MA in Computational Social Science

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- Sabrina Nardin (MACSS)
- Zhao Wang (MACSS)
- Christopher Dobronyi (MACSS- Econ)

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MA in Computational Social Science

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GENERAL INFORMATION

The Master of Arts in Computational Social Science (http://macss.uchicago.edu/) is a two-year program of graduate study. It has a structured curriculum, with a total of 18 required and elective courses tailored to the disciplinary track a student follows. Students submit an article-length MA thesis in their second year, modeled on a professional journal article.

The program aims to produce leading social scientists in each of the core social science fields—economics, sociology, political science, psychology, history, and anthropology—producing competitive PhD applicants, well-trained in computational approaches, who have mastered the research and analytical skills necessary to make important contributions. MACSS also offers a concentration in economics which is operated jointly with the Department of Economics. Students receive close mentorship from the program’s Faculty Directors, academic staff, and members of our Executive and Affiliated Faculty to design a customized curriculum, define an area of scholarly research, and write a MA Thesis. They receive full professional support from the director of career services, with biweekly workshops, career planning, and employer recruitment.

Finally, all MA students may participate in an optional summer practicum between their first and second years, with internships drawn from academic and professional organizations. International students have three years of STEM work eligibility after they graduate.

PROGRAM REQUIREMENTS AND COURSE WORK

GENERAL MACSS CURRICULUM

In their first year, all MA students will complete:

- The Computational Math camp or the Econ Math camp, which run for three weeks in September.
- A Computational Statistics placement exam, offered during orientation week.
- A three-course core in Perspectives (Perspectives on Computational Analysis, Perspectives on Computational Modeling, and Perspectives on Computational Research).
- A two-course core in Computer Science with Social Science Applications in the Fall and Winter, and Large-Scale Computing for the Social Sciences in the Spring.
- Three graduate social science electives that will vary, depending on the student’s prior training and intended disciplinary path.
- Minor exceptions: (1) students who do not place out on our statistics exam will take an introductory course in computational statistics instead of a social science elective in the Fall quarter; (2) students may take more advanced programming instead of the two courses in Computer Science with Social Science Applications if they place out on a computer science placement exam.

In their second year, all MA students will complete:

- Three advanced courses in computational methods, drawn from any graduate department or professional school of the University.
- Three graduate social science electives.
- Three graduate courses that the student may select, from any UChicago department or professional school, where the student meets the minimum prerequisites.
- Students may register for the MA Research Commitment up to three times and use this as elective credit. This option allows students to allocate more time to their MA thesis.

Outside of their coursework, all MA students are expected to attend our weekly Computation Workshop, where advanced scholars and invited guests present drafts of their research for critique and discussion.

MACSS-ECON CURRICULUM

In their first year, all MACSS-Econ students will complete:
Computational Math Camp (MACS 33000), which will run for three weeks in September.
Computing Fundamentals Boot Camp (MACS 30120), which will also run for three weeks in September.
A Statistics placement exam, offered during orientation week.
A Computer Science placement exam, offered during orientation week.
A two-course core in Perspectives on Computational Analysis and Computational Modeling, the first of which must be taken autumn quarter.
A three-course core in Foundations of Quantitative Analysis. (Up to 2 courses may be waived via statistics placement exam)

In their second AND/OR first year, all MACSS-Econ students will complete:

- Econ Math Camp (ECON 30400) which will run for three weeks in September.
- A three-course core in Computer Science with Social Science Applications. (Up to 2 courses may be waived via computer science placement exam)
- Two courses to satisfy the Foundations in Economic Theory requirement.
- Two courses to satisfy the Foundations in Empirical Analysis/Computational Methods requirement.
- Six graduate economics/computational method electives that will vary, depending on the student's prior training and intended disciplinary path. (This number may increase if student earns placement on CS or stats exams)
- Students may register once for the MA Research Commitment and use this as an elective credit. This option allows students to allocate more time to their MA thesis.

Outside of their coursework, all MA students are expected to attend our weekly Computation Workshop, where advanced scholars and invited guests present drafts of their research for critique and discussion.

ADMISSION
MACSS applicants must meet the formal requirements of the Graduate Social Sciences Division.
All applicants must submit GRE scores, except for those applying for the joint BA/MA degree.
Financial aid is merit-based, and MACSS offers tuition scholarships at the time of admission. Some financial need-based grants may be available through an application process after prospective students are admitted.

Joint BA/MA applicants pay graduate tuition rates, and are eligible to receive the same aid they had in the College.

Applicants from non-English speaking countries must provide evidence of English proficiency by submitting scores from either the Test of English as a Foreign Language (TOEFL) or the International English Language Testing System (IELTS).

Some non-native English speakers are exempt, if they have studied in an English language University. Please contact our Dean of Students Office with any questions: ssd-admissions@uchicago.edu

HOW TO APPLY
The Application for Admission and Financial Aid, with instructions and deadlines, is available online at: https://apply-ssd.uchicago.edu/apply/.

Qualified students in the College who wish to pursue a joint BA/MA degree should consult first with their College Adviser, then with the Assistant Dean of Students for Admissions in the Division of the Social Sciences (Lindsey Weglarz lweglarz@uchicago.edu?subject=re:%20BA/MA%20inquiry%20(MACSS)).

Any questions about MACSS can be directed to our Student Affairs Administrator (Sabrina Biggus sbiggus@uchicago.edu?subject=re:%20BA/MA%20inquiry%20(MACSS)).

Prospective BA/MA students must meet with the Director of Undergraduate Studies in their college major, filling out a form available through Lindsey Weglarz lweglarz@uchicago.edu?subject=re:%20BA/MA%20form %20for%20the%20MACSS%20application in the Dean of Students office, to confirm their eligibility for the BA/MA, to specify how many of the 9 graduate courses they would take in their first year will be double-counted to satisfy their BA requirements, and to assure that all BA requirements will be met no later than June convocation of their fourth year. That form, with the signature of the Director of Undergraduate Studies (or their designee), must be submitted as part of the BA/MA application.

Please also visit our website: https://macss.uchicago.edu (https://macss.uchicago.edu/)

COURSES
MACS 30000. Perspectives on Computational Analysis. 100 Units.
Massive digital traces of human behavior and ubiquitous computation have both extended and altered classical social science inquiry. This course surveys successful social science applications of computational approaches
to the representation of complex data, information visualization, and model construction and estimation. We will reexamine the scientific method in the social sciences in context of both theory development and testing, exploring how computation and digital data enables new answers to classic investigations, the posing of novel questions, and new ethical challenges and opportunities. Students will review fundamental research designs such as observational studies and experiments, statistical summaries, visualization of data, and how computational opportunities can enhance them. The focus of the course is on exploring the wide range of contemporary approaches to computational social science, with practical programming assignments to train with these approaches.

Instructor(s): Benjamin Solttof Terms Offered: Autumn

MACS 30005. Graduate Practicum in the Social Sciences. 100 Units.

Students interested in gaining additional applied experience or writing an alternative or public facing thesis should consider taking the Graduate Practicum in the Social Sciences course. The practicum is a hands-on experiential course designed to enable students to apply and expand their knowledge in a career pathway based on their unique interests and improve their technical and applied writing skills, all while providing a useful service to a Chicago-based community partner. During the course, students work individually or in small teams to research a career pathway and identify and address issues/needs faced by a local community partner of their choice. Each student or team receives guidance from their instructor and community partner throughout the project. The experience culminates in a final project (report and formal presentation to the community partner and/or class).

Instructor(s): Robinson, Shellyl Terms Offered: Spring
Equivalent Course(s): MAPS 30005, INRE 30005

MACS 30100. Perspectives on Computational Modeling. 100 Units.

This is a core-course for the MACSS program and it requires Python programming experience (for non-MACSS students, please email the instructor for consultation). This course will teach fundamental skills of applying statistical machine learning models in computational social science tasks. It will focus on understanding the strengths and weaknesses of modern machine learning algorithms as well as their applications in real-world tasks. Topics will include the key techniques in standard machine learning pipelines: data processing (e.g., data representation, feature selection), classification models (e.g., decision trees, logistic regression, naive bayes), regression models (e.g., linear regression), model evaluation (e.g., cross-validation, confusion matrix, precision, recall, and $F_1$ for classification models; RMSE and Pearson correlation for regression models), and error analysis (e.g., data imbalance, bias-variance tradeoff, interpret model performance).

Instructor(s): Wang, Zhao Terms Offered: Winter
Prerequisite(s): Consent required for all Non MACSS students

MACS 30111. Principles of Computing 1: Computational Thinking for Social Scientists. 100 Units.

This course is the first in a three-quarter sequence that teaches fundamentals of computational thinking to students in the social sciences. Lectures in the class will cover topics such as functions, data structures, as well as classes and objects. Assignments will give students the opportunity to practice these basic computing concepts using the Python programming language and get familiar with computational logic in real-world tasks.

Instructor(s): Wang, Zhao Terms Offered: Autumn
Prerequisite(s): This course is intended for those who placed into it via MACS 30120 "Computing Fundamentals Boot Camp" or for those who are not otherwise prepared to independently and fluently write code using any programming language (e.g., R, Python, C, C++, Java). Note that this is the introductory version of MACS 30121. We will provide several test questions to help students better identify the suitability of this course at the beginning of the quarter.

MACS 30112. Principles of Computing 2: Data Management for Social Scientists. 100 Units.

This course is the second in a three-quarter sequence that teaches computational thinking and programming skills to students in the social sciences. Specifically, this course equips students with a fundamental toolkit for working with social science data. Students will learn the basics of web-scraping, relational databases, record linkage, data cleaning, modeling, visualization, and data structures. The programming language of the course is Python.

Instructor(s): Nardin, Sabrina Terms Offered: Winter
Prerequisite(s): MACS 30111

MACS 30113. Principles of Computing 3: Big Data and High Performance Computing for Social Scientists. 100 Units.

Computational social scientists increasingly need to grapple with data that is too big and code that is too resource intensive to run on a local machine. Using Python, students in this course will learn how to effectively scale their computational methods beyond their local machines --optimizing and parallelizing their code across clusters of CPUs and GPUs, both on-premises and in the cloud. The focus of the course will be on social scientific applications, such as: accelerating social simulations by several orders of magnitude, processing large amounts of social media data in real-time, and training machine learning models on economic datasets that are too large for an average laptop to handle.

Instructor(s): TBD Terms Offered: Spring
Prerequisite(s): MACS 30111 and MACS 30112, or equivalent
MACS 30120. Computing Fundamentals Boot Camp. 000 Units.
This boot camp focuses on introducing fundamental open-source tools for producing reproducible, computational research. Topics include the basics of Python programming, working on the Linux command line, as well as using Git/GitHub for version control. The course assumes no prior exposure to these topics and serves as preparation for MACS 30121 "Computer Science with Social Science Applications 1."
Instructor(s): Jon Clindaniel Terms Offered: Summer

MACS 30121. Computer Science with Social Science Applications 1. 100 Units.
This course is the first in a three-quarter sequence that teaches computational thinking and essential skills to students in the social sciences. Lectures in the class will cover topics such as functions, data structures, classes and objects, as well as recursion. Assignments will give students the opportunity to practice these computing concepts using the Python programming language and apply the computational logic in a wide variety of social science applications. Previous example assignments include modeling epidemics, modeling language shifts, analyzing candidate tweets from presidential debates, determining the number of machines needed at a polling place, predicting housing price with linear regression models
Instructor(s): Zhao Wang Terms Offered: Autumn
Prerequisite(s): At least one completed programming course and the ability to fluently and independently write code using any programming language (e.g., R, Python, C, C++, Java). Note that this is the accelerated version of MACS 30111. We will provide several test questions to help students better identify the suitability at the beginning of the quarter.

MACS 30124. Computational Analysis of Social Processes. 100 Units.
How does the human social and cultural world develop and change? The focus of this course is on introducing computational methods for studying the evolution of phenomena over time, alongside relevant theories for interpreting these processes from fields such as History, Anthropology, and Sociology. Students will gain hands-on experience using the Python programming language to harness a diverse set of digital data sources, ranging from satellite images to social media posts. Additionally, they will learn to employ computational approaches, such as simulation and dynamic topic modeling, to study social processes over a variety of different time scales: from the short term (changes in social media network structures over the course of the past week), to longer term (the evolution of English language discourse over the past 100 years), to deep time scales (long-term settlement pattern dynamics over the past 10,000 years).
Instructor(s): Jon Clindaniel Terms Offered: Autumn
Equivalent Course(s): MAPS 30124

MACS 30150. Perspectives on Computational Modeling for Economics. 100 Units.
In this course students will learn several computational methodologies and tools to solve, simulate, and analyze models that are the backbone of current macroeconomic analysis. While learning the relevant computational methods is the main objective, the theoretical economic aspects of the model will be stressed and the students will be required to apply their economic knowledge and skills to interpret and analyze the results. We will examine non-stochastic and stochastic general equilibrium models, both under local and global approximations. The main part of the course will deal with representative agent models, but a significant part will be devoted to introducing students to the solution of heterogeneous agent models as well.
Instructor(s): Salas, Sergio Terms Offered: Winter
Prerequisite(s): PQ for undergraduates: Econ 20200/20210 and MATH 19620/Stat 24300/Math 20250 and Stat 23400/Stat 24400/Stat 24410.
Note(s): MACSS students have priority.
Equivalent Course(s): ECMA 31140

MACS 30200. Perspectives on Computational Research. 100 Units.
This course focuses on applying computational methods to conducting social scientific research through a student-developed research project. Students will identify a research question of their own interest that involves a direct reference to social scientific theory, use of data, and a significant computational component. The students will collect data, develop, apply, and interpret statistical learning models, and generate a fully reproducible research paper. We will identify how computational methods can be used throughout the research process, from data collection and hiding, to exploration, visualization and modeling, to the final communication of results. The course will include modules on theoretical and practical considerations, including topics such as epistemological questions about research design, writing and critiquing papers, and additional computational tools for analysis.
Instructor(s): Philip Waggoner Terms Offered: Spring
Prerequisite(s): MACSS students have priority. Others admitted with instructor consent.

MACS 30250. Perspectives on Computational Research for Economics. 100 Units.
This course focuses on scaling up computational approaches to social science analysis and modeling with big data in context of opportunities afforded by high performance and cloud computing. We will begin by exploring various data structures encountered in social science research, how to deal with large or complex data storage and streaming data, and how to factor considerations of computational complexity into their analyses. We will also study social science applications of parallel computing, both on stand-alone machines and in supercomputing environments, to carry out complex computations. Students will learn to carry out parallel I/O and parallel computation on their own machines and on a cluster. We will also address API construction and access, and explore cloud configurations for social science research designs. We will also help students
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constrcut web-based outward facing data, analysis and visualization portals. Students will efficiently gather, structure, perform and present analysis on large-scale social science data. This course will be specifically tailored to students concentrating in Economics.

Instructor(s): R. Evans
Terms Offered: Spring
Prerequisite(s): MACSS students have priority.

MACS 30300. Data Science Clinic. 100 Units.
In order to enroll in this class, students must first submit an application and be matched with a project. Visit the Data Science Clinic site for application deadlines, how to apply, and information session details: bit.ly/ds-clinic

The Data Science Clinic is an experiential project-based course in which students will be tasked with producing key deliverables such as data analysis, open source software, as well as final client presentations and reports. The Clinic partners with public interest organizations, industry, and research labs to leverage data science research and technology to address pressing social, environmental, industrial, and academic challenges. The Clinic also provides students with exposure to real-world projects and problems that transcend the conventional classroom experience including; (1) working with imperfect datasets, applying models and algorithms to real-world data, and navigating security and privacy issues, (2) communicating results to a diverse set of stakeholders (e.g., industry, public interest, government agencies), and translating information into actionable insights, policy briefs and software prototypes.

Instructor(s): STAFF
Terms Offered: Autumn Spring Winter
Prerequisite(s): Instructor Consent Required to Enroll Students must apply to participate in this class.
Application information can be found here: bit.ly/ds-clinic
Equivalent Course(s): CAPP 30300, MPSC 57300, PPHA 30581

MACS 30405. Exploring Cultural Space. 100 Units.
The class will put a special emphasis on the construct of space in cultural analysis. The first five weeks of lectures and discussion will cover the foundational social theories and most commonly-used statistical/computational methods in the studies of cultural space. We will ask and try to answer: what is a cultural space? What are its dimensions? What is its topology? What social processes take place in it? Major statistical techniques, such as principle component analysis, correspondence analysis and latent class analysis as well as recent advances in computational text analysis and world-embedding models, will be introduced. The second half of the class will be devoted to empirical studies and student projects. Students are expected to submit an empirical study or extensive literature review at the end of the course.

Instructor(s): Jonathan Clindaniel
Terms Offered: Winter

MACS 30501. Computational Anthropology. 100 Units.
This course exposes students to the methods and data of Computational Anthropology—the systematic, computational study of the human species, past and present. Such methods have been essential in recent years for simulating human behavior in different cultures and economic systems, uncovering ancient demographic changes that still have an influence into the present day, preserving cultural heritage, and much more.

Anthropological data allows social science researchers to evaluate long term trends in the human condition, across a variety of cultures, with a unique combination of material, textual, and structured database data. Students will have the opportunity to evaluate state of the art approaches in computational anthropology and learn how to apply these methods to their own social scientific research agendas using open anthropological datasets and the Python programming language.

Instructor(s): Jia, Shilin
Terms Offered: Winter

MACS 30519. Spatial Cluster Analysis. 100 Units.
This course provides an overview of methods to identify interesting patterns in geographic data, so-called spatial clusters. Cluster concepts come in many different forms and can generally be differentiated between the search for interesting locations and the grouping of similar locations. The first category consists of the identification of extreme concentrations of locations (events), such as hot spots of crime events, and the location of geographical concentrations of observations with similar values for one or more variables, such as areas with elevated disease incidence. The second group consists of the combination of spatial observations into larger (aggregate) areas such that internal similarity is maximized (regionalization). The methods covered come from the fields of spatial statistics as well as machine learning (unsupervised learning) and operations research. Topics include point pattern analysis, spatial scan statistics, local spatial autocorrelation, dimension reduction, as well as spatially explicit hierarchical, agglomerative and density-based clustering. Applications range from criminology and public health to politics and marketing. An important aspect of the course is the analysis of actual data sets by means of open source software, such as GeoDa, R or Python.

Instructor(s): P. Amaral
Terms Offered: Winter
Prerequisite(s): STAT 22000 or equivalent; SOCI 20253/30253 (or equivalent) Introduction to Spatial Data Science required.
Equivalent Course(s): SOCI 30519, SOCI 20519, GISC 30519, GISC 20519, ENST 20519

MACS 30550. From Data to Manuscript in R. 100 Units.
This course tackles the basic skills needed to build an integrated research report with the R programming language. We will cover every step from data to manuscript including: Using R's libraries to clean up and reformat messy datasets, preparing data sets for analysis, running statistical tools, generating clear and attractive...
figures and tables, and knitting those bits of code together with your manuscript writing. The result will be a reproducible, open-science friendly report that you can easily update after finishing data collection or receiving comments from readers. Never copy-paste your way through a table again! The R universe is large, so this course will focus specifically on: The core R libraries, the tidyverse library, and R Markdown. Students will also learn about the use of GitHub for version control.

Instructor(s): N. Dowling Terms Offered: Winter
Prerequisite(s): This is a project-based course. Students must already be in possession of a (partial or whole) dataset for which they would like to create a preliminary research report (e.g., for thesis submission, publication, or similar). No prior programming experience necessary.
Equivalent Course(s): CHDV 30550, PSYC 30550, CHDV 20550, MAPS 30550

MACS 30617. Introduction to Organizational Analysis. 100 Units.
Organizations impact almost every aspect of social life; further, organizations have become some of the most significant actors in society. The course will provide a grounding in the sociological literature on how organizations function as well as the dynamics that govern both their internal structures and their interface with society. The second part of the course will cover macro-social organizational processes with a particular focus on social movement organizations and neo-institutionalism. Throughout, we will engage questions pertaining to where organizations come from, how they function, when they 'succeed' and 'fail', as well as their social consequences. At the completion of the course, students will apply the concepts covered in class to develop a research proposal.

Instructor(s): Arroyo, Pedro Alberto Terms Offered: Winter
Equivalent Course(s): SOCI 30337, PBPL 23002

MACS 31300. AI Applications in the Social Sciences. 100 Units.
Artificial Intelligence (AI) describes algorithms constructed to reason in uncertain environments. This course provides an introduction to AI applications in the social sciences. Driven by the rapid increase in accessible big data documenting social behavior, AI has been applied to: increase effective diagnosis and prediction under different conditions, improve our understanding of human interaction, and increase the effectiveness of data management in different social and human services. Random forests and neural networks are among the most frequent AI methods used for prediction, while natural language processing and computer vision contribute to understanding decision-making and improving service provision. We begin with careful consideration for what AI can achieve and where current limitations exist by looking at a variety of real-world applications. We will focus on three core sections: search, representation, and uncertainty. In each section, we will explore major approaches, representational techniques and core algorithms. We will examine the trade-offs between model structure and the algorithmic constraints that this structure implies. The course is driven by hands-on exercises with AI algorithms written in Python. At the end of the term, you should be able to apply and tweak these algorithms to accommodate your own data and research interests.

Instructor(s): Brooke Luetgert Terms Offered: Spring
Prerequisite(s): One course in introductory data science as well as basic familiarity with Python are prerequisites for the course.

MACS 33000. Computational Math Camp. 000 Units.

MACS 33002. Introduction to Machine Learning. 100 Units.
This course requires Python programming experience. The course will train students to gain the fundamental skills of machine learning. It will cover knowledge and skills of running with computational research projects from a machine learning perspective, including the key techniques used in standard machine learning pipelines: data processing (e.g., data cleaning, feature selection, feature engineering), classification models (e.g., logistic regression, decision trees, naive bayes), regression models (e.g., linear regression, polynomial regression), parameter tuning (e.g., grid-search), model evaluation (e.g., cross-validation, confusion matrix, precision, recall, and f1 for classification models; RMSE and Pearson correlation for regression models), and error analysis (e.g., data imbalance, bias-variance tradeoff). Students will learn simple and efficient machine learning algorithms for predictive data analysis as well as gain hands-on experience by applying machine learning algorithms in social science tasks. The ultimate goal of this course is to prepare students with essential machine learning skills that are in demand both in research and industry.

Instructor(s): Wang, Zhao Terms Offered: Winter
Prerequisite(s): Python programming experience required.
Equivalent Course(s): MAPS 33002, PLSC 43505, MACS 23002

MACS 35000. MA Research Commitment. 100 Units.
Student Initiated research and writing for the MA research component.

Instructor(s): James Evans Terms Offered: Autumn Spring Winter

MACS 35001. Structured MA Research Commitment. 100 Units.
Student initiated research and writing for the MA research component.

Instructor(s): James Evans Terms Offered: Autumn

MACS 36000. Computational Methods Using Online Social Media Data. 100 Units.
This course will discuss a broad range of computational social science topics that leverage large-scale data from online communication platforms to gain insights into social issues. We will start from collecting and processing
data from social media platforms (e.g., Twitter, IMDB, Airbnb, Yelp), and then introduce computational research topics that include but are not limited to: sentiment analysis, deceptive marketing, recommendation system, fake news detection, spam detection, bot detection, demographic inference, public health, political attitude analysis, personality and behavior analysis, and cyberbullying. We will use version control techniques (e.g., git, Github) to keep track of the class projects. The ultimate goal of this course is to provide a broad introduction of computational social science research areas and train students to be familiar with the pipelines of doing computational research.

Instructor(s): Wang, Zhao Terms Offered: Winter
Equivalent Course(s): MACS 26000, MAPS 36001

MACS 37000. Thinking with Deep Learning for Complex Social & Cultural Data Analysis. 100 Units.

A deluge of digital content is generated daily by web-based platforms and sensors that capture digital traces of human communication and connection, and complex states of society, culture, economy, and the world. Emerging deep learning methods enable the integration of these complex data into unified social and cultural "spaces" that enable new answers to classic social and cultural questions, and also pose novel questions. From the perspective of deep learning, everything can be viewed as data—novels, field notes, photographs, lists of transactions, networks of interaction, theories, epistemic styles—and our treatment examines how to configure deep learning architectures and multi-modal data pipelines to improve the capacity of representations, the accuracy of complex predictions, and the relevance of insights to substantial social and cultural questions. This class is for anyone wishing to analyse textual, network, image or arbitrary structured and unstructured data, especially in concert with one another to solve complex social and cultural analysis problems (e.g., characterize a culture; predict next year's ideology).

Instructor(s): James Evans Terms Offered: Spring
Prerequisite(s): The course uses Python and the widely popular PyData ecosystem to demonstrate all motivating examples and includes working code, accompanying exercises, relevant datasets and additional analytics and visualization that facilitate social and cultural interpretation and communication. Familiarity with Python is required.
Equivalent Course(s): SOCI 30332

MACS 40100. Big Data and Society. 100 Units.

The massive explosion of information produced by computers and sophisticated computational methods capable of harnessing this data to generate inferences has led to an increasingly data-driven society. Businesses, governments, and individuals seek to leverage this data to develop and market products, formulate policy, and improve the human condition. Computational approaches to decision making have become increasingly prevalent in domains such as criminal justice, education, employment, finance, and politics. While decision making based on data mining and algorithms has the capacity to improve society, critics argue that these approaches strengthen socioeconomic class divisions, constitute an invasion of privacy, or violate the civil rights of minority groups. This course will survey some of the major uses of big data in society and assess the potential ethical, moral, and legal implications of these models.

Instructor(s): B. Soltoff Terms Offered: Autumn

MACS 40101. Social Network Analysis. 100 Units.

This course introduces students to concepts and techniques of Social Network Analysis ("SNA"). Social Network Analysis is a theoretical approach and a set of methods to study the structure of relationships among entities (e.g., people, organizations, ideas, words, etc.). Students will learn concepts and tools to identify network nodes, groups, and structures in different types of networks. Specifically, the class will focus on a number of social network concepts, such as social capital, homophily, contagion, etc., and on how to operationalize them using network measures, such as centrality, structural holes, and others.

Instructor(s): Sabrina Nardin Terms Offered: Autumn
Equivalent Course(s): MACS 20101, SOCI 40248

MACS 40400. Computation and the Identification of Cultural Patterns. 100 Units.

Culture is increasingly becoming digital, making it more and more necessary for those in both academia and industry to use computational strategies to effectively identify, understand, and (in the case of industry) capitalize on emerging cultural patterns. In this course, students will explore interdisciplinary approaches for defining and mobilizing the concept of "culture" in their computational analyses, drawing on relevant literature from the fields of Anthropology, Psychology and Sociology. Additionally, they will receive hands-on experience applying computational approaches to identify and analyze a wide range of cultural patterns using the Python programming language. For instance, students will learn to identify emerging social movements using social media data, predict the next fashion trends, and even decipher ancient symbols using archaeological databases.

Instructor(s): Clindaniel, Jon Terms Offered: Autumn Winter
Prerequisite(s): No previous coding experience required. A Python boot camp will be held at the beginning of the quarter to teach the coding skills necessary to succeed in the course. Open to Advanced Undergraduates with Instructor Permission.
Equivalent Course(s): MAPS 40401, MACS 20400, CHDV 40404, PSYC 40460

MACS 40550. Agent-Based Modeling. 100 Units.

Social science problems often have so many details and moving parts that it can be difficult for researchers to gain traction without models. In this course, we explore agent-based modeling approaches to understand these
social science problems including cooperation and the development of culture. Agent-based models enable us to build an understanding from the bottom up, starting with simple assumptions and analyzing how patterns emerge at a larger scale. Through the term, we’ll cover the fundamentals of modeling, including basic principles of model design, data extraction, and canonical examples like Conway’s Game of Life, Schelling’s segregation model, and Boids/flocking. The course is balanced between social science readings and applications and hands-on coding. It cumulates in a final project consisting of an agent-based model designed by students to apply to a social science phenomenon.

Instructor(s): Clipperton, Jean Terms Offered: Winter
Prerequisite(s): Students should have some background in Python at the level of MACS 30111 or equivalent. Consent required for all non MACSS students.

**MACS 40700. Data Visualization. 100 Units.**
Social scientists frequently wish to convey information to a broader audience in a cohesive and interpretable manner. Visualizations are an excellent method to summarize information and report analysis and conclusions in a compelling format. This course introduces the theory and applications of data visualization. Students will learn techniques and methods for developing rich, informative and interactive, web-facing visualizations based on principles from graphic design and perceptual psychology. Students will practice these techniques on many types of social science data, including multivariate, temporal, geospatial, text, hierarchical, and network data. These techniques will be developed using a variety of software implementations such as R, ggplot2, D3, and Tableau.

Instructor(s): Benjamin Soltoff Terms Offered: Spring
Equivalent Course(s): MACS 20700

**MACS 40900. Studying ‘Social Problems’: Theory and Methods. 100 Units.**
What does it mean for something to be a ‘social problem?’ How do particular ‘social problems’ emerge and how do they stop being ‘problems?’ This course answers these questions from the perspective of the sociology of social problems and introduces students to different tools and data sources they can use to better understand a social problem, or a variety of other phenomena, that they might be interested in. In the first part of the course, we will cover sociological theories of ‘social problems’ and read a selection of case studies. In the second part of the course, we will survey different kinds of data sources (Twitter feeds, newspaper and congressional records, article databases, various publicly available datasets, etc.) and discuss how you can best leverage them to study specific ‘social problems.’ By the end of the class, each student will have produced an extensive report on a topic of interest. As such, the class is particularly well-suited for students doing independent research, such as working on their BA or MA. The course does not assume any previous knowledge, beyond basic proficiency with the Internet and software such as Excel. However, the instructor will orient parts of the class towards students who have some programming background, in order to emphasize the utility of computational approaches.

Instructor(s): Miklin, Sanja Terms Offered: Winter
Equivalent Course(s): SOCI 20560, MAPS 40900, MACS 20900, SOCI 30560, CHDV 20900

**MACS 51000. Introduction to Causal Inference. 100 Units.**
This course is designed for graduate students and advanced undergraduate students from the social sciences, education, public health science, public policy, social service administration, and statistics who are involved in quantitative research and are interested in studying causality. The goal of this course is to equip students with basic knowledge of and analytic skills in causal inference. Topics for the course will include the potential outcomes framework for causal inference; experimental and observational studies; identification assumptions for causal parameters; potential pitfalls of using ANCOVA to estimate a causal effect; propensity score based methods including matching, stratification, inverse-probability-of-treatment-weighting (IPTW), marginal mean weighting through stratification (MMWS), and doubly robust estimation; the instrumental variable (IV) method; regression discontinuity design (RDD) including sharp RDD and fuzzy RDD; difference in difference (DID) and generalized DID methods for cross-section and panel data, and fixed effects model. Intermediate Statistics or equivalent such as STAT 224/PBHS 324, PP 31301, BUS 41100, or SOC 30005 is a prerequisite. This course is a prerequisite for "Advanced Topics in Causal Inference" and "Mediation, moderation, and spillover effects."

Instructor(s): G. Hong Terms Offered: Winter
Prerequisite(s): Intermediate Statistics or equivalent such as STAT 224/PBHS 324, PP 31301, BUS 41100, or SOC 30005
Note(s): CHDV Distribution: M; M
Equivalent Course(s): PLSC 30102, CHDV 20102, SOCI 30315, PBHS 43201, CHDV 30102, STAT 31900

**MACS 51100. Computational Social Science Skills Workshop. 000 Units.**
Modern social scientific research designs often require individuals to have advanced computational skills and the ability to write programs that implement the research tasks. This workshop teaches participants a range of computational tools and methods within open-source programming languages (e.g. R, Python, Julia). Workshop topics will vary throughout the quarter and have differing prerequisites (purely introductory, intermediate, advanced training, etc.).

Instructor(s): Soltsoff, Benjamin Terms Offered: Autumn Spring Winter

**MACS 54000. Introduction to Spatial Data Science. 100 Units.**
Spatial data science consists of a collection of concepts and methods drawn from both statistics and computer science that deal with accessing, manipulating, visualizing, exploring and reasoning about geographical data.
The course introduces the types of spatial data relevant in social science inquiry and reviews a range of methods to explore these data. Topics covered include formal spatial data structures, geovisualization and visual analytics, rate smoothing, spatial autocorrelation, cluster detection and spatial data mining. An important aspect of the course is to learn and apply open source GeoDa software.

Instructor(s): L. Anselin Terms Offered: Autumn
Prerequisite(s): STAT 22000 (or equivalent), familiarity with GIS is helpful, but not necessary
Equivalent Course(s): GISC 30500, GISC 20500, ENST 20510, SOCI 30253, SOCI 20253

MACS 95000. Computation MA Internship. 000 Units.
All MACSS students who have completed three academic quarters of full-time course work in our MA program are eligible to participate in the Computational Social Science Internship Program. Any interested persons must speak with Career Services, have an approved external employer, complete a petition from our Student Affairs Administrator, and enroll in this non-credit field research course. The course will appear on your transcript, and will be evaluated on a pass/fail basis, in consultation with the employer. Note that MACS 95000 does not count against your other curricular requirements.
Instructor(s): James Evans, Marc Berman Terms Offered: Autumn Spring Summer Winter