CS 2001
Data Structures

Muhammad Sohail
Fall 2021

Lecture 1
Introduction
&
Course Overview

September 06, 2021
Monday

TODAY's AGENDA

- Introductions
- What's this class about?
  - What you might get out of this class
  - What topics we'll learn about
- Course Logistics
  - Text Books
  - Quizzes
  - Programming Assignments
  - Project
  - Grading Policy

INTRODUCTIONS

About me? About you?

ABOUT ME !

Muhammad Sohail

BS Computer Science
COMSATS University Islamabad

Masters Control Science & Engineering
Shanghai Jiao Tong University, China

Joined FAST NUCES August 2021
Lecturer

ABOUT YOU!

Your name? What you aspire to be?
Please be Very brief
5 ~ 10 Seconds.

Have you heard of the term Data Structure before?

Repeating the Course

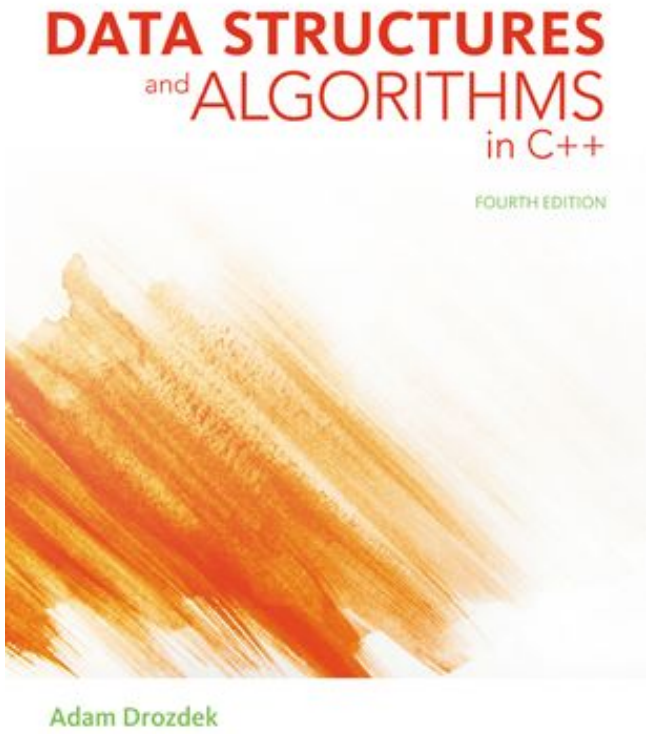
WHAT'S THIS CLASS ABOUT?

- You will understand some basic & advanced Data Structures.
- You will be able to perform analysis of Data Structures for real world Applications.
  - Trade off between different types of data structures.
- You will be able to write software solutions
  - Insert, Traverse, Search, Update and Delete Operations efficiently.

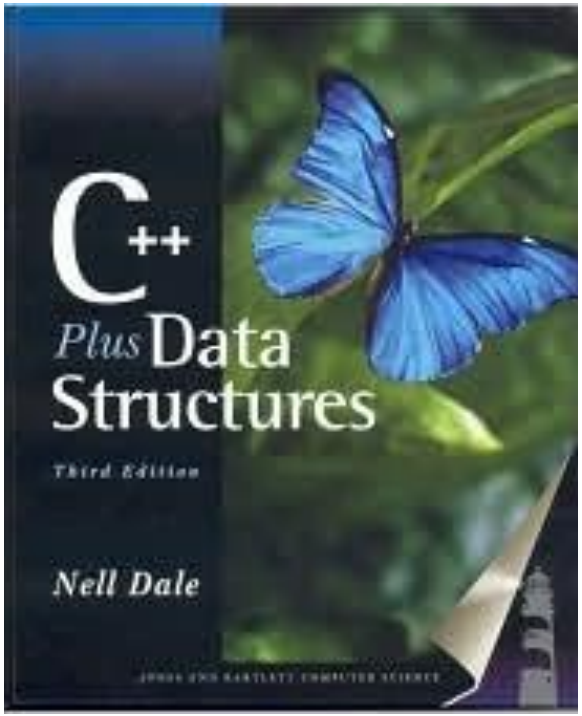
PROGRAMMING LANGUAGE C++

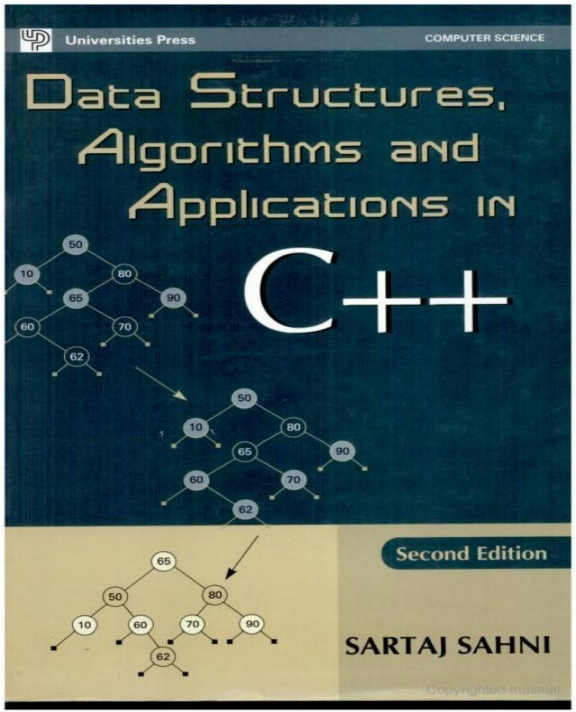
TEXT BOOK

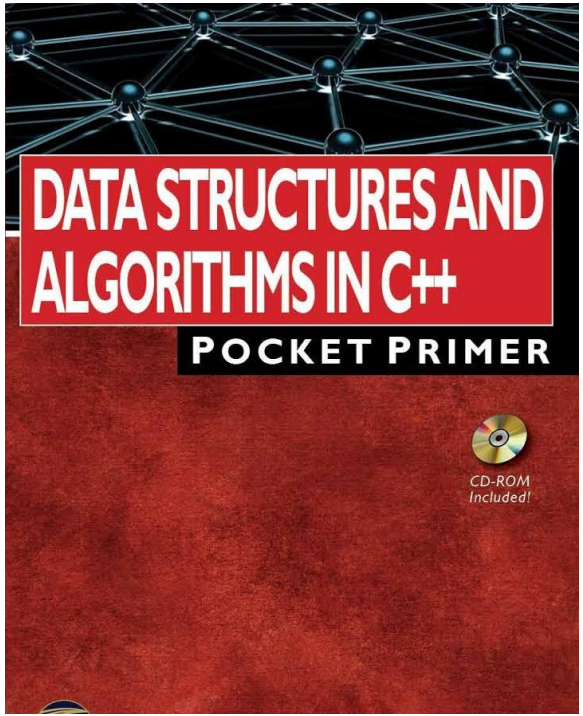
- Leading Text in the world of CS.
- Helps you strengthen your foundations and will allow you to build more stable and efficient software solutions.



SOME ADDITIONAL READINGS







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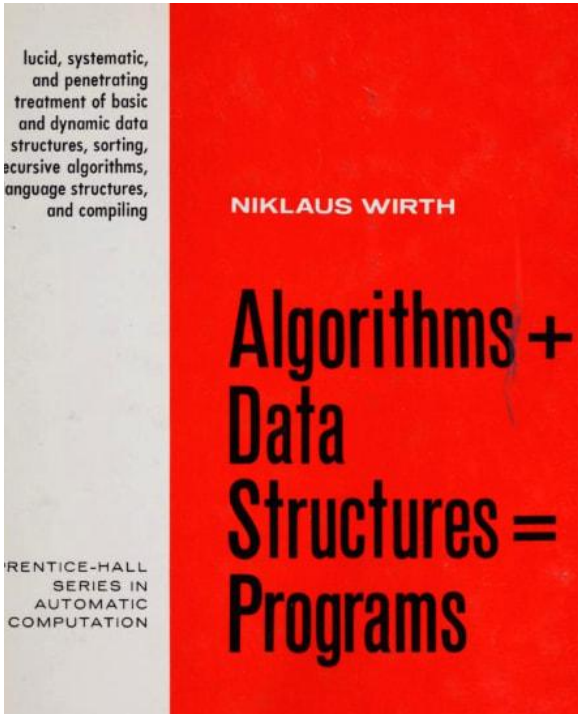
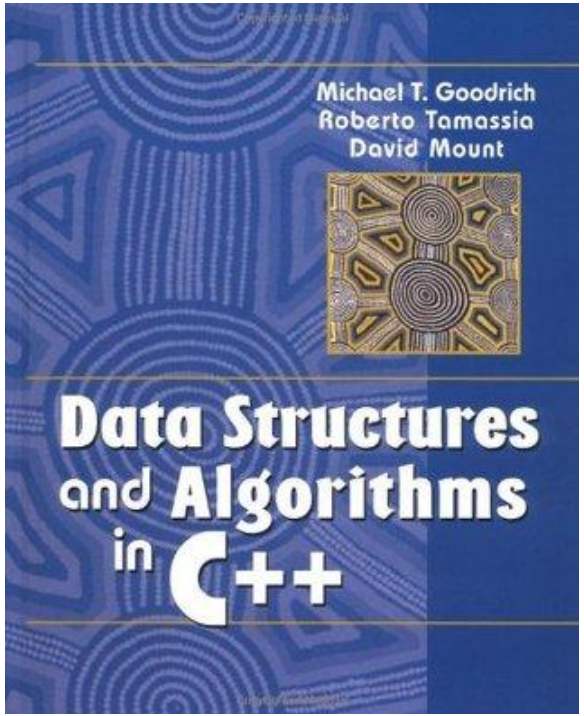
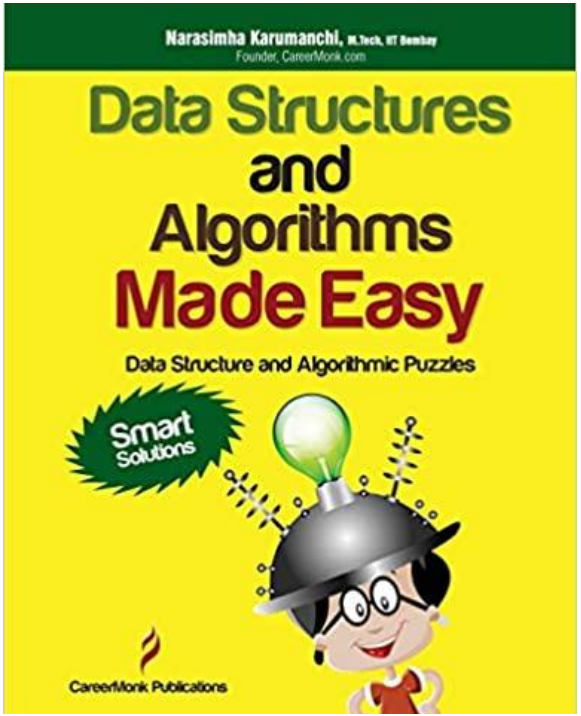






GRADED COURSE COMPONENTS

Weightage 05%

QUIZZES (5 total)

Surprised

The pattern may vary usually 1 ~ 2 Problems, couple of MCQs.
15 ~ 30 Minutes Long

Only Top 4 will be Graded

Your lowest quiz will be dropped

NO QUESTIONS ASKED :)

PROGRAMMING ASSIGNMENTS

Weightage 15%

- 03 in Total. 2 ~ 4 Problems per Assignment. Designed to check your concepts as well as implementation power.
- Individual task, you may discuss with your friends but try not to submit a single solution for multiple students. Same assignments will get 0.
- Will be on Slate. Access the platform with your nu mail id.
- Assignment might have hidden test cases. Design more general solution.

PROGRAMMING ASSIGNMENTS

Be very Careful of the Deadlines

- Usually the assignment will be due within 2 weeks.
- Late submissions will be penalized. You will lose 25% marks each 48 hours passed deadline. Assignment will get 0 after 8 days of deadline.
- Plagiarised work will receive 0.

CLASS PROJECT

Weightage 10%

- Due at the end of the term. 2 ~ 3 students per projects will be allowed. All project member should be within the same section.
- **“Data Structures for Large Datasets”**, will be theme of the projects.
- Class Project call and schedule will be announced on **Slate** later.
- Will have 3 ~ 4 Bird of Feather (BOF) meetings during the course for the project.

CLASS PROJECT

- Call for Class Projects
  - You will be required to submit a project proposal.
  - Highlighting what you intend to accomplish (description of the project).
  - Title of the Project.
  - List of Members.

CLASS PROJECT

Total marks 10

Project Proposal	**01**
Project Demonstration	**02**
Code Review	**02**
Idea & Completion	**04**
Project Report	**01**

EXAMS

Mid I & II

One hour long each

20% Weightage (10 + 10)

Final Exam

Three hours long

50% Weightage

COURSE GRADING POLICY

Quizzes
05%

Programming Assignments
15%

Mid I & II
20%

Class Projects
10%

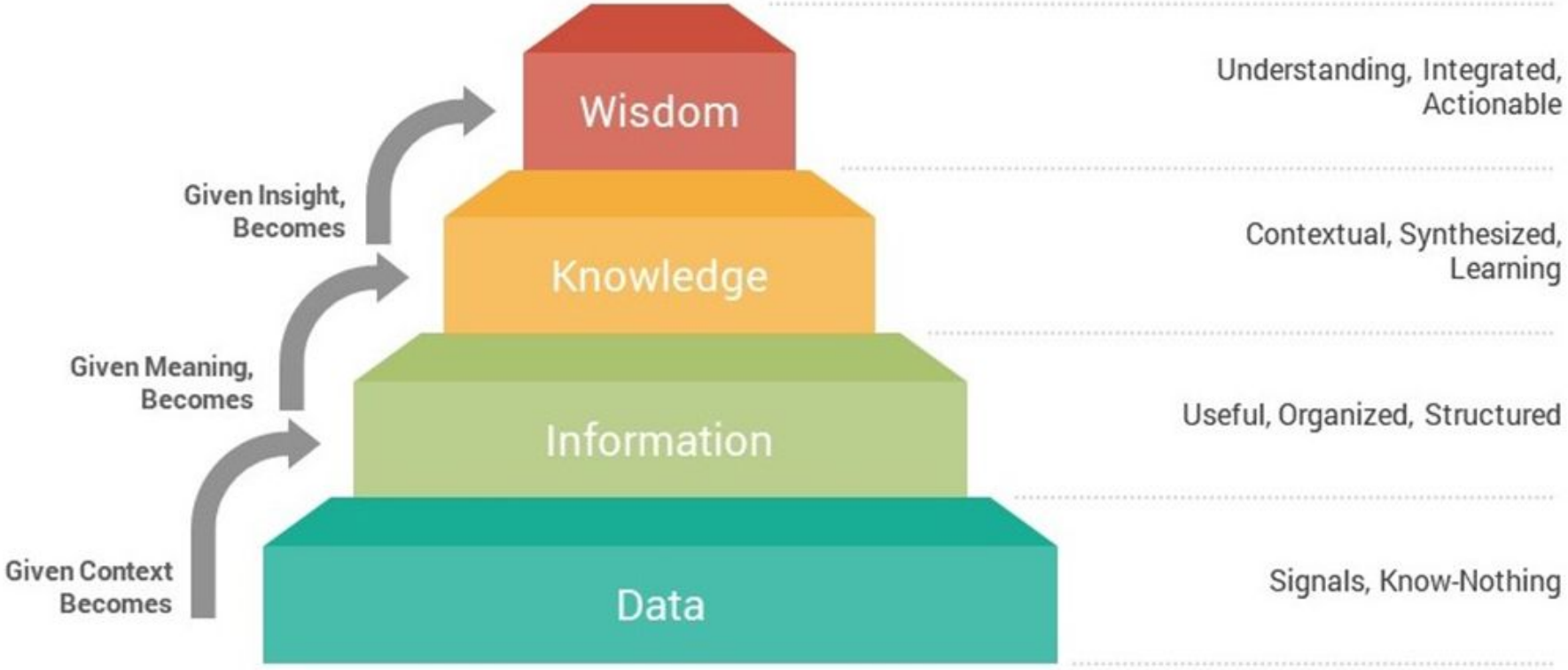
Final Exam
50%

Data Structures

- **What** is Data Structures?
  - What comes to your mind?

- **What** is Data?
  - Why is Data so important in Computer Science?
  - Why is Data important to every field and every human?

Data, Information, Knowledge, Wisdom



WHAT EXACTLY DOES "DATA" MEAN?

Punjab, 13,022,591, 45,540,221, 378,288, 418,478, Sindh,1,119,970, KPK, 155,712

Data are discrete, objective facts or observations, which are unorganized and unprocessed, and do not convey and specific meaning

(Awad and Ghaziri, 2004).

DATA + CONTEXT → INFORMATION

Fully Vaccinated: 13,022,591; Total Doses Administered: 45,540,221

Confirmed Cases: 1, 119, 970

Active Cases

Punjab: 378, 288; Sindh: 418, 478; KPK: 155, 712

Data that have been shaped into a form that is meaningful and useful to human beings

(Laudon & Laudon 2006, p. 13).

INFORMATION+ APPLICATION → KNOWLEDGE

Fully Vaccinated; How much time will it take to fully vaccinate the country?
Total Doses Administered: Can we open up more vaccination center? Staff, number of doses, per day vaccination rate?

Data/Information that have been organized and processed to convey understanding, experience, accumulated learning and expertise as they apply to a problem at hand

(Turban et al., 2005, p.38).

KNOWLEDGE + EXPERIENCE → WISDOM

Fully Vaccinated, is number of active cases dropping? How fast?

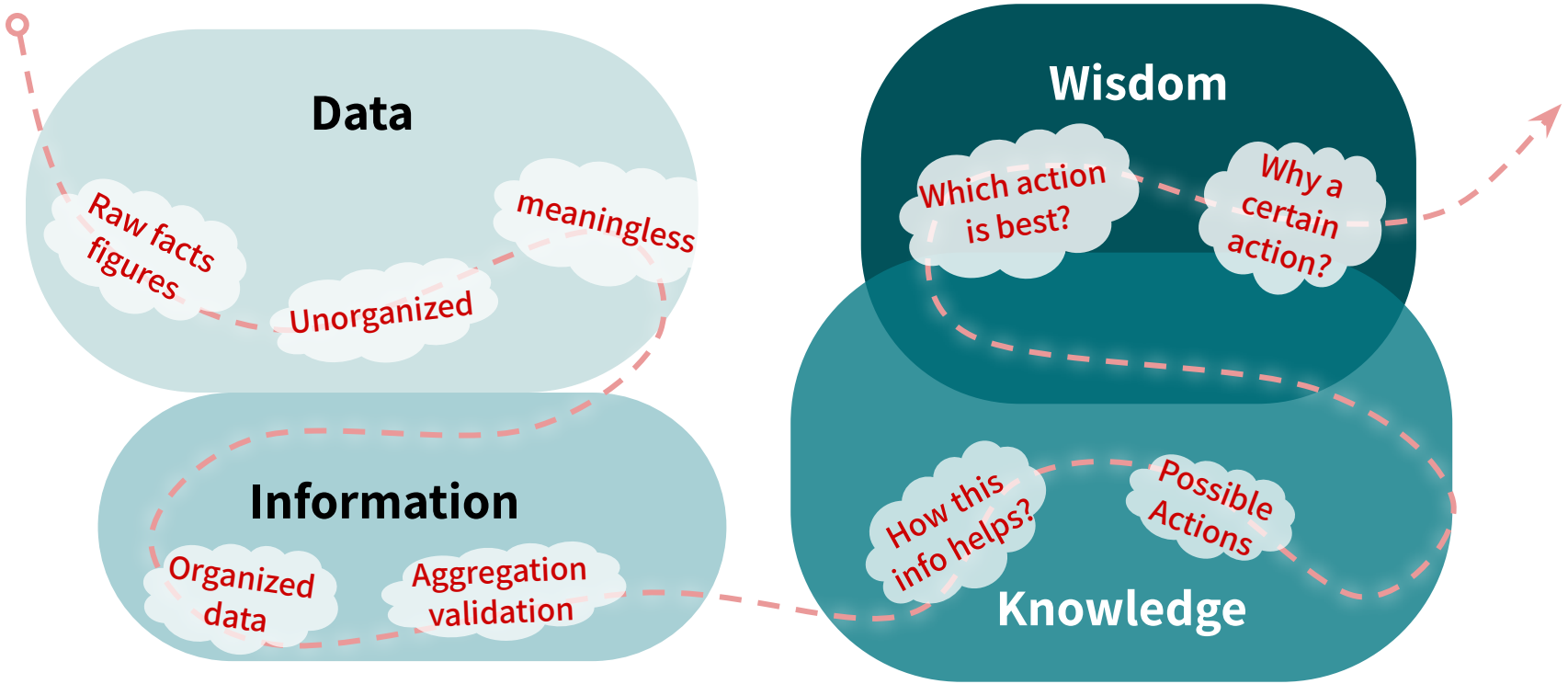
Total Doses Administered: is opening more vaccination center the real solution?

What is happening in USA, China, India?

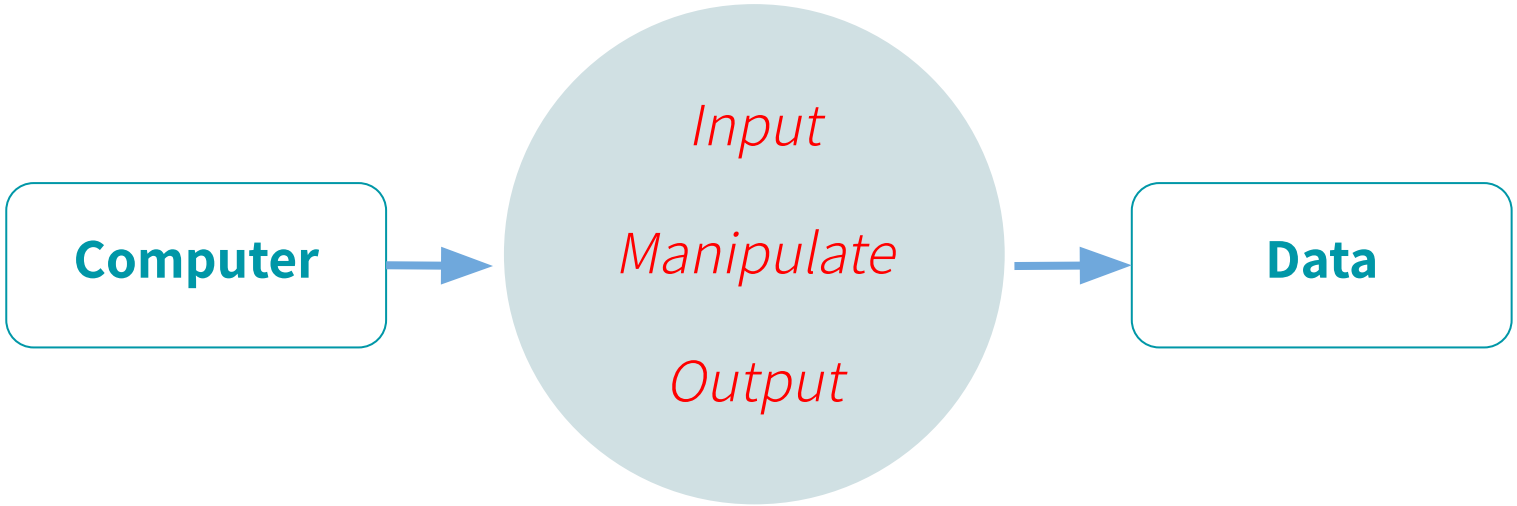
Accumulated knowledge, which allows you to understand how to apply concepts from one domain to new situations or problems

(Jessup & Valacich, 2003).

Why is Data Important..!



DATA & COMPUTER SCIENCE



DATA ABSTRACTION

- Separation of data types logical properties from its implementation

- Integers are represented differently on different computers
  - May be binary-coded decimal
  - One’s complement
  - Two’s complement
- A programmer is only interested in
  - Declaration, assignment, addition, subtraction, multiplication etc.

- Logical properties refers to the “What”.

ABSTRACT DATA TYPE (ADT)

- Data item is a piece of information whose value is drawn from a type.

Data type whose properties (domain & operations) are specified independently of any particular implementation.

- Set of all possible values
  - Int, float, boolean, etc.
- Operations to create & manipulate data
  - Addition ‘+’, Subtraction ‘-’, Multiplication ‘*’, Division ‘/’, etc.

DATA STRUCTURE

A collection of data elements whose organization is characterized by accessing operations that are used to store and retrieve the individual data elements.

The implementation of the composite data members in an ADT

A data item composed of multiple data types

A bank record contains: name, address, account number, account balance etc.

DATA STRUCTURE | TYPES

Based on Definition

Primitive

That do not involve any other elements as its subparts

Integers, Characters, etc.

Non Primitive

That define a set of derived elements

Arrays, Class, Structure etc.

DATA STRUCTURE | TYPES

Based on Organization

Linear

If elements form a sequence or linear list. Every data element has a unique successor and predecessor.

Arrays, Linked lists.

Non Linear

If elements form a hierarchical or network relationship. Every data element may have more than one successor and predecessor.

Trees, Graphs.

DATA STRUCTURE | TYPES

Based on Memory Allocation

Static

If it is created during compile time. The variables have user defined names.

Array.

Dynamic

If it is created at run-time. The variables are not always referenced by user-defined name.

Linked list.

DATA STRUCTURE | TYPES

Based on State

Persistent (Functional)

Supports operation on the most recent version as well as the previous version.

Example: Inserting an element into a list yields new list.

Ephemeral (Imperative)

That supports operations only on the most recent version.

Example: inserting an element into a list mutates the list.

DATA STRUCTURE | TYPES

Based on Access

Sequential Access

To access the nth element, we must access the preceding (n - 1) data elements.

Example: LInked list.

Direct Access

Any element can be accessed without accessing its predecessor or successor

Example: ArrayA

WHAT WE WILL BE LEARNING

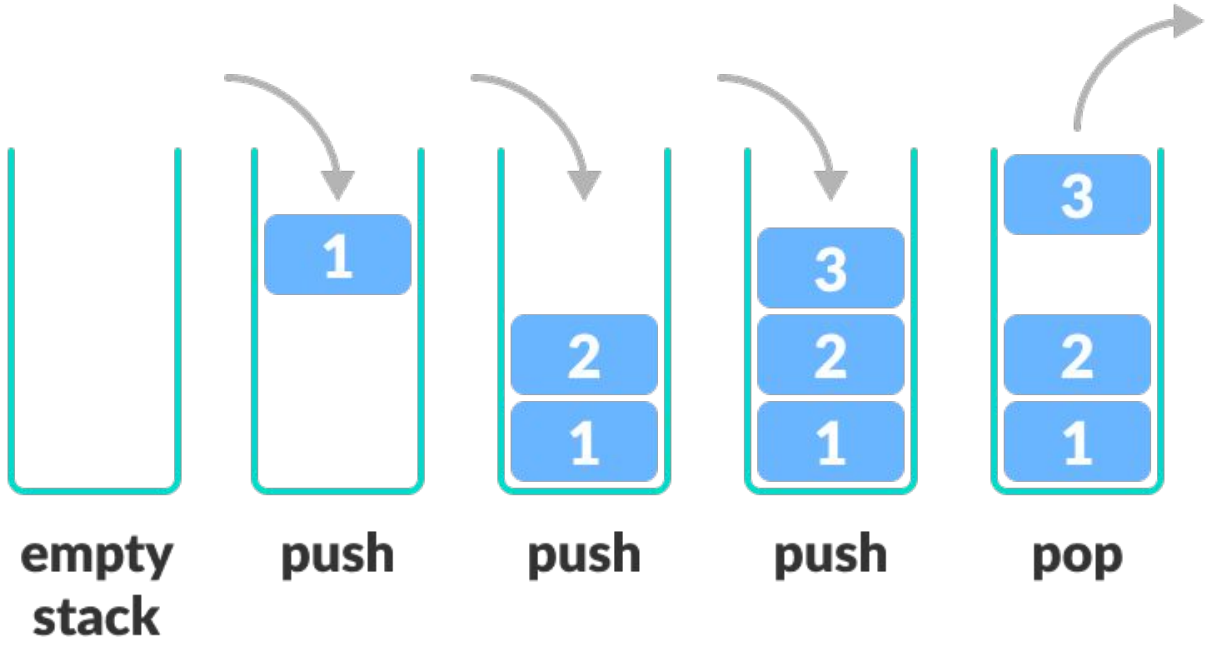
1. Arrays
2. Linked List
3. Stacks
4. Queues
5. Heap
6. Tree
7. Hashing
8. Graphs

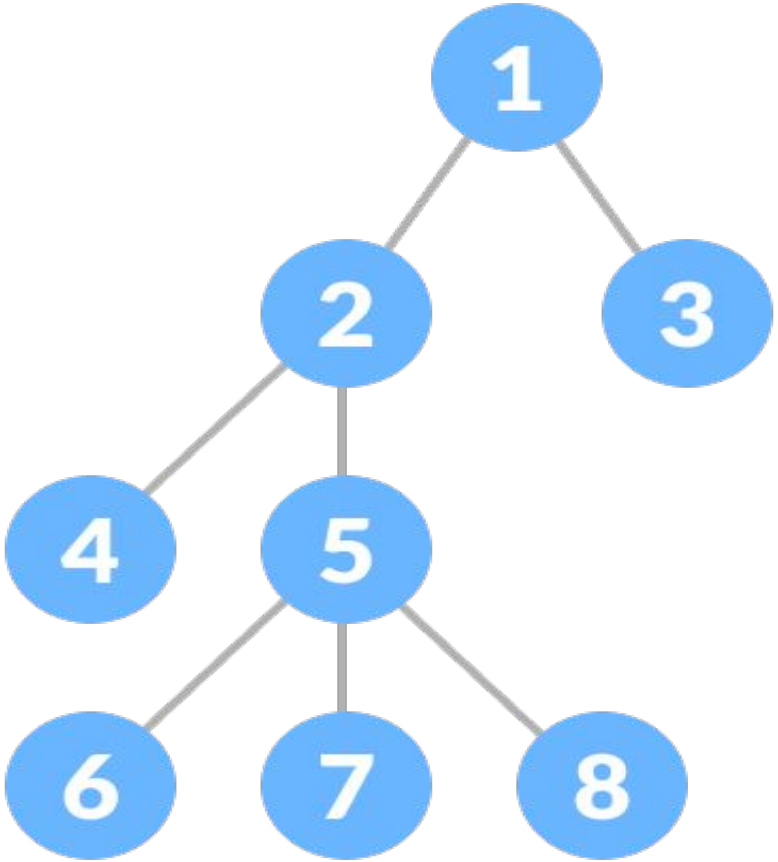
1. C++ Language Specification
2. OOP Concepts
3. Memory Management
4. Recursion
5. Sorting
6. Searching

DATA STRUCTURES EXAMPLE | ARRAY

DATA STRUCTURES EXAMPLE | LINKED LIST

DATA STRUCTURES EXAMPLE | STACK





DATA STRUCTURES EXAMPLE | TREE

RECAP

You'll learn how to **design**, **analyze**, and **communicate about** data structures.

We have learned the importance of Data.

The relationship between Data, Information, Knowledge and Wisdom.

We have talked about Abstraction and Abstract Data Types

Data Structures, its types and some examples!

Which Data Structures we will learn in this course.

NEXT TIME

Revision of

Pointers & their uses

Dynamic Memory Management