MASTER OF URBAN SPATIAL ANALYTICS (MUSA)

MUSA 5000 Statistical and Data Mining Methods for Urban Data Analysis
This hands-on course will cover a wide range of methods frequently used for analyzing urban and spatial data. These methods are drawn from a variety of fields, including traditional statistics, spatial econometrics, and machine learning, and include 1) regression analysis (OLS, ridge/lasso, logistic, multinomial logit); 2) measures of spatial autocorrelation; 3) spatial regression (spatial lag, spatial error, geographically weighted regression); 4) point pattern analysis; 5) an introduction to clustering methods (k-means, hierarchical clustering, DBSCAN); and 6) big data and GIS. Students will learn the assumptions and limitations of each method, and assignments will focus on the implementation, presentation and interpretation of the analyses. Students will use R and GeoDa in this course.
Fall
Also Offered As: CPLN 6710
Mutually Exclusive: CPLN 5920
1 Course Unit

MUSA 5030 Modeling Geographical Objects
This course offers a broad and practical introduction to the acquisition, storage, retrieval, maintenance, use, and presentation of digital cartographic data with vector-oriented (i.e. drawing-based) geographic information systems (GIS) for a variety of environmental science, planning, and management applications. Previous experience in GIS is not required.
Fall
Also Offered As: CPLN 5030
1 Course Unit

MUSA 5080 Public Policy Analytics
This course teaches advanced spatial analysis and an introduction to data science/machine learning in the urban planning and public policy realm. The class focuses on real-world spatial analysis applications and, in combination with introductory machine learning, provides students a modern framework for efficiently allocate limited resources across space. Unlike its private sector counterpart, data science in the public or nonprofit sector isn’t strictly about optimization - it requires understanding of public goods, governance, and issues of equity. We explore use cases in transportation, housing, public health, land use, criminal justice, and other domains. We will learn novel approaches for understanding and avoiding risks of "algorithmic bias" against communities/people of color as well as communities of different income levels. The format of the class includes weekly lectures/in-class demos and labs. There are seven required assignments, including two projects. Prerequisites include either CPLN503, the summer GIS course or prior experience with GIS in a formal setting. The class is conducted entirely in R. Having experience in R and the ‘tidyverse’ is helpful but not strictly required.
Fall
Also Offered As: CPLN 5920
1 Course Unit

MUSA 5090 Geospatial Cloud Computing & Visualization
This course teaches students how to collect, store, wrangle and display cartographic data in a cloud-based setting. Students will learn a reproducible approach for pulling spatial data from APIs with emphasis on PostGIS, Socrata and BigQuery; to wrangle these data in python; and visualize in various platforms including Seaborn and Carto. Students will build their own APIs and eventually develop their own introductory custom web applications. This course is the first in a progression and leads to the Spring course on Javascript Programming for Planning (a class on building comprehensive mapping applications.)
1 Course Unit

MUSA 5500 Geospatial Data Science in Python
This course will provide students with the knowledge and tools to turn data into meaningful insights, with a focus on real-world case studies in the urban planning and public policy realm. Focusing on the latest Python software tools, the course will outline the "pipeline" approach to data science. It will teach students the tools to gather, visualize, and analyze datasets, providing the skills to effectively explore large datasets and transform results into understandable and compelling narratives. The course is organized into five main sections: Exploratory Data Science; Introduction to Geospatial Data Science; Data Ingestion & Big Data; Geospatial Machine Learning; Data Visualization & Storytelling.
Fall
Also Offered As: CPLN 6720
1 Course Unit

MUSA 6110 JavaScript Programming for Planners and Designers
This course will introduce City Planning, MUSA and design graduate students to JavaScript. Students will learn the logic and syntax of the JavaScript programming language for use in simple web applications, as well as how to program data and map-oriented web applications using Javascript. The "hands-on" uses of JavaScript in urban planning applications will be emphasized. Students will hone their skills through a series of complete application projects.
Fall
Also Offered As: CPLN 6920
1 Course Unit

MUSA 6500 Geospatial Machine Learning in Remote Sensing
Satellite remote sensing is the science of converting raw aerial imagery into actionable intelligence about the built and natural environment. This course will provide students the foundation necessary for the application of machine learning algorithms on satellite imagery. Use cases include building footprint detection, multi-class object detection in cities and land cover/land use classification. The students will learn basic concepts of machine learning, including unsupervised and supervised learning, model selection, feature elimination, cross-validation and performance evaluation. After learning traditional methods and algorithms, the course will focus on recent deep learning methods using convolutional neural networks and their application on semantic image segmentation. Prerequisites include MUSA 508, Geospatial Data Science in Python or equivalent.
Spring
1 Course Unit

MUSA 6950 Topics in Spatial Data & Analytics
Various topics pertaining to urban spatial analysis
Fall
1 Course Unit

MUSA 6951 Topics in Data Analytics
Class that examines various topics in data analytics
1 Course Unit
MUSA 7950 MUSA Summer: Introduction to GIS & Statistics
The summer GIS Bootcamp prepare students for the intermediate GIS classes that begin in the fall semester. It begins with a discussion of GIS in planning and the social sciences and then moves on to topics related to spatial data, geocoding, projection, vector and raster-based geoprocessing, 3D visualization and more. Each class includes a brief lecture and a walk through involving actual planning related data. Course enrollment is by permit only. Please contact Roslynne Carter (CPLN Dept.) at roslynne@design.upenn.edu.
Summer Term
0 Course Units

MUSA 8000 MUSA Capstone Project
Fall or Spring
1 Course Unit

MUSA 8010 MUSA/Smart Cities Practicum
The purpose of this course is for students to work with city and non-profit clients on data science that convert government data into actionable public policy intelligence. Groups of 2-3 students will work with the client to understand the business process, wrangle data, develop spatial and aspatial analytics and serve these outputs to non-technical decision makers through the medium of data visualization. Students will be mentored by MUSA Faculty and advised by someone from the partnering agency. Prerequisites: students must have a working knowledge of R and experience building both spatial and statistical models including machine-learning models. Prerequisites include MUSA-5080/CPLN-5920 and either CPLN-5050 or MUSA-5000. Students without these specific prerequisites are asked to contact the instructor. Interested students are asked to contact the instructor to learn about specific projects and how to apply for the course.
Spring
Also Offered As: CPLN 7900
Prerequisite: (CPLN 5050 OR MUSA 5000) AND (MUSA 5080 OR CPLN 5920)
1 Course Unit

MUSA 8020 Advanced Topics in GIS Capstone
This course offers students an opportunity to work closely with faculty, staff, local practitioners, and each other on a capstone project that involves the development of a GIS and/or urban data management application.
Spring
1 Course Unit