

Introduction to Python

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Outline

Variables and Types

Operations on different types

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Intro to Python functions

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Assigning variables

- ▶ A variable is assigned by placing, on one line,
`<variable name> = <assigned value>.`

```
1 | x = 5.11
2 | y = 5
3 | name_full = 'Chris Cornwell'
```

↑ this code assigns three variables, x, y, and name_full

- ▶ To “comment out” a line, begin line with #. Good for notes to yourself, or others reading the code.

```
1 | # Make an ordered pair; output would be (10.11, 4)
2 | (x + y, y - 1)
```

- ▶ Possible to assign more than one variable in one line.

```
1 | x, y = 5.11, 5
2 | # or, you could use
3 | x = 5.11; y = 5
```

Data type

Each variable has a *data type* (or, simply *type*).¹

```
1 | x = 5.11
2 | y = 5
3 | name_full = 'Chris Cornwell'
```

↑ the types of the assigned vars are **float**, **int**, and **str** respectively.

Unlike in other programming languages, don't need to declare the types of the variables. Python *interprets* it. (The type might even *change* at a later point.)

- ▶ type **int**: like an integer.
- ▶ type **float**: like a real number in decimal form ...*kind of*.
- ▶ type **str**: a “string,” or sequence of *characters* (that can be typed from keyboard). Will return to this again.

¹[Information from Python documentation](#) about standard types.

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Numerical types

The four main operations² +, −, *, and / work as you would expect on numerical types **int** and **float**. Unlike when writing math, you cannot leave out * when multiplying.

Question

Why would it be a *bad* idea to have Python interpret something like `ab` as being “a times b”?

Assigning after an operation. **Very** often want to change a variable by some amount (e.g., increase it by 1); to keep new value, *reassign* after the operation.

```
1 | y = y + 1
2 | # A convenient shorthand for line above is
3 | y += 1
```

This is *not* a mathematical equation, but an assignment. The shorthand works for other operations.

²Representing addition, subtraction, multiplication, and division.

Logical types and None

We have some logical types, as every language needs – True and False. Usually, no need to directly assign or work with these. They are “under the hood” when making comparisons.

- ▶ Technically, True and False are like 1 and 0 in Python. Use this fact only with *extreme care*! (Maybe just avoid it.)

```
| True*False
```

↑ the line above will return 0.

The *null* type in Python is None. We'll talk about using it in later lectures.

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Basics of lists

list is a *sequential* data type in Python – it holds a sequence of “items.”

Each item could be an **int**, each could be a **list**, or possibly some with one type, some with another.

Example below: a list with **int** and **str** type items.

```
1 | my_list = [2, 3, 5, 'p']  
2 | empty_list = []
```

Referring to a list item by index:

`my_list[0]` is 2 above, `my_list[1]` is 3, and so on.

The + operation is defined on lists. It results in the *concatenation* of the lists – putting them together, end to end.

```
1 | # the code below outputs [2, 3, 5, 'p', 11, 13]  
2 | my_list + [11, 13]
```

Other operations on lists

- Multiplication by an integer: adds that many copies of the list together. For example, `[1,2]*3` will result in `[1,2,1,2,1,2]`, since
$$[1,2] + [1,2] + [1,2] = [1,2,1,2,1,2].$$
- Length of a list: use the function `len()`, with your list as input, to get the number of items in your list.
- Checking if an item is in a list: use the *keyword* `in` to check this. For example, if `my_list` is `[2, 3, 5, 'p']` then the first line below would result in `True`, the second would be `False`.

```
1 | print( 2 in my_list )  
2 | print( 4 in my_list )
```

Strings and other sequential types

- ▶ Some other sequential types: **tuple**, **range**.
- ▶ The operations we discussed (on lists) will work in same way on these.
- ▶ Final important sequential type: **str**, “strings.”
 - ▶ a sequence of *characters*, from your keyboard
- ▶ Above, the variable that was assigned 'Chris Cornwell', and the item 'p' in `my_list`, each is a string.
- ▶ *Thinking* of a string as a list of single characters, operations on strings work like they do on lists (e.g., `+` will concatenate and `len()` gives the number of characters, etc.

f-strings

To produce an output string that uses values of some variables in memory: two methods (*there are others I won't mention*).

Say a variable `i` is in memory, with `i = 2`.

```
1 | # the next line will print out 'The value of i is 2 .'
2 | print('The value of i is', i, '.')
```

- ▶ Works, but has some downsides.
- ▶ Better: use so-called f-strings, allowing variable(s) directly inside the string, surrounded by braces `{ }`.

```
1 | # the next line will print out 'The value of i is 2 .'
2 | print(f'The value of i is {i}.')
```

Escape characters can be handled inside strings also: e.g., `'\t'` will produce a tab; `'\n'` produces a newline.

Two more container types

Two important types that contain items, but are not sequential are sets (**set** type) and dictionaries (**dict** type).

- ▶ **set**: roughly matches the mathematical notion of a set. Items are not ordered; there are no repeated items.
- ▶ **dict**: has *dictionary keys*; for each key there is an item (the “entry” for that key).
- ▶ Two example dictionaries with same keys:

```
1 | my_pet = {'name': 'Spot', 'age': 4, 'type': 'dog'}  
2 | neighbor_pet = {'name': 'Checkers', 'age': 2, 'type': 'dog'}
```

Good idea to work with dictionaries for certain kinds of data. Later in the semester, will work with something very similar to a dictionary – a DataFrame.

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Basic functions

Similar to most programming languages, Python uses *functions*, each of which takes some number of *arguments* (sometimes an argument is optional).

- ▶ Common function, already encountered: `print()`.
- ▶ Absolute value: `abs()`. Takes a numeric argument – either **int** or **float** type.
- ▶ Round to nearest integer: `round()`. Takes argument that is **float** (if an **int**, will return the same thing).
 - ▶ Optional 2nd argument, the number of decimal digits.

In Python, run the following to see how `round()` works.

```
1 | a = -3**2/8
2 | print( a+8 )
3 | print( (round(a+8), round(a+8, 2)) )
```


Changing one type to another

Some functions change the type of the input, when possible.

Some examples:

- ▶ `str()` changes to a string; works on nearly anything.
- ▶ `int()` will convert a float to an int; always rounds toward 0.
- ▶ `set()` will convert a list or tuple into a set; “forgets” order, drops repeats.

Slicing lists

Recall: if `my_list` is a list, the item at index `i` is found with `my_list[i]`.
To get shorter list with consecutive items from `my_list`.

```
1 | my_list = ['a','b', 'c', 'd', 'e', 'f', 'g', 'h', 'i']
2 | # Return letters at index 1 to 4 (excluding 4)
3 | print(my_list[1:4])
4 |
5 | # Leave off number either left of colon, or right of it;
6 | # will go from the start, or until the end
7 | print(my_list[:5])
8 |
9 | # Negative numbers to step back from end of the list
10 | print(my_list[-1])
11 | print(my_list[-2:])
```

There is an easy way to reverse the order of a list.³

```
| my_list[::-1]
```

³Only as an output. This does not change the list variable unless you reassign it.

Basic list methods

Methods are functions that you call on an instance of a class. There are several methods for lists. Here are two.

- ▶ `append()`: the command `my_list.append(x)` puts `x` at the end of `my_list`.
 - ▶ Changes `my_list` “in place.”
 - ▶ Is equivalent to `my_list += [x]`.
- ▶ `remove()`: the command `my_list.remove(x)` takes out the *first* item in `my_list` that is equal to `x`.
 - ▶ Changes `my_list` in place, making it shorter.
 - ▶ `my_list.pop(i)` does something similar with item at index `i`, but also returns (has as output) that item.

More information on working with lists, tuples, sets, and dictionaries:

[Tutorial from the Python documentation.](#)