Introduction to Programming

Spring2022

Objectives

- Numeric Data Type
- Type Conversion and Rounding
- Using the Math Library

Data Type

- The information that is stored and manipulated by computer programs is referred to as data.
- Python treat all data as objects
  - Other programming languages have primitive data types which are not objects
- Types of data in Python:
  - Built-in by default
  - User created

Data Type

- Data type build-in by default
  - Text type – str
  - Numeric types – int, float, complex
  - Sequence types – list, tuple, range
  - Mapping type – dict
  - Set types – set, frozenset
  - Boolean type – bool
  - Binary type – bytes, bytearray, memoryview

Numeric Data Types

- Numeric types
  - int are whole numbers – they do not have fractional part
  - Example: 5, 4, 9, -1, -45, 1234
  - float are also called fractions and have fractional part
  - Example: 1.25, -45.333, 96.456, 0.001, 14.0

Numeric Data Types

- Inside the computer, whole numbers (int) and floating point numbers (float) are represented quite differently!
- We say that int and float numbers are two different data types.
- The data type of an object determines what values it can have and what operations can be performed on it.
- Example

Numeric Data Types

- How can we tell which is which?
  - A numeric literal without a decimal point produces an int value
  - A literal that has a decimal point is represented by a float (even if the fractional part is 0)

Numeric Data Types

- Python has a special function to tell us the data type of any value.
- It is called type
- Example

Numeric Data Types

- Why do we need two number types?
  - Values that represent counts can't be fractional (you can have 3 cars but not 3.5 cars)
  - Most mathematical algorithms are very efficient with integers
  - The float type stores only an approximation to the real number being represented!
  - Since floats aren't exact, use an int whenever possible!

Numeric Data Types

- Operations on ints produce ints, operations on floats produce floats (except for //).
- Examples

Numeric Data Types

- Integer division produces a whole number.
- That's why 10//3
- 10%3 = 1 is the remainder of the integer division of 10 by 3.
- This is very useful in converting from one unit to another

Type Conversions & Rounding

- We know that combining an int with an int produces an int, and combining a float with a float produces a float.
- What happens when you mix an int and float in an expression?

```
x = 5.2 * 2
```

- What do you think should happen?

Type Conversions & Rounding

- For Python to evaluate this expression, it must either convert 5.0 to 5 and do an integer multiplication, or convert 2 to 2.0 and do a floating point multiplication.
- Converting a float to an int will lose information
- Ints can be converted to floats by adding ".0"

Type Conversions & Rounding

- In mixed-typed expressions Python will convert ints to floats.
- Sometimes we want to control the type conversion. This is called explicit typing.
- Converting to an int simply discards the fractional part of a float – the value is truncated, not rounded.

Type Conversions & Rounding

- To round off numbers, use the built-in round function which rounds to the nearest whole value.
- If you want to round a float into another float value, you can supply a second parameter that specifies the number of digits after the decimal point.

Type Conversions & Rounding

- Type conversion also works with numerical string
- Examples
- This is useful as a secure alternative to the use of eval for getting numeric data from the user.

Arithmetic Operators

- +, -, *, /, //, **, %, abs

Using the Math Library

- A library is a module with some useful definitions/functions.
- To use a library, we need to make sure this line is in our program:import math
- Importing a library makes whatever functions are defined within it available to the program.

Using the Math Library

Using the Math Library

Class Work

- Write a program to calculate the volume and surface area of a sphere from its radius, given as input.

$$V = \frac{4 * \pi * r^3}{3} \qquad A = 4 * \pi * r^2$$

- Write a program that calculate the cost per square inch of a circular pizza, given its diameter and price.

$$A = \pi * r^2$$