CheatSheet INF102

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Contents

1 Sorting Algorithms

1.1 Selection sort

Time Complexity = $O(n^2)$
Sorts an array by repeatedly selecting the smallest or largest element from the unsorted portion and swapping it with the first unsorted element. Continues until list is sorted.

1.2 Insertion sort

Time Complexity = $O(n^2)$
Simple sorting algorithm that works by iteratively inserting each element of an unsorted list into its correct position in a sorted portion of the list. The same algorithm you use when sorting playing cards. You pick a card and insert it into the correct relative position.

1.3 Bubble sort

Time Complexity = $O(n^2)$
Works by repeatedly swapping the adjacent elements if they are in the wrong order. Continues this process until it has a pass with know swaps.

1.4 Quick sort

Worst Case = $O(n^2)$ Occures with poor pivot.
Average Case = $\theta(nlog(n))$
Based on divide and conquer. Quick sort chooses a random pivot P, and swaps P with the last element. Two pointer, left bound and right bound points to index 0 and n - 1. Left bound moves to the right until it hits an element $\geq P$ or crosses the right bound. Right bound does the samle until i finds an element $\leq P$. Swap elements that right and left bound points to. Continue this process until either they crosses, this indicates that all elements smaler than P is on the left and larger are one the right. The last element right or left bound points to swap places with pivot. Since pivot was left at the end in first step. Repeat this with left and right sub-list.

1.5 Merge sort

Average Case = $(nlog(n))$
Divide the list into two smaller sublists, continues on dividing until list has size 1. Merges each of the smaller lists in correct order until everything is sorted.

1.6 Bucket sort

Average Case = $(nlog(n))$
Works if you have repeated elements in a list. Adds elements into different groups based on size. Sort each bucket on it own afterwards.

1.7 Radix sort

2 ArrayList vs. LinkedList

Operation	ArrayList	LinkedList
size()	O(1)	O(1)
add()	O(n)*	O(1)
contains(obj)	O(n)	O(n)
remove(obj)	O(n)	O(n)
toArray()	O(n)	O(n)
indexOf(obj)	O(n)	O(n)
get(int i)	O(1)	O(n)
set(int i, E e)	O(1)	O(n)

- *O(1) in amortized time (when resizing is not needed)

3 ArrayList vs. LinkedList (Queue/Stack)

	ArrayList		LinkedList	
	Queue	Stack	Queue	Stack
offer / push	O(n)	O(n)*	O(1)	O(1)
poll / pop	O(1)	O(1)	O(1)	O(1)
peek	O(1)	O(1)	O(1)	O(1)

- *O(1) in amortized time (when resizing is not needed)

4 PriorityQueue

4.1 PriorityQueue

Operation	Time Complexity
add()	O(log(n))
remove(Head)	O(log(n))
remove(Specific object)	O(n)
poll()	O(log(n))
peek()	O(1)
size()	O(1)

4.2 PriorityQueue - SortedList

Operation	Time Complexity
add(T element)	O(n)
T findMin()	O(1)
T removeMin()	O(1)

4.3 PriorityQueue - LinkedList

Operation	Time Complexity
add(T element)	O(1)
T findMin()	O(n)
T removeMin()	O(n)

5 HashSet vs. TreeSet

Operation	HashSet	TreeSet
add()	O(1)*	O(log(n))
remove()	O(1)*	O(log(n))
contains(obj)	O(1)*	O(log(n))
findMin	O(n)	O(log(n))
findMax	O(n)	O(log(n))

- *HashSet har O(1) i snitt, men O(n) i worst case

6 Heap

Operation	Time Complexity
add(T element)	O(log(n))
T peekMin()	O(1)
T removeMin()	O(log(n))
Construct heap	O(n)
delete()	O(log(n))

7 Graph Datastructures

7.1 EdgeList

Metode	Kjøretid
Adjacent	O(M)*
Vertices	O(M)
Edges	O(N)
Neighbours	O(M)*
AddVertex	O(1)*
AddEdge	O(1)*

7.2 Adjacency Set

7.3 Adjacency List

Metode	Kjøretid
Adjacent	O(1)*
Vertices	O(1)
Edges	O(M)
Neighbours	O(1)*
AddVertex	O(1)*
AddEdge	O(1)*

Method	Runtime
Adjacent	O(degree)
Vertices	O(1)
Edges	O(M)
Neighbours	O(1)*
addVertex	O(N)
addEdge	O(degree)

7.4 Adjacency Matrix

Method	Runtime
Adjacent	$O(1)$
Vertices	$O(1)$
Edges	$O(N^2)$
Neighbours	$O(N)$
addVertex	$O(N^2)$ or $O(N)$
addEdge	$O(1)$

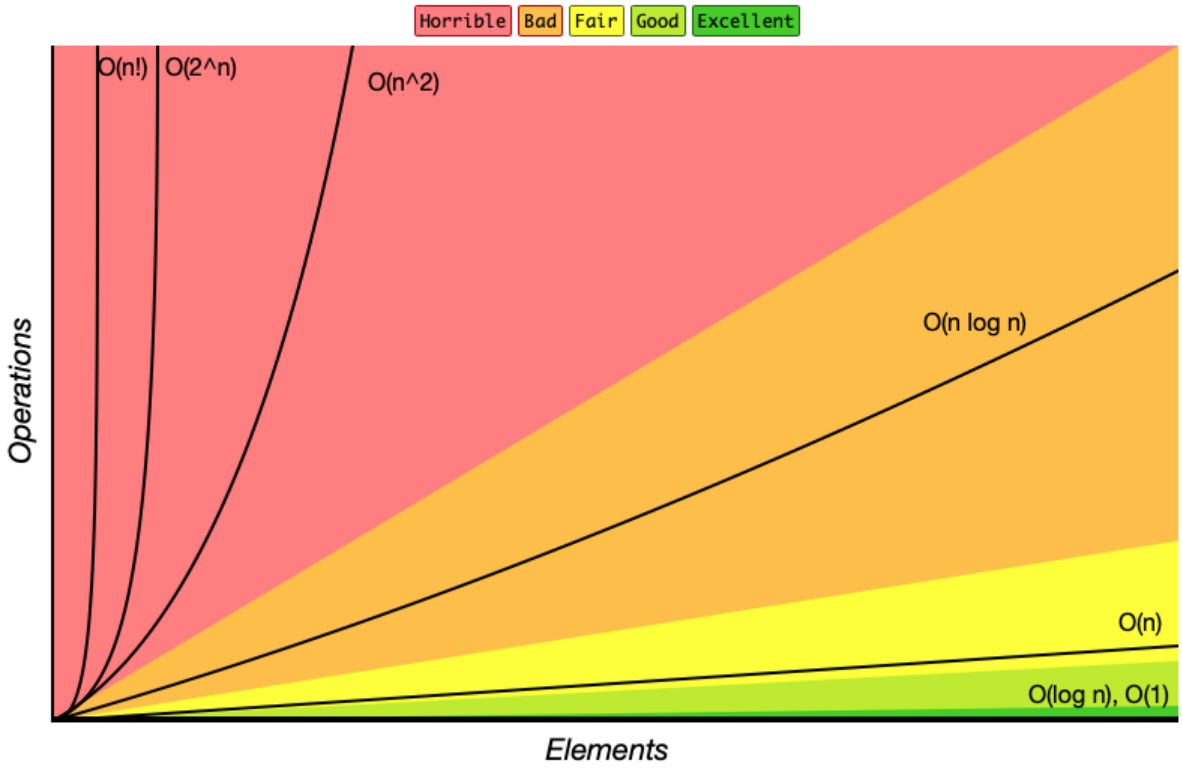
8 Summary of Graph Algorithms

Algorithm	Graph Type	Time Complexity
BFS	Unweighted	$O(m+n)$
DFS	Unweighted	$O(m+n)$
Dijkstra	Positive weights	$O(m \log m)$
Bellman-Ford	Negative weights, no negative cycle	$O(n \cdot m)$
Brute-Force	Negative weights	$2^{O(n)}$
A^*	Weighted	$mlog(n)$
Kruskal's	Weighted	$O(m \log n)$
Prim's	Weighted	$O(m \log n)$
Union-Find		$O(m \log n)^*$

Table 1: Summary of Graph Algorithms

9 Images

Big-O Complexity Chart



Common Data Structure Operations

Data Structure	Time Complexity								Space Complexity
	Average				Worst				Worst
	Access	Search	Insertion	Deletion	Access	Search	Insertion	Deletion	
Array	Θ(1)	Θ(n)	Θ(n)	Θ(n)	O(1)	O(n)	O(n)	O(n)	O(n)
Stack	Θ(n)	Θ(n)	Θ(1)	Θ(1)	O(n)	O(n)	O(1)	O(1)	O(n)
Queue	Θ(n)	Θ(n)	Θ(1)	Θ(1)	O(n)	O(n)	O(1)	O(1)	O(n)
Singly-Linked List	Θ(n)	Θ(n)	Θ(1)	Θ(1)	O(n)	O(n)	O(1)	O(1)	O(n)
Doubly-Linked List	Θ(n)	Θ(n)	Θ(1)	Θ(1)	O(n)	O(n)	O(1)	O(1)	O(n)
Skip List	Θ(log(n))	Θ(log(n))	Θ(log(n))	Θ(log(n))	O(n)	O(n)	O(n)	O(n)	O(n log(n))
Hash Table	N/A	Θ(1)	Θ(1)	Θ(1)	N/A	O(n)	O(n)	O(n)	O(n)
Binary Search Tree	Θ(log(n))	Θ(log(n))	Θ(log(n))	Θ(log(n))	O(n)	O(n)	O(n)	O(n)	O(n)
Cartesian Tree	N/A	Θ(log(n))	Θ(log(n))	Θ(log(n))	N/A	O(n)	O(n)	O(n)	O(n)
B-Tree	Θ(log(n))	Θ(log(n))	Θ(log(n))	Θ(log(n))	O(log(n))	O(log(n))	O(log(n))	O(log(n))	O(n)
Red-Black Tree	Θ(log(n))	Θ(log(n))	Θ(log(n))	Θ(log(n))	O(log(n))	O(log(n))	O(log(n))	O(log(n))	O(n)
Splay Tree	N/A	Θ(log(n))	Θ(log(n))	Θ(log(n))	N/A	O(log(n))	O(log(n))	O(log(n))	O(n)
AVL Tree	Θ(log(n))	Θ(log(n))	Θ(log(n))	Θ(log(n))	O(log(n))	O(log(n))	O(log(n))	O(log(n))	O(n)
KD Tree	Θ(log(n))	Θ(log(n))	Θ(log(n))	Θ(log(n))	O(n)	O(n)	O(n)	O(n)	O(n)

Array Sorting Algorithms

Algorithm	Time Complexity			Space Complexity
	Best	Average	Worst	Worst
Quicksort	Ω(n log(n))	θ(n log(n))	O(n^2)	O(log(n))
Mergesort	Ω(n log(n))	θ(n log(n))	O(n log(n))	O(n)
Timsort	Ω(n)	θ(n log(n))	O(n log(n))	O(n)
Heapsort	Ω(n log(n))	θ(n log(n))	O(n log(n))	O(1)
Bubble Sort	Ω(n)	θ(n^2)	O(n^2)	O(1)
Insertion Sort	Ω(n)	θ(n^2)	O(n^2)	O(1)
Selection Sort	Ω(n^2)	θ(n^2)	O(n^2)	O(1)
Tree Sort	Ω(n log(n))	θ(n log(n))	O(n^2)	O(n)
Shell Sort	Ω(n log(n))	θ(n(log(n))^2)	O(n(log(n))^2)	O(1)
Bucket Sort	Ω(n+k)	θ(n+k)	O(n^2)	O(n)
Radix Sort	Ω(nk)	θ(nk)	O(nk)	O(n+k)
Counting Sort	Ω(n+k)	θ(n+k)	O(n+k)	O(k)
Cubesort	Ω(n)	θ(n log(n))	O(n log(n))	O(n)