McGill initiative in Computational Medicine

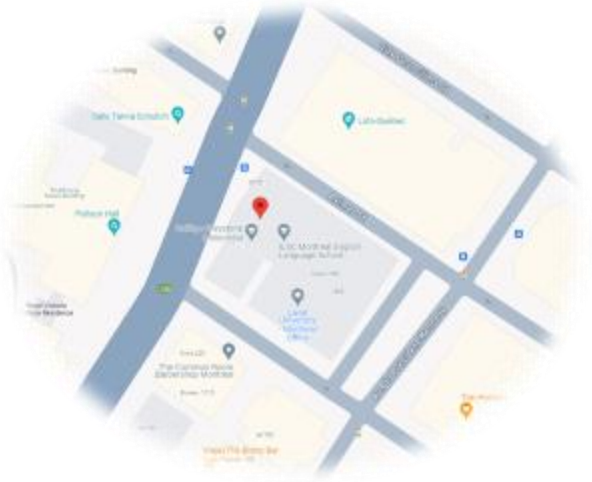
Data Processing in Python
Part 2

Benjamin Rudski
February 25, 2025

McGill Quantitative Life Sciences | Sciences quantitatives du vivant

MiCM McGill initiative in Computational Medicine

QLS-MiCM mission statement: deliver quality workshops designed to help biomedical researchers develop the skills they need to succeed.



Location: 550 Sherbrooke Street, Montreal, Quebec

Scan the QR code to sign up for our **mailing list**

Contact: workshop-micm@mcgill.ca

McGill Quantitative Life Sciences | Sciences quantitatives du vivant

Workshop Series

Workshop	Date	Location	Registration
How to think in Code	Jan. 28 1PM-3PM	EDUC 133	Closed
Intro to Git & GitHub	Jan. 30 1PM-5PM	EDUC 133	Closed
Intro to Unix	Feb. 6 1PM-5PM	EDUC 133	Closed
Intro to Python (Part 1)	Feb. 11 1PM-5PM	EDUC 133	Open
Intro to R (Part 1)	Feb. 13 1PM-5PM	EDUC 133	Open
Exploring MATLAB	Feb. 18 1PM-5PM	EDUC 133	Open
Statistics in R (Part 2)	Feb. 20 1PM-5PM	EDUC 133	Open
Data Processing in Python	Feb. 25 1PM-5PM	EDUC 133	Open
Intro to Machine Learning	Mar. 13 1PM-5PM	EDUC 133	TBA
Intro to R (Part 1)	TBA	EDUC 133	TBA
Intro to Python (Part 1)	TBA	EDUC 133	TBA

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

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!

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)

`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)

`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)

`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)

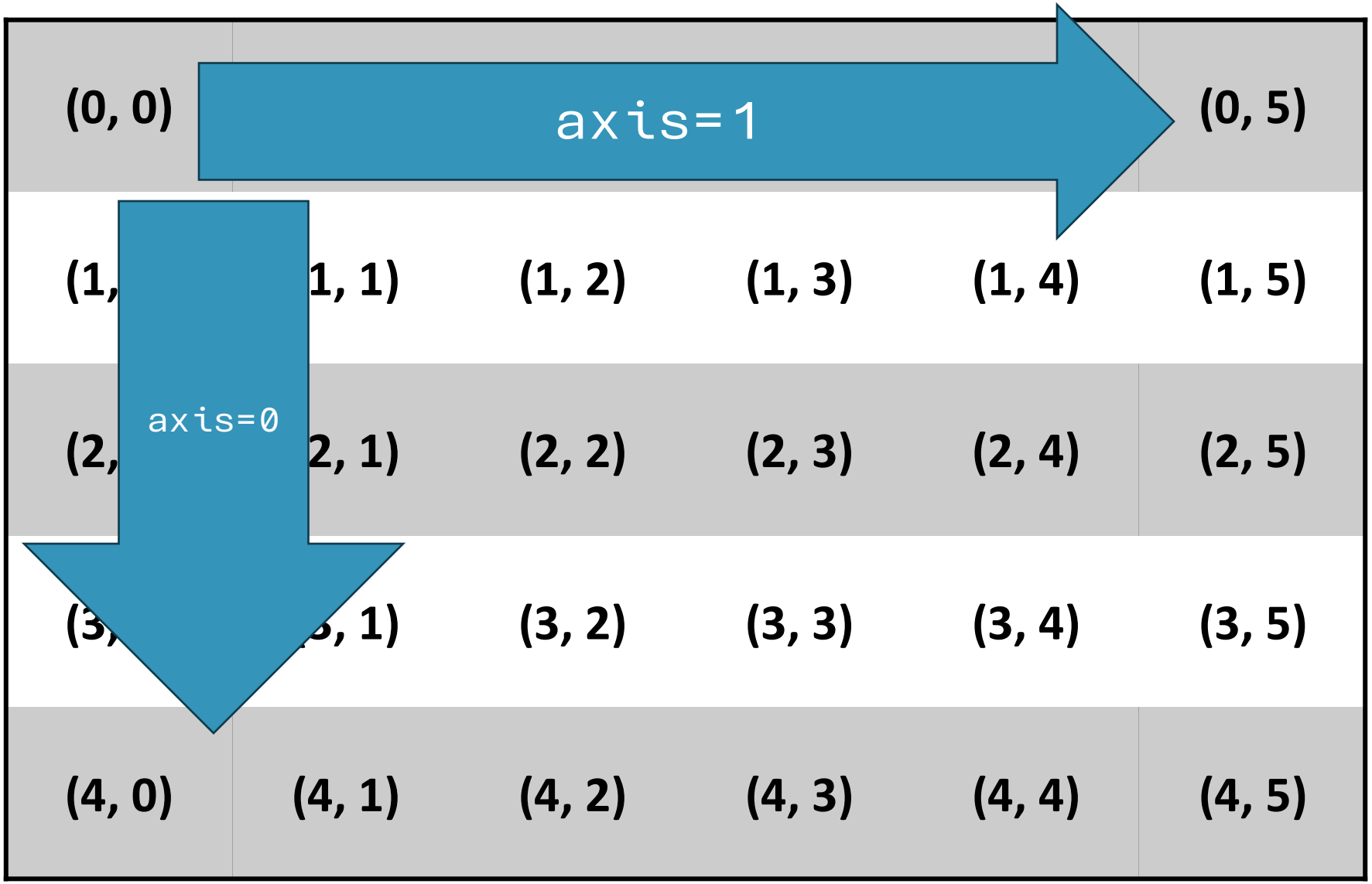
Shape: (5, 6)

`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)

my_array



Shape: (5, 6)

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"]`

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]`

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.

Acknowledgements

- Thank you to QLS-MiCM for giving me this opportunity and for helping me along the way.
- Thank you to the professors from the McGill School of Computer Science for helping me along my programming journey and for inspiring me to share my programming experience with others.
- Thank you to Professor Mathieu Blanchette, whose COMP 204 course helped introduce me to Python (back in Fall 2018).
- Thank you to the Python, NumPy, Matplotlib and pandas communities!