Introduction to Python Day 2

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Jupyter Notebook

Recap homework

Let's take a look at the homework

Functions part 2

Goal of today

```
import numpy as np
import os

def AP_check(folder):
    AP_sweep_count = 0
    for filename in os.listdir(folder):
        if filename.endswith('.csv'):
            with open(os.path.join(folder, filename), 'r') as file:
                data = np.loadtxt(file, skiprows=1)
                if any(data > 20):
                    AP_sweep_count += 1
                    print("AP found in " + filename)
                else:
                    print('No AP in ' + filename)
    return AP_sweep_count

file_path = 'data/sweeps_csv/'
```

```
sweep_count = AP_check(file_path)
print(sweep_count)
```

This is an example to showcase what we will achieve today.

Global vs. Local

- Scopes
- Local variables live and die inside a function
- Global variables
  - declared outside of fucntions
  - lost when programme closed

- global scope - of the whole program
- local scope of a separate function
- Local variables
  - Variables that live only inside of functions, minutes in our example
  - They no longer exist once the function is done executing show it by running minutes
  - If we try to access their values outside the function, we will encounter an error
- Global variables
  - variables defined outside any function

Short interlude

- Whole numbers: Integers `int`

```
type(1)
```

```
int
```

```
number_string = "1"
number = int(number_string)
print(number)
type(number)
```

```
1
```

```
int
```

- Real numbers: Floats `float`

```
type(1.0)
```

```
float
```

```
fake_integer = float(1)
type(fake_integer)
```

```
float
```

- Most of the time it might not matter[1]

```
1 == 1.0
```

```
True
```

- Sometimes there is a difference, and we will see later why

Most of the time python handles the integer vs. float automatically. You will not have to worry about assigning.

But sometimes it does

- Sometimes you will see `is` instead of `==`.

```
1 == 1.0
1 is 1.0
```

```
<>:2: SyntaxWarning: "is" with 'int' literal. Did you mean "=="?
<>:2: SyntaxWarning: "is" with 'int' literal. Did you mean "=="?
```

```
True
```

[1] In python

```
/tmp/ipykernel_2228/3921864666.py:2: SyntaxWarning: "is" with 'int' literal. Did you mean "==
  1 is 1.0
```

```
False
```

- They often do the same thing but work differently
  - Careful when using it!
  - `is` and `is not` is also checking the type!

This can sometimes lead to an unexpected behaviour if you did not plan to use it in this way. Only use `is` and `is not` when you really want the identical object.

Conditional statements

The important question of what to do "if" something happens.

- Programming languages are languages
- `if` something is `True`
  - you should do `something`
- `else`
  - do `something else`

```
if *statement*:
    print("the *statement* is true")
else:
    print("the *statement* is false")
```

This structure is the simplest of conditionals. The statement has to be `True` to enter the `if` part to execute. Should the statement by `False` it will skip and enter the `else` part which will then be executed.

Multiple if-statements

```
value = 3
if value == 1:                                                    ①
    print("the value is 1")
elif value == 2:                                                  ②
    print("the value is 2")
elif value == 3:                                                  ③
    print("the value is 3")                                       ④
else:
    print("the value is something else")
```

① Check if `value` is `1`
② Check if `value` is `2`
③ Check if `value` is `3`
④ Execute block

```
the value is 3
```

Statements will be checked sequentially. Should one statement be `True` the corresponding part of the `if`/`elif` block will be executed. All other blocks after that will be skipped. This means one `True` expression is enough.

Short forms for conditionals

```
amplitude = 24
is_action_potential = "is AP" if amplitude > 0 else "no AP"
print(is_action_potential)
```

```
is AP
```

- You can write a lot on one line
  - Do if you have to but be careful

How to check if everything is true?

- Validate all the statements in a list

```
everything_is_true = [True, True, True]
something_is_true = [True, False, False]

all(everything_is_true)
all(something_is_true)
```

```
True
```

```
False
```

- Sometimes only something has to be true

```
any(everything_is_true)
any(something_is_true)
```

```
True
```

```
True
```

For loops

```
for *element* in *iterable*:
    *body*
```

- iteration is the repetition of a process until a specific condition is met
- what's iterable?

```
# calcualte a sum
list_to_sum = [2,3,4,5,7]
num_sum = 0
for val in list_to_sum:
   num_sum = num_sum + val
```

- For loop = An iterating function used to execute statements repeatedly.
- Iterate = In programming, iteration is the repetition of a code or a process until a specific condition is met.
- Iterables = objects in Python that you can iterate over, e.g. container types (list, numpy arrays, tuples, sets), dictionary.keys(), strings

TO DO

Given: A = [3, 4, 5, 9, 12, 87, -65, 300, 450, -32]

Use *for loops* to: 1. Add 3 to each element of the list 2. Calculate the average of the list, but negative values are calculated as 0s 3. Find the maximum value 4. Find the index (position) of the max value

Index based *for loops* - range()

- generates integer sequences
- range(n) generates the series of n values from 0 to n − 1

```
for i in range(5):
    print(i)
```

```
0
1
2
3
4
```

```
# looping through data indices. find the max
B = [1, 4, 6, 7, 89, 54]
big_indx = 0
for i in range(len(B)):
    if B[i] > B[big_indx]:
        big_indx = i
print('The max value in B is', B[big_indx], 'found on position', big_indx)
```

```
The max value in B is 89 found on position 4
```

Index based *for loops* - enumerate()

- assigns a count to each item within an iterable and returns it as an enumerate object

```
import numpy as np

array_a = np.arange(20, 25)
for indx, val in enumerate(array_a):
    print('the index is', indx)
    print('the value is', val)
```

```
the index is 0
the value is 20
the index is 1
the value is 21
the index is 2
the value is 22
the index is 3
the value is 23
the index is 4
the value is 24
```

! range() and enumerate() - none of the two returns a list of objects!

- motivation: limitation in 'simple' for loops - we don't know the position of an element within a sequence, as we experienced in the last example
- range(n) generates the series of n values from 0 to n − 1
- precisely the series of valid indices into a sequence of length n
- range() - returns a range object that is iterable
- enumerate() - returns an enumerate object that is also iterable
- they are mainly used in loops

Index based *for loops* [1]

enumerate()

- one way to avoid nested loops

Break and continue statements

- break - oimmediately terminates the loop

- a break statement that immediately terminates a while or for loop when executed within its body
-

List comprehension

Compare different functions

While loops

- Perform a task `while` something is `True`
- Be careful:
  - Some loops never finish (get stuck)
  - Make sure that condition for ending the loop can be fullfilled

```
while check_condition:
    perform_task()
```

If your python terminal gets stuck at one point you can try a `KeyboardInterrupt` using `Ctrl+C`, which will kill the running script.

Let's wait while we wait

- Start a little counter

```
import time
counter = 0
while counter < 10:
    time.sleep(1)
    counter += 1
    print("You waited for " + str(counter) + " seconds...")
```

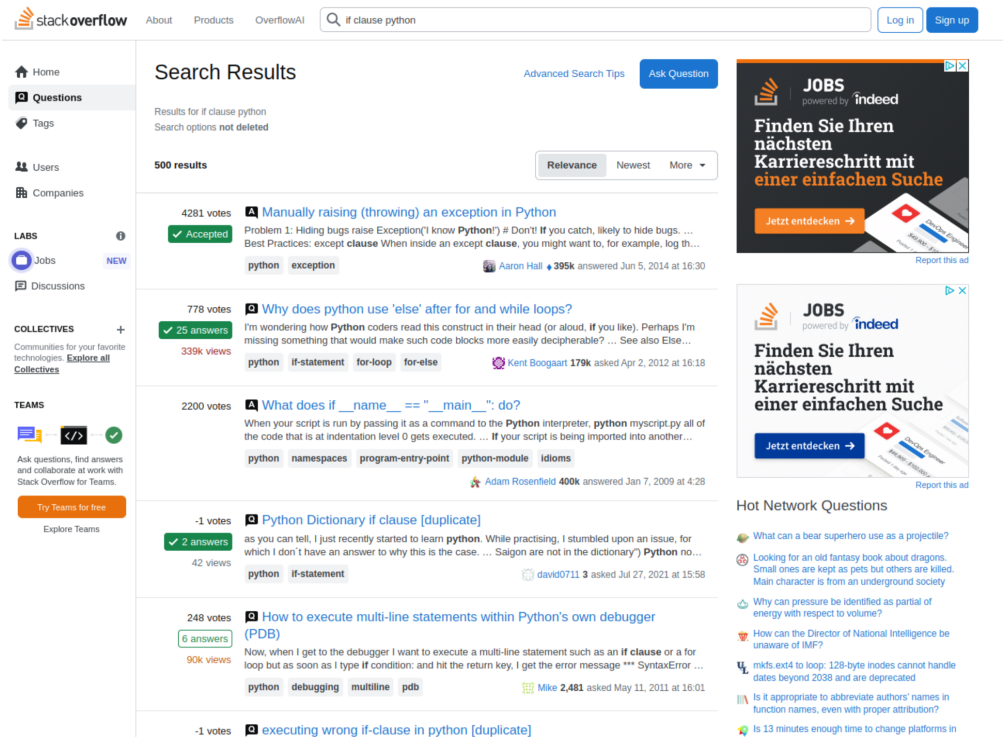
- Good for keeping processes running

Try to avoid `while` loops as much as possible. They can be useful if you do not have information how long it should run, but know it will at one point finish.

Errors and how to read them

There are useful resources regarding errors

- Simply googling works surprisingly well
- You will often end up on stackoverflow
  - There is no question which was not already asked[2]



Types of errors

1. SyntaxErrors
2. IndentationError
3. NameError
4. TypeError
5. IndexError
6. AttributeError
7. etc.

[2] if that is not true open up a question

Fix errors

- Breath
- Don't panic
  - Identify the error by checking the terminal output
  - Look at the line provided
  - Go backwards if error is nested