2017-09-07

Course Schedule

1. Search & sort using **comparison model**
    - **Comparison model** = the model of the situation in which you don't have foreknowledge of the structure of the array
2. Graphs, traversal, and shortest paths using **dynamic programming**

What is an algorithm?

- **Algorithm** = an efficient way to solve a problem
    - **Problem** = a system that describes the desired relation between an input and an output
        * Algorithm can be thought of as an instantiated solution to a problem
    - Al-Khwarizmi = Arab philosopher that developed Algebra
        * Term algorithm comes from the quadratic formula

Why study algorithms? Why not just code?

1. We wouldn't know whether our code is correct
    - Code is the encoding of an algorithm, but that still leaves the problem of designing good algorithms
2. We wouldn't know how efficient/scalable our code is
    - **Worst case runtime** = the amount of time associated with completing an algorithm with the worst possible input
3. We wouldn't create elegant solutions

Abstract vs Instance

- Programs are an instance of an algorithm
- A computer/CPU is an instance of a **model of computation**
    - **Model of computation** = a set of defined operations that can be performed in constant time
        * **Random Access Machine** = a model of computation that thinks of data as belonging to cells in an infinite array

        - **Word** = a segment of the infinite array that constitutes one discrete piece of data(like 16-bit word, 32-bit word, etc)
    * **Pointer machine** = a model of computation that is based on dynamic memory allocation
        - Very similar to random access machine, but permits the use of pointers as words

Data Structures

- **Data structure** = a defined abstract unit that encodes specific information
  - Array = elements that take up space linearly in a memory store
  - Hash = elements are tagged with a unique hash
  - Heap =
  - Adjacency List = a collection of nodes which stores information about the location of adjacent nodes as well as the contents of a node
  - Binary tree = a sorted
- Different data structures are more efficient at different things

Algorithmic Design Strategies

- Brute force
- Greedy
- Divide & Conquer
  - Typically leads to more elegant solution

Local Maximum in Array

- **Local maximum** = an element whose neighbors are smaller or equal to the element
- Brute force approach
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- Greedy approach
- Divide & Conquer approach
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  - **Invariant**