College of computer science & mathematics

Dep. Of Computer Science

DATA STRUCTURE

هياكل البيانات

Prepared & Presented by

Mohammed B. Omar

2024 -2025	Lecture 1 : intro To principle of Data Structure

DATA STRUCTURE

هياكل البيانات

Lecture 1 : intro To principle of Data Structure

Data Structure

A data structure is the link between the programmer's view of data and the implementation of these data in computers. It consists of a storage method and one or more algorithm that used to access or modifies data.

Data structure = Data + Algorithm

There are many different data structures, each with its own advantages and disadvantages. Some of the most common data structures are arrays, lists, trees, and graphs.

The data structure isn't a programming language like C, C++, Java, etc. It is a set of algorithms that can be used in any programming language to organize the data in the memory.

Need of Data Structure

As applications are becoming more complex and the amount of data is increasing day by day, which may cause problems with processing speed, searching data, handling multiple requests etc. Data structure provides a way of organizing, managing, and storing data efficiently.

With the help of data structure, the data items can be traversed easily. Data structure provides efficiency, reusability and abstraction. It plays an important role in enhancing the performance of a program because the main function of the program is to store and retrieve the user's data as fast as possible.

Criteria to choose correct Data Structure:

a) The size of data will be used.

b) Speed & Method of using the data.

c) Data Dynamics. (الطبيعة الديناميكية للبيانات كتغييرها وتعديلها دورياً**)**

d) Storage Space Required.

e) Retrieval time required to access any data item.(الزمن اللازم لاسترجاع اية معلومة من الهيكل البياني**)**

f) Programming techniques.

Primitive and Non-Primitive data Types

Data type specifies the type of data stored in a variable. The data type can be classified into two types, primitive data type and non-primitive data type.

1. Primitive Data types:

Are the basic data types that are available in most of the programming languages. The primitive data types are used to represent single values like:

- **Integer: This is used to represent a number without decimal point. Example: 12, 90**
- **Float and Double: This is used to represent a number with decimal point. Example: 45.1, 67.3.**
- **Character: This is used to represent single character. Example: “C”, “a”.**
- **String: This is used to represent group of characters. Example: "Tikrit University".**
- **Boolean: This is used represent logical values either true or false.**

Primitive and Non-Primitive data Types

Data type specifies the type of data stored in a variable. The data type can be classified into two types, primitive data type and non-primitive data type.

2. Non-Primitive Data types: are derived from primary data types and used to store group of values like:

- **Arrays.**
- **Structure.**
- **Link list.**
- **Stack.**
- **Queue.**
- **Tree.**
- **Graph.**

Data Structure Operations:

The common operations that can be performed on the data structures are as follows:

1. Traversing: It is used to access each data item exactly once so that it can be processed.

2. Searching: It is used to find out the location of the data item if it exists in the given collection of data items.

3. Inserting: It is used to add a new data item in the given collection of data items.

4. Deleting: It is used to delete an existing data item from the given collection of data items.

5. Sorting: It is used to arrange the data items in some order i.e. in ascending or descending order in case of numerical data and in dictionary order in case of alphanumeric data.

6. Merging: It is used to combine the data items of two sorted files into single file in the sorted form.

Types of data structures

There are two types of data structures, these are:

- **Linear Data Structure: Is the data structure that every element is linked with the next one sequentially. Since the data items are arranged in sequence. Samples of a linear data structure are the stack and the queue.**

- **Nonlinear data structure: is the data structure where the element may attach to more than one element and data items are not in sequence. A sample of nonlinear data structure is a tree.**

Types of data structures

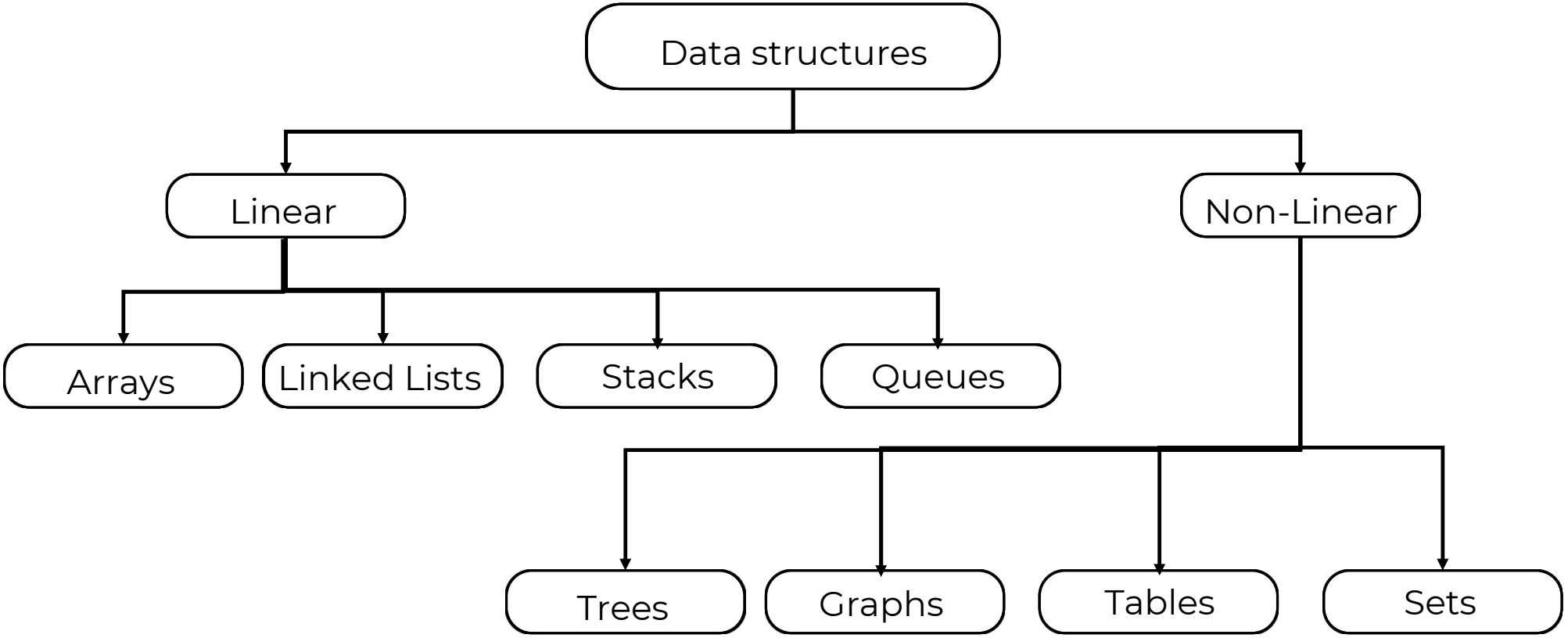

Figure (1): Types of data structures

Storage Allocation:

It's the way in which the data items are physically stored in the memory, so there are the following two types :

1-sequential allocation: it's the simpler way in which the data items are stored in continuous memory allocations one by one. Arrays are the data types that are used to implement such types of storages.

Sequential Allocation Advantages:

- **Easy to implement.**
- **Less storage space.**

Sequential Allocation Disadvantages:

- **It needs a sequential free space in memory.**
- **It required that we know previously the max number of items that will be used.**
- **Over flow problem is occasionally occurs.**

Storage Allocation:

2-Dynamic Allocation: implementation of data structure is the dynamic linking; since there is no sequential allocation but every data item has the address of the next one instead.

Here each data item will be called as "node"; this node will have two parts, one carried the required information and the other is for the next item address.

Dynamic Allocation Advantages:

- **Easy to add or remove.**
- **No over flow problem.**
- **We do not need to specify the number of nodes previously.**

Dynamic Allocation Disadvantages:

- **More storage space for each data item, since each one must has a value and the information of the next address as well.**
- **Complicated and hard to achieve random access.**