

# **Computer Practical 1**

## **Outline of the Class**

- Introduction to Python, Colab and GitHub, Q-Gis
- Introduction to basic programming in Python
- Undertaking basic statistics in Python (Colab Notebook)
- Creating spatial images.

## **Activities**

- Reading data into Python
- Undertaking some basic statistics on 1D data
- Plotting line data
- Undertaking some basic statistics of quasi-3D data
- Plotting image data in python and Q-GIS

## **Introduction to Coding**

Welcome to the exciting world of Python programming! If you have never seen code before, don't worry – we'll take you through everything you need to know to get started with this powerful and flexible language.

Python is a high-level programming language that has been designed with simplicity and ease-of-use in mind. It's used by professional developers, scientists, and academics around the world to build software, analyze data, and solve complex problems.

One of the great things about learning to program in Python is that it can help you to develop a whole new set of skills that will be useful

in many different areas of your life. Here are some of the key benefits of using code:

1. **Problem-solving:** Learning to code in Python can help you develop your problem-solving skills. As you write code, you'll need to break down complex problems into smaller, more manageable steps, and find ways to solve them systematically.
2. **Career opportunities:** In today's digital age, knowledge of programming is becoming increasingly important. Many businesses and organizations are looking for people with coding skills to help them solve problems, develop new software, and manage data.
3. **Creativity:** Programming can also be a creative endeavor. As you learn to code in Python, you'll find that you can use your newfound skills to build your own projects, create your own apps, and bring your ideas to life.
4. **Improved critical thinking:** Programming requires attention to detail and logical thinking. You will learn how to identify and fix errors in your code, and build solutions that are efficient and effective.
5. **Community:** Learning to code in Python will also give you access to a vibrant and supportive community of developers who are passionate about sharing their knowledge and helping others. This community offers online forums, tutorials, and other resources to help you learn and grow.

So, let's get started! Whether you want to build your own web apps, analyze data, or solve complex problems, Python is a great language to learn. With a bit of practice, you'll be writing your own programs in no time!

## Google Colab

Google Colab is an online platform that provides a free and easy way to learn, create, and share code. It is a cloud-based Jupyter notebook environment that allows you to write and run Python code in your web browser. This means that you don't need to install any software on your computer, and you can access your code and data from anywhere with an internet connection.

One of the most exciting features of Google Colab is that it provides access to powerful hardware resources, such as GPUs and TPUs, which are typically only available on high-end computers or expensive cloud services. These resources can greatly speed up computations and allow you to work with large datasets and complex machine learning models.

Google Colab is also an excellent tool for collaboration and sharing. You can easily share your notebooks with others, work together in real-time, and even publish your work to the web. This makes it a great platform for students and researchers to collaborate on projects, and for instructors to create and share course materials.

Whether you're new to coding or an experienced programmer, Google Colab provides a fun and accessible way to learn, experiment, and create. With its powerful resources and collaborative features, it is a fantastic tool for exploring the exciting world of programming and data science.

## GitHub

GitHub is a platform for people to store, share, and collaborate on code. Think of it like a virtual filing cabinet for code. But instead of just storing your code in a folder on your computer, you can upload

it to GitHub where you and others can work on it together, even if you're in different parts of the world.

One of the great things about GitHub is that it makes it easy to keep track of changes to your code over time. Whenever you make changes to your code, you can create a "commit" that documents what you changed and why. This makes it easy to keep track of your progress and work collaboratively with others.

Another great feature of GitHub is the ability to create "branches" of your code. This means that you can create a copy of your code to work on a new feature or bug fix without affecting the main codebase. Once you've made the changes and tested them, you can merge the branch back into the main codebase.

GitHub is used by millions of developers and companies around the world. It's a great way to showcase your coding skills and collaborate on open source projects with other developers. And because it's free and easy to use, there's no reason not to give it a try and start building your own virtual filing cabinet of code!

## Types of data

In this module, we'll dive into the fascinating world of air quality data using the cutting-edge technology of the University of Liverpool air quality network. With a constantly growing network of 37 sensors, we have access to an extensive database available in two formats - individual line data or spatially represented data.

The line data, which is raw and uncalibrated, provides a unique opportunity to explore the unfiltered data and discover previously unseen patterns. On the other hand, the spatial data, which has been meticulously calibrated using a state-of-the-art Cree model and benchmarked against DEFRA and Met Office stations, offers a complete representation of the city at hourly intervals.

Each type of data has its own advantages and limitations. The spatial data is especially useful for examining air quality distributions on a large scale, but it requires a model for calibration and interpretation. Nevertheless, we use a machine learning model to identify and remove errors in the data, ensuring the highest quality results.

Meanwhile, the point data is ideal for examining specific aspects of the air quality, offering a chance to drill down into the details of a particular area. However, it's important to keep in mind that certain limitations at each sensor, such as someone smoking nearby or a localized event, may slightly skew the results.

## Activity

I know this may seem a bit intimidating, but don't worry. The goal of today is to introduce you to programming and provide you with the tools to navigate large data sets in air quality research. In order to do this, we'll be using Python, which is a powerful, free programming language that is widely used in data analysis.

Over the next few hours, you'll have the opportunity to explore different data sets and packages. If you're feeling overwhelmed or have any questions, don't hesitate to ask myself or one of the facilitators for help. We're here to assist you in any way we can.

To get started, I'd like you to navigate to the map repository and download a CSV data set. Once you've done this, load it into Python and try running some statistics on the data. If you feel comfortable, you can even download two or three data sets and compare them.

Next, I'd like you to produce a plot comparing pollution levels at 9:00 AM and 5:00 AM for one month of the year. Don't be afraid to play around with the formatting and make the plot as visually appealing as possible. As you delve further into the scientific literature, you'll find that many academics use similar plotting packages.

Finally, using the spatial data, create a mean average for a specific month and export the data into a geotiff file. From there, you can create an Q-GIS image and customize it to your liking.

Remember, the goal of today is to get you comfortable with programming and introduce you to the tools needed to navigate large data sets in air quality research. If you have any questions or concerns, please don't hesitate to ask for help. Have fun exploring and experimenting with these powerful tools!