CSE-281: Data Structures and Algorithms

Introduction

Ref. Book: Schaum's Outline Series, Theory and problems of Data Structures
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Course Outline

- Concepts and Examples
- Elementary Data Objects
- Elementary Data Structures
- Arrays
- Lists
- Stacks
- Queues
- Graphs
- Trees
- Sorting and Searching
- Hash Techniques

Books

- Schaum's Outline Series, Theory and problems of Data Structures

  By Seymour Lipschutz

- Data Structures and Algorithms

  By A. V. Aho, J. E. Hopcroft, J. D. Ullman

- Data Structures Using C and C++

  By Y. Langsam, M. J. Augenstein, A. M. Tenenbaum

- Fundamentals of Computer Algorithms

  By Ellis Horowitz, Sartaz Sahni

Introduction

- To exactly know, what is data structure? We must know:
  - ***What is a computer program?***

Figure 1: Input-Processing-Output

Elementary Data Organization

- Data are simply values or sets of values.
- Collection of data are frequently organized into a hierarchy of fields, records and files.
- This organization of data may not complex enough to maintain and efficiently process certain collections of data.
- For this reason, data are organized into more complex type of structures called Data Structure.

Elementary Data Organization

- The way in which the data is organized affects the performance of a program for different tasks.
- Computer programmers decide which data structures to use based on the nature of the data and the processes that need to be performed on that data.

Data Structure

- Definition — In computer science, a data structure is a data organization, management and storage format that enables efficient access and modification.

- In Simple Words —

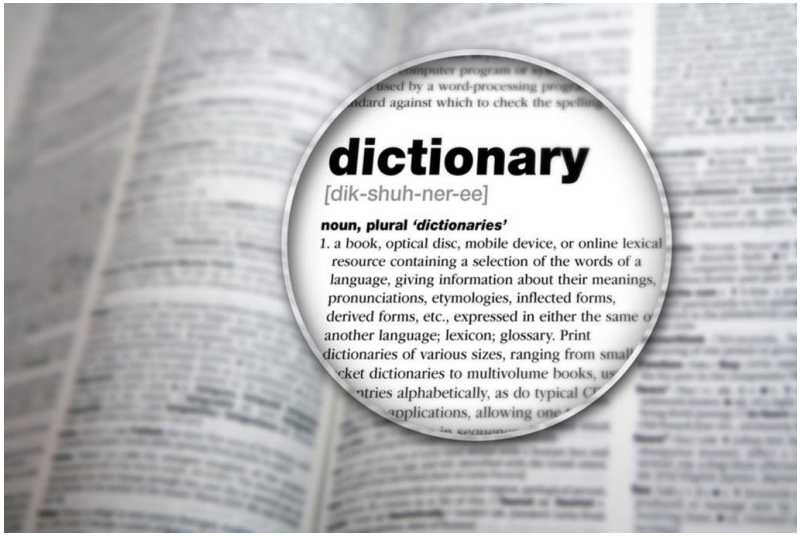
Data Structure is a way in which data is stored on a computer.

Why do we need Data Structure

Data structure is a particular way of storing and organizing information in a computer so that it can be retrieved and used most productively.

- Each Data Structure allows data to be stored in specific manner.
- Data Structure allows efficient data search and retrieval.
- Specific Data structures are decided to work for specific problems.
- It allows to manage large amount of data such as large databases and indexing services such as hash table.

Real World Scenario



Data Structures

Data Structures

The logical or mathematical model of a particular organization of data is called a data structure.

Types of Data Structure

1. Linear Data Structure

   Example: Arrays, Linked Lists, Stacks, Queues

2. Nonlinear Data Structure

   Example: Trees, Graphs

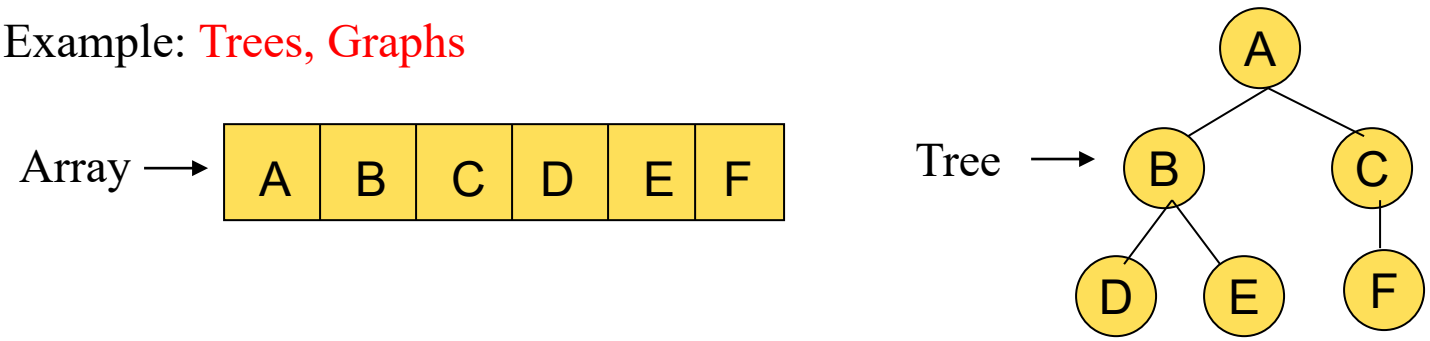
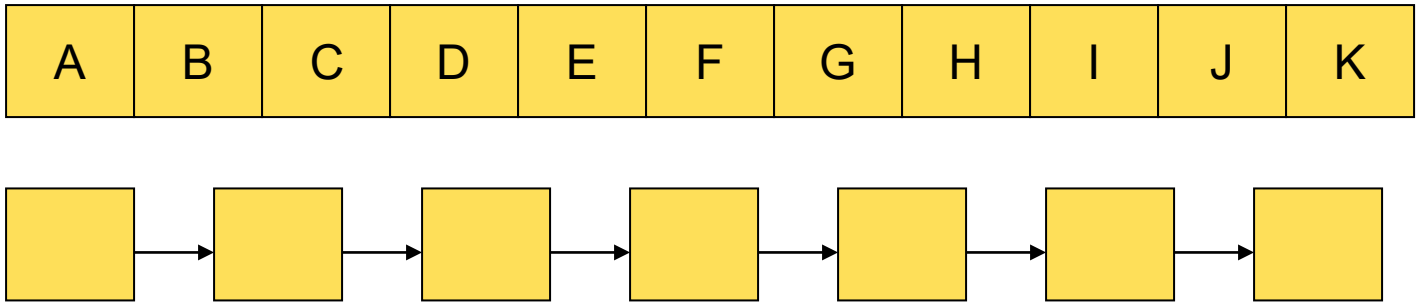


Figure 2: Linear and nonlinear structures

Which data structure to use?

- Data structures let the input and output be represented in a way that can be handled efficiently and effectively.



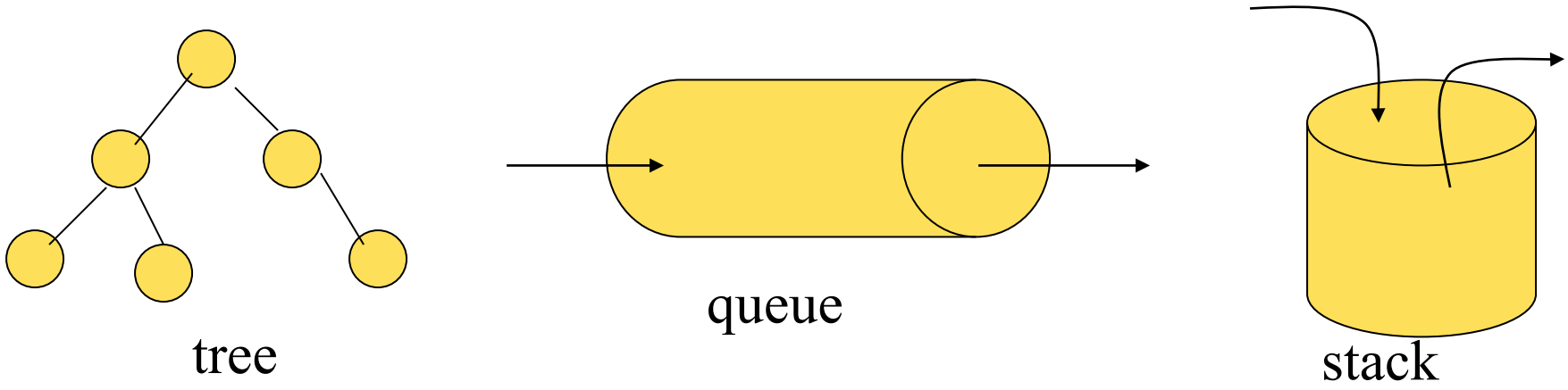


Figure 3: Different Data Structures

Data Structures

- **3 steps in the study of data structures**
  - Logical or mathematical description of the structure
  - Implementation of the structure on the computer
  - Quantitative analysis of the structure, which includes determining the amount of memory needed to store the structure and the time required to process the structure

Choice of Data Structures

The choice of data structures depends on two considerations:

1. It must be rich enough in structure to mirror the actual relationships of data in the real world.
2. The structure should be simple enough that one can effectively process data when necessary.

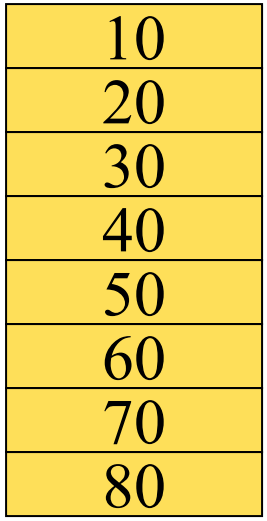


Figure 4: Array with 8 items

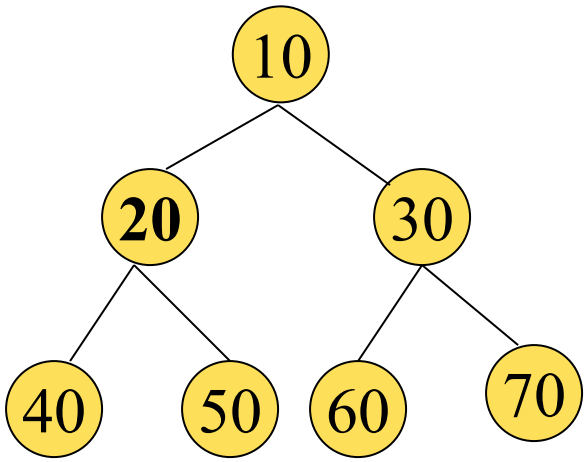


Figure 5: Tree with 8 nodes

Data Structure Operations

1. **Traversing:** Accessing each record exactly once so that certain items in the record may be processed.
2. **Searching:** Finding the location of the record with a given key value.
3. **Inserting:** Adding a new record to the structure.
4. **Deleting:** Removing a record from the structure.
5. **Sorting:** Arranging the records in some logical order.
6. **Merging:** Combing the records in two different sorted files into a single sorted file.

Thank You