

# Lesson 2

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## 1 Lesson 1: Introduction to Programming II

### 1.1 Data Types: Numbers

In algebra, most variables store numbers. However, computers can store other types of data as variables, in addition to numbers.

Specifically, we will be storing four types of data in variables: floats, integers (ints), strings, and Booleans. We can use the command `type()` to assess the data type of the input.

We will start by taking a look at the two numerical types: floats and integers (ints). Floats contain decimal points whereas ints are whole numbers, positive or negative.

While we don't normally make the distinction between floats and ints typically, understanding how our computer interprets each of these data types is important for writing good code! Let's test the type of a couple of numbers:

```
[1]: print(type(10))
      print(type(10.0))
      print(type(-10))
```

```
<type 'int'>
<type 'float'>
<type 'int'>
```

### 1.2 Data Types: Strings

If we would like to store or print a word instead of a number, we can use the string data type. We use double- or single- quotation marks to denote strings.

Let's try creating a variable to store a string:

```
[3]: message = "Hello, world!"
      print(message)
      print(type(message))
```

```
Hello, world!
<type 'str'>
```

### 1.3 Concatenation

It can be helpful to concatenate (join) strings together to print statements containing strings stored in variables. The operation for concatenation is the + symbol (just like addition, but between two strings).

Note that while you can add two numbers (floats or ints) together and you can concatenate two strings together, adding a number to a string will result in an error.

Let's try concatenating different data types together:

```
[4]: name = "Katie" # Try with your own name!  
print("My name is " + name)
```

My name is Katie

Concatenation is just like addition with strings!

```
[6]: ageInYears = 9 # Try with your own age!  
print("I am " + ageInYears + " years old")
```

```
↳  
-----  
↳  
TypeError                                Traceback (most recent call↳  
↳last)  
  
  <ipython-input-6-9400f29e9929> in <module>()  
    1 ageInYears = 9 # Try with your own age!  
----> 2 print("I am " + ageInYears + " years old")
```

TypeError: cannot concatenate 'str' and 'int' objects

```
[7]: ageInYears = "9" # Try with your own age!  
print("I am " + ageInYears + " years old")
```

I am 9 years old

You can't concatenate a number (float or int) to a string. This may be your first error, but it won't be your last (that's okay, mistakes happen, especially while coding!)

```
[27]: # Try making ageInYears a variable storing a string  
ageInYears = str(9)  
print("I am " + ageInYears + " years old")
```

I am 9 years old

## 1.4 Conversion

It is possible to convert from one data type to another with the commands `float()`, `int()`, and `str()`.

Operations combining different numerical data types together can also convert between the data types:

`Int + Int -> Int`

`Float + Float -> Float`

`Int + Float -> Float`

Let's try converting between different data types:

```
[9]: # Convert a string to a float
x = float("3")
print(type(x))

# Convert an integer to a string
x = str(4)
print(type(x))

#Convert a float to an integer
x = int(4.0)
print(type(x))
```

`<type 'float'>`

`<type 'str'>`

`<type 'int'>`

## 1.5 Data Types: Booleans

The last data type we will be using is called a Boolean, which can take one of two values: `True` and `False`. These data types might seem a little silly now, but will be really useful in the next section, when we talk about If Statements.

Let's see how Booleans work in code:

```
[12]: a = True
print(type(a))
b = False
print(type(b))
```

`<type 'bool'>`

`<type 'bool'>`

Make sure to always capitalize Booleans this way - any other way and the computer will get confused!

## 1.6 Checkpoint

In the last section, we covered the four main data types and how they interact with one another. Test what you've learned by identifying the type of each of the following variables. Use the terminal if you need to check your answer, using the `type()` command.

1. Identify the types of the following variables.

```
[15]: a = 4.0 # Float
      b = 2 * 10 # Integer
      c = "two" # String
      d = True # Boolean
      e = 4.0 / 2 # Float
      f = "12.0 * 3" # String
      g = "False" # String
      h = 2 / 5 # Float
      i = str(4.5) # String
      j = "ABC" + "123" # String
```

```
[ ]: ## Lesson 2 Summary
```

In this lesson, we've learned about four data types (floats, integers, strings, and Booleans), as well as how to concatenate these data types together and convert between them.

Let's put everything we've learned together into one final exercise:

Use the information in the Periodic Table to create 3 variables that can hold 1) the atomic number of an element, 2) the name of the element, and 3) whether or not the element is a noble gas.

# PERIODIC TABLE OF ELEMENTS

1 H Hydrogen Nonmetal

2 He Helium Noble Gas

3 Li Lithium Alkali Metal

4 Be Beryllium Alkaline Earth Metal

5 B Boron Metalloid

6 C Carbon Nonmetal

7 N Nitrogen Nonmetal

8 O Oxygen Nonmetal

9 F Fluorine Halogen

10 Ne Neon Noble Gas

11 Na Sodium Alkali Metal

12 Mg Magnesium Alkaline Earth Metal

13 Al Aluminum Post-Transition Metal

14 Si Silicon Metalloid

15 P Phosphorus Nonmetal

16 S Sulfur Nonmetal

17 Cl Chlorine Halogen

18 Ar Argon Noble Gas

19 K Potassium Alkali Metal

20 Ca Calcium Alkaline Earth Metal

21 Sc Scandium Transition Metal

22 Ti Titanium Transition Metal

23 V Vanadium Transition Metal

24 Cr Chromium Transition Metal

25 Mn Manganese Transition Metal

26 Fe Iron Transition Metal

27 Co Cobalt Transition Metal

28 Ni Nickel Transition Metal

29 Cu Copper Transition Metal

30 Zn Zinc Transition Metal

31 Ga Gallium Post-Transition Metal

32 Ge Germanium Metalloid

33 As Arsenic Nonmetal

34 Se Selenium Nonmetal

35 Br Bromine Halogen

36 Kr Krypton Noble Gas

37 Rb Rubidium Alkali Metal

38 Sr Strontium Alkaline Earth Metal

39 Y Yttrium Transition Metal

40 Zr Zirconium Transition Metal

41 Nb Niobium Transition Metal

42 Mo Molybdenum Transition Metal

43 Tc Technetium Transition Metal

44 Ru Ruthenium Transition Metal

45 Rh Rhodium Transition Metal

46 Pd Palladium Transition Metal

47 Ag Silver Transition Metal

48 Cd Cadmium Transition Metal

49 In Indium Post-Transition Metal

50 Sn Tin Post-Transition Metal

51 Sb Antimony Metalloid

52 Te Tellurium Metalloid

53 I Iodine Halogen

54 Xe Xenon Noble Gas

55 Cs Cesium Alkali Metal

56 Ba Barium Alkaline Earth Metal

57 La Lanthanum Lanthanide

58 Ce Cerium Lanthanide

59 Pr Praseodymium Lanthanide

60 Nd Neodymium Lanthanide

61 Pm Promethium Lanthanide

62 Sm Samarium Lanthanide

63 Eu Europium Lanthanide

64 Gd Gadolinium Lanthanide

65 Tb Terbium Lanthanide

66 Dy Dysprosium Lanthanide

67 Ho Holmium Lanthanide

68 Er Erbium Lanthanide

69 Tm Thulium Lanthanide

70 Yb Ytterbium Lanthanide

71 Lu Lutetium Lanthanide

72 Hf Hafnium Transition Metal

73 Ta Tantalum Transition Metal

74 W Tungsten Transition Metal

75 Re Rhenium Transition Metal

76 Os Osmium Transition Metal

77 Ir Iridium Transition Metal

78 Pt Platinum Transition Metal

79 Au Gold Transition Metal

80 Hg Mercury Transition Metal

81 Tl Thallium Post-Transition Metal

82 Pb Lead Post-Transition Metal

83 Bi Bismuth Post-Transition Metal

84 Po Polonium Metalloid

85 At Astatine Halogen

86 Rn Radon Noble Gas

87 Fr Francium Alkali Metal

88 Ra Radium Alkaline Earth Metal

89 Ac Actinium Actinide

90 Th Thorium Actinide

91 Pa Protactinium Actinide

92 U Uranium Actinide

93 Np Neptunium Actinide

94 Pu Plutonium Actinide

95 Am Americium Actinide

96 Cm Curium Actinide

97 Bk Berkelium Actinide

98 Cf Californium Actinide

99 Es Einsteinium Actinide

100 Fm Fermium Actinide

101 Md Mendelevium Actinide

102 No Nobelium Actinide

103 Lr Lawrencium Actinide

Then, do the following:

- What data type are each of these variables?
- Concatenate all variables to print a sentence with information about Hydrogen

```
[21]: atomicNumber = 1 # Integer
elementName = "Hydrogen" # String
nobleGas = False # Boolean
print("It is " + str(nobleGas) + " that " + elementName + " (" + str(atomicNumber) + ") is a noble gas.")
```

It is False that Hydrogen (1) is a noble gas.

- Change the values held by your variables to be about Xenon

```
[24]: atomicNumber = 54 # Integer
elementName = "Xenon" # String
nobleGas = True # Boolean
print("It is " + str(nobleGas) + " that " + elementName + " (" + str(atomicNumber) + ") is a noble gas.")
```

It is True that Xenon (54) is a noble gas.

The atomic weight of Xenon is 131.29 u. If this were saved as a variable, it would be a float data type.

```
[26]: atomicWeight = 131.29  
      print(type(atomicWeight))
```

```
<type 'float'>
```