

DATA TYPES

- ✓ A **data type** in programming languages is an attribute of a data which tells the computer (and the programmer) something about the kind of data it is. This involves setting constraints on what values it can take and what operations may be performed upon it.
- ✓ A data type defines a set of values and the allowable operations on those values. Almost all programming languages explicitly include the notion of data type, though different languages may use different terminology.

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✓ Most programming languages also allow the programmer to define additional data types, usually by combining multiple elements of other types and defining the valid operations of the new data type. For example, a programmer might create a new data type named "Person" that specifies that data interpreted as Person would include a name and a date of birth.

✓ Common data types may include:

- Integer
- Floating point
- Character
- String

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Integer

- ✓ A member of the set of:
 - positive whole numbers $\{1, 2, 3, \dots\}$
 - negative whole numbers $\{-1, -2, -3, \dots\}$
 - zero $\{0\}$.
- ✓ A complete unit or entity.
- ✓ A whole number.
- ✓ In programming, sending the number 123.898 to an integer function would return 123.
- ✓ Example of calculation;
 - $2 + 1 = 3$
 - $2.3 + 1.4 = 3$

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Floating point

✓ A method for storing and calculating numbers in which the decimal points do not line up as in fixed point numbers. The significant digits are stored as a unit called the "mantissa," and the location of the radix point (decimal point in base 10) is stored in a separate unit called the "exponent." Floating point methods are used for calculating a large range of numbers quickly.

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Floating point

✓ Floating point operations can be implemented in hardware (math coprocessor), or they can be done in software. In large systems, they can also be performed in a separate floating point processor that is connected to the main processor via a channel.

✓ FLOATING POINT EXAMPLES;

Mantissa	Exponent	Value
71	0	71
71	1	710
71	2	7100
71	-1	7.1

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Floating point

✓ Example of calculation;

- $2 + 1 = 3$

- $2.3 + 1.4 = 3.7$

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Character

- ✓ In computer and machine-based telecommunications terminology, a **character** is a unit of information that roughly corresponds to a symbol, such as in an alphabet in the written form of a natural language.
- ✓ *Characters* are the basic symbols that are used to write or print a language. For example, the characters used by the English language consist of the letters of the *alphabet*, numerals, punctuation marks and a variety of symbols (e.g., the ampersand, the dollar sign and the arithmetic symbols).

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Character

- ✓ Characters are fundamental to computer systems. They are used for;
 - input (e.g., through the keyboard or through optical scanning) and output (e.g., on the screen or on printed pages)
 - writing programs in programming languages
 - as the basis of some operating systems (such as Linux) which are largely collections of *plain text* (i.e., human-readable character) files
 - for the storage and transmission of non-character data (e.g., the transmission of images by e-mail using *base64*).

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String

- ✓ A **string data type** is a data type modeled on the idea of a formal string. Strings are such an important and useful data type that they are implemented in nearly every programming language. In some languages they are available as primitive types and in others as composite types. The syntax of most high-level programming languages allows for a string, usually quoted in some way, to represent an instance of a string datatype; such a meta-string is called a *literal* or *string literal*.
- ✓ In computer programming and some branches of mathematics, a **string** is an ordered sequence of symbols. These symbols are chosen from a predetermined set or alphabet.

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String

- ✓ In computer programming, a string is generally understood as a data type storing a sequence of data values, usually bytes, in which elements usually stand for characters according to a character encoding, which differentiates it from the more general array data type.
- ✓ In this context, the terms **binary string** and **byte string** are used to suggest strings in which the stored data does not (necessarily) represent text.
- ✓ A variable declared to have a string data type usually causes storage to be allocated in memory that is capable of holding some predetermined number of symbols. When a string appears literally in source code, it is known as a string literal and has a representation that denotes it as such.

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String

- ✓ Some languages like C++ implement strings as templates that can be used with any datatype, but this is the exception, not the rule.
- ✓ If an object-oriented language represents strings as objects, they are called *mutable* if the value can change at runtime and *immutable* if the value is frozen after creation.
- ✓ For example, Ruby has mutable strings, while Python's strings are immutable.
- ✓ Other languages, most notably Prolog and Erlang, avoid implementing a string datatype, instead adopting the convention of representing strings as lists of character codes.