Department of Computer Science and Engineering

PES UNIVERSITY

UE19CS202: Data Structures and its Applications (4-0-0-4-4)

DATA STRUCTURES

Abstract

Introduction to Data Structures and its Applications

Vandana M Ladwani

vandanamd@pes.edu

Contents

Introduction

Clever" ways to organize information in order to enable efficient computation

Data Structure is a way organizing data in such a way that we can perform operations on these data in an effective way for various applications

DS = Organized Data + Allowed operations

Data Structure Operations

- **Inserting**: Adding a new record to the structure.
- **Deleting**: Removing a record from the structure.
- **Traversing**: Accessing each record exactly once so that certain terms in the record may be proceeded.
- **Searching**: Finding the location of the record with a given key value.
- **Sorting**: Arranging the records either in ascending or descending order according to some key.
- **Merging**: Combining the records in two different sorted files into a single sorted file.
- **Copying**: Records in one file are copied to another file.

Classification of Data Structures

- Simple Data Structure
- Compound Data Structure
    - Linear Data Structure
    - Nonlinear Data Structure

➢ Simple Data Structure

It can be constructed with the help of Primitive Data Structure.
A **primitive data structure** is used to represent the standard data types of a particular programming language. Built in data types, arrays, pointers, structures, unions, etc. are examples of simple data structures.

➢ Compound Data Structure

Compound data structure can be constructed with the help of any one of the primitive data structure. Various operations that can be performed are decided by the designer to cater to the specific requirements of the applications.

It can be classified as

1) Linear Data Structure
2) Non-linear Data Structure

1. Linear Data Structures

In a linear data structure elements are accessed in a sequence.
Some of the operations that can be applied on linear data structure include

- Add an element
- Delete an element
- Traverse
- Sort the list of elements
- Search for a data element

Example: Stack, Queue, Tables, List, and Linked Lists.

2. Non-Linear Data Structures

Non-linear data structure can be constructed as a collection of randomly distributed set of data item. In non-linear Data structure the relationship of adjacency is not maintained between the Data items.
Some of the operations that can be applied on non-linear data structures:

- Add an element
- Delete an element
- Traverse
- Search for a data element

Example: Tree, Decision tree, Graph and Forest

Applications of Data Structures

Array

- Represent/implement other data structures in memory
- Store files in memory

Linked Lists

- Represent/implement other data structures in memory
- Dynamically allocate space in the main memory
- Allocate blocks in hard disk
- Manipulate large numbers

Stacks

- Recursion
- Call stack is used to keep track of program with multiple functions
- Infix to postfix expression conversion
- Evaluate a postfix expression
- Rearranging railroad cars
- Implement undo and redo operation for various applications

Queues

- Job scheduling
- Process scheduling in Operating system
- Handling events in event controlled applications
- Handling of interrupts by the operating system
- Store the browsing history

Trees

- Auto complete features (Trie)
- For easier substring matching
- For metadata indexing in file systems (B+ tree)
- To maintain table indices in relational database systems (B+ tree)
- Store dictionary in a mobile (Trie)

- To check spellings (Trie)
- To construct associative array (Red black trees)
- To ensure direct access of data blocks in file systems (B tree)
- Used by compilers to check the syntax of a statement in a program (Parse Trees)
- Used by operating systems to maintain the structure of a file system

➢ Heaps

- Priority queue Implementation
- Heapsort

➢ Graphs

- Social network analysis
- Shortest path problems
- Disease modelling
- Citation of journals
- Computer Networks