Learning Activity (1 of 2): Numeric Variables

Overview

In the previous lesson, you learned how to store words in variables and display them later in the program. In this lesson, you will learn how to work with numbers as well, including computing mathematical formulas and other types of expressions, or combinations of variables and operations.

For many types of programmers, working through calculations and manipulating numeric data is the primary reason they write programs. For example, scientists today use computers to simulate complex interactions that would be too difficult to work out by hand.

Preparation Material

Data Types

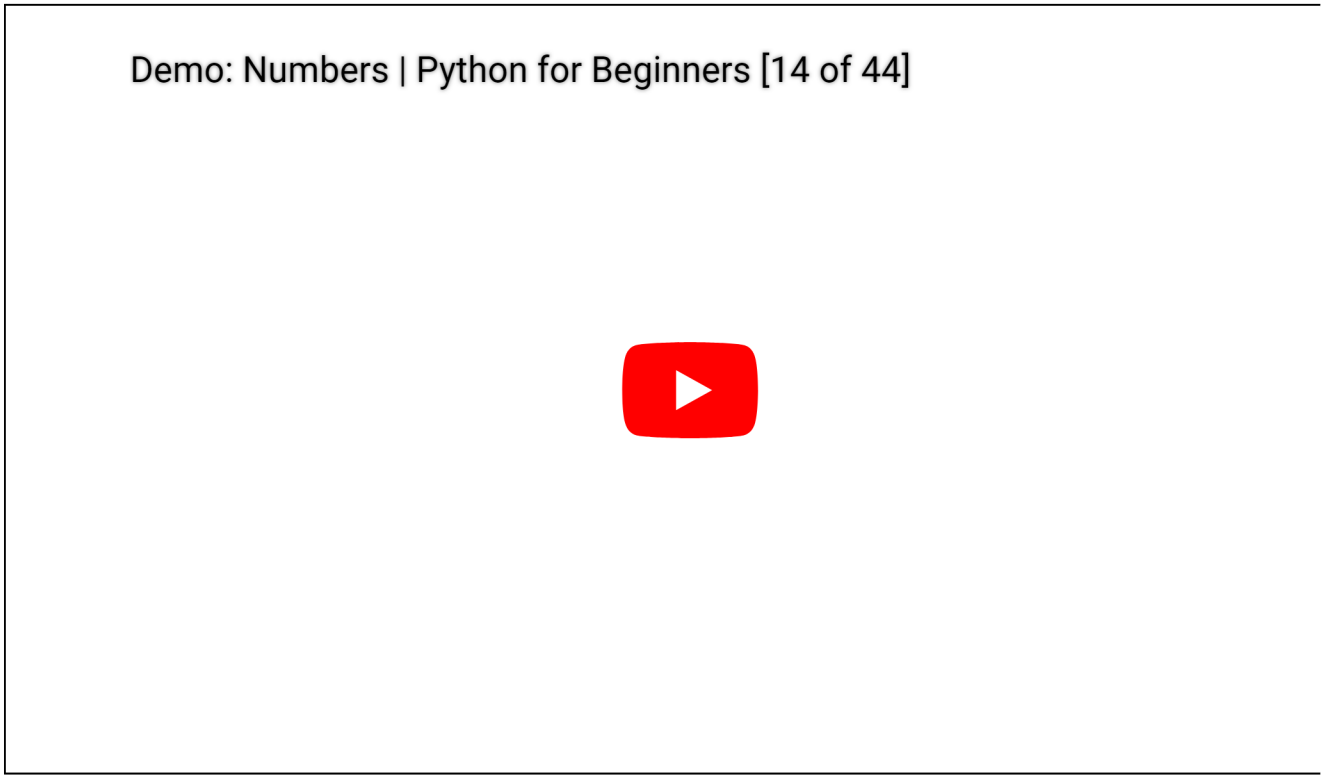
To this point, you have been working with a type of data called *strings*, which can be sequences of any kind of characters (letters, numbers, symbols, spaces, etc.), such as **`"The book of: 1 Nephi"`**, **`"yellow puppy"`**, or **`"byui-cse.github.io/cse110-course"`**.

A sequence of numbers, such as **`"48212"`**, can be converted to a numeric data type and stored internally as a *number*; otherwise, the computer doesn't distinguish numbers from a sequence of letters. Once you have converted the string to a number, you can use it in mathematical formulas or expressions.

Please watch the following videos for more information:

- Direct Link: Numeric Data Types (6 mins)

- Direct Link: Demo: Numbers (6 mins)



Using Different Data Types

As shown above, when data is stored in a variable, the computer treats it as a certain data type (such as a string or an integer). You have to be conscious of these different data types when you want to mix them together, such as when you want to display a number alongside the text of a string.

The easiest way to display numbers alongside text, is to use a format string:

```
number = 7
print(f"The number is {number}.")
```

This is simple and works well, and is the preferred way to display a number in your print statement alongside text. But in order to properly use different data types, you will need a little deeper understanding of them as well as how operators like the plus sign work with them.

Operators and Different Data Types

Consider the plus operator **+**. When you add two strings, it glues them together, one right after the other (the technical term for this is that it *concatenates* them):

```
color = 'blue'
animal = 'horse'

# You can add, or concatenate, two strings together with +:
print(color + animal)
# This displays: bluehorse

# You can add many strings together, whether the strings are variables
# the quotation marks:
print(color + ' ' + animal + '!')
# This displays: blue horse!

# You can also save the result into a new string variable:
combined_words = color + ' ' + animal + '!'
print(combined_words)
```

On the other hand, if the data type of the variables is integer or floating point, the **+** operator actually performs the mathematical addition:

```
boys_count = 10
girls_count = 12

# Add two numbers together using the + operator:
print(boys_count + girls_count)
# This displays: 22
```

```
# You can save the result in a new variable to use later:
total_count = boys_count + girls_count
print(total_count)
```

Mixing Strings and Numbers

A potential problem arises if you try to mix strings and numeric data types together. For example, trying to add a string to an integer produces an error:

```
apple_count = 5

# Error on this line... You can't add strings and integers together!
print("You have " + apple_count + " apples") # ERROR!
```

The computer doesn't know how to add strings to numbers, which causes an error. In this case, what you want is for the computer to treat the number stored in the **`apple_count`** variable as a string instead of a number. It might seem obvious to you that this is the desired behavior, but the computer doesn't try to guess what you want, you must explicitly tell it when you want it to convert one type of data to another.

Converting data from one type to another is called type-casting, or "casting." That's just a fancy way of saying "treat it like a number please." To convert data to an integer, you put "int" before it, and then wrap it in parentheses, like this: **`int(your_data_here)`**. The same is true for converting it to a floating point number with the term **`float()`** or to a string with **`str()`** and so forth.

For example:

```
# This creates a new integer variable with the value of 10
# There is nothing magical about the "_num" in the variable name, it wi
# help us keep track of it
length_num = 50
width_num = 10

# If you add the numbers together, you would get the result you expect:
print(length_num + width_num) # This displays: 60

# You can convert the values to the strings "50" and "10" like this:
length_string = str(length_num)
width_string = str(width_num)

# The computer now thinks of these variable as two characters, the digi
# by the digit 0, and the digit 1 followed by the digit 0.
```

```
# If you try to add the two strings together, it will concatenate them,
# one after the other:
```

Whenever you get input from the user using **`input`**, it will be a string by default:

```
quantity_from_user = input("How many items do you have? ")

# The variable quantity_from_user is a string.
# To convert it to an integer you use the int(...) notation:
quantity_number = int(quantity_from_user)

# Because the quantity_number variable is an integer you can do math wi
double_number = quantity_number * 2

# If you want to use these values in strings, you CANNOT just add them,
# have to convert them to a string:

# WRONG:
print("Twice as many is: " + double_number)

# Right:
double_string = str(double_number)
print("Twice as many is: " + double_string)

# You can also do this in one step:
# Right:
print("Twice as many is " + str(double_number))
```

Similar to the last example, you can combine the **`input`** and **`int`** commands into one line:

```
# Using two lines:
people_string = input("How many people are in the room? ")
people_number = int(people_string)

# Using one line:
people_number = int(input("How many people are in the room? "))

# The same works for floating point numbers:
length_number = float(input("What is the length? "))
```

Hint from Instructor:

In the examples on this page, we used variables like **`quantity_string`** and **`quantity_number`** to try to illustrate the data types of each variable, but when you write your code, you don't need to include the **`_string`** or **`_number`** parts. You should use variable names that are short and to the point such as: **`quantity`**, **`apples`**, **`length`**, etc.

Expressions and Mathematical Operations

Once you have numeric values stored in variables, you can perform a variety of complex mathematical operations. The following are common mathematical operators in Python:

Operator	Symbol	Example	Result
Add	`+`	`3 + 4`	`7`
Subtract	`-`	`3 - 4`	`-1`
Multiply	`*`	`3 * 4`	`12`
Divide	`/`	`15 / 4`	`3.75`
Divide and drop remainder	`//`	`15 // 4`	`3`

Operator	Symbol	Example	Result
Remainder or Modulus (Get the remainder that would result from dividing the first number by the second one.)	`%`	`25 % 7`	`4`
Exponent (To the power of)	`**`	`3 ** 4`	`81`

These operators follow standard mathematical orders of operation (where **`*`** happens before **`+`**), but you can force it to evaluate using parentheses. For example, **`(3 + 4) * 2`** will perform the addition first, and then multiple the result by 2.

Activity Instructions

For this assignment, you will practice several different examples, but they should all be part of the same program.

> Hint from Instructor:
>
> After completing part of the assignment, if you want to keep the code there, but not have it run each time, you can put a **`#`** character at the front of the line to "comment it out" or temporarily turn it into a comment. Then, if you want the code to run again, you remove the **`#`** character and it is code again.

Write a program that does the following:

1. Prompt the user for their age. Convert it to a number, add one to it, and tell them how old they will be on their next birthday.
2. Prompt the user for the number of egg cartons they have. Assume each carton holds 12 eggs, multiply their number by 12, and display the total number of eggs.
3. Prompt the user for a number of cookies and a number of people. Then, divide the number of cookies by the number of people to determine how many cookies each person gets.

Here is an example of the tasks when run:

```
How old are you? 25
On your next birthday, you will be 26

How many egg cartons do you have? 3
You have 36 eggs

How many cookies do you have? 18
How many people are there? 8
Each person may have 2.25 cookies
```

Sample Solution

When your program is finished, please view a sample solution of this program to compare your approach to that one.

You should work to complete this checkpoint program first, without looking at the sample solution. However, if you have worked on it for at least an hour and are still having problems, you may feel free to use the sample solution to help you finish your program.

- Sample solution

Testing Procedure

Verify that your program works correctly by following each step in this testing procedure:

1. Run through the entire program using the inputs shown in the example above. Make sure your output matches the output shown above.
2. For the first question, regarding ages, try entering the ages 18 and 59 (one at a time), and ensure that the program correctly outputs the numbers 19 and 60 for the next birthdays.
3. For the second question, regarding eggs, try entering a 5 and 0 (one at a time), and ensure that the program outputs 60 and 0 eggs.
4. For the third question, regarding cookies, trying entering two more sets of values (one at a time) and make sure the division works correctly. Try one set of values that results in an even number (no decimal part) and one that results in a decimal and make sure they both work correctly.

5. Double check that the output matches the example output exactly, including:
    - The numeric values should appear in the middle of the other words, not on a separate line.
    - The number of spaces before and after the numbers should match the example output.
    - There should be a blank line before each section.

Submission

When you have completed all of the learning activities for this week, you will return to Canvas and submit the associated quiz there.

Up Next

- Learning Activity (2 of 2): Mathematical Expressions

Other Links:

- Return to: Week Overview | Course Home