

Search - is x in ℓ ?

Runtime to search in linear data structures (unsorted) is $O(n)$

Linear search -

Average case: $n/2$

However, if probability access index i is
$$(1-p)^{i-1} p$$

Then $O(1)$ search in expectation.

Pre-processing - process data before use to save time in the future!

Suppose data was sorted - how could we search?

Binary Search

Why does this work? A **loop invariant** is a property that holds before and after each iteration of a program.

What are some loop invariants above?

Since these invariants hold and upper-lower decreases in each iteration, either find x or terminate and return not in ℓ .

Storytime

Binary search & pre-processing are so useful!

• 2-Sat $(x_1 \vee x_2) \quad (x_2 \vee \bar{x})$

iterate through & compute function on clauses w/ x_i

- Want to solve max customers visited
s.t. route length $\leq B$
but can actually solve min route length
s.t. # customers $\geq k$

Group Work

- Efficiently find # copies of x in l
(use loop invariants)
- Use binary search to calculate \sqrt{x} up to some specified precision. What is runtime?
- Alice has forgotten everything outside of DSA, including where she lives. One night she exits her favorite restaurant but can't remember which direction to walk in (she does know she lives on this street). Define an efficient way for Alice to get home.

Quick Think!

- A company has a database of 10,000 customers, 40% of which are preferred customers who account for 66% of accesses. Which of the following data structures should the company use?
 - Put all customers in a single array and use binary search.
 - Put preferred customers in one array and others in another. If customer is not found in the first array, search the second.

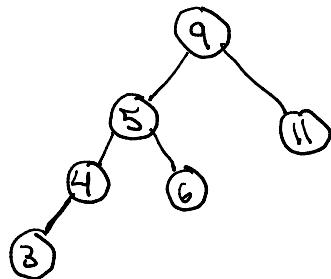
What if linear search is used?

More Trees!

A **Binary Search Tree**. Is a tree... 1 ...

more trees!

A **Binary Search Tree** is a tree-based data structure such that any node has value \leq values in left subtree and \geq values in right subtree.



Time to search?

A **self-balancing** tree updates to keep height $\leq \lceil \log n \rceil$ and such that

- insert
- delete
- search

Why do we want to use?

Hash tables next week!

Group Work

[Brain Teasers](#) | [Brooklyn Nine-Nine](#) | [Comedy Bites](#)
Comedy Bites



- 12 islanders, 1 not the same weight

- 12 islanders, 1 not the same weight
- Can use scale (see-saw) 3 times

