# GGS 366: Lab 6

## General guidelines

**Please submit the .ipynb notebook containing all the codes.** Make sure the notebook is properly formatted by following the instructions below.

* Separate answers to each question using text cells and markdown headings. See example syntax here: [Markdown Guide - Colab](https://colab.research.google.com/notebooks/markdown_guide.ipynb)
* Write the essay questions in your Python notebook using text cells.
* The function body (where appropriate) must include a docstring to provide a general description of the function.
* Each step of the code needs to be commented.
* The code needs to be properly indented and readable. For more on formatting guidelines: [PEP 8 – Style Guide for Python Code | peps.python.org](https://peps.python.org/pep-0008/) and [PEP 257 – Docstring Conventions | peps.python.org](https://peps.python.org/pep-0257/)

You may use GenAI as a supporting tool. However, directly copying code from GenAI will be considered plagiarism and hinder your learning process. This can negatively impact your performance in course exams and, ultimately, your professional success. Therefore, it is in your best interest to thoroughly understand the fundamental concepts and make a genuine effort to solve the problems on your own.

## Question 1 (5 points)

For this lab, we will use crime incidents in DC in 2024. We will retrieve the data from here: [Crime Incidents in 2024 | Open Data DC](https://opendata.dc.gov/datasets/DCGIS::crime-incidents-in-2024/explore?location=38.903805%2C-77.012050%2C10.15)

The dataset has **29,295** records. To extractthe entire dataset, use this **base URL**: <https://maps2.dcgis.dc.gov/dcgis/rest/services/FEEDS/MPD/MapServer/6/query> and **modify the *fetch\_all\_data()*** function from Lecture 8 in the following ways:

* The function will take only **one parameter: *data\_crs***
* ***batch\_size*** will be **1000** (this is the default query limit set for this dataset)
* In the ***params*** dictionary, set ***"where": "1=1"***(this will retrieve all data without filtering through any column)
* Making all these changes and then calling the function should return you the entire dataset.

## Question 2 (10 points)

* Estimate the **mean center, standard distance, standard deviation Ellipse, convex hull, and minimum bounding rectangle** for the crime dataset.
* Visualize a map that
  + Plot the crime point pattern and the four other features you just calculated.
  + Use **OpenStreetMap basemap** and make it **50% transparent**
  + Has proper **legend** placed on the **top left** corner
  + Use proper color composition and padding to make all map elements visible.

## Question 3 (10 points)

* Estimate **quadrat density** for the crime dataset using square grid cells of **500m, 1000m, and 3000m**.
* **Visualize three quadrat density** maps:
  + Make sure you eliminate the grid cells outside the study area
  + Use proper **legend, legend labels, and map title**
* **Compare patterns** across different grid sizes. Explain how the **choice of** **grid cell size** influences the results and interpretation.

## Question 4 (10 points)

* Compute **Kernel Density** for the crime dataset using **100m grid cells** and a **500m bandwidth**.
* Create a **Kernel Density Map**:
  + Make sure you eliminate the grid cells outside the study area
  + Use appropriate color composition
  + Contain **basemap, legend, legend labels, map title, North sign and scale bar** using the instructions from Lecture 7
* How would you **interpret the kernel density map**?