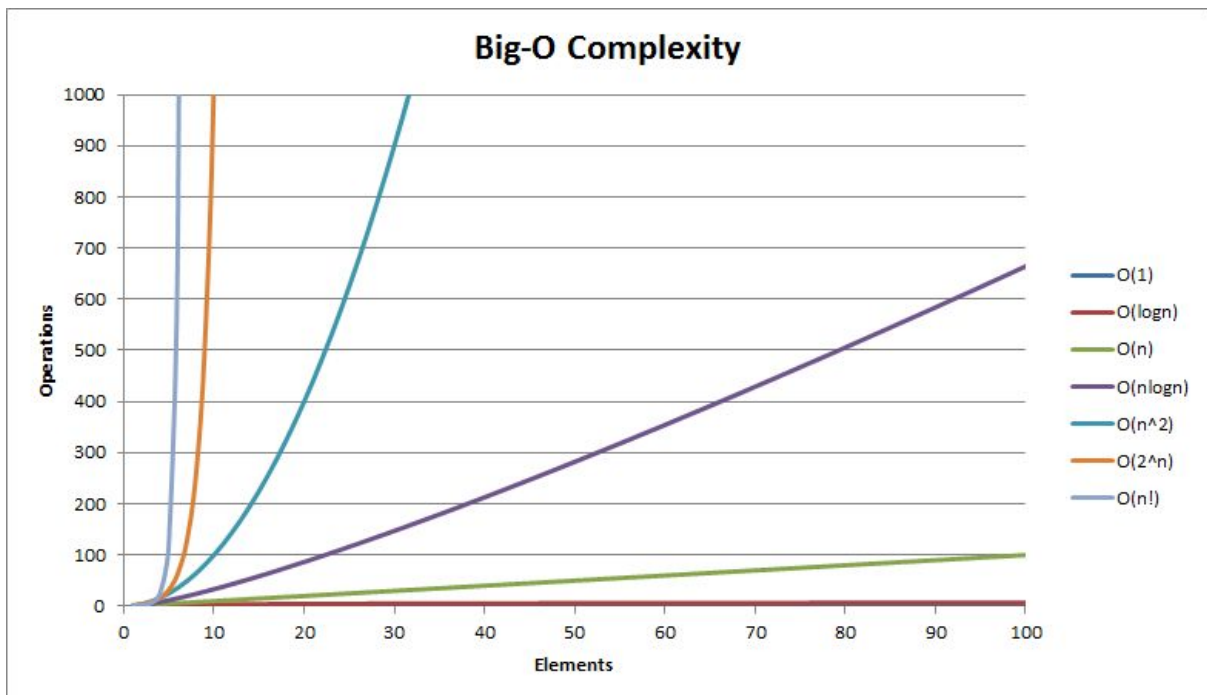


Data structures and Algorithms with their Complexities

- **Big O Complete Graph**



- Legend

Excellent

Good

Fair

Bad

Horrible

Data Structures

Data Structure	Time Complexity								Space Complexity
	Average				Worst				Worst
	Indexing	Search	Insertion	Deletion	Indexing	Search	Insertion	Deletion	
Basic Array	O(1)	O(n)	-	-	O(1)	O(n)	-	-	O(n)
Dynamic Array	O(1)	O(n)	O(n)	O(n)	O(1)	O(n)	O(n)	O(n)	O(n)
Singly-Linked List	O(n)	O(n)	O(1)	O(1)	O(n)	O(n)	O(1)	O(1)	O(n)
Doubly-Linked List	O(n)	O(n)	O(1)	O(1)	O(n)	O(n)	O(1)	O(1)	O(n)
Skip List	O(log(n))	O(log(n))	O(log(n))	O(log(n))	O(n)	O(n)	O(n)	O(n)	O(n log(n))
Hash Table	-	O(1)	O(1)	O(1)	-	O(n)	O(n)	O(n)	O(n)
Binary Search Tree	O(log(n))	O(log(n))	O(log(n))	O(log(n))	O(n)	O(n)	O(n)	O(n)	O(n)
Cartesian Tree	-	O(log(n))	O(log(n))	O(log(n))	-	O(n)	O(n)	O(n)	O(n)
B-Tree	O(log(n))	O(log(n))	O(log(n))	O(log(n))	O(log(n))	O(log(n))	O(log(n))	O(log(n))	O(n)
Red-Black Tree	O(log(n))	O(log(n))	O(log(n))	O(log(n))	O(log(n))	O(log(n))	O(log(n))	O(log(n))	O(n)
Splay Tree	-	O(log(n))	O(log(n))	O(log(n))	-	O(log(n))	O(log(n))	O(log(n))	O(n)
AVL Tree	O(log(n))	O(log(n))	O(log(n))	O(log(n))	O(log(n))	O(log(n))	O(log(n))	O(log(n))	O(n)

Data Structures

[illegible]

Searching

Algorithm	Data Structure	Time Complexity		Space Complexity
		Average	Worst	
Depth First Search (DFS)	Graph of $ V $ vertices and $ E $ edges	-	$O(E + V)$	$O(V)$
Breadth First Search (BFS)	Graph of $ V $ vertices and $ E $ edges	-	$O(E + V)$	$O(V)$
Binary search	Sorted array of n elements	$O(\log(n))$	$O(\log(n))$	$O(1)$
Linear (Brute Force)	Array	$O(n)$	$O(n)$	$O(1)$
Shortest path by Dijkstra, using a Min-heap as priority queue	Graph with $ V $ vertices and $ E $ edges	$O((V + E) \log V)$	$O((V + E) \log V)$	$O(V)$
Shortest path by Dijkstra, using an unsorted array as priority queue	Graph with $ V $ vertices and $ E $ edges	$O(V ^2)$	$O(V ^2)$	$O(V)$
Shortest path by Bellman-Ford	Graph with $ V $ vertices and $ E $ edges	$O(V E)$	$O(V E)$	$O(V)$

Sorting

Algorithm	Data Structure	Time Complexity			Worst Case Auxiliary Space Complexity
		Best	Average	Worst	
Quicksort	Array	$O(n \log(n))$	$O(n \log(n))$	$O(n^2)$	$O(n)$
Mergesort	Array	$O(n \log(n))$	$O(n \log(n))$	$O(n \log(n))$	$O(n)$
Heapsort	Array	$O(n \log(n))$	$O(n \log(n))$	$O(n \log(n))$	$O(1)$
Bubble Sort	Array	$O(n)$	$O(n^2)$	$O(n^2)$	$O(1)$
Insertion Sort	Array	$O(n)$	$O(n^2)$	$O(n^2)$	$O(1)$
Select Sort	Array	$O(n^2)$	$O(n^2)$	$O(n^2)$	$O(1)$
Bucket Sort	Array	$O(n+k)$	$O(n+k)$	$O(n^2)$	$O(nk)$
Radix Sort	Array	$O(nk)$	$O(nk)$	$O(nk)$	$O(n+k)$

Heaps

Heaps	Time Complexity						
	Heapify	Find Max	Extract Max	Increase Key	Insert	Delete	Merge
Linked List (sorted)	-	$O(1)$	$O(1)$	$O(n)$	$O(n)$	$O(1)$	$O(m+n)$
Linked List (unsorted)	-	$O(n)$	$O(n)$	$O(1)$	$O(1)$	$O(1)$	$O(1)$
Binary Heap	$O(n)$	$O(1)$	$O(\log(n))$	$O(\log(n))$	$O(\log(n))$	$O(\log(n))$	$O(m+n)$
Binomial Heap	-	$O(\log(n))$	$O(\log(n))$	$O(\log(n))$	$O(\log(n))$	$O(\log(n))$	$O(\log(n))$
Fibonacci Heap	-	$O(1)$	$O(\log(n))^*$	$O(1)^*$	$O(1)$	$O(\log(n))^*$	$O(1)$

