

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")
```

```
↳  
-----  
↳last)                                Traceback (most recent call↳  
  
    <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

PubChem

1 H Hydrogen Nonmetal																	2 He Helium Noble Gas	
3 Li Lithium Alkali Metal	4 Be Beryllium Alkaline Earth Metal																	10 Ne Neon Noble Gas
11 Na Sodium Alkali Metal	12 Mg Magnesium Alkaline Earth Metal																	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 Metalloid	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		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 Metalloid	84 Po Polonium Metalloid	85 At Astatine Halogen	86 Rn Radon Noble Gas	
87 Fr Francium Alkali Metal	88 Ra Radium Alkaline Earth Metal		104 Rf Rutherfordium Transition Metal	105 Db Dubnium Transition Metal	106 Sg Seaborgium Transition Metal	107 Bh Bohrium Transition Metal	108 Hs Hassium Transition Metal	109 Mt Meitnerium Transition Metal	110 Ds Darmstadtium Transition Metal	111 Rg Roentgenium Transition Metal	112 Cn Copernicium Transition Metal	113 Nh Nihonium Post-Transition Metal	114 Fl Flerovium Post-Transition Metal	115 Mc Moscovium Post-Transition Metal	116 Lv Livermorium Post-Transition Metal	117 Ts Tennessine Halogen	118 Og Oganesson Noble Gas	
			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	
			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'>
```