Binary Search

Notebook:	Problem Solving		
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Binary Search - Reduce the size of the search space significantly with each iteration.

Applications:

1. Used to efficiently store data in sorted form in order to access and search stored elements quickly.
2. They can be used to represent arithmetic expressions
3. BST used in Unix kernels for managing a set of virtual memory areas (VMAs).
4. Binary search can be used to find square root. Find an upper bound, find a lower bound. Then apply a a search between the bounds.

Interesting Reads:

- What happens if the values of 'left' and 'right' are way bigger than what you can store? https://ai.googleblog.com/2006/06/extra-extra-read-all-about-it-nearly.html

When to use binary search?

The monotonic nature of course. if y = f(n) : where n is your input, f() is the problem and y is your expected output, if this shows a monotonic behavior, (that is increases or decreases, depending on the increase or decrease of the parameter), generally this tells you that you can apply a binary search here. (It's a bird's eye view but most of the case this is similar). I think in any case you want to use a binary search, this property must hold.

And, to know if it requires a binary search, first, it is a O(lg(n)) algorithm. So if you become certain that your program will be too slow for O(n^2) to pass, often you can use a O(n lg n) approach where you eliminated a linear portion with binary search of some form, or when you see your program will be too slow for O(n), it means you have to opt for binary search instead of linear approach.

We can use binary search algorithm on any monotonic function whose domain is the set of integers. For example, we will find x for which f(x) is equal to some target value.

What is a monotonic function?

A monotonic function is a function which is either entirely nonincreaseing or nondecreasing. A function is monotonic if its first derivattive (which need not be continous) does not change sign. That is, barte thakle bartei thakbe or same. Opposite for nondecreasing.