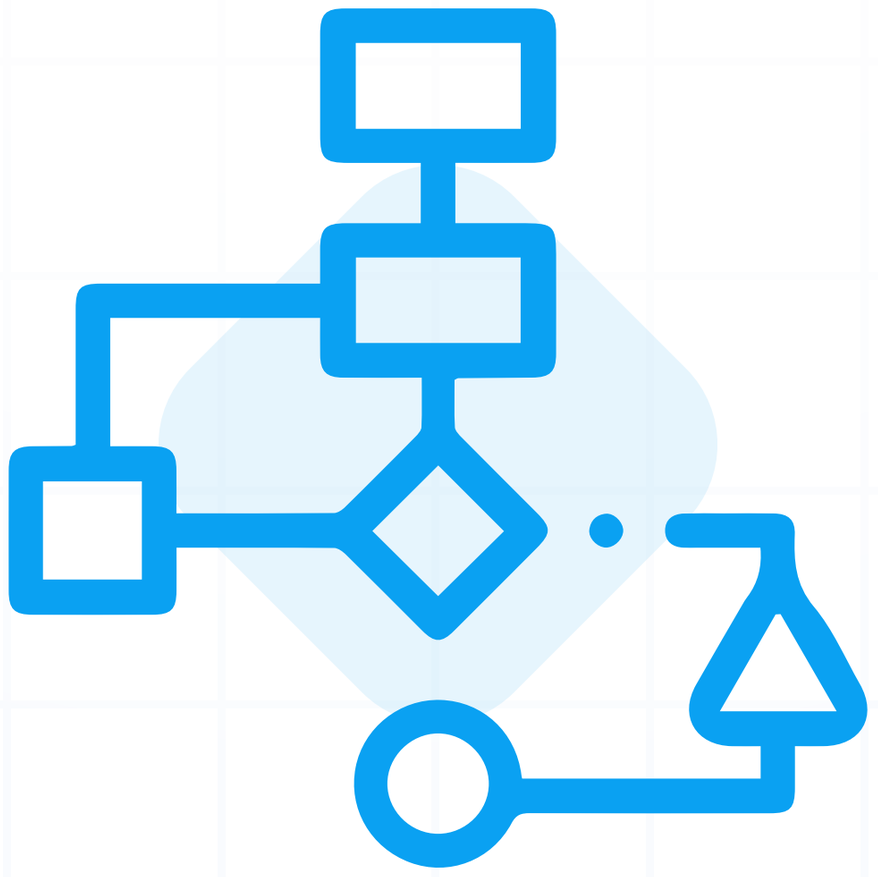
BOSSCODER ACADEMY

14 ALGORITHMS

Every Programmer Should Know



BASIC TO ADVANCE

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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 ($log_2 n$)

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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)

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➤ 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 (nlogn)

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

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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

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➤ Sieve of Eratosthenes:

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

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➤ 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

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5. Algorithms Tree

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)

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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

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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

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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.

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8. Coding Huffman 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