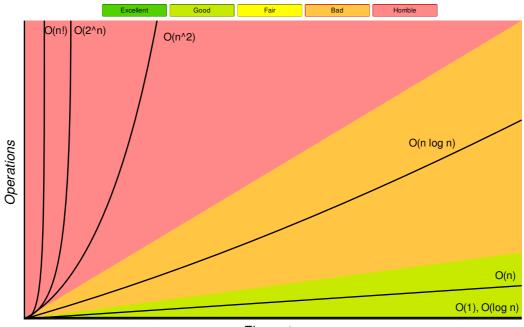
Know Thy Complexities!

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Big-O Complexity Chart



Elements

Common Data Structure Operations

Data Structure	Time Complexity							Space Complexity	
	Average				Worst				Worst
	Access	Search	Insertion	Deletion	Access	Search	Insertion	Deletion	
Array	O(1)	O(n)	O(n)	O(n)	O(1)	O(n)	O(n)	O(n)	O(n)
Stack	O(n)	O(n)	O(1)	O(1)	O(n)	O(n)	O(1)	O(1)	O(n)
Queue	O(n)	O(n)	O(1)	O(1)	O(n)	O(n)	O(1)	O(1)	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	N/A	O(1)	O(1)	O(1)	N/A	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	N/A	O(log(n))	O(log(n))	O(log(n))	N/A	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	N/A	O(log(n))	O(log(n))	O(log(n))	N/A	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)
KD Tree	O(log(n))	O(log(n))	O(log(n))	O(log(n))	O(n)	O(n)	O(n)	O(n)	O(n)

Array Sorting Algorithms

Algorithm	Time Comple	Space Complexity		
	Best	Average	Worst	Worst
Quicksort	O(n log(n))	O(n log(n))	O(n^2)	O(log(n))
Mergesort	O(n log(n))	O(n log(n))	O(n log(n))	O(n)
Timsort	O(n)	O(n log(n))	O(n log(n))	O(n)
Heapsort	O(n log(n))	O(n log(n))	O(n log(n))	O(1)
Bubble Sort	O(n)	O(n^2)	O(n^2)	O(1)
Insertion Sort	O(n)	O(n^2)	O(n^2)	O(1)
Selection Sort	O(n^2)	O(n^2)	O(n^2)	O(1)
Tree Sort	O(n log(n))	O(n log(n))	O(n^2)	O(n)

Shell Sort	O(n log(n))	O(n(log(n))^2)	O(n(log(n))^2)	O(1)
Bucket Sort	O(n+k)	O(n+k)	O(n^2)	O(n)
Radix Sort	O(nk)	O(nk)	O(nk)	O(n+k)
Counting Sort	O(n+k)	O(n+k)	O(n+k)	O(k)
Cubesort	O(n)	O(n log(n))	O(n log(n))	O(n)

Graph Data Structure Operations

Data Structure	Time Complexity						
	Storage	Add Vertex	Add Edge	Remove Vertex	Remove Edge	Query	
Adjacency list	O(V + E)	O(1)	O(1)	O(V + E)	O(E)	O(V)	
Incidence list	O(V + E)	O(1)	O(1)	O(E)	O(E)	O(E)	
Adjacency matrix	O(V ^2)	O(V ^2)	O(1)	O(V ^2)	O(1)	O(1)	
Incidence matrix	O(V · E)	O(V · E)	O(V · E)	O(V · E)	O(V · E)	O(E)	

Heap Data Structure Operations

Data Structure	Time Complexity						
	Find Max	Extract Max	Increase Key	Insert	Delete	Merge	
Binary Heap	O(1)	O(log(n))	O(log(n))	O(log(n))	O(log(n))	O(m+n)	
Pairing Heap	O(1)	O(log(n))	O(log(n))	O(1)	O(log(n))	O(1)	
Binomial Heap	O(1)	O(log(n))	O(log(n))	O(1)	O(log(n))	O(log(n))	
Fibonacci Heap	O(1)	O(log(n))	O(1)	O(1)	O(log(n))	O(1)	

Graph Algorithms

Algorithm	Time Comple	Space Complexity		
	Average	Worst	Worst	
Dijkstra's algorithm	O(E log V)	O(V ^2)	O(V + E)	
A* search algorithm	O(E)	O(b^d)	O(b^d)	
Prim's algorithm	O(E log V)	O(V ^2)	O(V + E)	
Bellman-Ford algorithm	O(E · V)	O(E · V)	O(V)	
Floyd-Warshall algorithm	O(V ^3)	O(V ^3)	O(V ^2)	
Topological sort	O(V + E)	O(V + E)	O(V + E)	