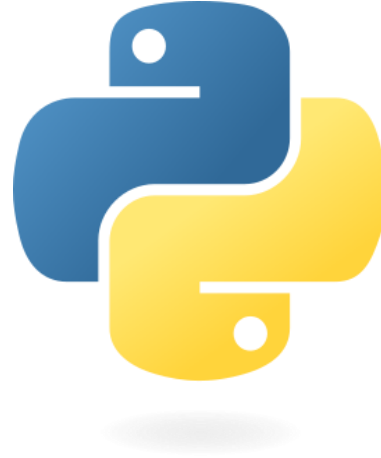# Python Programming for the Movement Sciences

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Brief History of Python

- Invented in the Netherlands at the beginning of the 90s by Guido van Rossum

- Named after Monty Python (British comedy troupe)

- Thought of as a scripting language, but in fact it is a lot more than that

- Open source from the beginning

- Used by major companies such as Google

- Becoming increasingly popular

https://statisticsanddata.org/
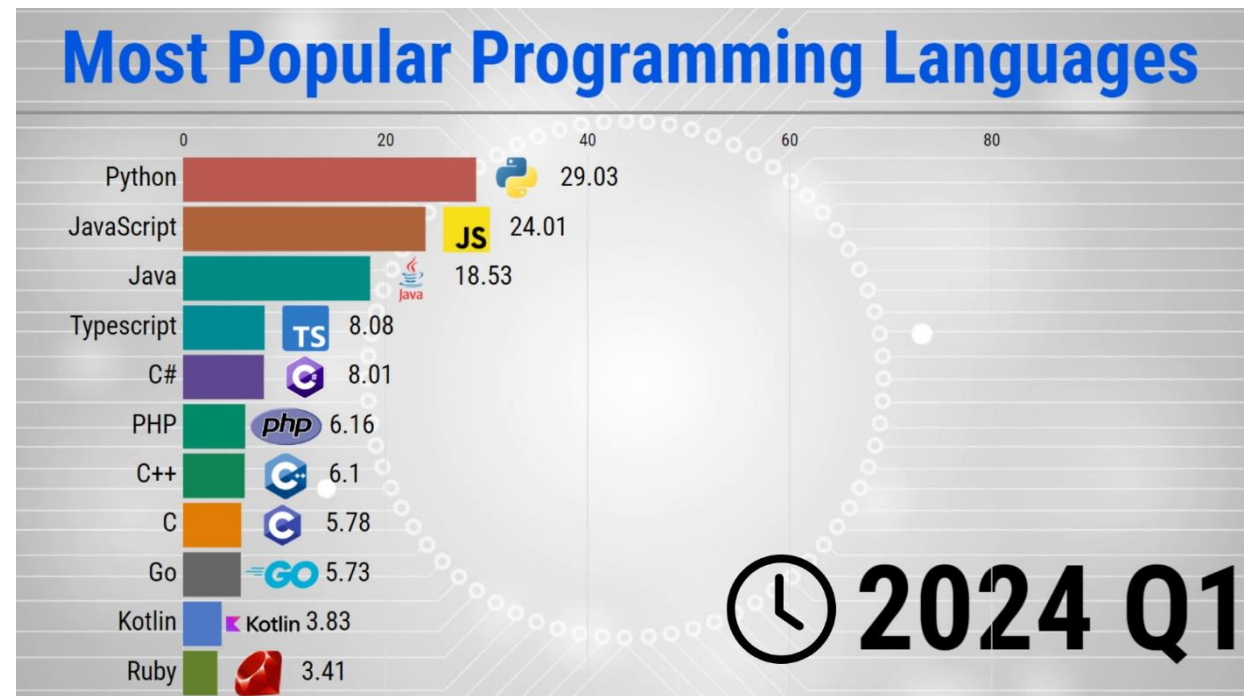
Brief History of Python

"Python is often described as a 'batteries included' language, meaning it has a rich and versatile standard library that is immediately available to users."
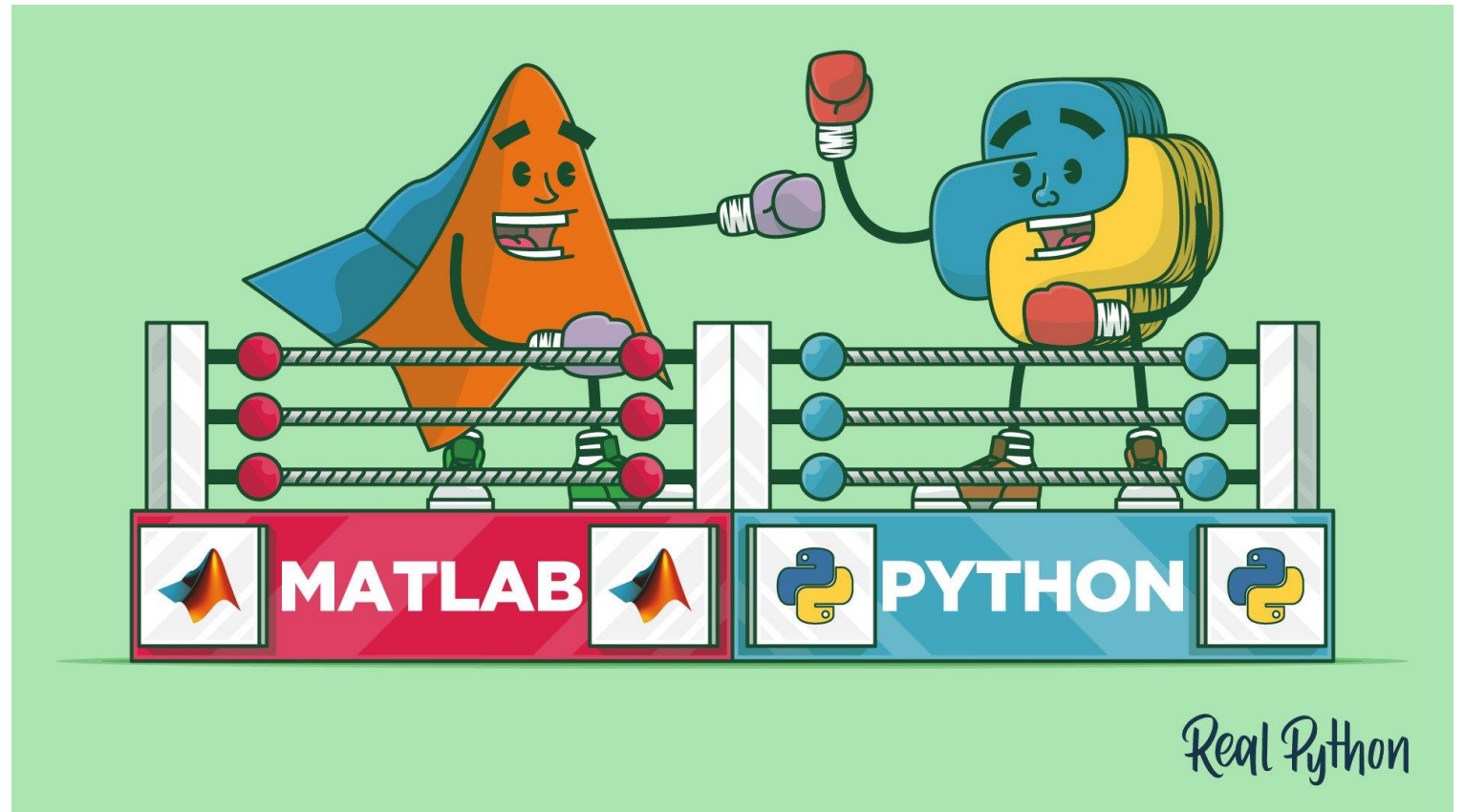
- Guido van Rossum

Introduction to Python

Some Key Features:

- **High-Level Language**

- **Portable Language**

- **Easy to learn and use**

- **Readability and simplicity**

- **Extensive libraries and frameworks**

- **Strong community support**

- **Open-source**

https://realpython.com/matlab-vs-python/

Python Packages

Commonly used packages:

- **NumPy:**

  For numerical computing and handling arrays.

- **Pandas:**

  For data manipulation and analysis, using data frames.

- **Matplotlib and plotly:**

  For creating visualizations like plots and charts.

- **SciPy:**

  For scientific computing with advanced mathematical functions.

- **Scikit-learn:**

  For machine learning tasks and data analysis.

- **So on…**

https://www.naukri.com/code360/library/python-packages
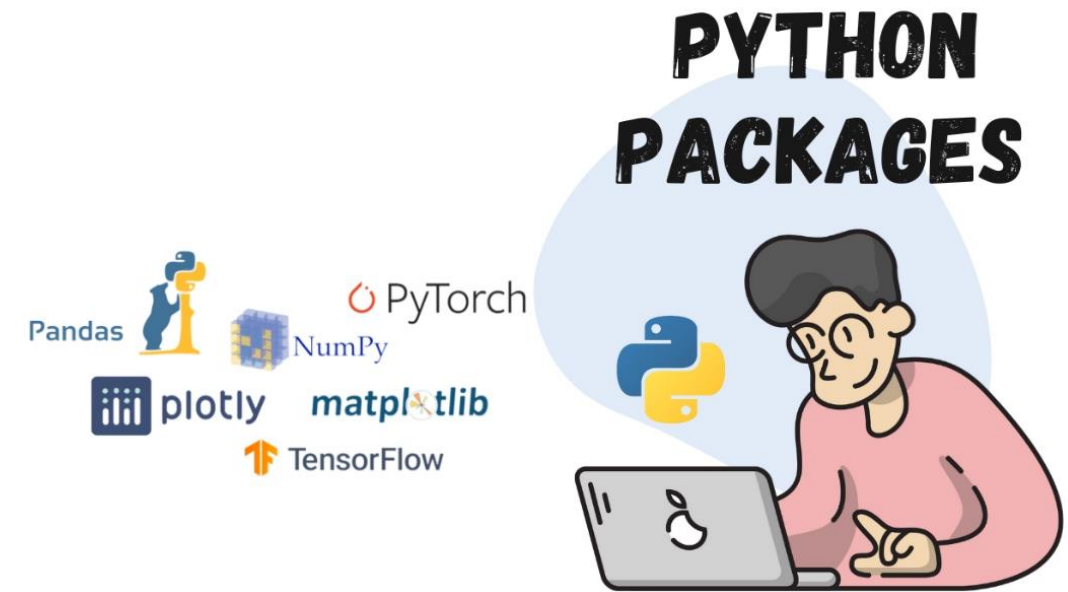
Python Applications in Movement Science

- Analyze movement data.

- Movement pattern simulation.

- Visualization of the data to derive insights.

- Development of algorithms for tracking movement.

https://github.com/mad-lab-fau/gaitmap
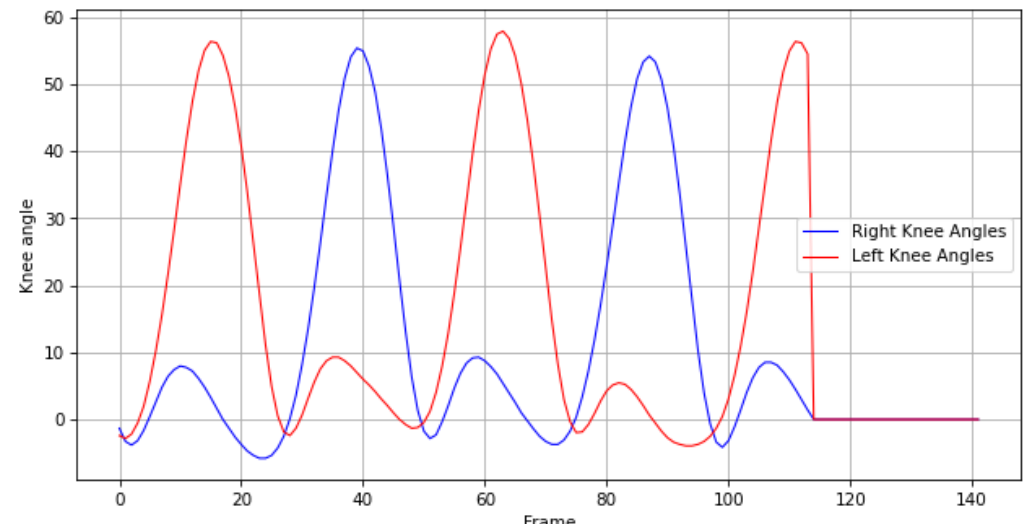
What does the movement data look like?

Sample recording from a motion capture (MOCAP) system:

- **File Type:** C3D files are standard data files used in motion capture systems.
- **Data Content:** They store three-dimensional motion capture data, including biomechanical information.
- **File Structure:** C3D files utilize a compact binary structure for efficient data storage.
- **Read/Write Functionality:** An easy method is needed to read and potentially write these files for further analysis.

https://assistiverobotcenter.github.io/projects/2019/06/19/sensors-paper5
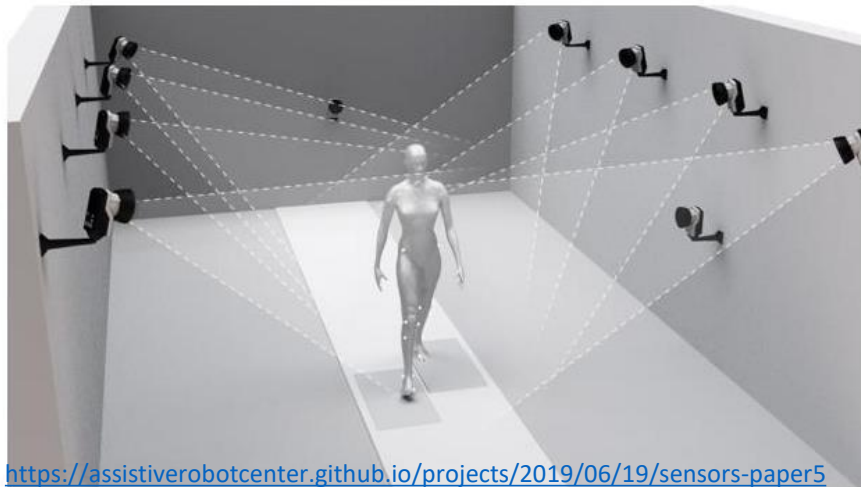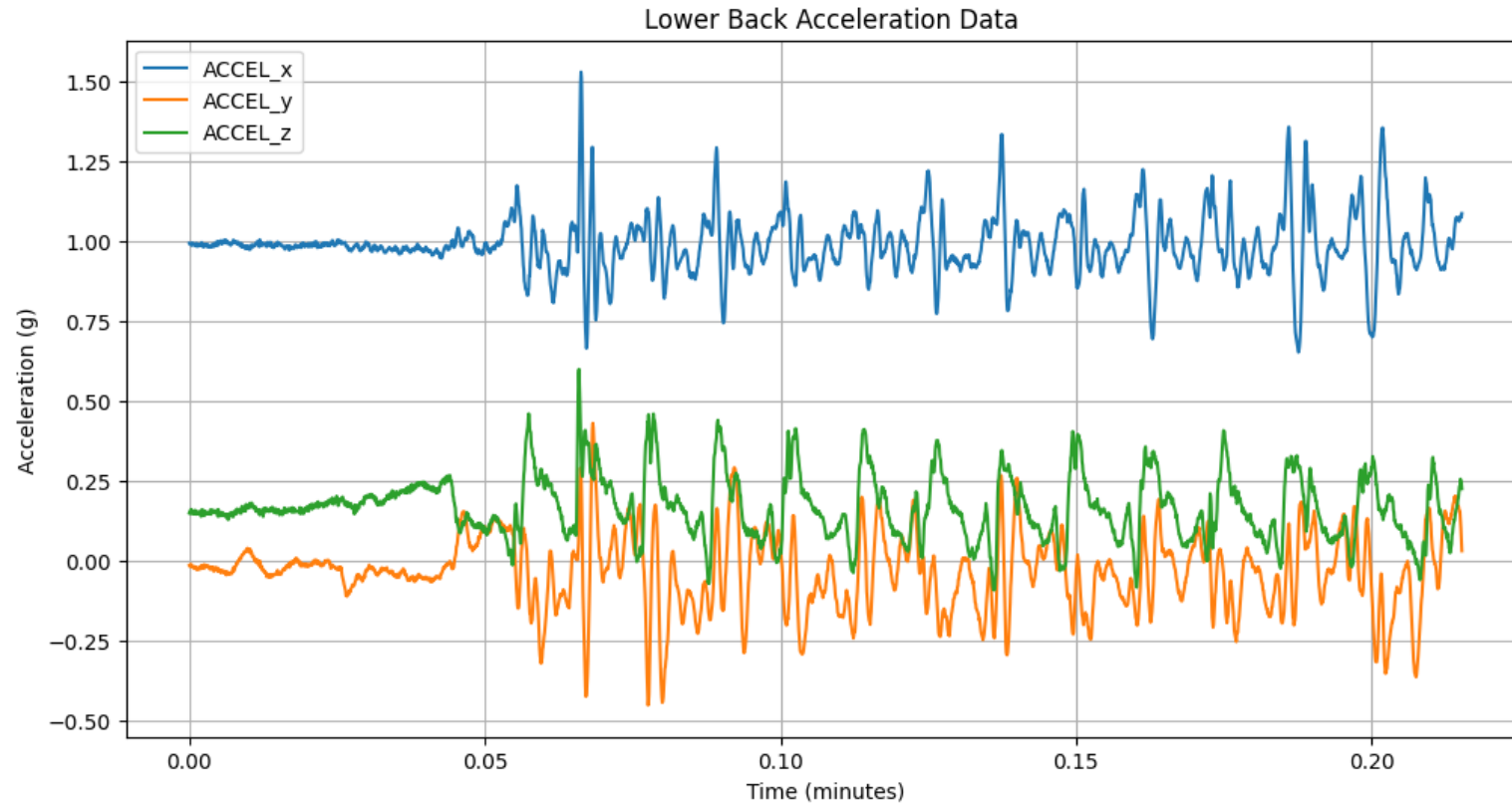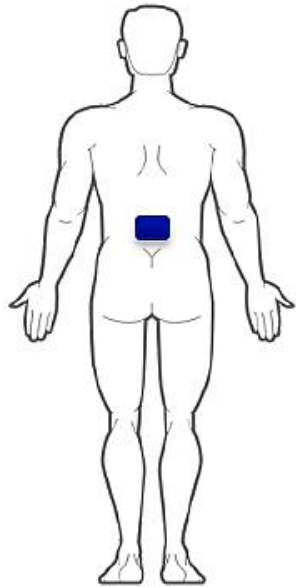
Data recorded using MOCAP system

Data loaded from a C3D file

What does the movement data look like?

Sample recording from an inertial measurement unit (IMU) sensor:

Data acquired using wearable IMU sensor placed on lower back, performing slow walking (Warmerdam et al., 2022)

What is coming up next:

- Basics of Python scripting

- Primary data types, collections, control structures, functions, etc.

- Essential packages for movement data analysis

- Loading and visualizing different movement data types such as data from motion capture systems, and wearable sensors such as IMUs.

- Analysis of movement data using open-source Python packages such as KielMAT, Gaitmap, etc.

To reach out the materials, please visit the **GAMMA** workshop repository:

https://github.com/neurogeriatricskiel/gamma_2024

GAMMA Workshop – Kiel 2024

Welcome to the GAMMA 2024 Workshop on Python Programming for Movement Sciences. This repository provides the materials and guidance for participants to get hands-on experience with Python programming for movement data analysis.

Python for Movement Sciences

In this workshop, we will cover essential programming concepts tailored to analyzing movement data using Python. The workshop is designed to be beginner-friendly and will guide you through setting up the environment and running your first analyses.

Before Getting Started

To follow along with this workshop, you'll need access to Google Colab. Below are the steps to get you set up and ready for the exercises:

Access Google Colab

1. Sign in to Google Colab
   Go to Google Colab and sign in with your Google account. If you don't have an account, you can create one for free.

2. Create a New Notebook
   Once signed in, click on "File" in the top-left corner and select "Open notebook."

3. Open the GitHub Tab
   In the dialog, select the GitHub tab and paste the following repository URL:
   `https://github.com/neurogeriatricskiel/gamma_2024`

4. Open the Notebook
   In the repository, find the notebook named `gamma_ws3_python_programming.ipynb` and open it. This notebook contains the core exercises and instructions for the workshop.

Running Jupyter Notebooks Locally

For those who prefer to run the notebooks on their local machines:

1. Navigate to the Notebooks Folder
   Inside this repository, you will find a `notebooks` subfolder containing all workshop materials.

2. Launch Jupyter
   Start Jupyter Notebook by navigating to the folder in your terminal or command prompt and running:

   ```
   jupyter notebook
   ```