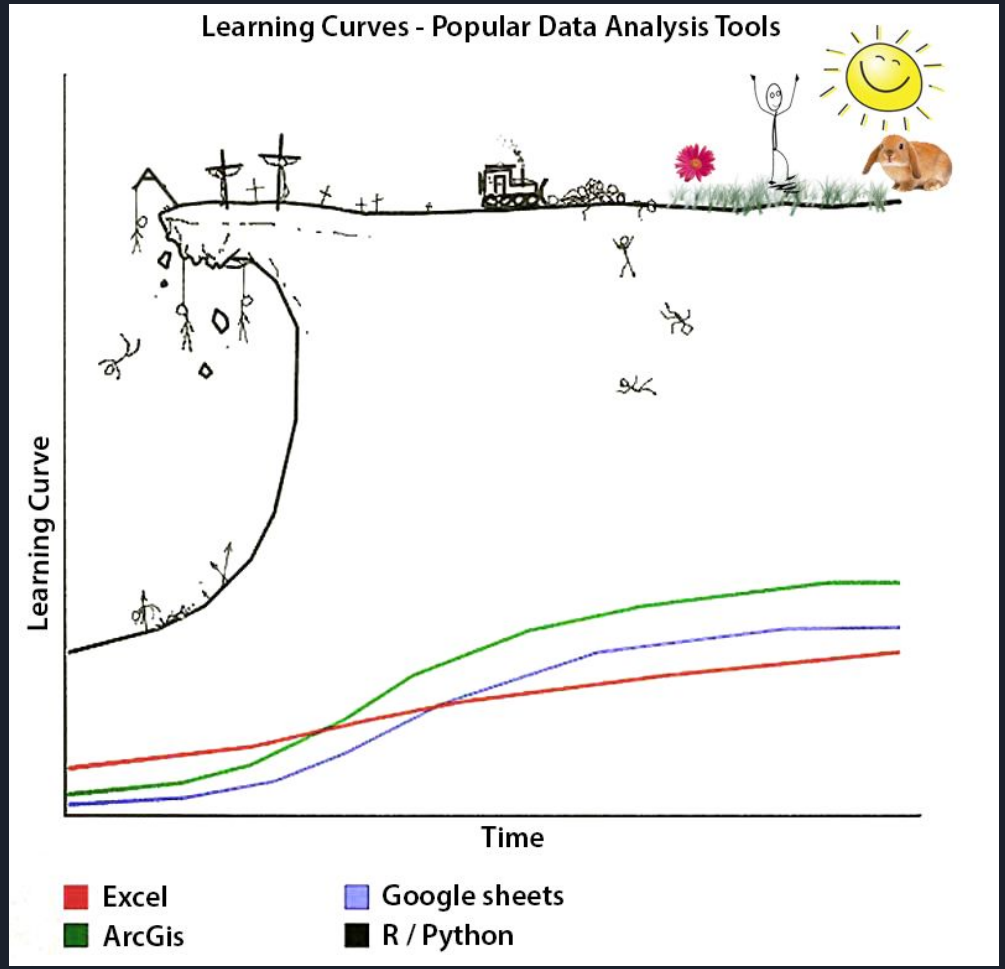
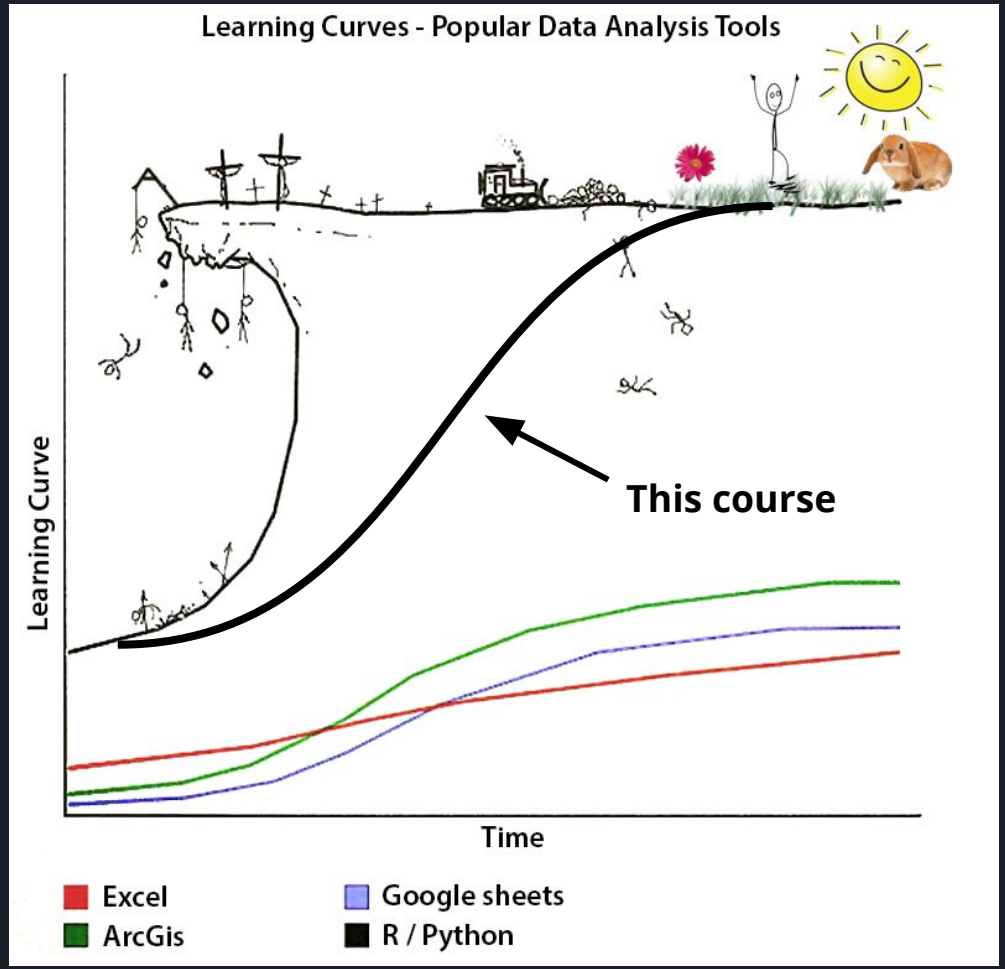
Applied Data Science with Python for Beginners

Lecture 1 - 27 April 2021


Learning Curves - Popular Data Analysis Tools
Learning Curve
Time
Excel
ArcGis
Google sheets
R / Python


Learning Curves - Popular Data Analysis Tools
Learning Curve
This course
Time
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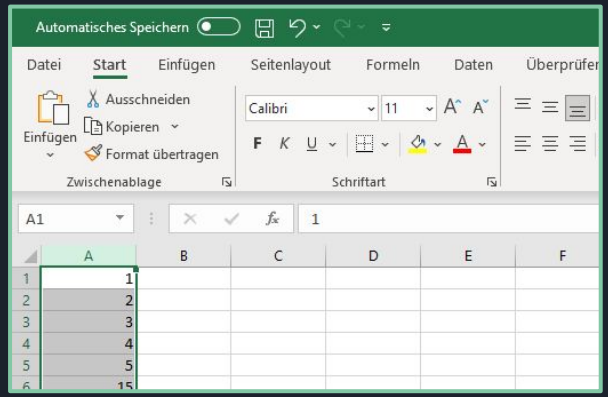
Excel vs Python

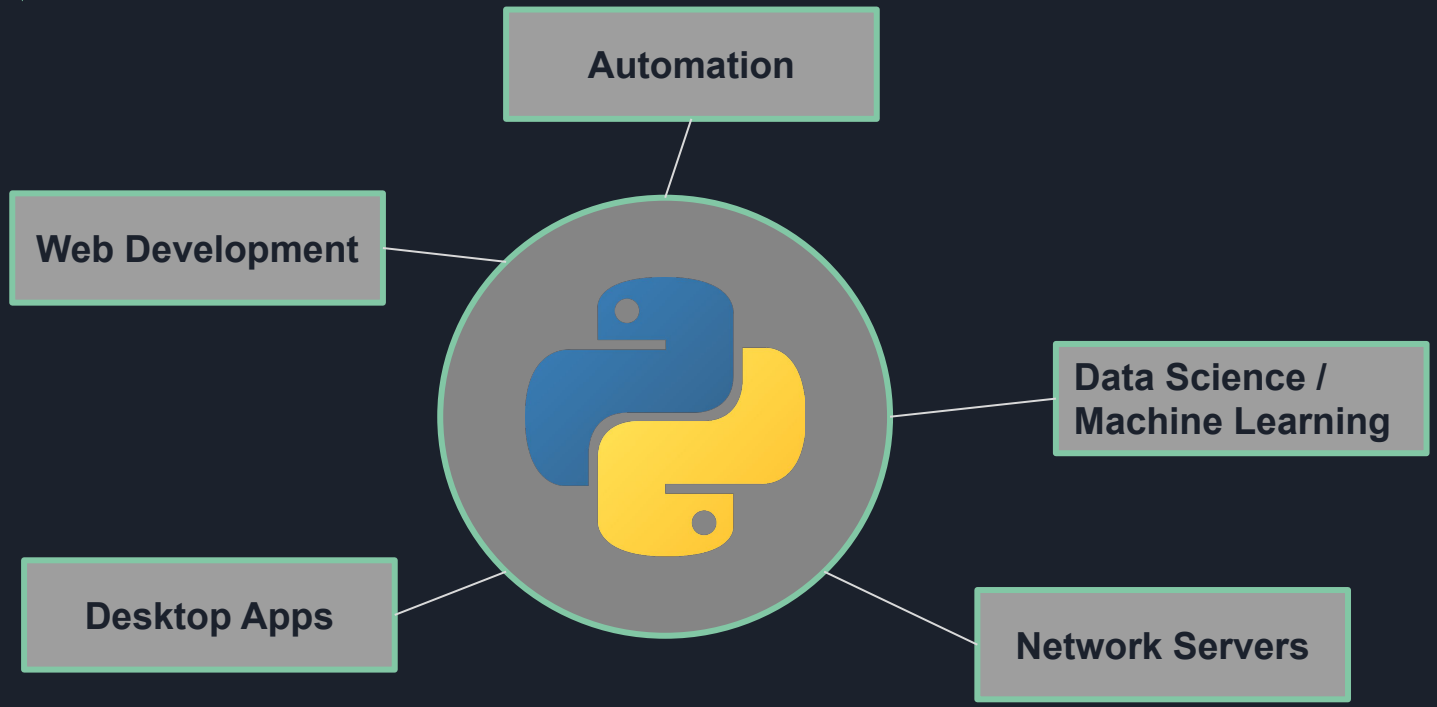
1. Select data
2. Click on buttons :)



1. Write code in text editor
2. Execute code with Python
3. Result will be returned

```
data = pd.read_csv(file)
mean = data.mean()
print(mean)
```

A General Purpose Coding Language



Structure of the course

Lectures (3 times)

- Introduce new concepts on slides
- Live coding in Google Colab
- Your turn! - Small exercises (~5 minutes)
- Slides and notebooks will be uploaded

Homework (3 times)

- each week a set of exercises about the topics from the lecture (~ 1h)
- solutions will be provided, no hand-in

Questions?
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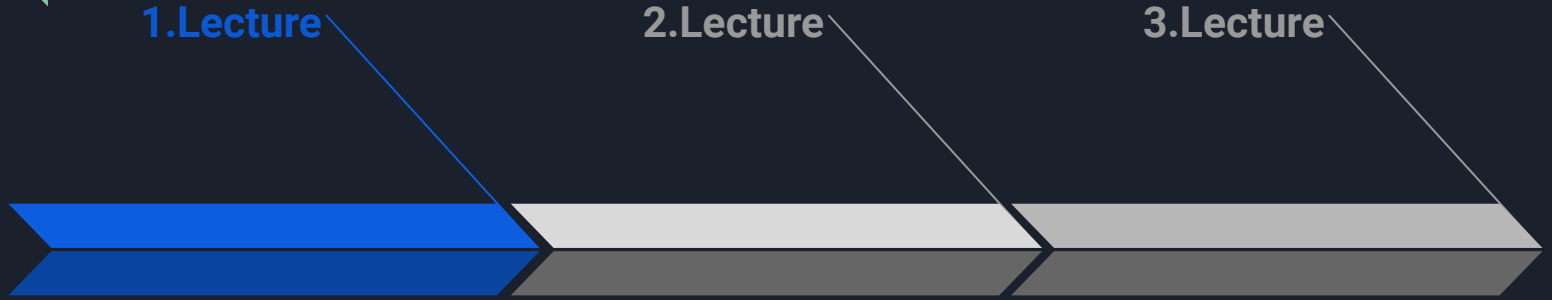
Topics of the course



Python Fundamentals

Basic concepts, Variables, basic data structures, functions

Data Wrangling & Simple visualizations

How to process data with pandas and visualize it with matplotlib

Visualizations & Modelling

More plots with matplotlib and seaborn and an introduction to modelling

Google Colab

- Environment to write and execute code
- Accessed via Browser (runs on Google Servers)
- No pre-configurations necessary
- Independent from your local machine
- Jupyter Notebook format heavily used in data science community

Fundamentals - Data Types

How is data stored and processed ?

- Values are stored in **variables**
- The four most important data types in Python:

```
integer = 10
float = 2.8
string = "This is a string"
boolean = True
```

How is data stored and processed ?

- We can compute with these variables

```
a = 10
b = 5
c = a + b
print(c)
```

```
Output: 15
```

What kind of data type is this : `"27-03-2021"` ?

a) integer b) float c) string d) date

What kind of data type is this : `"27-03-2021"` ?

a) integer b) float c) string d) date

Fundamentals - Data Structures

Data Structures - Lists

We can combine values in lists

```
a = [5, 3, 9, 7, 4, 10, 3]
b = ["Justus", "Peter", "Bob"]
```

Data Structures - Lists

Value	5	3	9	7	4	10	3
Index	0	1	2	3	4	5	6

Data Structures - Lists

Access the data with an index

```
a = [5, 3, 9, 7, 4, 10, 3]
b = ["Justus", "Peter", "Bob"]
a[0] → 5
```

Data Structures - Lists

Access the data with an index

```
a = [5, 3, 9, 7, 4, 10, 3]
b = ["Justus", "Peter", "Bob"]
a[0] → 5
b[1] → "Peter"
```

Data Structures - Lists

```
a[start:stop:step_size]
```

Data Structures - Lists

Value	5	3	9	7	4	10	3
Index	0	1	2	3	4	5	6

```
a[1:4]
```

Data Structures - Lists

Value	5	3	9	7	4	10	3
Index	0	1	2	3	4	5	6

```
a[1:4:2]
```

Data Structures - Dictionaries

```
translate = {"Eins":"One",
             "Zwei":"Two",
               "Ja":"Yes"}
translate["Eins"] → "One"
```

Quick - Summary

Data types

```
integer    2
float      2.32
string    "Text"
boolean    True/False
```

Data structures

```
lists:  a = [1,2,3]
dictionary: b={“a”:1}
```

Exercise 1

Data structures - Hints

lists:

```
    create:  a = [1,2,3]
    access: a[0]
```

dictionary:

```
    create: b={“a”:1}
    access: b[“a”]
```

Relational operators

- Compare variables

  a == b → is a equal to b?

  returns **True / False**

- Combine operators with "**and**" / "**or**"

  "and": (a >= b) & (a<=c)

  "or": (a >= b) | (a<=c)

==	is equal
<	smaller than
>	greater than
<=	smaller or equal than
>=	greater or equal than
!=	not equal than

QUIZ

```
a = 1
b = 2
c = 2

(a>b) or (a<=c)
```


```
a = 1
b = 2
c = 2
```

(a>b) or (a<=c)

False or True → True

Very important for filtering

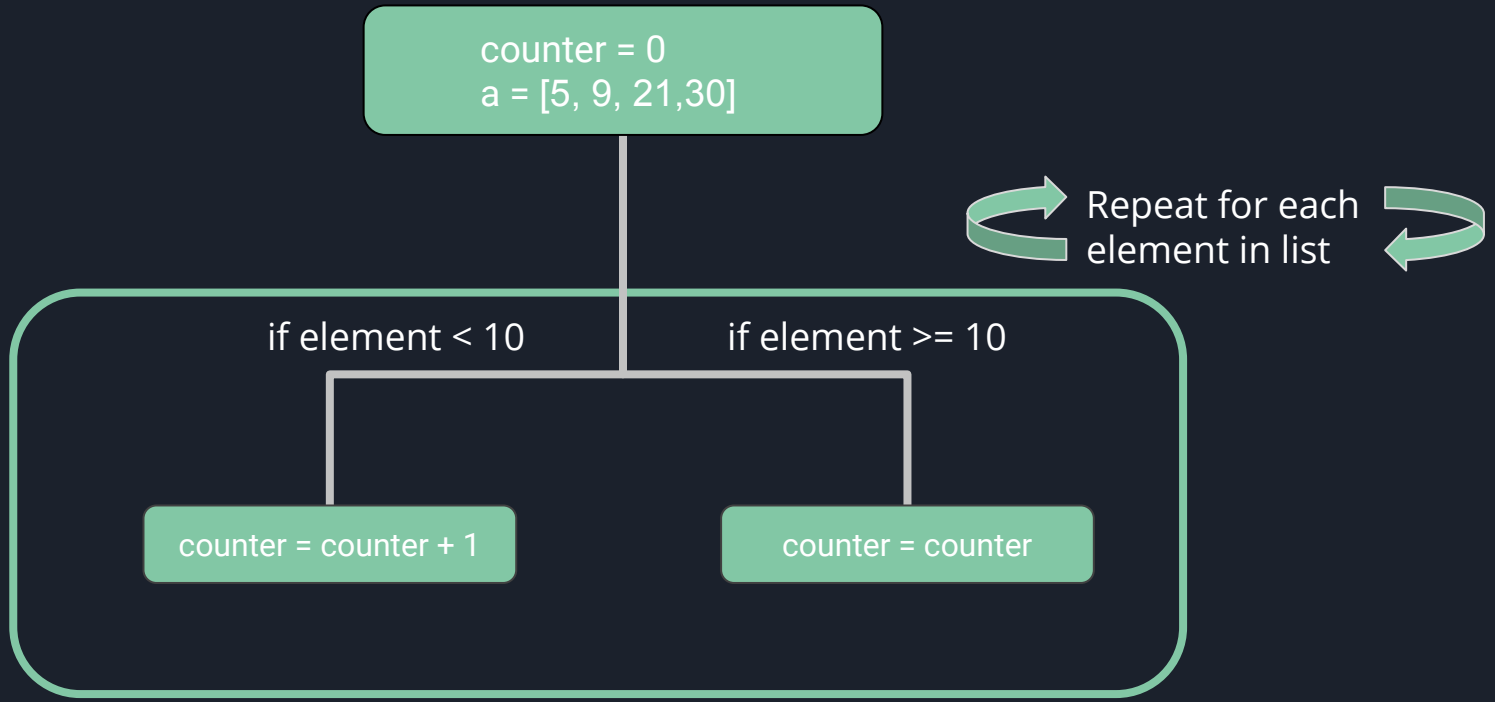
Name	Gender	Age
“Tim”	“M”	20
“Nina”	“F”	24
“John”	“M”	26

Select all Names with following condition:

(Gender == “F”) **&** (Age > 20)

Fundamentals - Control Flow

Count numbers smaller than 10 in a list



Control Flow - if / else

- Control which block of code will be executed
- Blocks defined by indentation

```
if BOOLEAN-CONDITION:
    print("A")
else:
    print("B")
```

Control Flow - if / else

- Control which block of code will be executed
- Blocks defined by indentation

```
if a>2:
    print("A")
else:
    print("B")
```

Control Flow - for-loop

- Repeat blocks of your code
- Use different values in each loop

```
for element in [1,2,3,4]:
    print(element)
```

Exercise 2

Count amount of numbers in a list which are smaller than 5

```
for element in [1,2,3,4]:
    print(element)
```

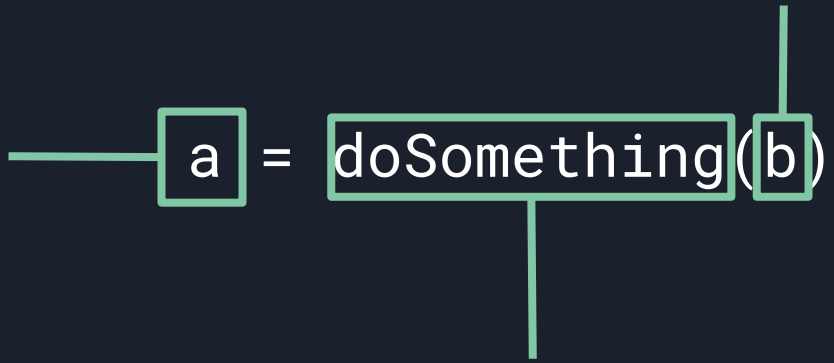
```
if a>2:
    print("A")
else:
    print("B")
```

Fundamentals - Functions & Libraries

functions

Parameter of function
(can be a value, variable, list, dict,...)

Variable for
return value



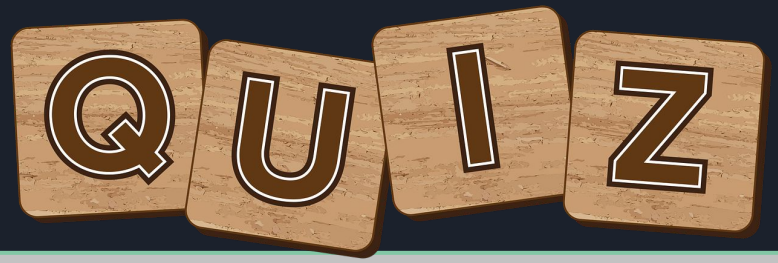
Name of function

functions - round function

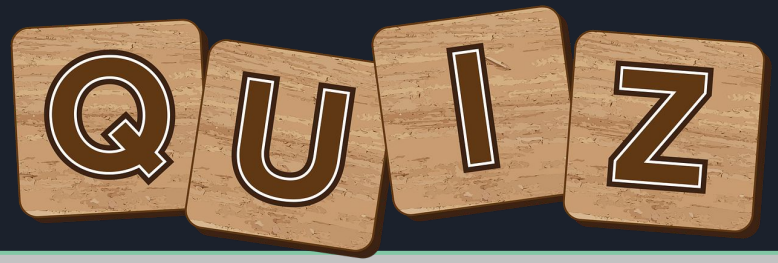
```
b = 5.2
a = round(b)
→ a = 5.0
```

Built-in Functions

`print()`	`sum()`
`round()`	`abs()`
`min()`	`range()`
`max()`	`sorted()`




```
round(2.34)   == ?
abs(-2)       == ?
a = [0,4,1,3,2]
max(a)        == ?
sum(a)        == ?
len(a)        == ?
sorted(a)     == ?
```




```
round(2.34)   == 2.0
abs(-2)       == 2
a = [0,4,1,3,2]
max(a)        == 4
sum(a)        == 10
len(a)        == 5
sorted(a)     == [0,1,2,3,4]
```

Create own functions

- Define own functions for repeating tasks
- reduce amount of code lines

```
def my_function(a,b):
    c = ...
    return c
```

Create own functions

- Define own functions for repeating tasks
- reduce amount of code lines

```
def my_function(a,b):
    return a + b
my_function(1,2) # 3
```

Exercise 3

Convert your code which counts amount of numbers smaller 10 into a function

```
def smaller_than(numbers, value):
    # your code here
    return counter
```

Libraries

- A collection of functions is bundled in a **library**
- we import these libraries and can use the defined functions
- Some libraries come with a Python installation, some need to be installed

... for plotting and visualization

... for working with tabular data (Excel-files, csv-files,...)

... creating machine learning models

Import Libraries

```
import library

library.function_name()
```

Import Libraries

```
import library as l

l.function_name()
```

Import Libraries

```
from library import function

function()
```

NumPy - library

- Library for scientific computing
- Work with lists, matrices or higher dimensional structures
- NumPy lists have much more functionality than usual lists

```
import numpy as np

a = np.array([1,2,3,4])
```

NumPy - library

- Library for scientific computing
- Work with lists, matrices or higher dimensional structures
- NumPy lists have much more functionality than usual lists

```
import numpy as np

a = np.array([1,2,3,4])
a.sum() # 10
a.mean() # 2.5
a.std() # 1.118...
```

NumPy - Append

```
import numpy as np

a = np.array([1,2,3,4])
np.append(a, [5,6,7]) # array([1, 2, 3, 4, 5, 6, 7])
```

NumPy - Append

```
import numpy as np

a = np.array([1,2,3,4])
np.append(a, [5,6,7]) # array([1, 2, 3, 4, 5, 6, 7])
a = np.append(a, [5,6,7])
```

Compute with arrays - Broadcasting

```
import numpy as np
a = np.array([1,2,3])
a * 2 # array([2, 4, 6])
a ** 2 # array([1, 4, 9])
a - 1 # array([0, 1, 2])
```

Compute with arrays

```
import numpy as np
a = np.array([1,2,3])
b = np.array([1,1,1])
a + b # array([2, 3, 4])
```

Indexing

```
import numpy as np

a = np.array([1,2,3,4])
a[0:2] # array([1,2])
```

Boolean Indexing

```
import numpy as np

a = np.array([1,2,3,4])
a[[True,True,False,False]] # array([1,2])
```

Boolean Indexing

```
import numpy as np

a = np.array([1,2,3,4])
a <= 2 # [True, True, False, False]
```

Boolean indexing

```
import numpy as np

a = np.array([1,2,3,4])
a <= 2 # [True, True, False, False]
a[a<=2] # array([1,2])
```

Exercise 4

```
import numpy as np

a = np.array([1,2,3,4])
a = np.append(a, [5,6,7])  # append
a[a<=2] # boolean indexing
```

Quick-Summary

```
for element in [1,2,3,4]:
    print(element)
```

```
if a >= 3:
    print("A")
else:
    print("B")
```

```
import numpy as np

a = np.array([1,2,3,4])
a.sum()
```

```
a = np.array([1,2,3,4])
a[a>2]
```