Big-O Cheat Sheet

Preface

This is a LaTeX'ed version of `http://bigocheatsheet.com/` (as of 17 February 2015).

Legend: Good Fair Poor

Searching

Algorithm	Data Structure	Time Complexity		Space Complexity
		Average	Worst	Worst
Depth First Search (DFS)	Graph of $\lvert V\rvert$ vertices and $\lvert E\rvert$ edges	-	$O(\lvert E\rvert + \lvert V\rvert)$	$O(\lvert V\rvert)$
Breadth First Search (BFS)	Graph of $\lvert V\rvert$ vertices and $\lvert E\rvert$ edges	-	$O(\lvert E\rvert + \lvert V\rvert)$	$O(\lvert V\rvert)$
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 $\lvert V\rvert$ vertices and $\lvert E\rvert$ edges	$O((\lvert V\rvert + \lvert E\rvert) \log \lvert V\rvert)$	$O((\lvert V\rvert + \lvert E\rvert) \log \lvert V\rvert)$	$O(\lvert V\rvert)$
Shortest path by Dijkstra, using an unsorted array as priority queue	Graph with $\lvert V\rvert$ vertices and $\lvert E\rvert$ edges	$O(\lvert V\rvert^2)$	$O(\lvert V\rvert^2)$	$O(\lvert V\rvert)$
Shortest path by Bellman-Ford	Graph with $\lvert V\rvert$ vertices and $\lvert E\rvert$ edges	$O(\lvert V\rvert\lvert E\rvert)$	$O(\lvert V\rvert\lvert E\rvert)$	$O(\lvert V\rvert)$

Sorting

Algorithm	Data Structure	Time Complexity			Worst Case Auxiliary Space Complexity
		Best	Average	Worst	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	$O(n)$	$O(n^2)$	$O(n^2)$	$O(1)$
Selection Sort	Array	$O(n^2)$	$O(n^2)$	$O(n^2)$	$O(1)$
Bucket sort[a]	Array	$O(n+k)$	$O(n+k)$	$O(n^2)$	$O(nk)$
Radix sort[b]	Array	$O(nk)$	$O(nk)$	$O(nk)$	$O(n+k)$

[a] Only for integers with range k

[b] Constant number of digits ‘k’

Graphs

Node/Edge Management	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	$O(\|V\|\|E\|)$	$O(\|V\|\|E\|)$	$O(\|V\|\|E\|)$	$O(\|V\|\|E\|)$	$O(\|V\|\|E\|)$	$O(\|E\|)$

Data Structures

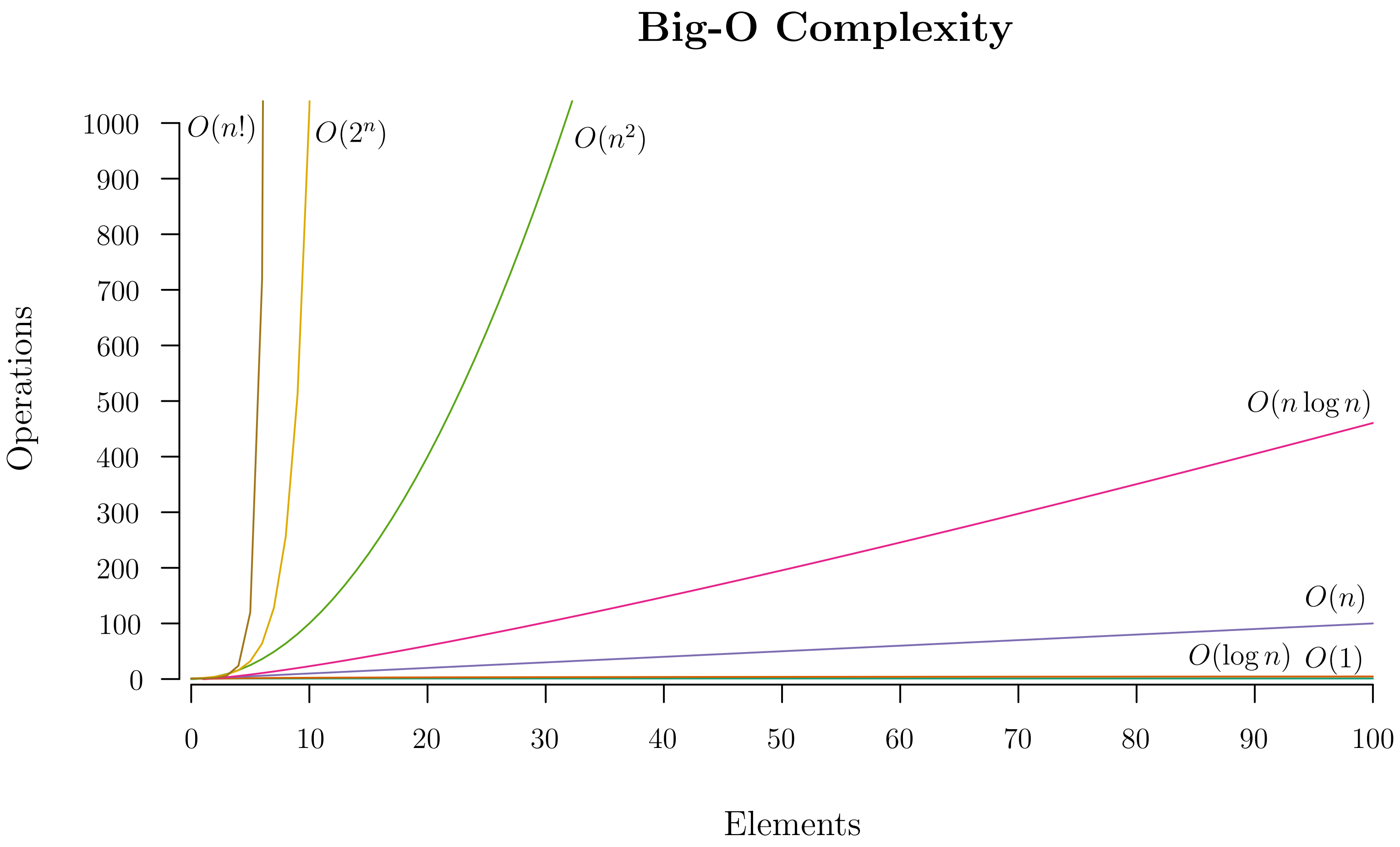
Data Structure	Time Complexity								Space Complexity
	Average				Worst				Worst
	Indexing	Search	Insertion	Deletion	Indexing	Search	Insertion	Deletion	
Basic Array	$O(1)$	$O(n)$	-	-	$O(1)$	$O(n)$	-	-	$O(n)$
Dynamic Array	$O(1)$	$O(n)$	$O(n)$	$O(n)$	$O(1)$	$O(n)$	$O(n)$	$O(n)$	$O(n)$
Singly-Linked List	$O(n)$	$O(n)$	$O(1)$	$O(1)$	$O(n)$	$O(n)$	$O(1)$	$O(1)$	$O(n)$
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	$O(\log n)$	$O(\log n)$	$O(\log n)$	$O(\log n)$	$O(\log n)$	$O(\log n)$	$O(\log n)$	$O(\log n)$	$O(n)$

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	-	$O(1)$	$O(\log n)$[a]	$O(1)$[a]	$O(1)$	$O(\log n)$[a]	$O(1)$

[a] Amortized

Big-O Complexity Chart


Big-O Complexity
Operations
$O(n!)$
$O(2^n)$
$O(n^2)$
$O(n \log n)$
$O(n)$
$O(\log n)$
$O(1)$
Elements