



CS6402-DESIGN AND ANALYSIS OF ALGORITHM

Question Bank

Unit-I

Introduction

Part - A

1. What is an Algorithm?
2. Write the Euclid's algorithm for GCD calculation?
3. What is algorithm design Technique?
4. Differentiate time and Space efficiency?
5. Design an algorithm to compute the area and Circumference of a circle
6. List the important problem types
7. How will you measure input size of algorithms
8. Define best, worst and average case efficiency?
9. Define big oh(O),Big omega(Ω) and big theta(Θ) notations
10. List the basic efficiency classes
11. Define recurrence relation?
12. What is non recursion relation?
13. Define nonrecursive algorithm?
14. Define order of growth? Find the order of growth of $\sum_{i=1}^{n-1} (i^2 + 1)^2$
15. Consider the following algorithm

```
S=0
for i=1 to n do
S=S+i
return i
```



What does this algorithm compute? How many times is the basic operation executed?

16. Write an algorithm using recursive function to find the sum of n numbers.
17. What is algorithm optimality
18. List the factors which affects the running time of the algorithm.
19. What is meant by substitute methods?
20. Write the general plan for analyzing Time efficiency of recursive algorithm

PART - B

1. Discuss in detail about fundamentals of algorithmic problem solving?
2. Explain the important problem types in detail
3. Explain the necessary steps for analyzing the efficiency of recursive algorithms
4. Explain the general framework for analyzing the efficiency of algorithm.
5. Write the asymptotic notations used for best case ,average case and worst case analysis of algorithms and Write an algorithm for finding maximum element of an array perform best , worst and average case complexity with appropriate order notations
6. Explain the method of solving recurrence equations with suitable example.
7. Explain the method of solving Non recursive equations with suitable examples
8. i) Describe the basic efficiency classes in detail.
ii) Write an algorithm for Fibonacci numbers generation and compute the following
 - a) How many times is the basic operation executed
 - b) What is the efficiency class of this algorithm
9. Solve the following recurrence relations
 - a) $x(n)=x(n-1) + 5$ for $n > 1$ $x(1)=0$
 - b) $x(n)=3x(n-1)$ for $n > 1$ $x(1)=4$
 - c) $x(n)=x(n-1)+n$ for $n > 0$ $x(0)=0$
 - d) $x(n)=x(n/2)+n$ for $n > 1$ $x(1)=1$ (solve for $n=2^k$)
 - e) $x(n)=x(n/3)+1$ for $n > 1$ $x(1)=1$ (solve for $n=3^k$)



10. Consider the following recursion algorithm

```
Min1(A[0 -----n-1])  
If n=1 return A[0]  
Else temp = Min1(A[0.....n-2])  
    If temp <= A[n-1] return temp  
Else  
    Return A[n-1]
```

- a) What does this algorithm compute?
- b) Setup a recurrence relation for the algorithms basic operation count and solve it

UNIT-2

BRUTE FORCE AND DIVIDE-AND-CONQUER

PART - A

1. Define brute force method
2. Write an algorithm for brute force closest –pair problem
3. Define convex hull problem
4. Define exhaustive search
5. Give formula for Manhattan distance computation
6. What is median of three partitioning?
7. Write an algorithm for binary search.
8. What is worst case complexity of binary search?
9. What is Hamiltonian circuit?
10. Define Hungarian method.
11. What are the conditions for travelling salesman problem?
12. Define Knapsack problem?
13. List the general plan in divide and conquer algorithm
14. Write an algorithm for merge sort
15. Write an algorithm for quick sort
16. How the operations performed in Strassen's Matrix multiplication



17. What is the largest number of key comparisons made by binary search in searching for a key in the following array?

3,14, 27, 31, 39, 42, 55, 70, 74, 81, 85, 93, 98

18. Apply the Quick sort to the list

E , X , A , M , P , L , E

19. Compute $2011 * 1130$ using divide and conquer algorithm.

20. Solve the average case recurrence for quick sort.

PART - B

1. Explain selection sort and bubble sort algorithm using brute force method and analyze with examples

2. Describe Sequential search and brute force string matching using brute force method

3. Explain the following in detail

i) Closest pair problem

ii) Convex hull problem

4. Describe exhaustive search in detail

5. Explain in detail quick sorting method. Provide a complete analysis of quick sort with example.

6. Explain in detail merge sort. Illustrate the algorithm with a numeric example. Provide complete analysis of the same.

7. Describe binary search in detail? And provide the complete analysis with example

8. Write short notes on the following

i. Strassen's Matrix Multiplication

ii. Multiplication of largest integer.

9. Apply strassen's algorithm to compute

$$\begin{vmatrix} 1 & 2 & 1 & 1 \\ 0 & 3 & 2 & 4 \\ 0 & 1 & 1 & 1 \\ 5 & 0 & 1 & 0 \end{vmatrix} * \begin{vmatrix} 2 & 1 & 0 & 2 \\ 1 & 2 & 1 & 1 \\ 0 & 3 & 2 & 1 \\ 4 & 0 & 0 & 4 \end{vmatrix}$$



10. Find the optimal solution for the assignment operator given below

	Job1	Job2	Job 3	Job 4
Person 1	4	3	8	6
Person 2	5	7	2	4
Person 3	16	9	3	1
Person 4	2	5	3	7

UNIT – 3

DYNAMIC PROGRAMMING AND GREEDY

PART - A

1. What is principle difference between dynamic programming and divide and Conquer techniques?
2. Compute Fibonacci series using dynamic programming
3. Apply Warshall's Algorithm to find the transitive closure of the digraph defined by the following adjacency matrix

$$\begin{vmatrix} 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 \end{vmatrix}$$

4. What is meant by principle of optimality?
5. Define optimal binary search tree with example
6. What is the use of Warshall's algorithm and Floyd's Algorithm?
7. Define greedy technique.\
8. What is minimum spanning tree problem?
9. Define min heap and max heap
10. What are the operations performed by disjoint subset?
11. What is single source shortest path algorithm?
12. Differentiate variable length encoding and fixed length encoding
13. Write the Huffman Algorithm.
14. Define prim's Algorithm
15. What is Kruskal's Algorithm?



16. Define Dijkstra’s Algorithm
17. Differentiate prim’s Algorithm and Kruskal’s Algorithm
18. What is Knapsack problem?
19. Define Quick find and quick union
20. How to calculate the efficiency of Dijkstra’s Algorithm?

PART - B

1. Write an algorithm for binomial coefficient computation and analyze the efficiency of algorithm
2. Describe the Warshall’s algorithm with example and analyze its efficiency
3. Explain Floyd’s Algorithm for all pair shortest path algorithm with example and analyze its efficiency
4. Explain optimal binary search tree algorithm with example and analyze its efficiency
5. Describe Knapsack problem and Memory functions with example
6. Apply the bottom up dynamic programming algorithm to the following instance of Knapsack Problem

Item	Weight	Value
1	7	\$42
2	3	\$12
3	4	\$40
4	5	\$25

Capacity $W=10$

7. Explain in detail about prims algorithm with example and analyze its efficiency
8. Describe in detail about Kruskals Algorithm with example and analyze its efficiency
9. Explain Dijkstra’s Algorithm in detail with example and analyze its efficiency
10. Write the Huffman’s Algorithm. Construct the Huffman’s tree for the following data and obtain its Huffman’s Code

Character	A	B	C	D	E	-
probability	0.5	0.35	0.5	0.1	0.4	0.2



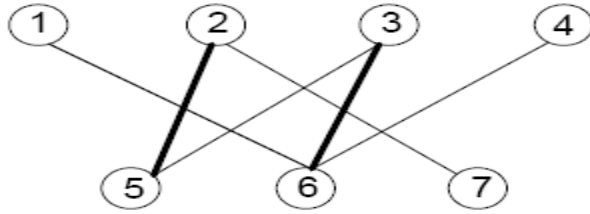
UNIT -4

ITERATIVE IMPROVEMENT

PART - A

1. Define the iterative improvement technique.
2. List the standard form requirements of linear programming problem in simplex method.
3. Define the extreme Point theorem
4. Define basis and non basic solution
5. List the steps of simplex method
6. What is two phase simplex method?
7. Define Ellipsoid method
8. What is Bland's rule?

9. Differentiate Feasible and optimal solution
10. Solve the linear programming problem geometrically
Maximize $3x+y$
Subject to $-x+y \leq 1$
 $2x + y \leq 4$
 $x \geq 0 \quad y \geq 0$
11. List the properties of flow network
12. Define Max-Flow Min-Cut Theorem
13. What is Flow conservation requirement?
14. Define Augment path method/ Ford-fulkerson method
15. What is shortest augment path algorithm?
16. Define bipartite graph
17. What is maximum cardinality matching?
18. Write the stable marriage algorithm
19. Define forward and backward edges
20. For each matching shown below in bold, find an augmentation





PART - B

1. Describe in detail about outline of simplex method
2. Explain geometric interpretation of Linear programming with example
3. Trace the simplex method on the following problems

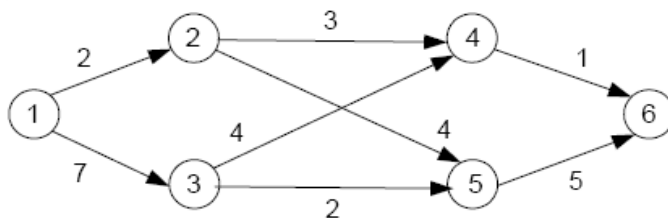
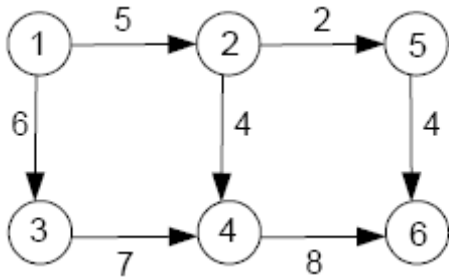
$$\text{Maximize } p = 2x - 3y + 4z$$

$$\text{Subject to } 4x - 3y + z \leq 3$$

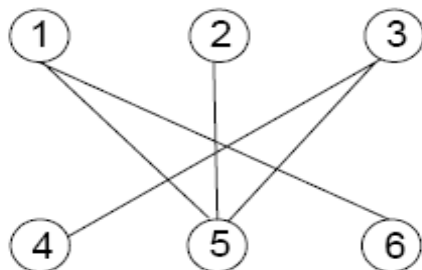
$$x + y + z \leq 10$$

$$2x + y - z \leq 10 \text{ where } x, y \text{ and } z \text{ are non negative}$$

4. Explain the maximum flow problem algorithm and prove the max Flow min cut theorem
5. Apply the shortest augmenting path algorithm to find a maximum flow and minimum cut in the following network



6. Write the algorithm for maximum matching in Bipartite Graphs and prove the theorem with example
7. Apply the maximum matching algorithm to the following bipartite graphs





8. Explain the algorithm for stable marriage problem and prove the theorem with

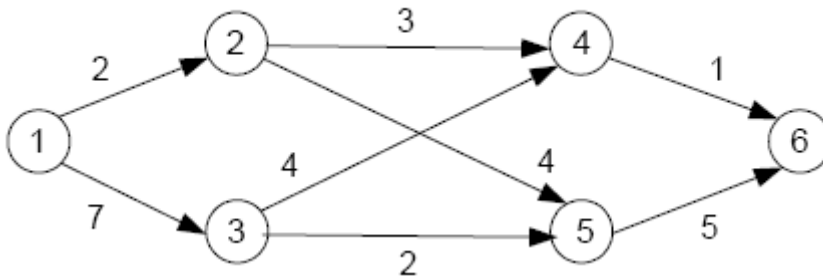
Example

9. Consider an instance of the stable marriage problem given by the ranking matrix

	A	B	C
α	1,3	2,2	3, 1
β	3,1	1,3	2, 2
γ	2,2	3,1	1, 3

For each of its marriage matching's, indicate whether it is stable or not

10. Illustrate pictorially the Ford –Fulkerson method by showing the flow augmenting paths in bold for the given flow network



UNIT 5

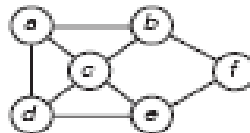
UNIT V COPING WITH THE LIMITATIONS OF A LGORITHM POWER

PART - A

1. What is information theoretic lower bound?
2. Define adversary method.



3. List the lower bounds for sorting, searching and multiplication.
4. Define decision tree with example
5. Write the formula for decision tree for searching a sorted array.
6. Define complexity theory
7. What is halting problem.
8. Define P and NP problems.
9. Give examples for NP Complete problems
10. What is CNFs satisfiability problem?
11. What are the additional items required for branch and bound compared to backtracking technique
12. State the reason for terminating search path at the current node in branch bound algorithm
13. Define State Space tree
14. What is subset- sum problem?
15. Define N queens problem
16. Define branch and bound problem
17. Write nearest neighborhood algorithm
18. Write greedy algorithm for discrete knapsack problem
19. Define local search heuristics
20. Draw the Hamiltonian circuit for the given graph



PART - B

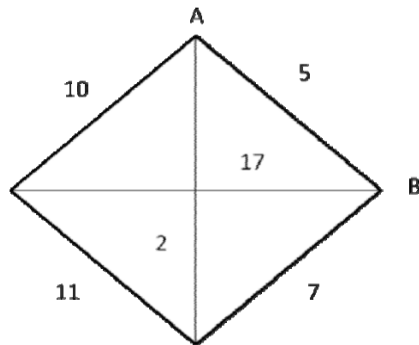
1. Explain lower bound Arguments in detail.
2. Draw the Decision Tree and Find the number of Key Comparison in the worst and average case for:
 - a. The four Element Binary search
 - b. the Three-element basic insertion sort.
3. i) Describe in detail about P and NP Problems ii)
Write short notes on NP Complete Problem



4. Write backtracking algorithm for
 - a. The n-queens problem
 - b. Hamiltonian problem
 - c. The subset-Sum problem
5. Explain the Assignment problem in Branch and bound with Example.
6. Solve the following instance of Knapsack problem by Branch and bound Algorithm

Item	weight	profit	
1	5	\$40	
2	7	\$35	
3	2	\$18	W=15
4	4	\$4	
5	5	\$10	
6	1	\$2	

7. Apply the branch and bound algorithm to solve the traveling salesman problem for the following graph



8. Write short notes on the following using approximation Algorithm
 - i) Nearest –neighbor algorithm with example
 - ii)Multifragment heuristic algorithm with example
- 9.i)Describe in detail about Twice around the tree algorithm with example
 - ii) Explain local search heuristic with example
10. Explain the knapsack problem using approximation algorithm with example