Computer Algorithms

Binary Search

The Art of Algorithms

...

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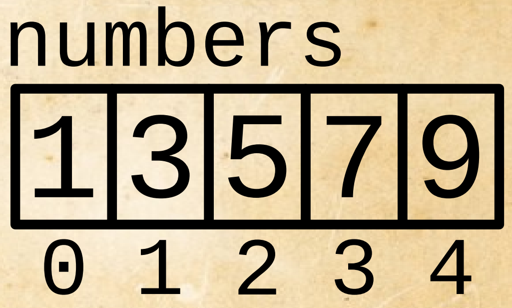
If there is a lot of data to process,
we use the strategy of “divide and conquer”

Lecture Contents

- Review Linear Search
- Binary Search
- Reading:
  - "*Searching Algorithms: Binary Search*" (top of page 20 until end of page 22), including *Efficiency of Searching Algorithms*

Linear Search

- Not very efficient
- Frequently used because it’s very simple
- Start at the beginning and go through each element step by step



Binary Search

- Consider… how do you find a specific page in a book?
  - Linear search?
    - Start at page 1 and keep flipping through the pages?

Binary Search

- Consider… how do you find a specific page in a book?
  - Linear search?
    - Start at page 1 and keep flipping through the pages?
  - **Divide and conquer!**
    - Open the book somewhere in the middle.
    - Is it the right page?
    - Do we need to search before or after this page?
    - (repeat until found)

Binary Search

- Things to consider about ***binary search***
  - Requires the data to be sorted
    - It takes much longer to sort the data than it does to do a linear search

Binary Search

- Things to consider about ***binary search***
  - Requires the data to be sorted
    - It takes much longer to sort the data than it does to do a linear search
  - The benefits are only significant when the data set is large
    - While the code for ***binary search*** is slightly more complicated than for ***linear search***.

Binary Search

- We can estimate time by counting the number of comparisons...
  - How long does it take to find an element using ***linear search***,
    - worst case?
    - on average?
  - How long does it take to find an element using ***binary search***, worst case?

-7	1	4	9	13	21	21	22	32	92
0	1	2	3	4	5	6	7	8	9

Binary Search

- We can estimate time by counting the number of comparisons...
  - How long does it take to find an element using ***linear search***,
    - worst case? **10 comparisons → for *n* elements, *n* comparisons**
    - on average? **For *n* elements, (*n+1)*/2 comparisons, close enough to (n/2)**
  - How long does it take to find an element using ***binary search***, worst case?

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Binary Search

- We can estimate time by counting the number of comparisons...
  - How long does it take to find an element using ***linear search***,
    - worst case? **10 comparisons → for *n* elements, *n* comparisons**
    - on average? **For *n* elements, $(n+1)/2$ comparisons, close enough to (n/2)**
  - How long does it take to find an element using ***binary search***, worst case?
    - **$\log_2(n)$**

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Computer Algorithms

Binary Search