



Exercises for **Programming, Data Analysis, and Deep Learning in Python** (SoSe 2021)

Exercise Sheet no. 5, *Deadline*: Monday, May 17, 10:15

Notes

- Pay attention to the notes on the previous sheet.

In the following it is assumed you have imported `numpy` as `np`. Use `print(np.__version__)` to determine the installed `numpy` version. Make sure it is at least 1.18.

Exercise 16 Numpy Elementary (programming exercise) (8 points)

- a) In the following code, `v1` is a so-called *rank 1 array*, `v2` is a so-called *rank 2 array*.

```
v1 = np.array([1,4,7])  
v2 = np.array([[1,4,7]])
```

Use `reshape` to convert `v1` into a *rank 2 array* that coincides with `v2`. Output both the result and `v2` to compare them.

- b) Define the following vectors and matrices as rank 2 arrays in Python and output them:

$$i) v = (9 \ 8 \ 7)^T, \quad ii) M = \begin{pmatrix} 3 & 4 \\ 5 & 6 \\ 7 & 8 \end{pmatrix}^T$$

- c) Run the following code:

```
1 v1 = np.array([1,4,7])  
2 print(v1==v1.transpose())  
3 print((v1==v1.transpose()).all())
```

What does the code do? Why can the result of the last line be misleading?

Hint: Consider part a).

- d) Explain the output of the following code:

```
v3 = np.array(['a', 1, 4.0])  
print(v3[1] + v3[2])
```

- e) Does `transpose()` in Numpy yield a (deep) copy of the matrix or vector to be transposed? Prove your answer with an example code.

Exercise 17 Vectors and Matrices in Numpy (programming exercise)

(8 points)

If possible, calculate in Python and output the result:

a) $3 \cdot \begin{pmatrix} 9 & 5 \\ 4 & 2 \end{pmatrix}$

e) $\begin{pmatrix} 9 & 5 \\ 4 & 2 \end{pmatrix} - \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$

b) $\begin{pmatrix} 1 & 2 & 3 \end{pmatrix} \cdot \begin{pmatrix} 1 \\ 2 \\ 3 \end{pmatrix}$

f) $\begin{pmatrix} 2 & 4 & 6 \\ 1 & 3 & 5 \end{pmatrix} + \begin{pmatrix} 7 & 2 \\ 3 & 4 \end{pmatrix}$

c) $2 \cdot \begin{pmatrix} 2 & 4 & 6 \\ 1 & 3 & 5 \end{pmatrix} \cdot 3$

g) $\begin{pmatrix} 9 & 4 \\ 4 & 2 \end{pmatrix} \cdot \begin{pmatrix} 6 & 2 \\ 3 & 4 \end{pmatrix}$

d) $\begin{pmatrix} 4 \\ 5 \\ 6 \end{pmatrix} \cdot \begin{pmatrix} 7 & 8 & 9 \end{pmatrix}$

h) $\begin{pmatrix} 1 & 2 \\ 3 & 4 \\ 5 & 6 \end{pmatrix} \cdot \begin{pmatrix} 2 & 4 & 6 \\ 1 & 3 & 5 \end{pmatrix}$

Exercise 18 Organizing presents (programming exercise)

(8 points)

Your friend needs help after having organized a gift list as a dictionary:

```
gift_dict = {'Playmobil': 'Alf', 'Slingshot': 'Bart', 'Guitar':  
            'Lisa', 'Earrings': 'Nina', 'Playstation': 'Maya', 'Books':  
            'Lisa', 'TV': 'Alf', 'Money': 'Alf', 'Joghurt': 'Nobody'}
```

The presents were stored as keys, while the persons were stored as values.

- a) Why is this not a good idea if each person is to receive exactly one gift?

Before going shopping, your friend noticed that a person can receive two or more gifts this way. However, each person is to receive exactly one gift. At the same time, no person should be left empty-handed. Hence, it is important to find all persons who are in the dictionary more than once. Use the above dictionary to test whether your program works.

- b) Output all names of those who will receive two or more gifts and output the exact number of presents for each of these names.
- c) In addition, for all persons from b), output a list of all keys (gifts) that this person would receive. You may combine this task part with b).

Hints: Use the (Dictionary) commands from the Python 3 Cheat Sheet. Depending on the procedure, it may be useful to remove duplicates from a (suitable) list.