WEEK FOURTEEN

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ALGORITHMS

- Approach to solving a computational problem
- Algorithms must be:
 - Finite: must terminate eventually
 - Correct: must solve the problem every time
 - Deterministic: made of concrete, computer-executable steps, and produce the same output every time
- Good algorithms are:
 - Bug-free
 - Secure
 - Fast
 - Don't hog memory

SEARCH ALGORITHMS

- Linear search
 - Step through items one-by-one until the desired item is located
- Binary search
 - Requires a sorted list
 - Split the list in half, check if the value is greater than or less than the central pivot
 - If greater, move to the right side of the list and repeat
 - If less than, move to the left side of the list and repeat

SORTING ALGORITHMS

- Selection sort
 - Remove the min/max item from an unsorted list and add (swap) it to the beginning/end of a new sorted list
- Insertion sort
 - Take each element, in position order, and move it into the appropriate sorted location in a 'new' sorted list
- Bubble sort
 - Sort in multiple passes
 - In each pass, successively swap neighboring elements if they are in the wrong natural order
 - Continue passes until all elements are fully ordered

Selection

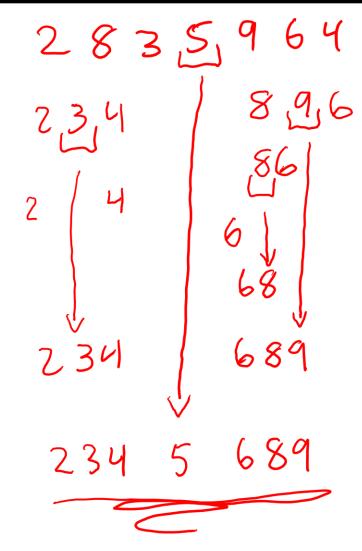
Insertion

Bubble

Bass &

2354689 2385964 2358649





SORTING ALGORITHMS CONTINUED

- Merge sort
 - Usually done recursively
 - Divide array into two halves
 - As base case, sort the two remaining values
 - Upon exiting the recursive call, poll items from each half in order
- Quick sort
 - Pick a pivot
 - Reposition items so all items less than pivot will appear to its left and all greater items will appear on the right
 - Continue on smaller and smaller portions until the list is sorted

BIG-0

- How long an algorithm takes to run in relation to the input
- Function can be simplified by:
 - Removing any constant coefficients
 - Removing all but the highest order term
- Example:
 - $7n^2 + 5^n + 3$ becomes...
 - n²

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COMMON RATES OF GROWTH (BY MAGNITUDE)

- O(1) constant
- O(log n) logarithmic
- O(n) linear
- O(n * log n) log-linear
- O(n^c) polynomial
 - $O(n^2)$ quadratic
 - $O(n^3)$ cubic
 - Etc.

- O(cⁿ) exponential
 - O(2ⁿ)
 - O(3ⁿ)
 - Etc.
- O(n!) factorial

https://www.desmos.com/calculator/jpskgp3y7a

SORTING ALGORITHMS AND THEIR COMPLEXITY

- Selection
- Insertion
- Bubble
- Merge
- Quick

- $O(n^2)$
- $O(n^2)$
- $O(n^2)$
- O(n log(n))
- O(n²)