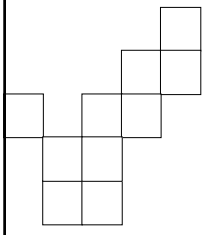

Topics In Programming

Why Algorithms Matter: Search

Searching A List

- If there's no order to the list (like the deck of cards)...
  - best you can do is start at the beginning
  - This is called sequential or linear search
- Binary search is a simple, common sense way to search through an *ordered* set of items.
  - Questions, often referred to as queries or probes, are asked to *find if the desired item is smaller or larger*.
  - If the question is chosen from the middle of the sequence, ½ the possibilities are eliminated with each answer.
  - It's a bit like 20 questions, but MUCH more specific.

How Good is a Particular Algorithm?

- You might think we can't answer this question without programming a computer and trying it.
- Amazingly, it is possible to make very good comparisons between algorithms without programming them!
- Basic idea: estimate the number of "steps" each algorithm needs to solve the problems.
- This gives us an abstract, mathematical way to compare the speed of different algorithms

Algorithm vs. Program

- Remember that an algorithm is an abstraction.
- We can apply it, at least mentally, to a variety of situations, even without a computer
- A program incorporates all the details needed for a computer to perform the algorithm
- A program for search will encode the algorithm for a specific situation, in a specific language, with specific assumptions

Battle of the Algorithms

- Binary Search: Each question allows you to throw out half of the unexamined items (throw half of the phone book away each time)
- Linear Search: Each question lets you tear out only one page, or throw out one card

Do The Math for Searching 200 Items

	linear	binary
step 0	200 remaining	200
step 1	199	100
step 2	198	50
step 3 see where it's going?	197	25

Bottom Line

- It can be shown mathematically that when a sorted list of N items is to be searched…..
- Linear search needs on average about N/2 steps
- Binary search needs on average about Log_2N steps
  - No, you don't have to be able to compute Log_2N !
  - Just remember this, the bigger N is, the bigger the improvement.
  - So, the larger the number of things to be searched, the faster binary search becomes

Trade-Offs

- If we know algorithm A has a better formula than algorithm B:

Would we ever still want to use algorithm B??

Searching a small set of things: 20

	linear	binary
step 0	20 remaining	20
step 1	19	10
step 2	18	5
step 3 Could you tell the difference in time if a computer does the search?	17 …	3 …