

Southern Technical University
Technical Institute / Qurna
Dep. of Computer Systems Techniques

Second class

Subject : Data Structures

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Lecture no.1

(Data Structures)

- الاسبوع الاول -

A// Rationale (مبررات الوحدة) :-

A data structure is very important subject to be studied in order to have a full knowledge about data types to select the appropriate data structure which can have different types and different lengths when used in programming. The used language is C++ which is one of the efficient programming languages that is used in most computer departments because it fast and easy to use.

C// Central Ideas (الفكرة المركزية):-

- A Tower of Memory
- Data and Memory
- Data and Information Definition
- Definition of Data Structures and types
- Basic Operations on Data Structures

D// Objectives (أهداف الوحدة):-

After studying this unit , the student will be able to:-

- Understand the Tour of Memory
- Realize the difference between data and information
- Realize the difference between data and memory
- Define the data structure and its types
- understand how is Data structure selected
- Realize the Basic Operations on Data Structures

Q// What are the basic operations on the data structures.

A) Tour of Memory

Computer memory is divided into three sections: main memory, cache memory in the central processing unit (CPU), and persistent storage. *Main memory*, also called *random access memory* (RAM), is where instructions (programs) and data are stored. Main memory is volatile; that is, instructions and data contained in main memory are lost once the computer is powered down.

Cache memory in the CPU is used to store frequently used instructions and data that either is, will be, or has been used by the CPU. A segment of the CPU's cache memory is called a register. A *register* is a small amount of memory within the CPU that is used to temporarily store instructions and data.

A bus connects the CPU and main memory. A *bus* is a set of etched wires on the motherboard that is similar to a highway and transports instructions and data between the CPU, main memory, and other devices connected to a computer.

Persistent storage is an external storage device such as a hard disk that stores instructions and data. Persistent storage is nonvolatile; that is, instructions and data remain stored even when the computer is powered down.

Persistent storage is commonly used by the operating system as virtual memory. *Virtual memory* is a technique an operating system uses to increase the main memory capacity beyond the random access memory (RAM) inside the computer. When main memory capacity is exceeded, the operating system temporarily copies the contents of a block of memory to persistent storage. If a program needs access to instructions or data contained in the block, the operating system switches the block stored in persistent storage with a block of main memory that isn't being used.

CPU cache memory is the type of memory that has the fastest access speed. A close second is main memory. Persistent storage is a distant third because persistent storage devices usually involve a mechanical process that inhibits the quick transfer of instructions and data.

Throughout this book, we'll focus on main memory because this is the type of memory used by data structures (although the data structures and techniques presented can also be applied to file systems on persistent storage).

-Programming Principles

The greatest difficulties of writing large computer programs are not in deciding what the goals of the program should be, nor even in finding methods that can be used to reach these goals.

-choice of data structures

Even with very large projects, difficulties usually arise not from the inability to find a solution but, rather, from the fact that there can be so many different methods and algorithms that might work that it can be hard to decide which is best, which may lead to programming difficulties, or which may be hopelessly inefficient. The greatest room for variability in algorithm design is generally in the way in which the data of the program are stored:

- ❖ How they are arranged in relation to each other.
- ❖ Which data are kept in memory.
- ❖ Which are calculated when needed.
- ❖ Which are kept in files, and how the files are arranged.

B- Data and Memory

Data used by your program is stored in memory and manipulated by various data structure techniques, depending on the nature of your program. Let's take a close look at main memory and how data is stored in memory before exploring how to manipulate data using data structures.

Memory is a bunch of electronic switches called *transistors* that can be placed in one of two states: on or off. The state of a switch is meaningless unless you assign a value to each state, which you do using the binary numbering system.

The *binary numbering system* consists of two digits called *binary digits* (bits): zero and one. A switch in the off state represents zero, and a switch in the on state represents one. This means that one transistor can represent one of two digits.

Memory is organized into groups of eight bits called a *byte*, enabling 256 combinations of zeros and ones that can store numbers from 0 through 255.

Quiz1:

Define : Main memory, Cache Memory, Virtual Memory.

Basic concept of Data Structures

C- Data and Information

Data: Is the fact that we can see and deal with in our daily life like : book, car, 1245,etc.

Information: Is a collection of words, numbers, dates, or communicated material that have some meaning.



Data system: The system that use the computer to store and process the data and the information, and other units of the system which consist of Data, users, and procedures that called: Environment unit.

Data Structure : The possible ways in which the data items (or atoms) are logically related. By choosing a particular structure for the data items, certain items will be neighbors.

Basic Operations on D.S.:

- 1- Creation (like int n;)
- 2- Insertion (adding)
- 3- Destroying (deletion or remove a record from the D.S.)
- 4- Searching (find the location of record satisfy one or more condition)
- 5- Traversing (accessing each record once and process its items)

Quiz2:

- 1- Define: Data, Information, Data structure.
- 2- Define the basic operations on the D.S.

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- ❖ Which are calculated when needed.
- ❖ Which are kept in files, and how the files are arranged.

Data Structure Selecting:

Although a unit of memory holds a byte, data used in a program can be larger than a byte and require 2, 4, or 8 bytes to be stored in memory. Before any data can be stored in memory, you must tell the computer how much space to reserve for data by using an abstract data type.

Memory is reserved by using a data type in a declaration statement. The form of a declaration statement varies depending on the programming language you use. Here is a declaration statement for C++:

```
int myVariable;
```

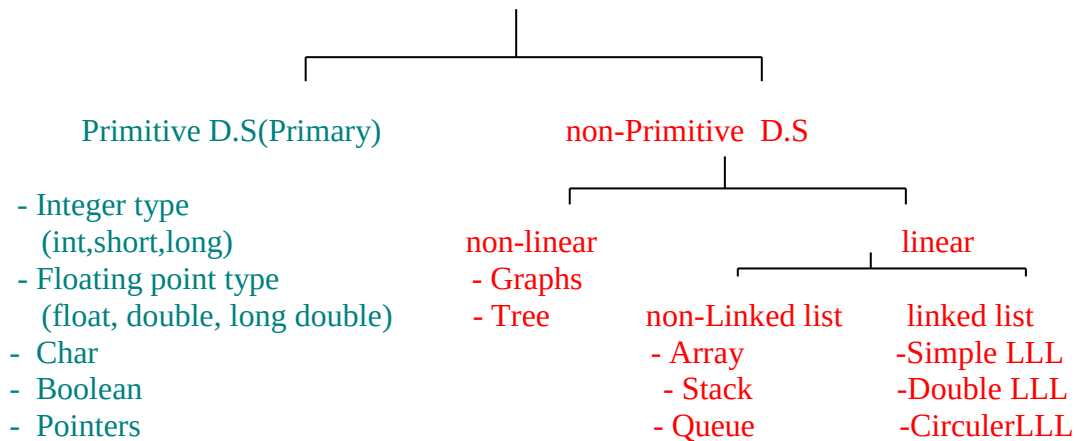
An abstract data type is a keyword of a programming language that specifies the amount of memory needed to store data and the kind of data that will be stored in that memory location. However, an abstract data type does not tell the computer how many bytes to reserve for the data. The number of bytes reserved for an abstract data type varies, depending on the programming language used to write the program and the type of computer used to compile the program.

You choose the abstract data type that best suits the data that you want stored in memory, then use the abstract data type in a declaration statement to declare a variable. A variable is a reference to the memory location that you reserved using the declaration statement.

Types of Data Structures

Data types determines the kind of the data going to be stored in the variable declared to be of that data type. C++ supports the following data types:

Data Structures



Types of primitive data types

Data Type	Data Type Size in Bits (bytes)	Range of Values	Group
Byte	8 (1 byte)	–128 to 127	Integers
short 16	16 (2 bytes)	–32,768 to 32,767	Integers
int 32	32 (4 bytes)	–2,147,483,648 to 2,147,483,647	Integers
long 64	64 (8 bytes)	–9,223,372,036,854,775,808 to 9,223,372,036,854,775,807	Integers
char 16 (Unicode)	16 (Unicode) (2 bytes)	65,536 (Unicode)	Characters
float 32	32 (4 bytes)	3.4e-038 to 3.4e+038	Floating-point
double 64	64 (8 bytes)	1.7e-308 to 1.7e+308	Floating-point
boolean	1	0 or 1	Boolean

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