Data Structures using C

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Introduction

- Data Structure provides an efficient way of storing and organizing data

- Some examples of Data Structures are arrays, Linked List, Stack, Queue, etc.

- Data Structures are widely used in almost every aspect of Computer Science i.e. Operating System, Compiler Design, Artificial intelligence, Graphics and many more.

Basic Terminology

- **Data:** Data can be defined as an elementary value or the collection of values, for example, student's name and its id are the data about the student.

- **Group Items:** Data items which have subordinate data items are called Group item, for example, name of a student can have first name and the last name.

- **Record:** Record can be defined as the collection of various data items, for example, if we talk about the student entity, then its name, address, course and marks can be grouped together to form the record for the student.

Basic Terminology

- **File:** A File is a collection of various records of one type of entity, for example, if there are 60 employees in the class, then there will be 20 records in the related file where each record contains the data about each employee.

- **Attribute and Entity:** An entity represents the class of certain objects. it contains various attributes. Each attribute represents the particular property of that entity.

- **Field:** Field is a single elementary unit of information representing the attribute of an entity.

Need of Data Structures

- **Processor speed:** To handle very large amount of data, high speed processing is required, but as the data is growing day by day to the billions of files per entity, processor may fail to deal with that much amount of data.

- **Data Search:** Consider an inventory size of 106 items in a store, If our application needs to search for a particular item, it needs to traverse 106 items every time, results in slowing down the search process.

- **Multiple requests:** If thousands of users are searching the data simultaneously on a web server, then there are the chances that a very large server can be failed during that process

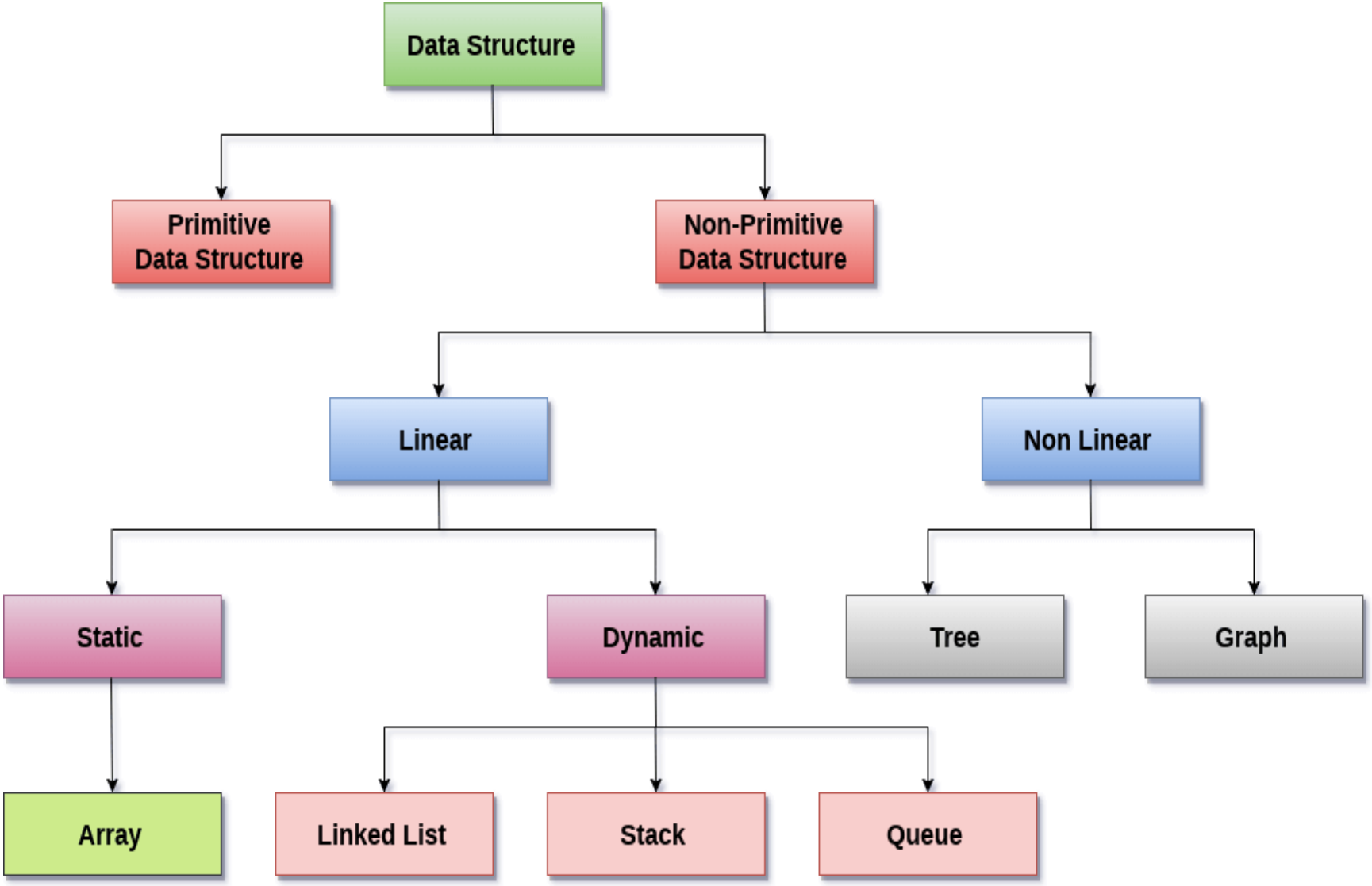
Advantages of Data Structures

- **Efficiency:** Efficiency of a program depends upon the choice of data structures. For example: suppose, we have some data and we need to perform the search for a particular record. In that case, if we organize our data in an array, we will have to search sequentially element by element. hence, using array may not be very efficient here. There are better data structures which can make the search process efficient like ordered array, binary search tree or hash tables.

- **Reusability:** Data structures are reusable, i.e. once we have implemented a particular data structure, we can use it at any other place. Implementation of data structures can be compiled into libraries which can be used by different clients.

- **Abstraction:** Data structure is specified by the ADT which provides a level of abstraction. The client program uses the data structure through interface only, without getting into the implementation details.

Data Structure Classification



Operations on data structure

- 1) **Traversing:** Every data structure contains the set of data elements. Traversing the data structure means visiting each element of the data structure in order to perform some specific operation like searching or sorting.

- 2) **Insertion:** Insertion can be defined as the process of adding the elements to the data structure at any location.

- 3) **Deletion:**The process of removing an element from the data structure is called Deletion. We can delete an element from the data structure at any random location.

  If we try to delete an element from an empty data structure then **underflow** occurs.

Operations on data structure

- 4) **Searching:** The process of finding the location of an element within the data structure is called Searching. There are two algorithms to perform searching, Linear Search and Binary Search. We will discuss each one of them later in this tutorial.

- 5) **Sorting:** The process of arranging the data structure in a specific order is known as Sorting. There are many algorithms that can be used to perform sorting, for example, insertion sort, selection sort, bubble sort, etc.

- 6) **Merging:** When two lists List A and List B of size M and N respectively, of similar type of elements, clubbed or joined to produce the third list, List C of size (M+N), then this process is called merging