Introduction to Data Structures Semester-III

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Learning Objectives

At the end of the lecture, students will be able to

- Define Data structures
- Classify different Data Structures
- List Linear and Non-Linear Data Structures with examples
- List areas were Data Structures are used extensively

Outline

- Why Learn Data Structures?
- Introduction to Data Structures
- Types of Data Structures
- Areas where Data Structures are used

Why Data Structures?

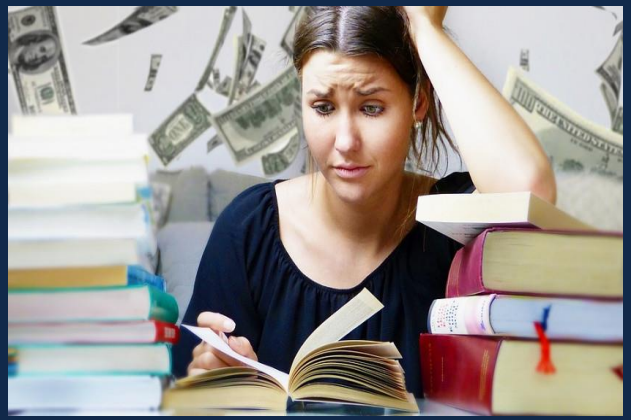
- A data structure is a specialized format for organizing, processing, retrieving and storing data
- Data structures **make it easy for users to access and work with the data they need in appropriate ways**
- **Data structures** allow us to organize and store data , while algorithms allow us to process that data in a meaningful way

Problem

Suppose you need to search your roll number in 10000 pages book (assume roll numbers are arranged in increasing order). How would you do that?

Solution

- Should I search it in a sequential manner or randomly.



Solution

- Go to page no. 5000
- If your roll no. is not there, but all other roll no. in that page are lesser than your roll no then
- Go to page no. 7500
- Still if your roll no. is not there. but this time all other roll no. is greater than your roll no.
- Go to the page no. 6450

- Continue the same process and within short period of time you will find your roll number.
- ***The approach that we just used is Binary Search algorithm***

1. If you need to keep a deck of cards and arrange it properly how would you do that?

2. How do you organize files and folders in your Computer Hard drive?

3. Can you imagine how your friends on Facebook, friends of friends, mutual friends they all can be represented?

4. If you need to search a word in the dictionary, what would be your approach?

Why Engineers working in Google, Microsoft, Facebook, Amazon-like companies are different than others and paid higher as compared to other companies?

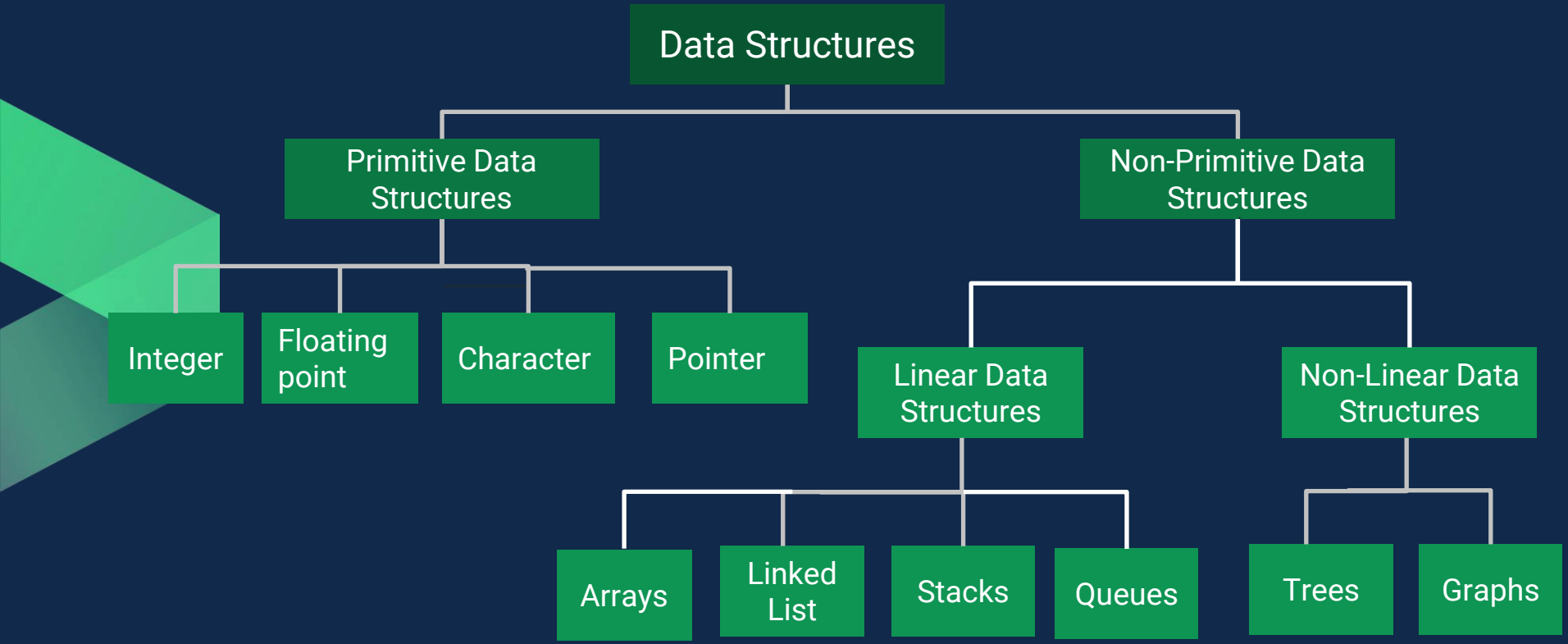
Why Learn Data Structures?

- If you love to solve the real-world complex problems.
- If you want to crack the interviews and get into the product based companies.
- If you plan to take up – GATE examination for PG studies.

Introduction

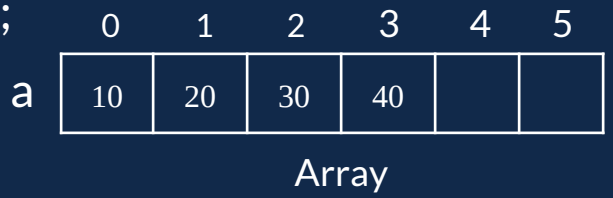
- Data structures is a way of organizing data in the memory of computer.
- In other words, a data structure is a way of organizing all data items that considers not only the elements stored but also their relationship to each other.
- The way in which data is organized effects the performance of a program for different tasks.
- A Data Structure should be seen as a logical concept that must address two fundamental concerns:
  I. How the data will be stored and
  II. What operations will be performed on it.

Types of Data Structures



Arrays

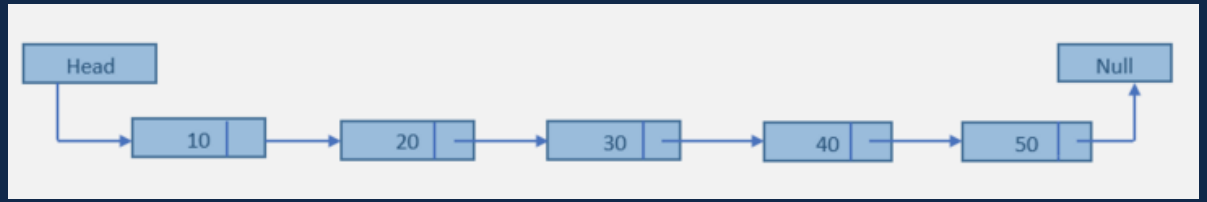
- An array is defined as a set of finite number of homogeneous elements
- It means an array can contain one type of data only, either all integer, all float-point number or all character.
- Types: 1 D array , 2 D Array ... Etc
- int a[6] ;



Array

Linked List

- A linked list is a linear collection of data elements, in which linear order is not given by their physical placement in memory.
- Elements may be added in the front, middle of list as well as end of the list.
- Linked list may be used for dynamic implementation of Stacks and Queues.



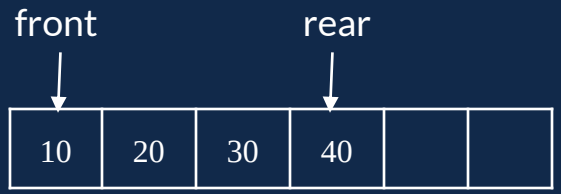
Linked list

Stacks

- Stack is a Last-in First-out data structure(LIFO).
- In stack, element is inserted and deleted only from one end called the top of the stack.
- Stack is useful in reversing a string, mathematical expression calculations, Recursive functions, Checking well-formedness of parenthesis, Backtracking, etc.

Queues

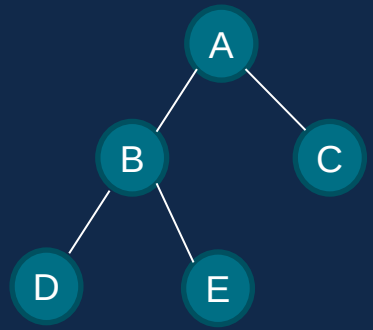
- Queue is a First-in First-out data structure(FIFO).
- In queue, elements are inserted at one end called rear and deleted from the other end called the front end of the queue.
- Queue applications are in Printer spooler, CPU task scheduling, Handling of interrupts in real-time systems, etc



Queue

Trees

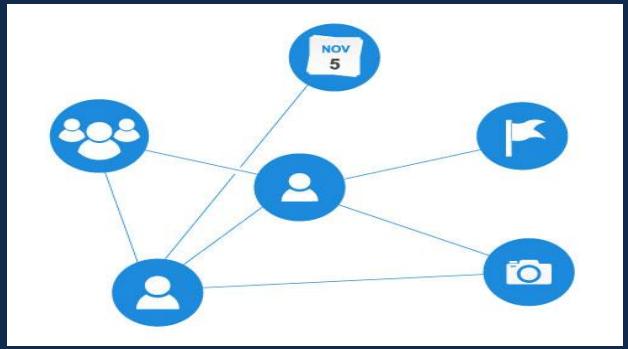
- A Tree is a nonlinear hierarchical data structure that consists of nodes connected by edges.
- **Tree Applications**
  - Manipulate hierarchical data.
  - Make information easy to search.
  - Manipulate sorted list of data.
  - As a workflow for compositing digital images for visual effects.
  - etc.



Tree

Graphs

- A graph data structure is a collection of nodes that have data and are connected to other nodes through edges.
- Graphs can be used for Finding shortest routes, searching, social network connections, internet routing.



Graph

Quiz

Queue data structure works on

A - LIFO
B - FIFO
C - FILO
D - none of the above

Quiz

Queue data structure works on

A - LIFO
B - FIFO
C - FILO
D - none of the above

Answer: option B

Explanation: In queue, elements inserted first, will be the first one to be removed from the queue. FIFO stands for First In First Out and is a correct answer.

Areas were Data Structures are used Extensively

- Compiler Design
- Operating System
- Database Management System
- Statistical analysis
- Networking
- Graphics
- Artificial Intelligence
- Simulation
- and many more …

Syllabus

Useful Links

1. https://nptel.ac.in/courses/106/102/106102064/
2. https://www.coursera.org/specializations/data-structures-algorithms
3. https://www.edx.org/course/data-structures-fundamentals
4. https://swayam.gov.in/nd2_cec19 _cs04/preview
5. https://www.hackerearth.com/practice/
6. https://www.techgig.com/practice/data-structure
7. https://practice.geeksforgeeks.org/home/
8. https://www.onlinegdb.com/online_c_compiler
9. https://www.tutorialspoint.com/compile_c_online.php

References

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- C & Data Structures, Prof. P.S. Deshpande, Prof. O.G. Kakde, DreamTech press.