Algorithmic Analysis

Big O: $f(n) \in O(g(n)) \longleftrightarrow \exists c \in \mathbb{R}, n_0 \in \mathbb{Z}^{\geq 0}$ s.t. $\forall n \geq n_0, f(n) \leq c \cdot g(n)$

Big Ω: $f(n) \in \Omega(g(n)) \longleftrightarrow \exists c \in \mathbb{R}, n_0 \in \mathbb{Z}^{\geq 0}$ s.t. $\forall n \geq n_0, f(n) \geq c \cdot g(n)$

Big Θ: $f(n) \in \Theta(g(n)) \longleftrightarrow f(n) \in O(g(n)) \wedge f(n) \in \Omega(g(n))$

$\longleftrightarrow \exists c_1, c_2 \in \mathbb{R}, n_0 \in \mathbb{Z}^{\geq 0}$ s.t. $\forall n \geq n_0, c_1 \cdot g(n) \leq f(n) \leq c_2 \cdot g(n)$

Growth Rates: $1 \to \log(n) \to n \to n\log(n) \to n^2 \to n^3 \to c^n \to n!$

Recursion Analysis

Case 1: work per call follows pattern - $T(n) = T(n-1) + O(1)$
Case 2: work per level is the same - $T(n) = 2T(\frac{n}{2}) + O(n)$
Case 3: work per call is the same - $T(n) = 2T(n-1) + O(1)$

Sorting Algorithms

Sort	Worst	Best	Expected
Bubble $A[i] \overset{swap}{\leftrightarrow} A[i+1]$	$O(n^2)$	$O(n)$ *pre-sorted*	$O(n^2)$
Insertion *by next unsorted*	$O(n^2)$	$O(n)$ *pre-sorted*	$O(n^2)$
Selection *by smallest*	$O(n^2)$	$O(n)$ *pre-sorted*	$O(n^2)$
Merge	$O(n \log n)$	$O(n \log n)$	$O(n \log n)$
Quick *3-partition*	$O(n^2)$	$O(n)$ *uniform list*	$O(n \log n)$
Radix	$O(d(n+N))$	$O(d(n+N))$	$O(d(n+N))$

Basic Data Structures

Amortisation: $T(n) \div n$, where $n =$ no. of operations

	access	*insert*	*delete*	*SPACE*
Dynamic Array	$O(1)$	$O(n)$*	$O(n)$	$O(n)$
Linked List	$O(1)$	$O(n)$	$O(n)$	$O(n)$
Stack LIFO	*push*	*pop*	*SPACE*	
	$O(1)$[1]	$O(1)$	$O(n)$	
Queue FIFO	*enqueue*	*dequeue*	*SPACE*	
	$O(1)$	$O(1)$	$O(n)$	
[1] *amortised if array-based implementation*				

Trees

Proper Binary Tree: internal nodes have 2 children (levels $\leq$ full)
Complete Binary Tree: levels $0 \to h-1$ full, level h left-most

Pre-Order	In-Order	Post-Order
self $\to$ left $\to$ right	left $\to$ self $\to$ right	left $\to$ right $\to$ self

Properties:

- Full level L has 2^L nodes (note $L \geq 0$)
- Max no. of nodes = $2^h - 1$, max internal nodes = $2^{h-1} - 1$

Other

test