DATA STRUCTURES & ALGORITHMS

Introduction

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Course Learning Outcomes

- *Describe* basic data structures and relevant standard algorithms
- *Demonstrate* working of different algorithms and processes of data structures
- *Design* different algorithms for data structures operations
- *Analyze* and compare algorithms for efficiency

Reference Books

1. Data Structures and algorithm analysis in C, Fourth Edition, by Mark Allen Weiss.
2. C++ Plus Data Structures, Fifth Edition, Nell Dale.
3. Foundations of Algorithms Using C++ Pseudocode, Third Edition, by Richard Neapolitan & Kumarss Naimipour.

Why Learn this course?

To address these issues:

- ✓ Data Search
- ✓ Processor speed
- ✓ Multiple requests

Introduction

Data can be referred as:

- *Collection of facts*
- *Value or Set of Values*
- *Raw information*

Structure refers to:

- *Way of organizing data*
- *Set of rules to hold data*

Data Structure

- Organizing & storing data
- Mathematical & logical model of organization of data
- Set of procedures to define, store, access & manipulate data

OR

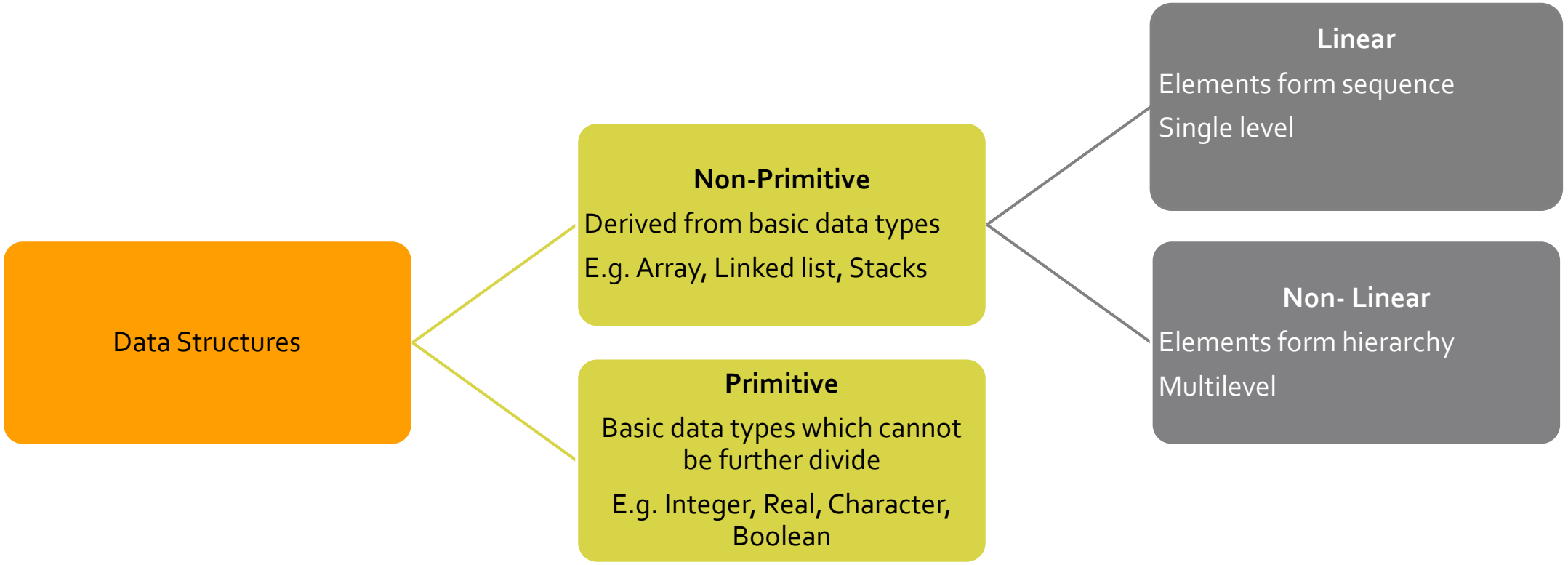
Data Structure is group of data elements which provides an efficient way of storing and organizing data in the memory.

How we define the efficient way of storing & organizing data?

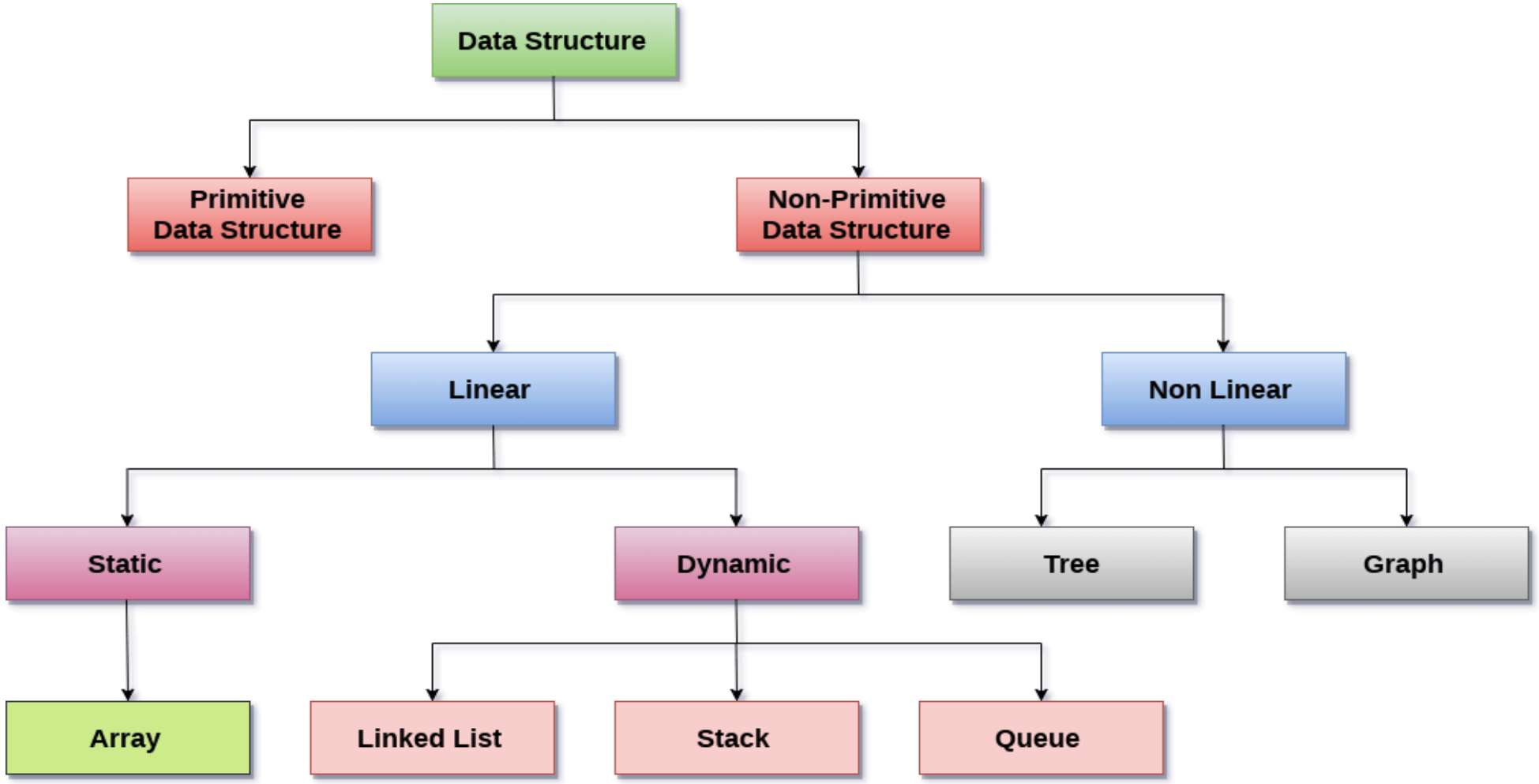
- Efficiency denotes to solve the problem within its resource constraints.
  - ✓Space
  - ✓Time

- Total resources that the solution consumes effects the solution's cost.

Types of Data Structures



Types of Data Structures



Linear Data Structures

Data Structure	Description
Array	Collection of items of same data type which stores in contiguous block of memory
Linked List	Sequence of links which contains items. Each link contains a connection to another link.
Stack	Linear list in which insertion and deletions are allowed only at one end, called top.
Queue	Opened at both end. It follows First-In-First-Out (FIFO) methodology for storing the data items.

Non – Linear Data Structures

Data Structure	Description
Tree	Multilevel data structures with a hierarchical relationship among its elements known as nodes.
Graph	Pictorial representation of the set of elements (represented by vertices) connected by the links known as edges.

Selecting a Data Structure

1. Analyze the problem to determine the resource constraints a solution must meet.
2. Determine the basic operations that must be supported. Quantify the resource constraints for each operation.
3. Select the data structure that best meets these requirements.

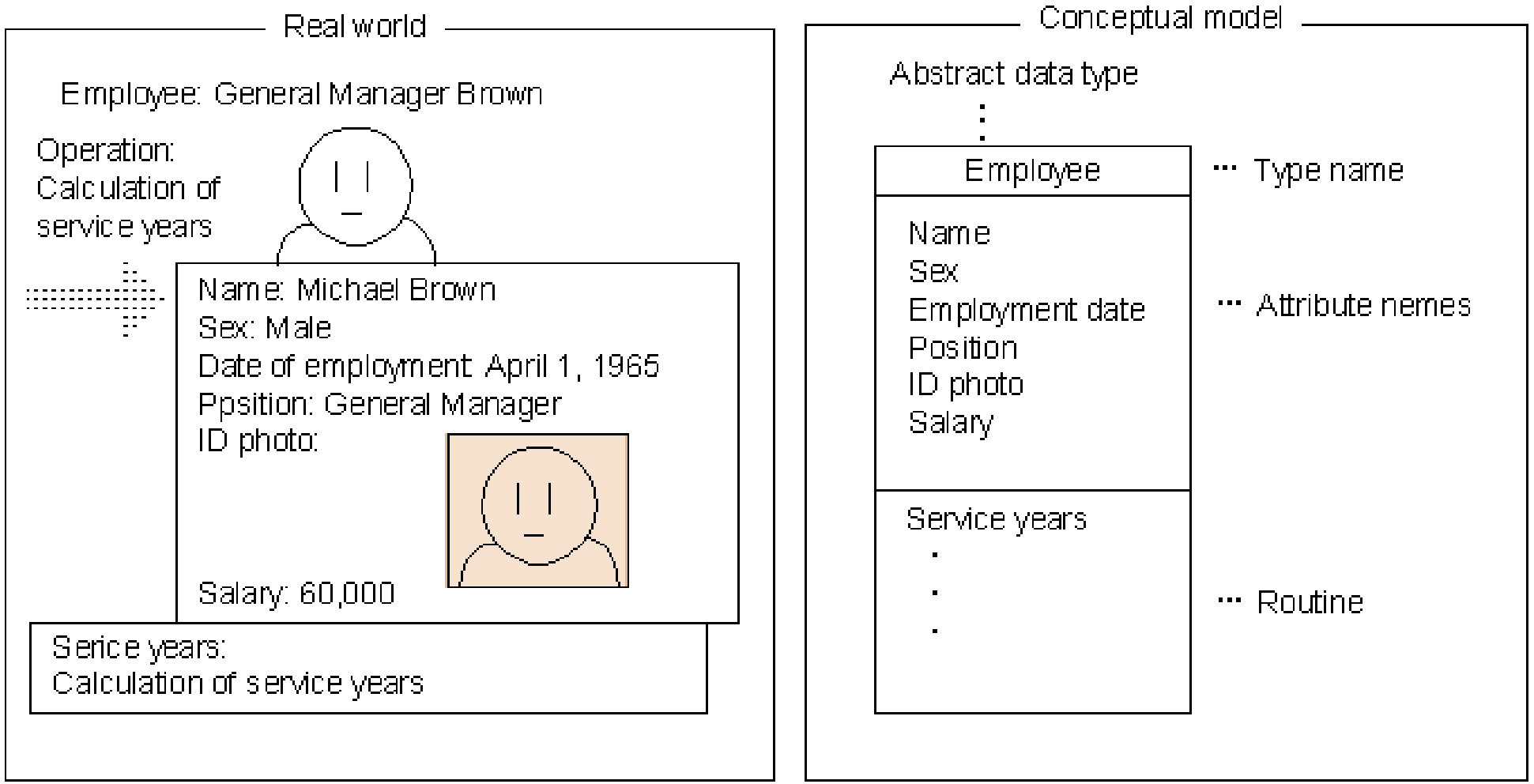
Operations

- Traversing
  - Accessing each data element exactly once so that certain items in the data may be processed
- Searching
  - Finding the location of the data element (key) in the structure
- Inserting
  - Adding a new data element to the structure
- Deleting
  - Removing a data element from the structure
- Sorting
  - Arrange the data elements in a logical order
- Merging
  - Combining data elements from two or more data structures into one

Abstract Data Types

- Abstract data type refers to a set of data values and associated operations that are specifically accurately, independent of any particular implementation.
- It is called "abstract" because it gives an implementation-independent view. The process of providing only the essentials and hiding the details is known as abstraction.

Think of ADT as a black box which hides the inner structure and design of the data type.


Real world
Employee: General Manager Brown
Operation:
Calculation of
service years
Name: Michael Brown
Sex: Male
Date of employment: April 1, 1965
Ppsition: General Manager
ID photo:
Salary: 60,000
Serice years:
Calculation of service years
Conceptual model
Abstract data type
Employee
Type name
Name
Sex
Employment date
Position
ID photo
Salary
Attribute nemes
Service years
Routine