

Data Structures and Algorithms

Prof. Ajit A. Diwan

Prof. Ganesh Ramakrishnan

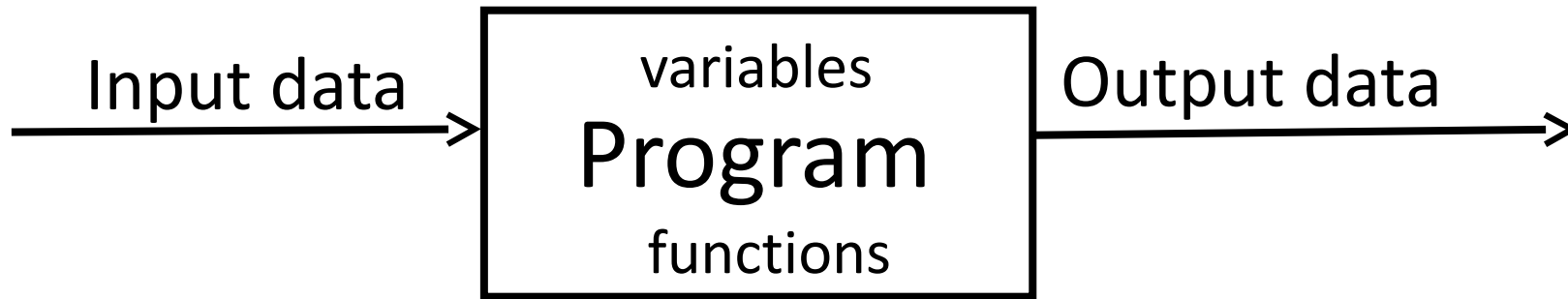
Prof. Deepak B. Phatak

Department of Computer Science and Engineering

IIT Bombay

Session: Abstract Data Type

Programming Problem



- Define variables to represent data
- Define functions to manipulate data

Abstract Data Type



- Variables have a **type**
- Type of a variable defines its possible values
- Defines the operations that can be performed on it
- Type can be defined independent of
 - the actual data structure
 - the programming language
 - the computer
- Hence called **ABSTRACT DATA TYPE**

Example: integers



- Integer
 - Values are, -3, -2, -1, 0, 1, 2, 3,
 - Operations are +, -, *, /, % ...
- The abstract data type Integer is an infinite set
- The built-in data structure `int` is a particular implementation of the abstract data type Integer
- Another built-in data structure `long long int` also implements the same abstract type

Example: real numbers

- Real numbers
 - Values : 2.5, 1.33333333..., 3.1415926..., 2.7182818...
 - Operations $+$, $-$, $*$, $/$, $\sqrt{\quad}$,
- Real values cannot be represented exactly
- Built-in types `float`, `double`, `long double` give a data structure for representing real numbers approximately
- Errors in representation
- May need other data structures to reduce errors

Definition vs. Implementation



- Use of abstract data types separates the definition of the type from its implementation
- We only need to define the abstract types to be used in a program
- This is independent of any computer or programming language or any specific implementation
- Implementation of a given type in a particular language can be done separately.
- For many common data types, implementations are readily available : **built-in types, libraries**, etc.

Exercise: rational numbers



- Define the abstract data type **Rational Number**
- A rational number is a ratio of 2 integers
- Define all arithmetic operations on rational numbers
- Build a data structure for implementing this abstract type
- Write functions for implementing all operations on rational numbers

Course Outline



- The first part of this course will concentrate on the definitions of some standard abstract data types, and their uses.
- The second part will concentrate on implementations of these types, including those that are available as part of standard libraries.
- The third part will look at uses of these types in algorithms for solving problems.