DATA STRUCTURES AND ALGORITHMS

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BS (AI)

Course Overview

Data Structures
Definitions

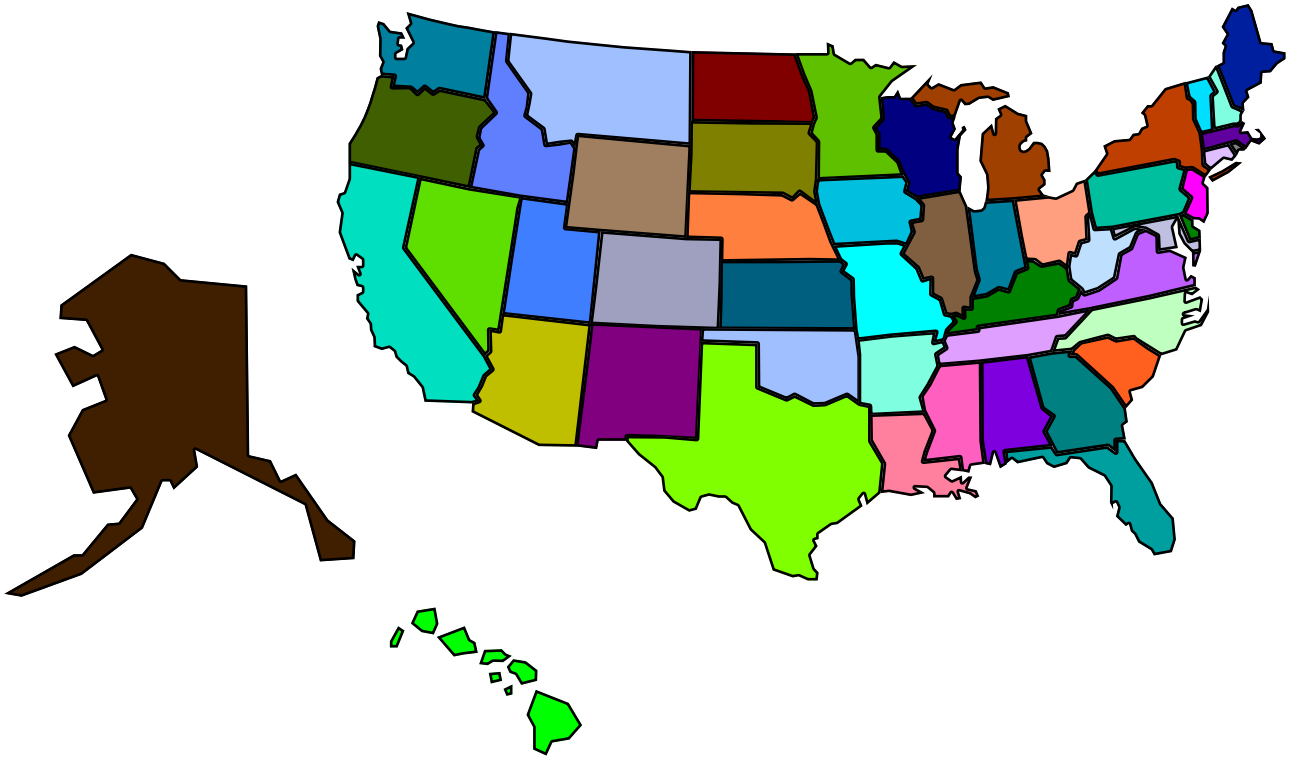
Ways to organize and store data

- Data Storages

Ways to access and manipulate the stored data.

- Methods to access storages

Example (adjacent states)



Problem

Definition: *adjacency:* if two states share a boundary, the two states are *adjacent*.

Given a state *X*, print a state *Z* that is not adjacent to *X*, but is adjacent to a state *Y* adjacent to *X*.

- for example,
  - Input: North Carolina
  - Output: Florida

Come up with Data Structures

Suppose you have only the following information

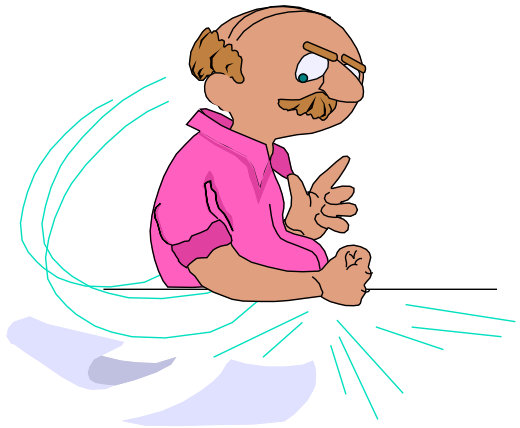
- for each state x, the list of states that are adjacent to state x.
- for example,
  - North Carolina : Georgia, south Carolina, Virginia, Tennessee.

How are you going to store this adjacency information to solve the problem efficiently?

Lessons

Different data structures lead to different ways to solve a given problem. (algorithms).

Different algorithms may give different efficiency (space and time).



Course outline

How to measure the efficiency of an algorithm.

- Each data structure has a different use and application. So we will also study….
  - Applications (problems), algorithms.
  - Their efficiency.

Course outline

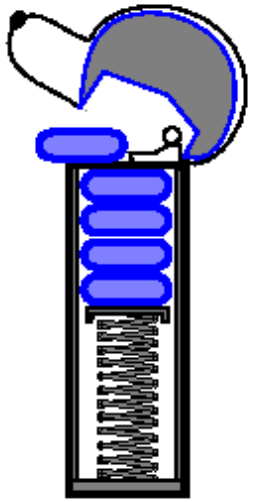
Data Structures

- Arrays
- Stacks, Queues
- List
- Priority queues
- Search Trees
- Graphs
- etc …

Stack

A container of objects that are inserted and removed according to the last-in-first-out (LIFO) principle.

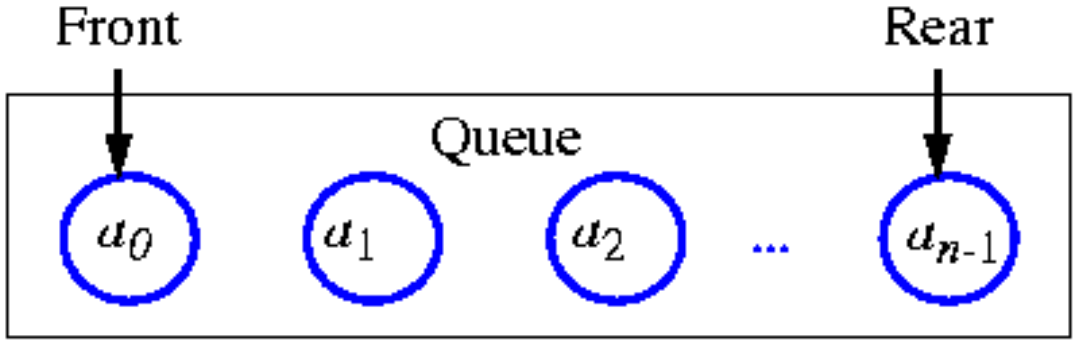
Only the last (the most recently inserted) object can be removed.



Queue

Differs from a stack in that its insertion and removal follows the first-in-first-out (FIFO) principle.

The element which has been in the queue the longest may be removed.



List

A collection of linearly arranged element (a linear order).

Provides methods for accessing, inserting, and removing arbitrary elements.

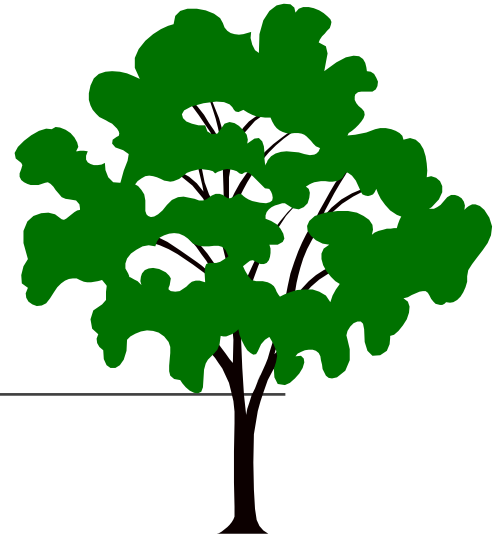
Notion of position, before and after.

Stacks and queues are a restricted form of a sequence.

Example,

- A,B,C,D,E,F
- a_1, a_2, a_3,…

Tree



A collection of objects arranged in a hierarchical fashion.

E.g., organization of a corporation, a table of content, dos/unix file systems, family tree.

Notion of parents and children, root and leaves.

Priority queue

An abstract type for storing a collection of prioritized elements that supports arbitrary element insertion but support removal of elements only in order of priority.

Examples…..

Graphs

Representing a way of connections or relationships between pairs of objects.

Algorithms and Applications

Every computer software uses some collections of data structures.

We will study algorithms to efficiently solve problems using various data structures.

Proof techniques for correctness or efficiency.