



# CSE1033

# Data Structures

May 24, 2019



# HELLO!

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# Course Outline

Google Classroom ID : **iy44dz**

Hint: visit [classroom.google.com](https://classroom.google.com)  
and join the class with above id.

Course Outline

: Check Classroom's **Classwork** tab.

# Data and Information

**Data** are plain facts

- ▶ Abul 172 85

**Information** is processed, organized, presented data that convey some meaning

- ▶ Abul is 172 cm tall and his weight is 85 kg

**Data Structures** The way/technique of storing/organizing data so that it can be processed efficiently

# Data Types and Variables

- ▶ Variables are like boxes (Harel and Feldman, 2004, page 34)
  - ▷ We can store items in them
  - ▷ Add more, take off items as needed
- ▶ Different items need different type of boxes to store them
  - ▷ Example: tea stall analogy
- ▶ Data types define the type of data, the range of values that can be stored in them and the operations that are allowed on them

# Primitive Data Types

- ▶ Built in data types are the basic building blocks
- ▶ C/C++ has the following primitive data types
  - ▷ char
  - ▷ short
  - ▷ int
  - ▷ long
  - ▷ long long
  - ▷ float
  - ▷ double
  - ▷ long double
  - ▷ void
  - ▷ pointers

# Abstract Data Types (ADT)

**ADTs** are mathematical model of a data type, not necessarily tied to any programming language

- ▶ Defines the abstract data structure for content
- ▶ Defines the operations that are permitted on them

Examples:

- ▶ Student
- ▶ Bank Account

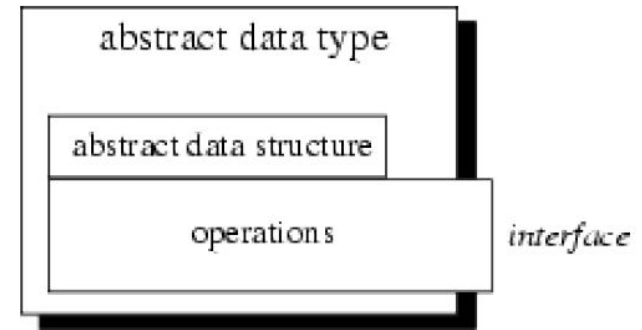


Figure: Block diagram of ADT

# Example of ADTs

## Student

- Abstract Data Structure
  - Name
  - Address
  - Date of Birth
  - CGPA
  - ...
- Operations
  - Get Address
  - Get Date of Birth
  - Set Address
  - Get CGPA
  - Compute CGPA
  - ...

## Bank Account

- Abstract Data Structure
  - Name
  - Address
  - Date of Birth
  - Balance
  - ...
- Operations
  - Get Address
  - Get Date of Birth
  - Set Address
  - Withdraw
  - Deposit
  - ...



# Programming Techniques or Paradigms

- ▶ **Unstructured Programming** Main program working directly on global data.
- ▶ **Procedural Programming** Related, meaningful and repeatable statements grouped into procedures and are called as needed.
- ▶ **Modular Programming** Procedures of common purposes groupd together into modules
- ▶ **Object Oriented Programming (OOP)** Centered around the objects that interact with each other

**Homework:** read (Harel and Feldman, 2004, Chapter 3, page 49-77)

**Homework:** read (Muller, 1997, A Survey on Programming Techniques)

## Video: Object Oriented Programming



## Video: Object Oriented Programming

- ▶ How is baking done in procedural programming language?
- ▶ What advantages do you see in OOP style of baking?
- ▶ How are different types of dogs created in OOP?

# Key OOP Concepts

- ▶ **Class**
  - ▷ An idea
  - ▷ An actual representation of an ADT
- ▶ **Object**
  - ▷ A real existence
  - ▷ An instance of a class
- ▶ **Example:**
  - ▷ Class is a blueprint that architects produce
  - ▷ Objects are the buildings that builders build

# Abstraction, Encapsulation and Relations

- ▶ **Abstraction**

- ▷ Hiding details that you need not be aware of
- ▷ Whenever you get on a lift, do you think about how it works every time?

- ▶ **Encapsulation**

- ▷ Access to data is only permitted through defined methods
- ▷ Would you want anyone and everyone to know your CGPA or worse yet, change it randomly?

- ▶ **Example:**

- ▷ Is-a
- ▷ Part-of
- ▷ Has-a

# Inheritance

- ▶ Classes are divided into
  - ▷ Base class or super class
  - ▷ Derived class or sub class
- ▶ Data members (attributes) and methods can be inherited
- ▶ Access modifiers can be used to control inheritance
- ▶ Example
  - ▷ Bank Account can be a base class
  - ▷ Savings Account, Current Account, Student Account, ... etc. can be subclasses
  - ▷ All accounts can deposit amounts, but interest calculation will be different, some accounts may not withdraw money

# Access Modifiers

- ▶ There are three types of access modifiers:
  - ▷ Private
  - ▷ Protected
  - ▷ Public
- ▶ Example:
  - ▷ Your mailbox is open for all to deliver mails to you - Public
  - ▷ Your television is accessible to you, your family, your relatives and your friends - Protected
  - ▷ Your safe is only accessible to you - Private
- ▶ Usual practice is to keep data members private and methods public

# Polymorphism

- ▶ Methods (functions) with same signature (same name, return type and parameter list) can behave differently in sub-classes
- ▶ Base classes' pointer can be used to refer to sub-classes' object
- ▶ We can use Bank Account's pointer to refer to Savings Account, Current Account's objects
- ▶ Why is it useful?



## References

- ▶ Harel, D. and Feldman, Y. (2004). Algorithmics: The Spirit of Computing. Addison Wesley.
- ▶ High School eLearning (Feb 13, 2009). Object Oriented Programming. <http://www.youtube.com/watch?v=c5kfCH50wI0> . [Online; accessed 24-May-2019].
- ▶ Muller, P. (1997). Introduction to object-oriented programming using C++. <http://www.desy.de/gna/html/cc/Tutorial/tutorial.html> .[Online; accessed 24-May-2019].