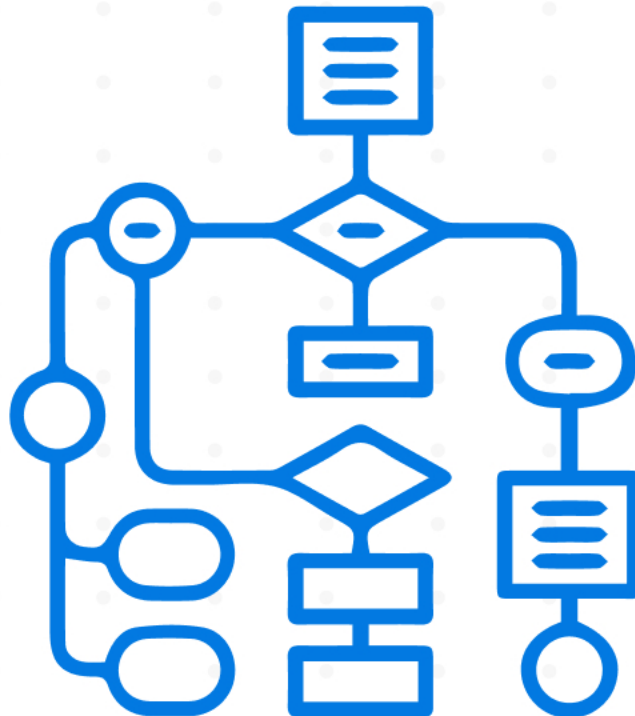


Algorithms

Every Programmer Should Know

Basic → Advance



1. Searching Algorithms

■ Linear Search

Search each and every element of the array till you find the required element

Time Complexity: $O(n)$

■ Binary Search

Searches for the element by comparing it with the middle item of the sorted array. If a match occurs, index is returned, else the searching area is reduced appropriately to either the upper half or lower half of the array

Time Complexity: $O(\log_2 n)$

2. **Sorting** Algorithms

■ **Bubble Sort**

Works by swapping adjacent elements in repeated passes, if they are not in correct order. High time complexity and not suitable for large datasets

Time Complexity: $O(n^2)$

■ **Insertion Sort**

The array is split into sorted and unsorted parts. Unsorted elements are picked and placed at their correct position in the sorted part

Time Complexity: $O(n^2)$

■ Selection Sort

The smallest value among the unsorted elements of the array is selected in every pass and inserted to its appropriate position into the array

Time Complexity: $O(n^2)$

■ Heap Sort

Uses the property of max and min heaps having largest and smallest elements at the root level It is an inplace sorting algorithm

Time Complexity: $O(n \log n)$

■ Merge Sort

Repeatedly divide the array into half, sort the halves and then combine them. It is a divide and conquer algorithm

Time Complexity: $O(n \log(n))$

■ Quick Sort

A pivot element is picked and the partitions made around it are again recursively partitioned and sorted. It is a divide and conquer algorithm.

Time Complexity: $O(n \log(n))$

Worst Case Time Complexity: $O(n^2)$

3. **Basic** Math Algorithms

■ **Euclid's Algorithm for GCD:**

Works by recursively dividing the bigger number with smaller number until the remainder is zero to get the greatest common divisor

■ **Sieve of Eratosthenes:**

Used for finding all prime numbers up to a given number by iteratively marking and removing the multiples of composite numbers

■ **Bit Manipulations:**

Perform operations at the bit-level or to manipulate bits in different ways by using bitwise operators AND, OR, NOT, XOR



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4. **Graph Algorithms**

■ **Breadth First Search and Depth First Search:**

Breadth First Search is implemented using a queue and starts at one given vertex and all its adjacent vertices are visited first before going to the next vertex

Depth First Search is implemented using a stack and starts at one given vertex and continues its search through adjacent vertices until there are none left

Time complexity for both is $O(V + E)$

■ Dijkstra's Algorithm:

Used to find the shortest path between two vertices in a graph. It is a greedy algorithm

5. **Tree** Algorithms

- **Inorder Traversal:** Traverse the left subtree, visit the root node and then the right subtree
- **Preorder Traversal:** Visit the root node, traverse the left subtree and then the right subtree
- **Postorder Traversal:** Traverse the left subtree, then the right subtree and then visit the root node

Time Complexity: $O(n)$

■ **Kruskal's Algorithm:**

Used for finding the minimum spanning tree, by sorting the edges in descending order and adding the smallest edge not added yet to form a tree with all the nodes

6. **Dynamic Programming**

Dynamic Programming works by storing the result of subproblems to access when needed without recalculation

It uses memoization which is a top down approach and tabulation which is a bottom up approach

Floyd-Warshall Algorithm is an algorithm for finding the shortest path between all the pairs of vertices in a weighted graph. This algorithm is dynamic programming based

7. **Backtracking** Algorithms

Solving problems by trying to build a solution one piece at a time, removing those solutions that fail to satisfy the constraints of the problem

Standard questions for backtracking include. The N-queens problem, Sum of Subsets problem, Graph Colouring and Hamiltonian cycles

8. **Huffman Coding** **Compression Algorithm**

It is a technique of compressing data to reduce its size without losing any of the details. Generally useful to compress data with frequently occurring characters

Involves two major parts:

- Building a Huffman tree
- Traversing the tree and assigning codes to characters based on their frequency of occurrence



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