ENSF 594
Lecture 01
Data Structure - Introduction

Dr. Sohaib Bajwa

Why study Data Structures?

- Manage the complexity of the problems
- To create better and more efficient problem solving process
- Example:
  - How to give result efficiently when you have millions of data?

Definitions

- Data Structure: the organization of elementary data types into a larger, structural aggregate

- User to store data for an application
- May be directly supported by a programming language
  - e.g. Arrays and structs in C
- Usually created by a programmer
  - Reusable code for a data structure may be kept in a library
    - E.g. Stack class in java.util

Definitions (cont'd)

- Algorithm: a well-defined set of instructions for solving a problem
- May be expressed:
  - Informally (e.g. in plain English)
  - Formally, using specially designed mathematical notations
- Is abstract
  - Is independent of its implementation (i.e. code written in a particular language)

Definitions (cont’d)

- Abstract Data Type (ADT): a data structure accompanied by a set of access functions
  - Can also be referred as mathematical model of a data
- The implementation details are concealed from client code
  - Uses information hiding
- The functions:
  - Create objects of the ADT
  - Access the contents of the data structure

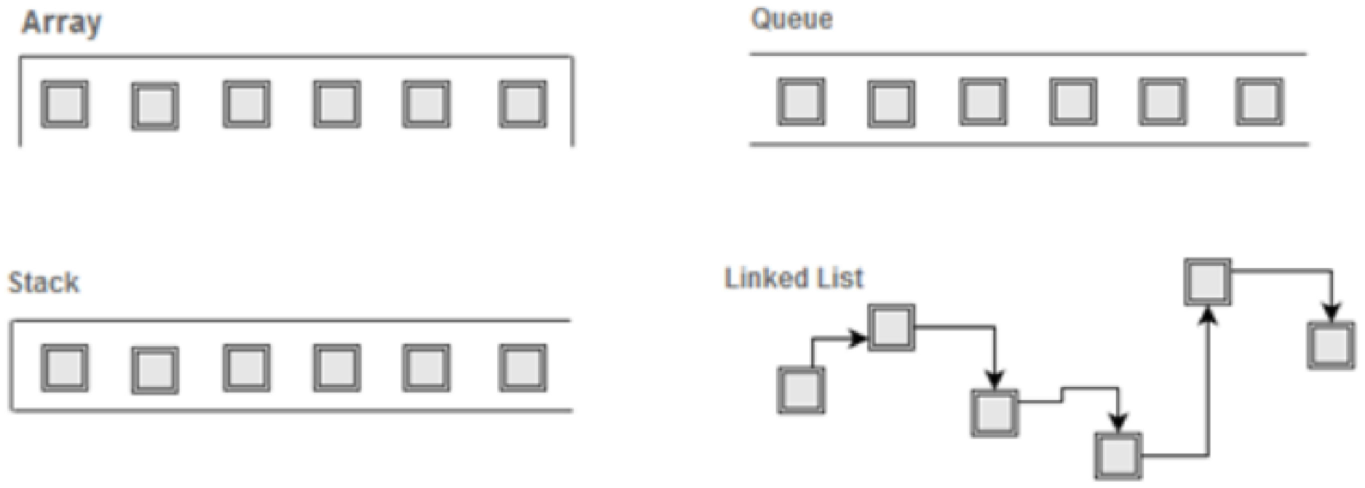
• Classes in OO language are ADTs where the concealment is enforced by language syntax

E.g. Stack ADT

Access functions: new, push, pop

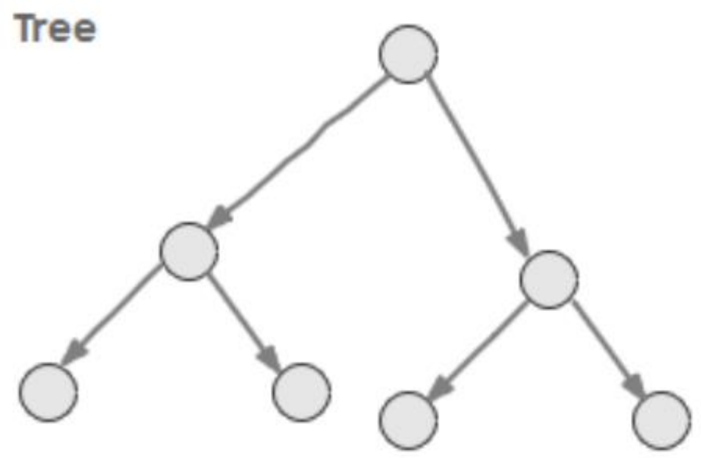
Classification of Data Structures

- Linear Structures
- Items are ordered depending upon how they are added or removed.
    - Item stays in that position relative to the other elements that came before and came after it.



Classification of Data Structures

- Hierarchical Structures (Trees)

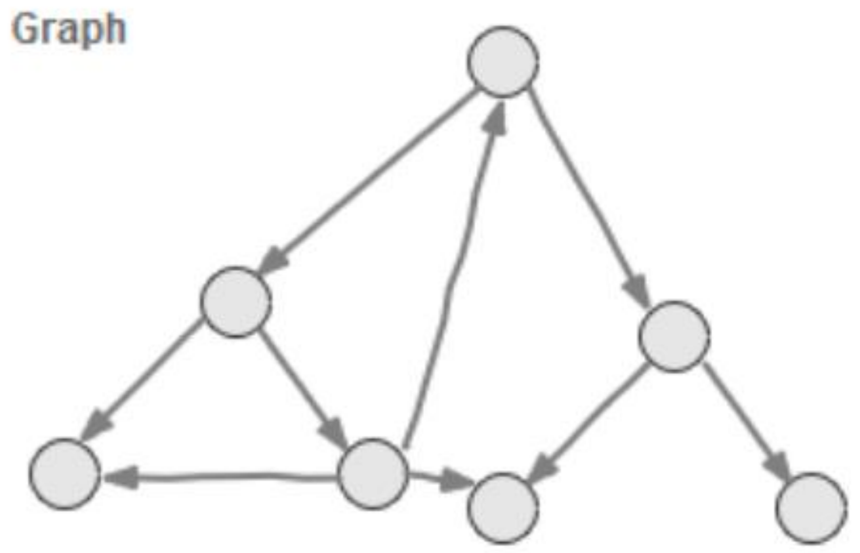


- Difference between Tree in nature and in Computer Science?
- Create a simple Tree?
- Example of Tree application?

Classification of Data Structures

- Graph Structures
- A more generalized structure
    - Trees are specific form of a Graph

- Example of some common graph structures



Operations on Data Structures

- Most data structures are dynamic
  - i.e. they can grow larger and smaller over time

- Modifying operations change the size of the data structure
  - Insert: adds a record to the data structure
  - Delete: removes a record

Operations on Data Structures (cont’d)

- Querying operations return information from the data structure
  - Search: returns a pointer to a record that matches a key value, or nil if there is no match
  - Minimum: returns the record with the smallest key
  - Maximum: returns the record with the largest key

Operations on Data Structures (cont’d)

- Successor: given some records, returns the next larger record, or nil if the record is the maximum record
- Predecessor: given some records, returns the next small record, or nil if the record is the minimum record

Operations on Data Structures (cont’d)

- Other operations modify the contents of a record in the data structure
  - Replace: replaces an entire record with another
    - Could be done with a delete and insert
  - Update: overwrites one or more fields in a record

Any questions?