

Tutorial & Lab Assignments-1

1. Implement all the operations of an array including creation, deletion, insertion, accessing, copying and doubling.
2. Implement all the operations of link list including creation, insertion (first, before, after and end), deletion (first, before, after and end), accessing and size.

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3. Implement all the operations of stack including pop, push, size and top.
4. Implement all the operations of queue including enqueue, dequeues, front, rear and size.

Tutorial & Lab Assignments-3

5. Implement Linear Search
6. Implement Binary Search
7. Implement Bubble Sort

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8. Implement Selection Sort
9. Implement Insertion Sort
10. Implement Quick Sort

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11. Implement Radix Sort
12. Implement Counting Sort
13. An array A contains n-1 unique integers in the range [0,n-1] that is there one number from the range that is not in A. Design an O(n) time algorithm for finding that number. You are allowed to use only O(1) additional space besides the array A itself.

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14. Josephus permutation problem is as follows: Suppose n people arranged in a circle & we are given a positive integer $m \leq n$. Beginning with a designated first person, we proceed around the circle removing m^{th} person. After each person is removed, counting continues around the circle that remains. This continues until all n people have been removed. The order in which the people are removed from the circle defines (n,m) Josephus permutation. E.g. Josephus (7,3) = 3,6,2,7,5,1,4 .Suppose that nm is a constant Describe an O(n) time algorithm that gives an integer n, outputs the (n.m) Josephus
15. Suppose that each row of an nXn array A consists of 1's and 0's such that in any row I of A, all the 1's come before any 0's in that row. Suppose further that the number of 1's in the row I is at least the number in row I+1, for I = 0,1,.....n-2. Assuming A is already in memory, describe a method running in O(n) time for counting the number of 1's in the array.

16. An evil king has a cellar containing n bottles of expensive wine, and his guards have just caught a spy trying to poison the king's wine. Fortunately, the guards caught the spy after he succeeded in poisoning only one bottle. Unfortunately they don't know which one. To make the matter worse the poison the spy used was very deadly. Just one drop diluted even to a billion will still kill someone. Even so, the poison works slowly. It takes a full month for the person to die. Design a scheme that allows the evil king to determine exactly which one of his wine bottles was poisoned in just one month's time while expending at most $O(\log n)$ of his taste testers.

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23. A certain one Way Street has m parking spaces in a row, numbered 1 through m . a man and his dozing wife drive by, and suddenly she wakes up and orders him to park immediately. He dutifully parks at the first available space, but if there are no available places he follows linear probing but does not back up. Suppose this happens for n different cars, where the j th wife wakes up just in time to park at space a_j . Input the sequence & check whether it can be safely parked assuming that street is initially empty & no one leaves after parking. E.g. when $n=m=9$ and $a_1 \dots a_9 = 3 \ 1 \ 4 \ 1 \ 5 \ 9 \ 2 \ 6 \ 5$, the cars will be parked as follows

2 4 1 3 5 7 8 9 6

24. Write a program to implement the Integer Multiplication of binary numbers using Divide & conquer where the number of bits in the binary number is in the multiple of two.

25. A magic square is an arrangement of the numbers 1 through n^2 in a square array so that the sum of each row and column is the same as well as the sum of the two main diagonals. Print the square.

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26. Write a program for Depth First Search for a given Graph & print the order in which the nodes will be accessed.

27. Write a program for Breadth first search for a given graph & print the order in which the nodes will be accessed.

28. Write a program for Fractional knapsack problem, given n items their weights and profits and the weight of the knapsack using greedy programming.

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29. Write a Program for 0/1 knapsack problem given n items their weights and profits and the weight of the knapsack using greedy programming.

30. Given an 8X8 chessboard. Solve 8-queen problem using backtracking. The queens attack each other if they are in the same row, same column or same diagonal.

31. Arrange 8 rooks and 8 bishops on the 8X8 Square board so that they don't attack the other side. Rooks and Bishops are friendly with in themselves. Use Backtracking technique to write the algorithm. We know that rooks go straight and bishops go diagonal.

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32. Each of n boys in an array may have one of the values red, white or blue. Give an efficient algorithm for rearranging the keys so that all red come before white & all white come before blue. It can happen that there are no keys of one or two colors. Operation permitted are swap. What is the worst case order?

33. A Consultant is to lay oil pipeline running east to west through an oil field of n wells. From each well a spur pipeline is to be connected directly to the main pipeline along a shortest path (either north or south). Given x & y coordinates of the wells, How should the professor consultant pick the optimal location of the main pipeline (the one that minimizes the total length of the spurs).

34. Write a program for Graph vertex coloring – colors the vertices of the graph such that no two adjacent vertices are with the same color.

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35. Write a minimum spanning tree algorithm using Prim Approach for a given undirected graph.

36. Write a minimum spanning tree algorithm using Kruskal approach for a given undirected graph.

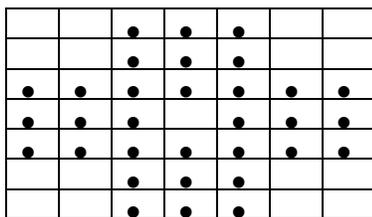
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37. Write a algorithm for the Knight Tour problem. You have an 8X8 chessboard and a knight which always moves two and a half move. Half move has to be in the 90 degree of the two moves direction. The knight is supposed to cover the whole board without repeating any of the postion. The result should either show sequence of moves or should say that no such tour exists.

38. Write an algorithm for checking that whether a given word is an anagram of another word. The word should have same length and same frequency of each letter occurring in the original word.

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39. Solve Checker's Game problem where the objective of the game is to remove all the pieces from the board. If one piece jumps over another piece to an empty place then the piece which has been jumped over is removed from the board.



Tutorial & Lab Assignment-14

40. Write an algorithm for 0/1 knapsack problem using dynamic Programming.

41. Write an algorithm for Multi stage Graph Problem using Dynamic Programming

Tutorial & Lab Assignment-15

42. Arbitrage is the use of discrepancies in the currency exchange rates to transform one unit of currency into more than one unit of the same currency. Suppose 1 US \$ buys 0.7 pounds, 1 pound buys 9.5 francs & 1 Franc buys 0.16 US \$. Then 1 US \$ buy $0.7 * 9.5 * 0.16 = 1.064$ US \$ having a profit of 6.4 %. We are given n currencies c_1, c_2, \dots, c_n & $n \times n$ table R of exchange rates, such that one unit of currency C_i buys $R[i, j]$ units of currency C_j . Give an efficient algorithm to determine whether or not there exists a sequence of currencies $\langle C_i, C_{i_2}, \dots, C_{i_k} \rangle$ such that $R[i_1, i_2] \cdot R[i_2, i_3] \cdot \dots \cdot R[i_{k-1}, i_k] \cdot R[i_k, i_1] > 1$
43. We are given set of n points $p_1, p_2, p_3, \dots, p_n$ with associated weights $w_1, w_2, w_3, \dots, w_n$. We wish to find a point p (not necessarily one of input points) that minimizes $\sum w_i d(p, p_i)$ where $d(a, b)$ is distance between points a and b . If points are x, y coordinate pairs & distance between points $a = (x_1, y_1)$ & $b = (x_2, y_2)$ is Manhattan Distance $d(a, b) = |x_1 - x_2| + |y_1 - y_2|$

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44. A programmer wants to test whether or not n given conditions are all simultaneously true (e.g. he may want to test whether both $x > 0$ & $y < z^2$, but it is not clear which condition should be tested first. Suppose that it costs T_i units of time to check condition i and that the condition will be true with probability p_i , independent of the outcomes of all other conditions. In which order he should make the test.
45. Write an algorithm for Optimal Binary Search tree using dynamic programming