# Algorithm List
# Masters level Computer Science Students

ISSC - M.Sc. Scientific Computing

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## 1. Foundational Algorithms

- **Sorting Algorithms**: QuickSort, MergeSort, HeapSort, Bubble Sort, Insertion Sort, Selection Sort, Counting Sort, Radix Sort, Bucket Sort
- **Searching Algorithms**: Binary Search, Interpolation Search, Linear Search
- **Hashing**: Hash tables, Hash maps, Open addressing, Separate chaining

## 2. Graph Algorithms

- **Graph Traversal**: Breadth-First Search (BFS), Depth-First Search (DFS)
- **Shortest Path**: Dijkstra's Algorithm, Bellman-Ford Algorithm, A* Algorithm
- **Minimum Spanning Tree**: Kruskal's Algorithm, Prim's Algorithm, Boruvka's Algorithm
- **Network Flow**: Ford-Fulkerson Method, Edmonds-Karp Algorithm, Dinic's Algorithm
- **Topological Sorting**
- **Strongly Connected Components**: Kosaraju's Algorithm, Tarjan's Algorithm
- **Eulerian and Hamiltonian Paths**

## 3. Dynamic Programming

- Longest Common Subsequence (LCS)
- Longest Increasing Subsequence (LIS)
- 0/1 Knapsack Problem
- Traveling Salesman Problem (TSP)
- Matrix Chain Multiplication

- Rod Cutting Problem
- Subset Sum Problem
- Edit Distance / Levenshtein Distance
- Floyd-Warshall Algorithm (All-Pairs Shortest Paths)
- Bell Numbers and Catalan Numbers

# 4. String Algorithms

- Naive String Matching
- Knuth-Morris-Pratt (KMP) Algorithm
- Rabin-Karp Algorithm
- Boyer-Moore Algorithm
- Suffix Arrays and Suffix Trees
- Aho-Corasick Algorithm
- Z Algorithm

# 5. Computational Geometry

- Convex Hull: Graham's Scan, Jarvis March
- Line Segment Intersection
- Closest Pair of Points
- Voronoi Diagrams
- Delaunay Triangulation
- Sweep Line Algorithm
- Rotating Calipers

# 6. Numerical and Optimization Algorithms

- Newton-Raphson Method
- Gradient Descent
- Simulated Annealing
- Genetic Algorithms
- Linear Programming: Simplex Algorithm, Interior Point Methods

- Dynamic Time Warping (DTW)
- Fast Fourier Transform (FFT)

# 7. Data Structure-Specific Algorithms

- Binary Search Trees: AVL Tree, Red-Black Tree, Splay Tree
- Trie and Ternary Search Trees
- Union-Find / Disjoint Set Union (DSU)
- Fenwick Tree (Binary Indexed Tree)
- Segment Tree and Lazy Propagation
- Bloom Filter
- Skip Lists

# 8. Advanced Topics in Graphs

- Planarity Testing
- Graph Coloring
- Maximum Bipartite Matching (Hungarian Algorithm)
- Spectral Graph Algorithms
- PageRank Algorithm

# 9. Cryptography and Security Algorithms

- RSA, Diffie-Hellman Key Exchange
- Elliptic Curve Cryptography
- Symmetric Key Algorithms: AES, DES, Triple DES
- Hashing: SHA Family, MD5 (not recommended)
- Merkle Trees

## 10. Machine Learning and Data Mining

- k-Nearest Neighbors (k-NN)
- k-Means Clustering
- Decision Trees
- Support Vector Machines (SVM)
- Apriori Algorithm (Association Rules)
- Expectation-Maximization (EM)
- Principal Component Analysis (PCA)

## 11. Parallel and Distributed Algorithms

- MapReduce
- Paxos and Raft Consensus Algorithms
- Work Stealing Algorithms
- Parallel Sorting: Bitonic Sort, Hypercube Merge Sort
- Distributed Hash Table (DHT)

## 12. Miscellaneous Algorithms

- Backtracking: N-Queens, Sudoku Solver, Subset Generation
- Divide and Conquer: Karatsuba Multiplication, Strassen's Matrix Multiplication
- Greedy Algorithms: Activity Selection, Huffman Encoding
- Randomized Algorithms: Reservoir Sampling, QuickSelect
- Monte Carlo and Las Vegas Algorithms
- Approximation Algorithms for NP-Hard Problems

## 13. Domain-Specific Algorithms

- **Bioinformatics**: Smith-Waterman, Needleman-Wunsch
- **Computer Vision**: Canny Edge Detection, RANSAC
- **Networking**: Dijkstra for Routing, TCP Congestion Control
- **Databases**: B-Trees, LSM Trees, Query Optimization Algorithms

# 14. Advanced Theoretical Algorithms

- Matrix Exponentiation
- Fast Modular Exponentiation
- Number Theoretic Algorithms: Sieve of Eratosthenes, Euclid's GCD, Extended Euclid's Algorithm, Modular Inverse
- Approximation Algorithms: Vertex Cover, Set Cover
- Randomized Algorithms: Min-Cut, Randomized QuickSort

# 15. Algorithms for Emerging Areas

- **Quantum Algorithms**: Shor's Algorithm, Grover's Algorithm
- Blockchain and Cryptographic Algorithms
- **Reinforcement Learning**: Q-Learning, Deep Q-Networks