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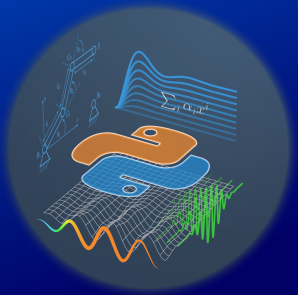
Chair of Fundamentals of Electrical Engineering

Python for Engineers (2)
Pythonkurs für Ingenieur:innen (2)

Introduction (part 2: files and functions)
Einführung (Teil 2: Dateien und Funktionen)

Dresden (Online), 2023-10-17

https://tu-dresden.de/pythonkurs
https://python-fuer-ingenieure.de



File access

function `open` (details see offical docs: docs.python.org/3/...)

```
# Writing
myfile = open("my_file.txt", "w")
myfile.write("Hello dear file.")
myfile.writelines(["more\n", "content\n"])
myfile.write(str(5))
myfile.close()

# Reading
myfile = open("my_file.txt", "r")
header = myfile.read(10) # read first 10 characters
lines = myfile.readlines() # list of lines (starting at file cursor)
```

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`open("xy.pdf", "rb")` or `open("xy.pdf", "wb")`

Strong recommendation: context manager syntax (using keyword `with`):

```
with open("my_file.txt") as myfile:
  lines = myfile.readlines()
  # myfile.close() is called automatically at the end of this block
```

Functions in Python (1)

- encapsulate recurring subtasks

→ deal with complexity

- common mistakes:
  - forgot colon (syntax error)
  - `return` forgotten (→ `None` is returned)

```
def donothing():
    pass # dummy statement (for Indentation)

# Call a function without arguments
print(donothing())  # -> None

def square1(z):
    """Squaring a number"""  # Docstring (=built-in doc)
    return z**2

square1(7) # -> 49
square1(7-12) # -> 25
```

Global and Local Variables

```
def square2(z):
    x = z**2 # local variable (because write access)
    print(x)
    return x

x, a = 5, 3 # "unpacking" of tuple (5, 3)
square2(a) # -> 9
square2(x) # -> 25
print(x) # -> 5
```

```
def square3(z):
    print(x) # here x is a global variable (only read access)
    return z**2
```

```
def square4(z):
    print(x) # Error (local variable not yet known)
    x = z**2 # write access -> x must be local variable
    return x
```

∃ keywords `global` and `nonlocal` (Explanation; but in general not recommended)

Default Arguments

```python
def square5(z=8):
    return z**2

square5() # -> 64
square5(2.5) # -> 6.25
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    return a**2 + b

square_sum(10)# -> 100
square_sum(10, 3)# -> 103
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```python
# explicit naming of the arguments ("keyword args")
square_sum(b=-3, a=10) # -> 97 (here: order does not matter)
```

explicit naming helpful for functions with many arguments

Arbitrary Number of Arguments (`*args`, `**kwargs`)

```
# positional arguments
def mysum(*args):              # the name `args` is just a convention
    print( type(args) ) # -> tuple
    s = 0
    for x in args:
        s += x
    return s
mysum(5, 20, 3) # -> 28
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numbers = [7, 4, -3, 15]
mysum(*numbers) # -> 23   # unpacking of the sequence inside the call
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```
# keyword args
def sentence(**kwargs):    # the name `kwargs` is just a convention
  print( type(kwargs) ) # -> dict
  for key, value in kwargs.items():
      print( f"The {key} is {value}." )

sentence(water="cold") # -> The water is cold.
sentence(u=8.2) # -> The u is 8.2.
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```
def complex_function(a, b, c, *args, **kwargs):
    ... # combination is possible
```

Functions as Objects → scoping

```
def plus(a, b):
    return a + b

print( type(plus) ) # -> function
z = plus # assignment (dt: Zuweisung) (no function call!)
print( type(z) ) # -> function
z == plus # -> True
z is plus # -> True
z(2, 3) # -> 5
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```
# factory functions ("closures")
def factory(q):
    b = q       # b is local here
    def add(a):
        return b + a # b is "global" here (from outer namespace)
    return add # an object of type `function` is returned
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```

```
# add is unknown here
p1 = factory(7)
p2 = factory(1.5)
p1(3) # -> 10
p2(3) # -> 4.5
factory("The sun is ")("shining.") # evaluation without assignment
```

Argument- and Type-checking

- very flexible function calls
- frequent source of errors: wrong arguments (values or types)
- type checking often useful (effort-benefit consideration)

```
def some_function(sentence, number1, number2, a_list):

   if not type(sentence) == str: # direct equality checking (not recommended)
      print("Type error: sentence")
      exit()
   if not isinstance(number1, int):
      print("Type error: number1")
      exit()
   if not isinstance(number2, (int, float)):
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```

Recommended: compact variant in one line with keyword `assert`:

```
   #
   assert isinstance(number1, int) and number1 > 0
   # -> raises an AssertationError if condition is not fulfilled
   ...
```

Docstrings

- Strongly recommended:
  - Write documentation and code in the same file and (almost) simultaneously

→ Docstrings ≙ docs available from the program)

- Allows for automatic creation of nice HTML doc with Sphinx

```
def calculate(x, mode="normal"):
    """
    Short description: A functions that does something.

    :param x:    main argument (float)
    :param mode: mode of the algorithm (str)
                 (e.g. "normal" or "reverse")

    :rtype:      result of complicated formula (float)

    After the description of the parameters, typically
    there is more information on the documented function.
    """

    y = x**2*some_other_function(x, mode) + complicated_formula(x)
    return y
```

Summary

- file access is simple (docs))
- functions are important and powerful
- different variants to call a function (‘polymorphism’)
- safety queries (`assert ...`) might save much debugging time
- docstrings recommended
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→ gain your own experience