7. Numpy Basics, Defining Arrays, Indexing, Read from file

PYTHON COURSE

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What is NumPy

1. Numpy is a scientific library in Python that deals numeric analysis and computation
2. Numpy supports multi-dimensional array, matrix and many mathematic operations.
3. Most of numpy's code utilizes CPython or C language which makes computation quite fast.

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Set-up NumPy

1. Right click on the tab of an opened code.
2. Click on “Open containing folder in cmd”
3. The CMD terminal will pop up.
4. Use pip to install numpy.

```
>pip install numpy
```

3

Create an array in NumPy

Check if your NumPy works:

```
1  import numpy as np
2
3  x = np.array([1,2,3])
4
5  print(x)
```

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Creating ndarrays

```
1  import numpy as np
2
3  x_zero= np.zeros((2,3))
4
5  print(x_zero)
6
7  x_arange=np.arange(10)
8
9  print(x_arange)
10
11 x_linspace=np.linspace(1,10,100)
12 print(x_linspace)
13
14 x_indices=np.indices((5,5))
15 print(x_indices)
```

np.zeros
np.arrange
np.linspace
np.indices

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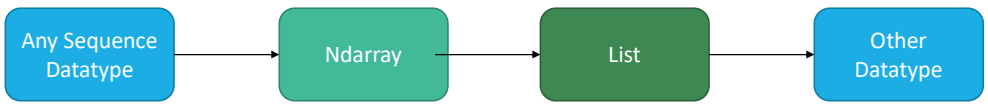
Conversion between list and ndarray

The array object in NumPy is called ndarray.

```
1  import numpy as np
2
3  X=[1,2,3,4]
4
5  X_array=np.array(X)
6  print(X_array)
7
8  X_list=X_array.tolist()
9  print(X_list)
```



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Basic operation of ndarray

```
1  import numpy as np
2
3  a=np.array([1,2,3])
4
5  b=np.array([4,5,6])
6
7  print(a+b)
8  print(a-b)
9  print(a*b)
10 print(a/b)

12 print(a[1])
13
14 c=np.array([[1,2,3],
15             [5,7,8]])
16
17 print(c[1,1])
```

Basic math operation (e.g. +, -, *, /) works as element-wise operation

Indexing works similar to lists

Reshaping works

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Challenge 1: Numpy operations

There are three students in your class, taken 3 subject examinations. This is their exam marks:

Student	Subject		
	90	50	40
	60	30	50
	60	65	65

However, there are questions that are being wrongly marked. Each wrongly marked question should result in an additional 2 points to the student. The questions that are wrongly marked are shown in the array below. **Find the final corrected marks** of the student in an array.

1	0	3
2	4	1
0	2	2

Number of questions wrongly marked

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Read data from file

1. Prepare an array in Microsoft Excel

Header	A	B	C
	1	2	3
	4	5	6
	7	8	9

2. Save it as read**.csv** (comma separated file).
3. Make sure it is in same folder as the code.
4. Read it.

```
1  import numpy as np
2
3  path=r'C:\Users\User\Desktop\Class\ClassCode\P7\\'
4
5  x= np.genfromtxt(path+'read.csv',delimiter=',',skip_header=True)
6
7  print(x)
```

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Challenge 2: Biased Teacher

Create an .csv file of student marks with the following details:

Student A	Student B	Student C
30	40	50
40	40	60
40	85	60

Students with that gave the teacher a Christmas present should randomly receive between 0 to 10 extra marks for each subject. Student that did not do their homework should have their marks deducted by 5. Find the final marks as an array. (Hint: np.random.rand(3,3))

Did they give Christmas present?

Student A	Student B	Student C
Yes	Yes	No

Did they do homework?

Student A	Student B	Student C
No	Yes	No

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Print to file using NumPy

Use the command np.savetxt()

Path and file name

Array name

```
14 np.savetxt(path+'final_marks.csv', final_marks, delimiter=',')
```

Comma for csv

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Homework: Who failed?

1. You have 5 students with exam scores as below.

A	B	C	D	E
30	40	50	30	60
40	40	60	20	10
40	85	60	90	80

Subject 1
Subject 2
Subject 3

2. Normalize their scores using min max normalization (see below).

$$x_{scaled} = \frac{x - x_{min}}{x_{max} - x_{min}}$$

Hint:
np.min(x),
np.max(x),
np.sum(x)

3. Find the weighted average using the following weights

Subject 1	3
Subject 2	1
Subject 3	2

4. Find the final average marks. The failing mark is below 40 %. Who failed?

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Conclusion

1. Introducing NumPy
2. Set-up NumPy
3. Create array
4. Conversion between list and ndarray
5. Basic operation of ndarray
6. Example for simple ndarray operation
7. Read data from file
8. Example for ndarray operation and read file
9. Write to file
10. Homework (normalization and weighted average)

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