EE 205: Lecture 1, Introduction

Data Structure and Algorithms for Electrical Engineering

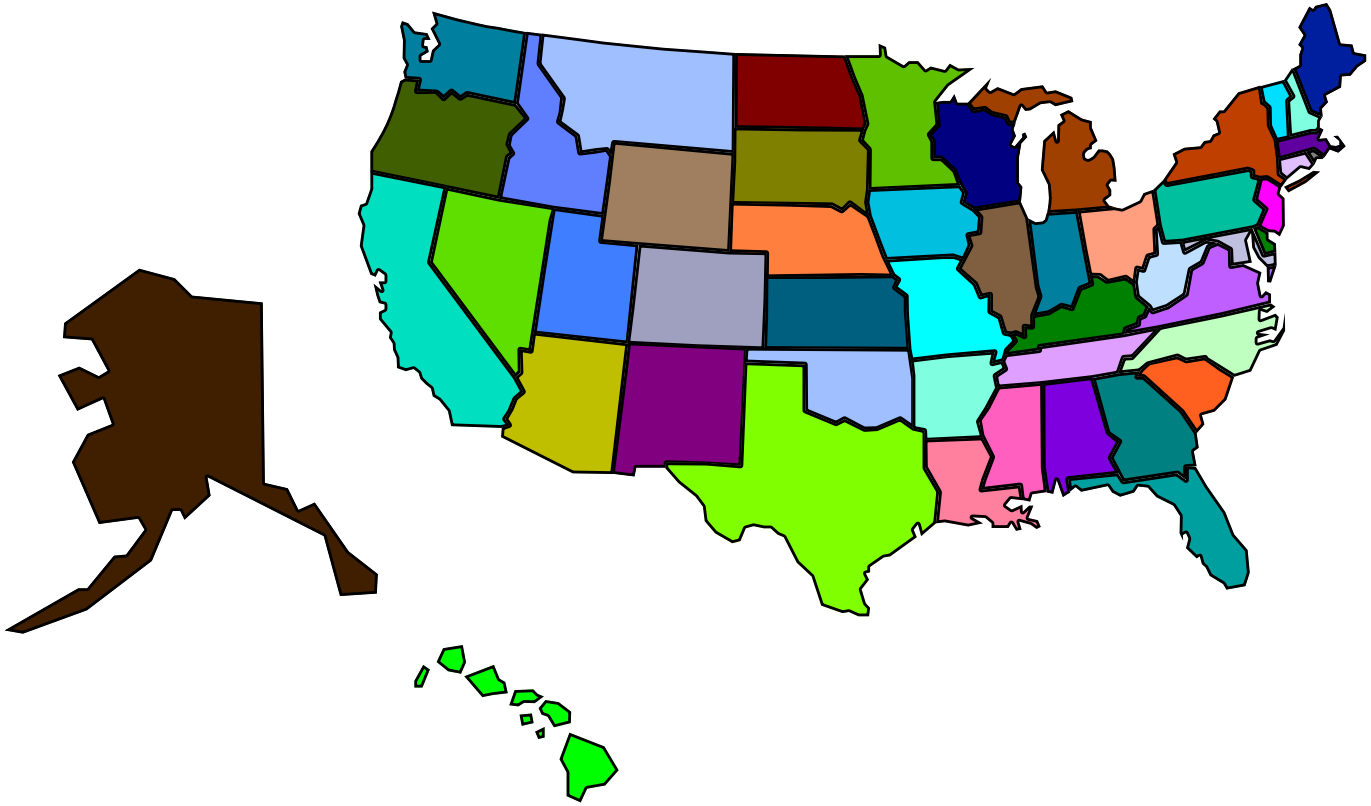
Yung Yi

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*.

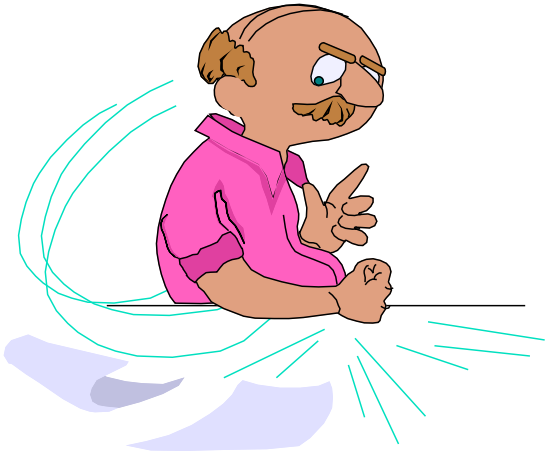
- Given a state *X*, print a state *Z* that is not adjacent to *X*, but is adjacent to a state *Y* adjacent to *X*.
  - ✓ for example,
    - Input: North Carolina
    - Output: Florida

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

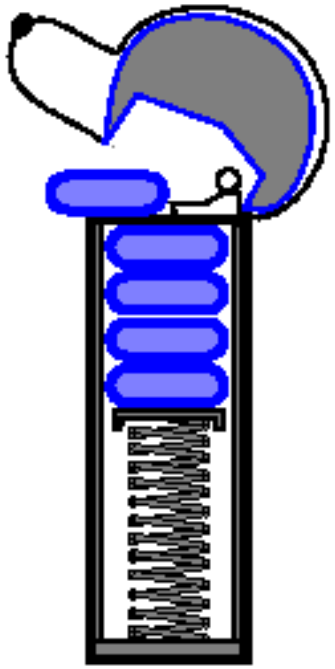
- First Topic: How to measure the efficiency of an algorithm.
  - ✓ Each data structure has a different use and application. So we will also study….
    - Applications (problems), algorithms.
    - Their efficiency.

Course outline

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

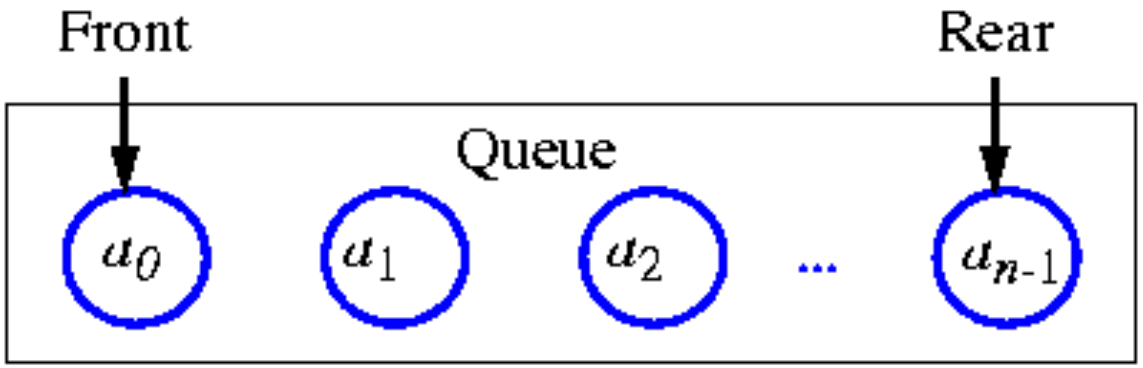
Stack

- 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.



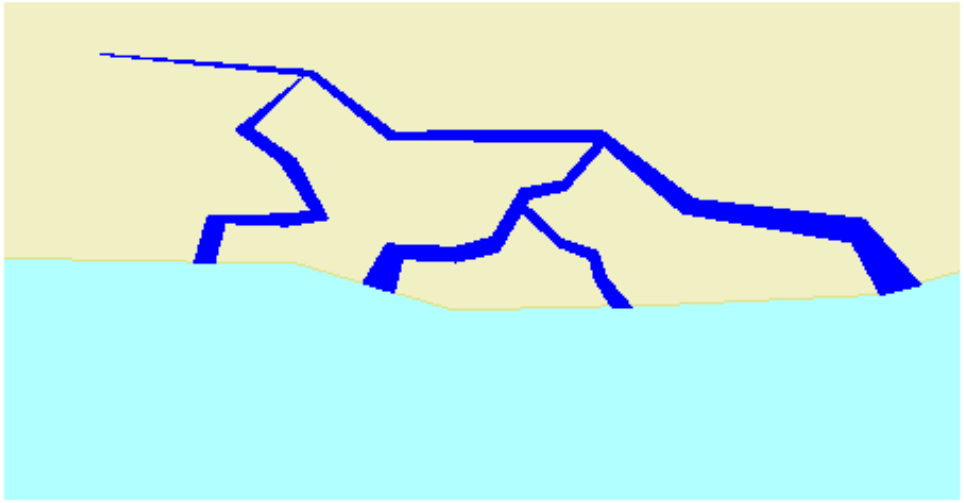
List

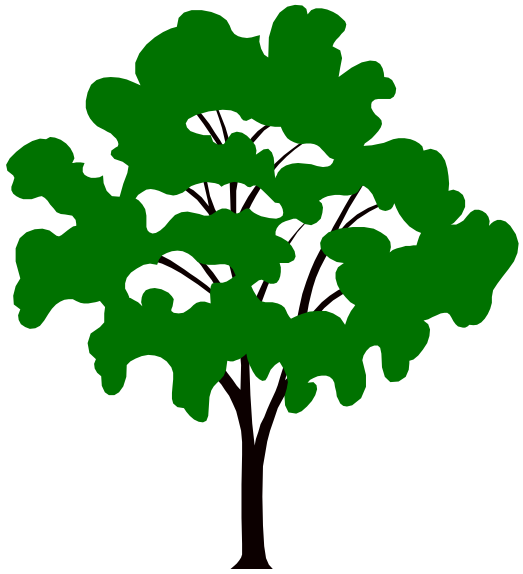
- A collection of linearly arranged element (a linear order).
- Provides methods for accessing, inserting, and removing arbitrary elements.
- Notion of position, before and after.

  - 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.



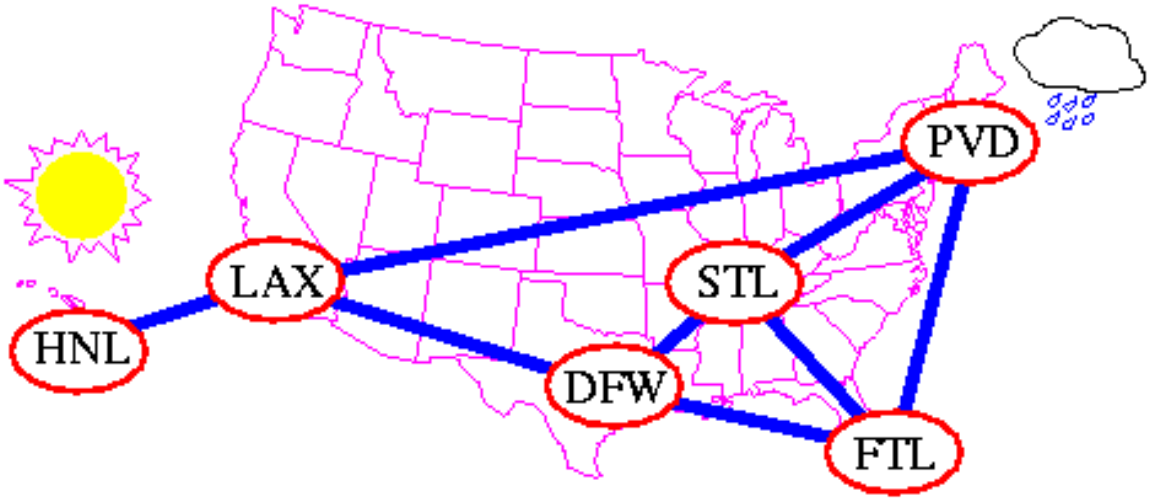


Priority queue

- 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…..

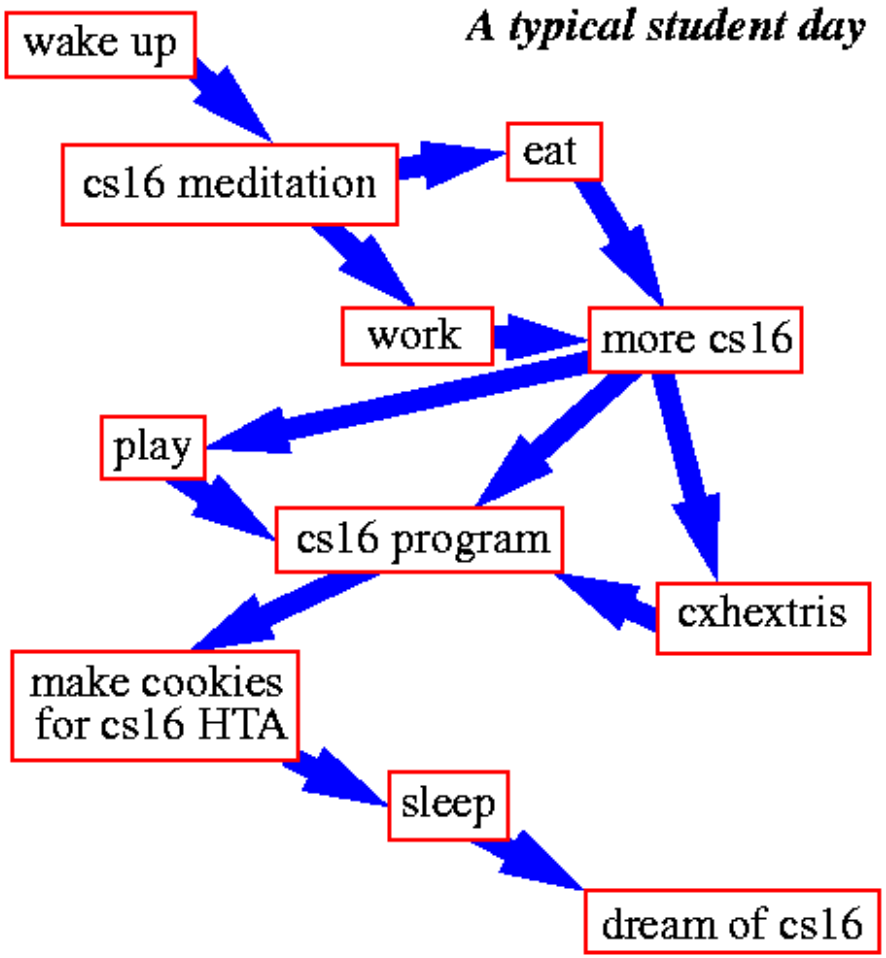
Graphs

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



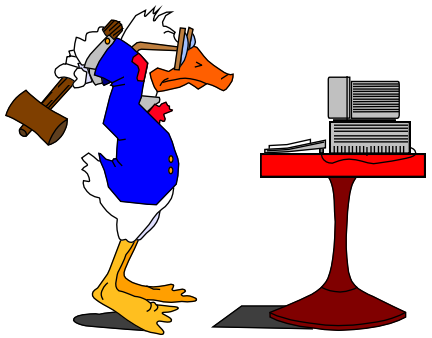
Graphs

- Not only physical connectivity, but also logical relationship.



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.



Questions?