithm
3. Prove that dynamic programming constructs solution in bottom up approach
4. Explain about multistage graphs.
5. Discuss about flow shop scheduling

Unit-IV

1. Describe the algorithm for Hamiltonian cycles and Determine the order of magnitude of the worst-case computing time for the backtracking procedure that finds all Hamiltonian cycles.
2. What are the factors that influence the efficiency of the backtracking algorithm?
3. Write in detail about Hamiltonian cycles. Give example to it.

4. Explain the Graph – coloring problem. And draw the state space tree for m= 3colors n=4 vertices graph. Discuss the time and space complexity
5. Write a program to generate Sum of subsets

Unit-V

1. Define : i) LC – Search ii) Branch and Bound (BB) iii) FIFO – BB.
2. Write Control Abstraction of Least – Cost(LC) Search.
3. Explain the FIFO BB 0/1 Knapsack problem procedure with the knapsack instance for n=4.m=15,(p1,p2,p3,p4)=(10,10,12,18) (w1,w2,w3,w4) =(2, 4, 6, 9). Draw the portion of the state space tree and find optimal solution.
4. Explain how branch and bound technique is used to solve 0/1 knapsack problem
5. Define Bounding Function? Give the statement of 0/1 Knapsack FIFO BB.