Data Processing in Python
Part 2

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Workshop Series

Workshop	Date	Location	Registration
How to think in Code	Jun. 25 10AM-12PM	EDUC 133	Closed
Intro to Git & GitHub	Jun. 26 9AM-1PM	EDUC 133	Closed
Intro to Unix	Jun. 30 9AM-1PM	EDUC 133	Closed
Intro to R	July 14 9AM-1PM	EDUC 434	Open
Intro to Python	July 15 9AM-1PM	EDUC 434	Open
Statistics in R	July 17 1PM-5PM	EDUC 434	Open
Data Processing in Python	July 21 9AM-1PM	EDUC 434	Open
Intro to Machine Learning	July	TBA	TBA
Data Processing for Genetics	August	TBA	TBA
Polygenic Risk Scores	August	TBA	TBA
Proteogenomics	August	TBA	TBA

https://www.mcgill.ca/micm/training/workshops-series

Learning Outcomes

Summary

In this 4-hour workshop, students will learn basic data processing skills using Python. Attendees will learn how to import code from other modules and packages to take advantage of the existing Python ecosystem. After seeing how to access packages, we will explore popular data analysis packages. We will see how to use NumPy to perform operations on large data arrays and how to use Matplotlib to generate clear data visualisations. We will also scratch the surface on using pandas to store data in tables. Along the way, we will discuss how to approach a new, unfamiliar package and learn how to use it.

Learning Objectives

1. Import code from existing modules and packages.
2. Use NumPy to easily process multidimensional data.
3. Use Matplotlib to generate different types of plots to visualise data.
4. Use pandas to represent data stored in tables.
5. Approach a new package and explore its documentation and examples.

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Outline

1. **Module 1 – Modules and Packages (40 minutes)**

   a. Using Modules

   b. A Brief Intro to Package Management

   c. Exercise

2. **Module 2 – Introduction to NumPy Arrays (50 minutes)**

   a. Introduction to Arrays

   b. Introducing NumPy

   c. Array Operations

   d. Exercise

Outline

3. **Module 3 – Visualising Data with Matplotlib (50 minutes)**

    a. Creating Plots with Matplotlib

    b. Exploring the Matplotlib Documentation

    c. Exercise

4. **Module 4 – Intro to Tabular Data with Pandas (30 minutes)**

    a. Fundamentals of pandas

    b. Exploring the pandas Documentation

5. **Module 5 – A Brief Guide to Exploring the Unknown (10 minutes)**

    a. What to learn next? How?

    b. How to get help and how not to get help

    c. Other cool programming topics

Interactive Workshop!

- That's pretty much all that will be in the slides… For the rest, we'll go to a Jupyter Notebook:

To the repository!

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Module 2
Introduction to NumPy Arrays

`my_array`

(0, 0)	(0, 1)	(0, 2)	(0, 3)	(0, 4)	(0, 5)
(1, 0)	(1, 1)	(1, 2)	(1, 3)	(1, 4)	(1, 5)
(2, 0)	(2, 1)	(2, 2)	(2, 3)	(2, 4)	(2, 5)
(3, 0)	(3, 1)	(3, 2)	(3, 3)	(3, 4)	(3, 5)
(4, 0)	(4, 1)	(4, 2)	(4, 3)	(4, 4)	(4, 5)

Shape: (5, 6)

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`my_array[0]`?

(0, 0)	(0, 1)	(0, 2)	(0, 3)	(0, 4)	(0, 5)
(1, 0)	(1, 1)	(1, 2)	(1, 3)	(1, 4)	(1, 5)
(2, 0)	(2, 1)	(2, 2)	(2, 3)	(2, 4)	(2, 5)
(3, 0)	(3, 1)	(3, 2)	(3, 3)	(3, 4)	(3, 5)
(4, 0)	(4, 1)	(4, 2)	(4, 3)	(4, 4)	(4, 5)

Shape: (5, 6)

```
my_array[0]
```

(0, 0)	(0, 1)	(0, 2)	(0, 3)	(0, 4)	(0, 5)
(1, 0)	(1, 1)	(1, 2)	(1, 3)	(1, 4)	(1, 5)
(2, 0)	(2, 1)	(2, 2)	(2, 3)	(2, 4)	(2, 5)
(3, 0)	(3, 1)	(3, 2)	(3, 3)	(3, 4)	(3, 5)
(4, 0)	(4, 1)	(4, 2)	(4, 3)	(4, 4)	(4, 5)

Shape: (5, 6)

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`my_array[:, 0]?`

(0, 0)	(0, 1)	(0, 2)	(0, 3)	(0, 4)	(0, 5)
(1, 0)	(1, 1)	(1, 2)	(1, 3)	(1, 4)	(1, 5)
(2, 0)	(2, 1)	(2, 2)	(2, 3)	(2, 4)	(2, 5)
(3, 0)	(3, 1)	(3, 2)	(3, 3)	(3, 4)	(3, 5)
(4, 0)	(4, 1)	(4, 2)	(4, 3)	(4, 4)	(4, 5)

Shape: (5, 6)

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my_array[:, 0]

(0, 0)	(0, 1)	(0, 2)	(0, 3)	(0, 4)	(0, 5)
(1, 0)	(1, 1)	(1, 2)	(1, 3)	(1, 4)	(1, 5)
(2, 0)	(2, 1)	(2, 2)	(2, 3)	(2, 4)	(2, 5)
(3, 0)	(3, 1)	(3, 2)	(3, 3)	(3, 4)	(3, 5)
(4, 0)	(4, 1)	(4, 2)	(4, 3)	(4, 4)	(4, 5)

Shape: (5, 6)

`my_array[1:3, 2:4]?`

(0, 0)	(0, 1)	(0, 2)	(0, 3)	(0, 4)	(0, 5)
(1, 0)	(1, 1)	(1, 2)	(1, 3)	(1, 4)	(1, 5)
(2, 0)	(2, 1)	(2, 2)	(2, 3)	(2, 4)	(2, 5)
(3, 0)	(3, 1)	(3, 2)	(3, 3)	(3, 4)	(3, 5)
(4, 0)	(4, 1)	(4, 2)	(4, 3)	(4, 4)	(4, 5)

Shape: (5, 6)

`my_array[1:3, 2:4]`

(0, 0)	(0, 1)	(0, 2)	(0, 3)	(0, 4)	(0, 5)
(1, 0)	(1, 1)	(1, 2)	(1, 3)	(1, 4)	(1, 5)
(2, 0)	(2, 1)	(2, 2)	(2, 3)	(2, 4)	(2, 5)
(3, 0)	(3, 1)	(3, 2)	(3, 3)	(3, 4)	(3, 5)
(4, 0)	(4, 1)	(4, 2)	(4, 3)	(4, 4)	(4, 5)

Shape: (5, 6)

`my_array[0:5:2]?`

(0, 0)	(0, 1)	(0, 2)	(0, 3)	(0, 4)	(0, 5)
(1, 0)	(1, 1)	(1, 2)	(1, 3)	(1, 4)	(1, 5)
(2, 0)	(2, 1)	(2, 2)	(2, 3)	(2, 4)	(2, 5)
(3, 0)	(3, 1)	(3, 2)	(3, 3)	(3, 4)	(3, 5)
(4, 0)	(4, 1)	(4, 2)	(4, 3)	(4, 4)	(4, 5)

Shape: (5, 6)

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```
my_array[0:5:2]
```

(0, 0)	(0, 1)	(0, 2)	(0, 3)	(0, 4)	(0, 5)
(1, 0)	(1, 1)	(1, 2)	(1, 3)	(1, 4)	(1, 5)
(2, 0)	(2, 1)	(2, 2)	(2, 3)	(2, 4)	(2, 5)
(3, 0)	(3, 1)	(3, 2)	(3, 3)	(3, 4)	(3, 5)
(4, 0)	(4, 1)	(4, 2)	(4, 3)	(4, 4)	(4, 5)

Shape: (5, 6)

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Module 4
Intro to Tabular Data with pandas

By name: `my_df.loc`

	Series 0	Series 1	Series 2
Row 0	["row 0", "series 0"]	["row 0", "series 1"]	["row 0", "series 2"]
Row 1	["row 1", "series 0"]	["row 1", "series 1"]	["row 1", "series 2"]
Row 2	["row 2", "series 0"]	["row 2", "series 1"]	["row 2", "series 2"]

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By integer number: my_df.iloc

	Series 0	Series 1	Series 2
Row 0	[0, 0]	[0, 1]	[0, 2]
Row 1	[1, 0]	[1, 1]	[1, 2]
Row 2	[2, 0]	[2, 1]	[2, 2]

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To summarize

✓ **Modules** and **packages** allow for code written by others to be easily imported and reused.

✓ **NumPy arrays** allow easily storing many numbers and performing operations without having to loop.

✓ **Matplotlib** can be used to generate many different types of plots.

✓ **pandas DataFrames** represent data in tables.

✓ Big projects have **documentation** to explain their functionality.

Now you are ready to:

• Import code from existing modules and packages.

• Use NumPy to easily process multidimensional data.

• Use Matplotlib to generate different types of plots to visualise data.

• Approach a new package and explore its documentation and examples.

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Acknowledgements

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- Thank you to the Python, NumPy, Matplotlib and pandas communities!

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