Data Structures and Algorithms

Lecture 1: Introduction - Basic Data Structures

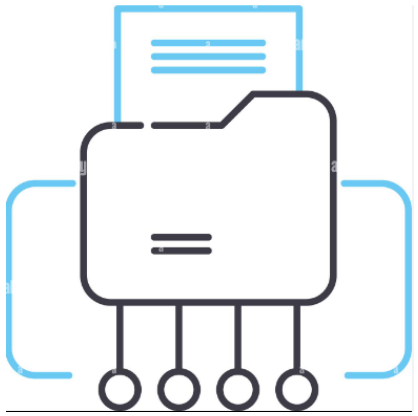
Data Structure:

A data structure is a storage that is used to store and organize data.

- It is a way of arranging data on a computer so that it can be accessed and updated efficiently.
- The idea is to reduce the space and time complexities of different tasks.

A data structure should be seen as a logical concept that must address two fundamental concerns.

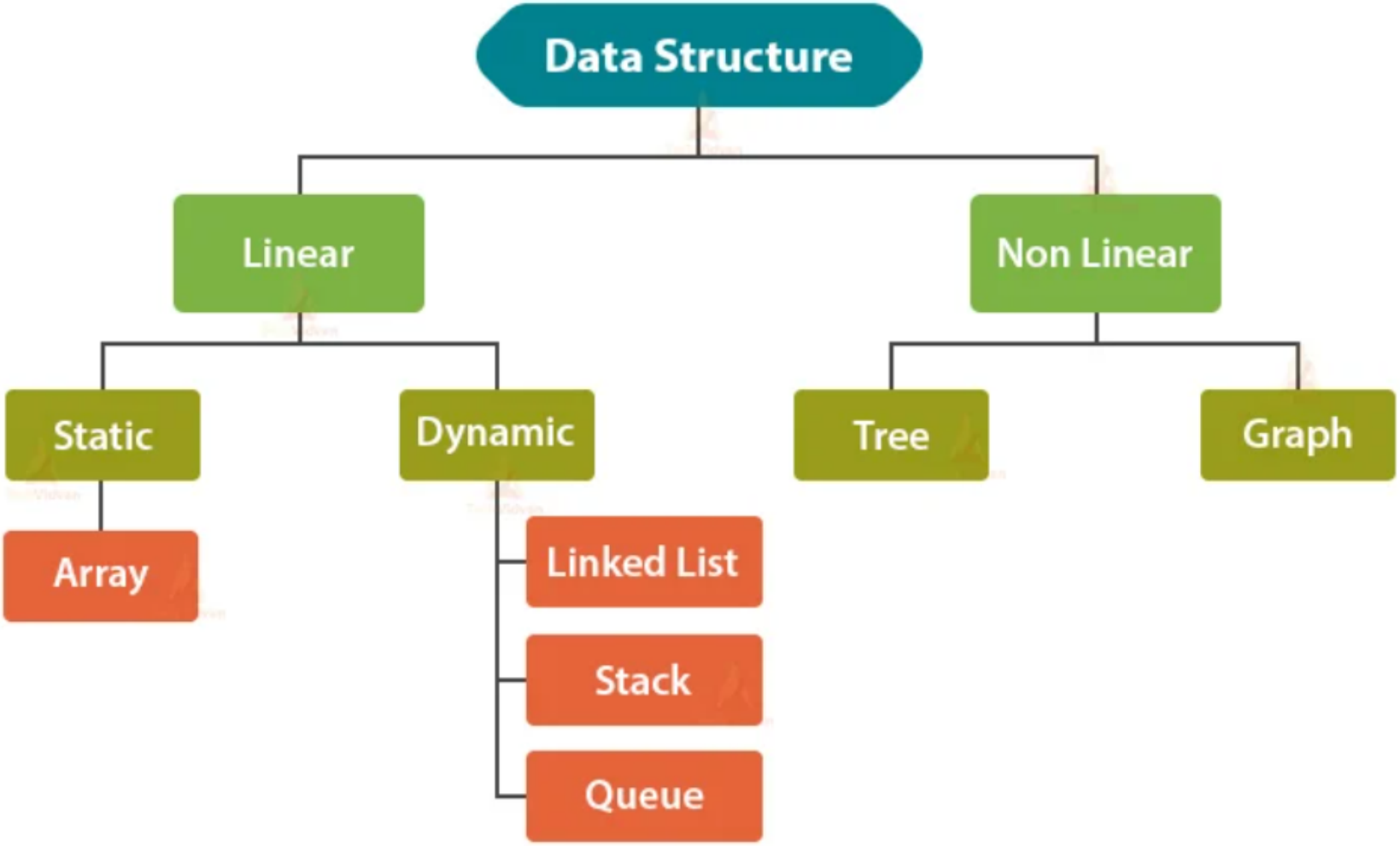
1. First, how the data will be stored, and
2. Second, what operations will be performed on it.



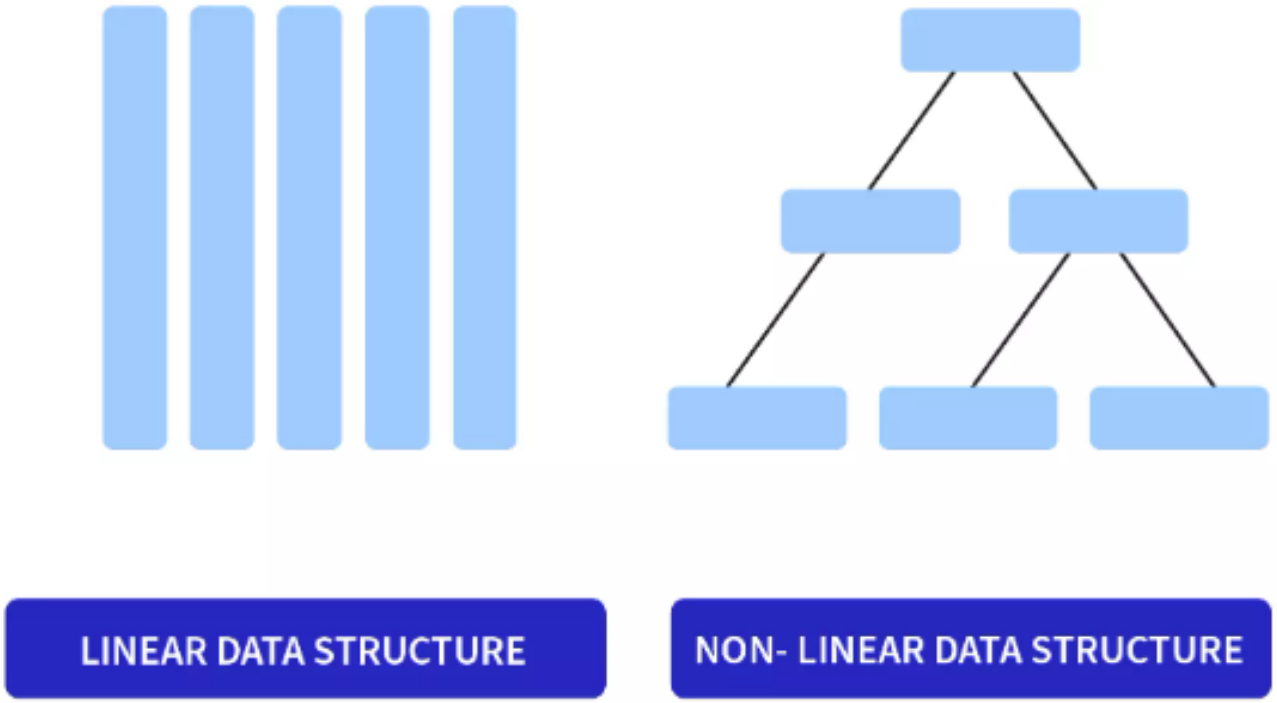
Importance of Data Structure:

- Data structure modification is easy.
- It requires less time.
- Save storage memory space.
- Data representation is easy.
- Easy access to the large database

Classification of Data Structure:



Classification of Data Structure:



Linear Data Structure:

- Elements are arranged in one dimension ,also known as linear dimension.
- Example: lists, stack, queue, etc.

Operations applied on linear data structure:

1. Add an element
2. Delete an element
3. Traverse
4. Sort the list of elements
5. Search for a data element

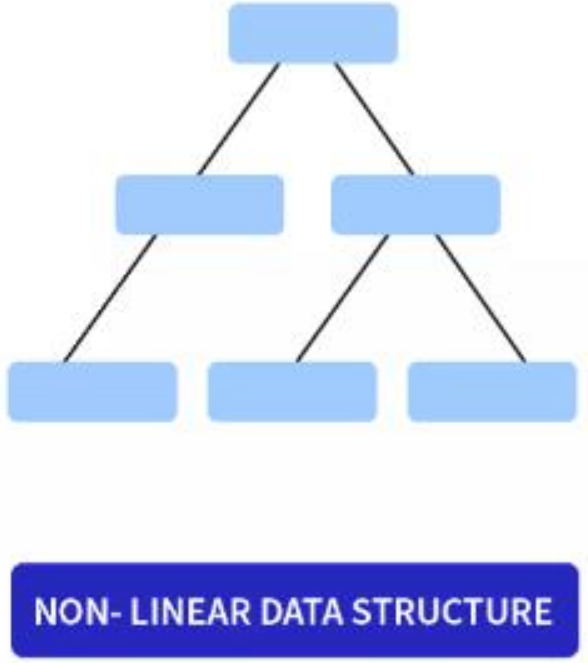
LINEAR DATA STRUCTURE

Non-linear Data Structure:

- Elements are arranged in one-many, many-one and many-many dimensions.
- Example: tree, graph, table, etc.

Operations applied on linear data structure:

1. Add an element
2. Delete an element
3. Display the elements
4. Sort the list of elements
5. Search for a data element



Applications of Data Structure:

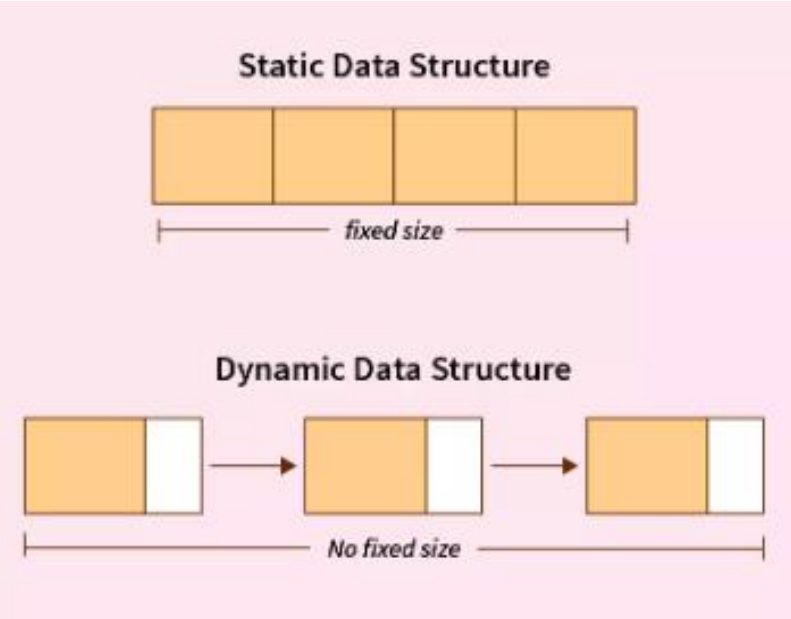
Data structures are used in various fields such as:

- Operating system
- Graphics
- Computer Design
- Blockchain
- Genetics
- Image Processing

Data structure types:

Data Structure are used to reduce complexity of the code. It can be of two types :

1. Static Data Structure - Example: Array
2. Dynamic Data Structure - Example: Linked List



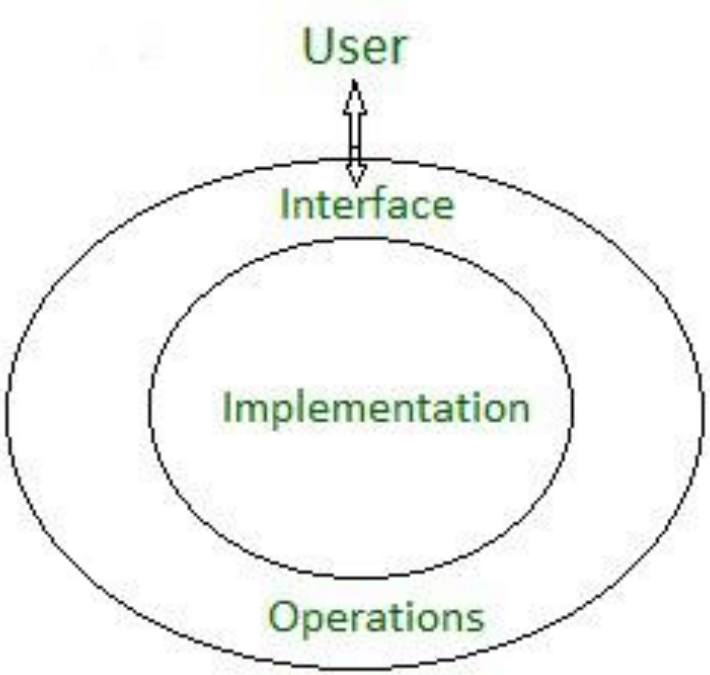
Static Data Structure vs Dynamic Data Structure

Aspect	Static DS	Dynamic DS
Size	Size is fixed and cannot be modified	Size can be modified during runtime
Access	Access time is faster as it is fixed	Access time may be slower due to indexing and pointer usage
Memory allocation	Memory is allocated at compile-time	Memory is allocated at run-time
Examples	Arrays, Stacks, Queues, Trees (with fixed size)	Lists, Trees (with variable size), Hash tables

Abstract Data Type:

Abstract data types (ADTs) are a way of encapsulating data and operations on that data into a single unit.

- The user does not need to know the implementation of the data structure only essentials are provided.
- ADT gives us a better conceptualization of the real world.
- The program is robust and has the ability to catch errors.



Recall:

- A data structure is a storage that is used to store and organize data
- Classification of data structure: Linear and Non-linear
- Applications of Data structures: Graphics, OS, Image processing and so
- Static vs Dynamic Data structure
- ADTs provide a powerful tool for organizing and manipulating data in a structured and efficient manner.