

23 Aug 2023

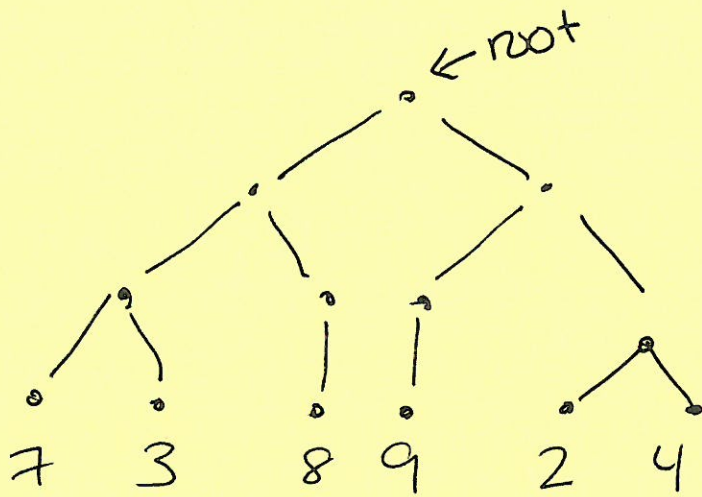
Advanced Algorithms

- ① What algorithms do you already know?
- ② What is an algorithm?
- ③ You: year, other classes? get to know each other!



① Algorithms we know

- depth-first search (DFS) } WFS
- breadth-first search (BFS) }
- binary search over a sorted array or BST
- sorting algorithms
 - bubble sort, worst case complexity $\Theta(n^2)$
 - quick sort, most implemented in production code
 - selection sort
- Dijkstra's algorithm: BFS on weighted graphs
- linear search ← for unsorted data or for searching in a list
- more sorting:
 - insertion sort
 - merge sort



this is a binary tree: each node has at most 2 children

* a binary search tree (BST) is a binary tree whose leaves are ^{totally} sorted & each node splits into above/below a certain threshold.

Algorithm

- set of instructions
- given an input, produces an output
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- output: can be returned, editing some saved variable, print to screen, ...
- many are deterministic = known input will always produce the same output
- others are probabilistic:
- there are properties of the output, based on what the input is, that must be met
- finite → otherwise, ^{we call them} procedures or "streaming algorithms"

Analysis of Algos

Algorithm 1

1: $x \leftarrow 0$
2: $x = x + 1$
3:
:

} a linear sequence of commands, each of which is $\Theta(1)$.

10: return x

~~Property X = the property required for line 10~~

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① Correctness = the program returns what it is supposed to return

stmt $A = x$ stores the correct return value

stmt $B =$ line 10 returns x

$A + B \Rightarrow$ Algorithm 1 above is correct