DATA SCIENCE AND SOCIETY (DATA)

Additional Resources

- · Catalog Course Search (https://catalog.unc.edu/course-search/)
- Course Numbering Guide (https://catalog.unc.edu/courses/coursenumbering/)
- · Scheduled Classes (https://reports.unc.edu/class-search/)
- Historical Course Record (https://reports.unc.edu/ historical_course_record/)

Courses

DATA 110. Introduction to Data Science. 3 Credits.

This course is a broad, high-level survey of the major aspects of data science including ethics, best practices in communication (e.g. data visualization), mathematical/statistical concepts, and computational thinking. Students will gain an understanding of the fundamentals of data science to support more in-depth, advanced coursework that are requirements for the data science majors. Honors version available.

Rules & Requirements

IDEAs in Action Gen Ed: FC-QUANT. **Grading Status:** Letter grade.

😳 DATA 120. Ethics of AI and Societal Decision Making. 3 Credits.

In an era of rapid advancements in data science and AI, ethical concerns related to data-intensive technologies are now of utmost importance. This course immerses students in data science ethics, facilitating a comprehensive exploration of the intricate interplay between data and societal values. By nurturing critical thinking grounded in ethical theories, this course provides students with a strong foundation in designing and analyzing data-intensive ecosystems that emphasize values such as fairness, accountability, ethics, and transparency. Honors version available.

Rules & Requirements

IDEAs in Action Gen Ed: FC-VALUES. **Grading Status:** Letter grade.

DATA 130. Critical Data Literacy. 3 Credits.

How do you become data literate? Data literacy is the ability to read, write, and communicate data in context, or in other words: perform data analysis, construct a data visualization, and then communicate that data. It is the story that gets told with the data. Data literacy helps us to understand data, learn about different types and scales of data, and understand why this is important in the world today.

Rules & Requirements

IDEAs in Action Gen Ed: FC-KNOWING. **Grading Status:** Letter grade.

DATA 140. Introduction to Data Structures and Management. 3 Credits.

Data structures provide a means to manage large amounts of data for use in our databases and indexing services. A data structure is a specialized format for organizing, processing, retrieving and storing data. There are several basic and advanced types of data structures, all designed to arrange data to suit a specific purpose. Data structures make it easy for users to access and work with the data they need in appropriate ways.

Rules & Requirements

Grading Status: Letter grade.

DATA 150. Communication for Data Scientists. 3 Credits.

The ability to collect and analyze data has changed virtually every field, yet data scientists often lack the ability to present their findings in effective formats. This class uses storytelling to help you connect with your audience and present your data in compelling and understandable ways so stakeholders can make the right decisions with data. Through hands-on exercises, you'll learn the advantages and disadvantages of oral, visual, and written formats.

Rules & Requirements

IDEAs in Action Gen Ed: COMMBEYOND. **Grading Status:** Letter grade.

DATA 395. Mentored Research in Data Science. 1 Credits.

Student will be working with a faculty member to assist in research. The students with the faculty advisor would work in the faculty's research area, understand the faculty's research, and, if needed, help evaluate results.

Rules & Requirements

IDEAs in Action Gen Ed: RESEARCH. **Grading Status:** Pass/Fail.

DATA 481. Data Science Practicum. 3 Credits.

This course is designed to give undergraduate students hands-on data science experience using real-world research requests. Students will learn and use the Data Science Project Cycle framework to complete a project from an external client. Clients from an array of industries, as well as those from within UNC, will submit project requests that are feasible within a 12-week period. The course will offer an authentic learning experience to develop students' research skills and professional attributes, such as teamwork, communication, and project management, in preparation for workforce entry.

Rules & Requirements

DEAs in Action Gen Ed: HI-GENERAL.

Requisites: Prerequisites, MATH 347 and STOR 455 and STOR 120 or 320; permission of the instructor for students lacking the prerequisites. **Grading Status:** Letter grade.

DATA 493. Internship in Data Science. 3 Credits.

An ideal internship provides students with practical experience in an organization outside of UNC, doing work that is relevant to their UNC education. The internship should develop and enhance the students' professional skill sets and involve experiences that allow students to have responsibility for results that are of value to the organization. A signed learning contract is required prior. Data science B.S. majors only. Permission of instructor and director of undergraduate studies required.

Rules & Requirements

IDEAs in Action Gen Ed: HI-INTERN. **Grading Status:** Letter grade.

DATA 495. Mentored Research in Data Science. 3 Credits.

For data science majors only and by permission of the instructor. Independent research to be conducted under the direct mentorship of a data science faculty member. If repeated, the repeated course can not be counted for the major. Students would be working with a faculty member to conduct research. Students along with the faculty advisor would work on a research idea, understand how to gather evidence, evaluate results, deliver the results in some fashion, and then use that to think of future impacts or other works. Majors only.

Rules & Requirements

IDEAs in Action Gen Ed: RESEARCH. **Grading Status:** Pass/Fail.

DATA 496. Directed Exploration in Data Science. 3 Credits.

By permission of the director of undergraduate studies. A deeper investigation under the supervision of a faculty member of topics in data science that may be, but need not be, connected with an existing course.

Rules & Requirements

Grading Status: Letter grade.

DATA 520. Research-Methods for Socially Responsible AI: An Ethical Expedition. 3 Credits.

This research-focused course immerses students in socially and ethically responsible Artificial Intelligence. Emphasizing hands-on experience, the course guides students through the intricacies of conducting ethically responsible AI research with a keen focus on AI fairness, societal impacts, and real-world applications. Students collaborate in teams, selecting their preferred research area and societal problem from broader data science themes, and pursue a semester-long data science project under the guidance of the faculty and advanced graduate student teaching assistants. The course curriculum spans crucial topics including exploration of emerging trends in AI and data science.

Rules & Requirements

IDEAs in Action Gen Ed: FC-VALUES, RESEARCH. **Requisites:** Prerequisite, DATA 120 or permission from the instructor. **Grading Status:** Letter grade.

DATA 521. Foundations in Artificial Intelligence. 3 Credits.

This course provides a comprehensive introduction to the foundations of artificial intelligence. Students will explore a range of topics including search algorithms, constraint satisfaction, and optimization problems, as well as logic and reasoning. The course will introduce probabilistic reasoning, decision theory, and Markov decision processes as frameworks for decision-making under uncertainty. In addition, students will learn the fundamentals of machine learning and examine key issues in trustworthy AI, focusing on fairness, interpretability, and ethical considerations. This course emphasizes both theoretical understanding and practical applications, preparing students to analyze and design AI systems in a variety of domains.

Rules & Requirements

Requisites: Prerequisites, COMP 110, COMP 116, or STOR 120; and BIOS 635, COMP 562, STOR 565, STOR 566, or MATH 560; and STOR 435/ MATH 535, STOR 535, or STOR 634; and MATH 347; and STOR 315, COMP 283 or MATH 381.

Grading Status: Letter grade.

DATA 522. Practical Deep Learning Systems. 3 Credits.

This course focuses on the practical implementation of deep learning systems, providing students with hands-on experience in designing, building, and optimizing machine learning (ML) and deep learning applications. Students will learn the foundational concepts of machine learning systems, gaining insights into the end-to-end process of developing a machine learning application. The course will cover essential techniques and tools for implementing modern deep learning algorithms across key areas such as computer vision, natural language processing, graph analysis, reinforcement learning, and generative models.

Rules & Requirements

Requisites: Prerequisites, COMP 211, and one of COMP 562, STOR 565, BIOS 635, or STOR 566; permission of the instructor for students lacking the prerequisites.

Grading Status: Letter grade.

DATA 523. Modeling and Data Mining For Artificial Intelligence. 3 Credits.

This course explores cutting-edge machine learning methods (ML), their applications across various domains, and foundational methods in modeling and data mining for artificial intelligence (Al). Topics include transfer learning, representation learning, graph mining, fundamentals of generative models, and uncertainty estimation. The course also presents case studies, hands-on coding assignments, and a final group project allowing students to implement scalable algorithms and address realworld challenges in Al. Students will gain a solid understanding of the underlying concepts, algorithms, and applications of Al, and practical experience in developing and implementing Al systems using modern data mining methods and modeling approaches.

Rules & Requirements

Requisites: Prerequisites, COMP 560 or DATA 521, and COMP 562 or STOR 565 or BIOS 635 or STOR 566. **Grading Status:** Letter grade.

DATA 540. Introduction to Risk Management and Insurance. 3 Credits.

Introduces the motivations, objectives, and principles of financial risk management through the lens of insurance, reinsurance and financial institutions. Students will become familiar with key concepts that shape these industries so they can effectively communicate using industry vocabulary, metrics, and tools. Standards governing financial risk management are introduced as are the different types of risks that financial institutions, insurers and reinsurers analyze when conducting business. Students will make use of software and tools to characterize and price risk in various activities, carry out basic quantitative risk assessments, and learn what drives success and failure in financial risk management.

Rules & Requirements

Requisites: Pre- or corequisite, Two or more of the following classes (or permission of the instructor): MATH 231, MATH 232, STOR 151, STOR 155, BIOS 511, BIOS 512, BIOS 600, ECON 400, BIOL/ENEC 562. **Grading Status:** Letter grade.

Same as: ENEC 540, ENVR 540.

DATA 541. Natural Hazards and Financial Risk. 3 Credits.

Society's growing exposure to the financial risks associated with natural hazards (e.g., flood, drought, extreme temperatures) has made it increasingly important to both accurately quantify these risks and develop innovative strategies for managing them. This course provides exposure to the fundamentals of financial risk management with application to natural hazards an emphasis on developing coupled models that consider natural variability, engineered/managed structures and financial/economic factors. Students will learn to (i) model the financial risk posed by extreme events; (ii) understand the merits of various risk management tools; and (iii) develop effective strategies for managing natural hazard-based financial risk.

Rules & Requirements

Requisites: Pre- or corequisite, At least 2 of the following courses in mathematics or statistics (or permission of instructor): MATH 231, MATH 232, STOR 151, STOR 155, BIOS 511, BIOS 512, BIOS 600, ECON 400, BIOL/ENEC 562; some programming experience (COMP 110, COMP 116, or BIOS 511) helpful, but not required. Grading Status: Letter grade. Same as: ENEC 541, ENVR 541.

DATA 542. Insurance: Balancing Risk and Return. 1.5 Credits.

Students will develop a quantitative understanding of concepts underlying actuarial science, including discounted cash flows, net present value and the uncertainties related to liabilities/claims, inflation and interest/discount rates. Asset/premium investment strategies will also be covered, with an introduction to the properties of different asset classes, consideration of uncertainty, and methods by which assets can be assembled into portfolios that balance profitability with the risk. The course will develop students' analytical skills and awareness of the benefits and challenges of quantitative risk analysis, and they will analyze situations in which risk management failed and describe the underlying causes of failure.

Rules & Requirements

Requisites: Pre- or corequisite, At least 2 of the following courses in mathematics or statistics (or permission of instructor): MATH 231, MATH 232, STOR 151, STOR 155, BIOS 511, BIOS 512, BIOS 600, ECON 400, BIOL/ENEC 562; some programming experience (COMP 110, COMP 116, or BIOS 511) is helpful, but not required. Grading Status: Letter grade. Same as: ENEC 542, ENVR 542.

DATA 543. Risk, Data Science and Al. 3 Credits.

Students are introduced to advanced techniques in data sciences, machine learning, and artificial intelligence and their application to the management of financial risks. Students will learn to discover, process, and visualize natural hazard and financial data, and will be taught to quantify various financial risks (e.g., natural hazards) and design management strategies to mitigate negative outcomes. Students will learn basic programming methods and apply data analysis and machine learning techniques to model the complex systems that give rise to risk. Structured case studies and in-class assignments will help students build expertise to be used in longer group projects.

Rules & Requirements

Requisites: Pre- or corequisite, At least 2 of the following courses in mathematics or statistics (or permission of instructor): MATH 231, MATH 232, STOR 151, STOR 155, BIOS 511, BIOS 512, BIOS 600, ECON 400, BIOL/ENEC 562; some programming experience (COMP 110, COMP 116, or BIOS 511) is helpful, but not required. Grading Status: Letter grade. Same as: ENEC 543. ENVR 543.

DATA 590. Special Topics in Data Science. 3 Credits.

This course has variable content and may be taken multiple times for credit. Different sections may be taken in the same semester.

Rules & Requirements

Requisites: Prerequisite, DATA 110 and MATH 347.

Repeat Rules: May be repeated for credit; may be repeated in the same term for different topics; 6 total credits. 2 total completions. **Grading Status:** Letter grade.

DATA 593. Internship in Data Science. 12 Credits.

Data science B.S. majors only. A signed learning contract is required prior. An experience providing students with practical experience in an organization outside of UNC, coupled with reflective practices during the semester-long experience. The internship should develop and enhance the student's professional skill sets and involve experiences that allow students to have responsibility for results that are of value to the organization. Permission of instructor and director of undergraduate studies required.

Rules & Requirements

IDEAs in Action Gen Ed: HI-INTERN. **Grading Status:** Letter grade.

DATA 693H. Honors Thesis in Data Science. 3 Credits.

For data science majors only and by permission of the instructor. Individual student research for students pursuing an honors thesis in data science under the supervision of a departmental faculty advisor. Majors only.

Rules & Requirements

IDEAs in Action Gen Ed: RESEARCH. **Requisites:** Prerequisite, By permission of the instructor. **Grading Status:** Letter grade.

😳 DATA 694H. Honors Thesis in Data Science. 3 Credits.

For data science majors only and by permission of the instructor. Individual student research for students pursuing an honors thesis in data science under the supervision of a departmental faculty advisor. Majors only

Rules & Requirements

IDEAs in Action Gen Ed: RESEARCH. **Requisites:** Prerequisite, By permission of the instructor. **Grading Status:** Letter grade.

DATA 710. Introduction to Applied Data Science. 3 Credits.

The first part of this course introduces various stages of the data life cycle, from defining data requirements to data creation and gathering to data fusion and data preparation to data cleaning and quality control to exploratory analytics, data interpretation, and visualization. We will explore FAIR data principles of curation, metadata, and digital preservation policies. The second part will introduce the concept of relational databases that provide storage and management for structured data.

Rules & Requirements

Grading Status: Letter grade.

DATA 715. Advanced Databases for Data Science. 3 Credits.

This course will explore intermediate-level design and implementation of database systems, emphasizing scalable, distributed systems. It will deepen students' knowledge of advanced relational database management and discuss current and emerging practices for dealing with big data and large-scale database systems. Concepts include design and implementation of relational databases, exploration of distributed data structures including graph, document, and key-value storage models and scalable and resilient query processing.

Rules & Requirements

Requisites: Prerequisite, DATA 710. **Grading Status:** Letter grade.

DATA 720. Programming Methods for Data Science. 3 Credits.

This course will provide students with advanced concepts on the construction and use of data structures and their associated algorithms. Concepts covered in this course will include: abstract data types, lists, stacks, queues, trees, and graphs; sorting, searching, hashing, and an introduction to numerical error control; techniques of algorithm analysis and problem-solving paradigms using relevant programming languages and tools.

Rules & Requirements

Grading Status: Letter grade.

DATA 730. Statistical Modeling and Inference for Data Science. 3 Credits.

The course will be coding-oriented and cover concepts such as foundations in probability, including basic rules, Bayes' theorem, and basic distributions; sampling and the central limit theorem; bootstrapping, confidence intervals, hypothesis testing, and multiple testing; linear models, basic and multiple regression, inference for regression, regularization; classification, logistic regression, and tree-based methods; and prediction, model interpretation, and model evaluation.

Rules & Requirements Grading Status: Letter grade.

DATA 735. Applied Causal Inference Methods in Data Science. 3 Credits.

This course equips participants with practical tools to estimate causal effects in real-world settings. After building a solid formal foundation, students will learn to design experiments, leverage natural experiments, and analyze observational data using modern causal inference methods. Ideal for those who want to move beyond predictive analytics in order to answer causal questions in their work.

Rules & Requirements

Requisites: Prerequisites, DATA 710 and DATA 730. **Grading Status:** Letter grade.

DATA 740. Governance, Bias, and Ethics in Data Science and Artificial Intelligence. 3 Credits.

We will explore the foundational concepts of ethics in data science and AI. This overview will set the stage for a deep understanding of what ethical frameworks mean in practice, providing students the opportunity to create actionable examples. By focusing on a wide variety of case studies throughout a myriad of industries and settings, this class will develop leaders who can effectively integrate and leverage data science solutions while ensuring responsible use of data.

Rules & Requirements

Requisites: Prerequisite, DATA 710. **Grading Status:** Letter grade.

DATA 750. Mathematical Tools for Data Science. 3 Credits.

This course will present the mathematical intuition, theory, and techniques driving the numerical computation methods used for processing and analyzing data in various real-life problems. Topics include dimensionality reduction; linear and non-linear approximation; frequency and wavelet analysis; and a glimpse into the mathematics of deep neural networks, classification, large-scale and high-performance numerical computing, and visualization.

Rules & Requirements

Requisites: Prerequisite, DATA 710. **Grading Status:** Letter grade.

DATA 760. Visualization and Communication in Data Science. 3 Credits.

This course will provide students with a foundational understanding of visual perceptional and data visualization design practices, provide instruction on using visualization for tasks such as exploratory analysis and storytelling to support both data-driven discovery and communication. The class will focus hands-on experiences with commonly used data science tools and technologies.

Rules & Requirements

Requisites: Prerequisite, DATA 710. **Grading Status:** Letter grade.

DATA 766. Leading Research Teams. 3 Credits.

Graduate students will lead groups of four to five undergraduate students to complete a project for an external client. Clients from an array of industries, as well as those from within UNC, will submit project requests that are feasible within a 12-week semester. The course will offer graduate students an authentic learning experience to develop management skills and professional attributes, such as teamwork, communication, and project management, in preparation for workforce entry.

Rules & Requirements

Requisites: Prerequisites, STOR 664, STOR 665 and STOR 765, or Instructor's Permission. Grading Status: Letter grade. Same as: STOR 766.

DATA 780. Machine Learning. 3 Credits.

This course will be an introductory course to machine learning (ML). The course will cover core principles of artificial intelligence for statistical inference and pattern analysis. Topics will include probability distributions; graphical models; optimization, maximum likelihood estimation, and regression; classification; cross validation; generalization and overfitting; neural networks; nonparametric estimators; clustering; autoencoders; generative models; and kernel methods. Applications in tabular, image, and textual data for supervised and unsupervised learning tasks also will be covered.

Rules & Requirements

Requisites: Prerequisites, DATA 710 and DATA 720 and DATA 730. **Grading Status:** Letter grade.

DATA 785. Deep Learning. 3 Credits.

Deep learning fundamentals and applications with emphasis on their broad applicability to problems across a range of disciplines. Topics include regularization, optimization, convolutional networks, sequence modeling, generative learning, instance-based learning, and deep reinforcement learning. Students will complete several substantive programming assignments in PyTorch and Keras.

Rules & Requirements

Requisites: Prerequisites, DATA 720, DATA 730, and DATA 780. **Grading Status:** Letter grade.

DATA 890. Special Topics in Data Science. 3 Credits.

The course goal is to expose graduate students in any UNC department to a broad range of topics in the theory and applications of data science. Students will learn about current and emerging methods and techniques in data science to advance individual research efforts and facilitate inter-disciplinary collaboration. Open to graduate students only and by permission only.

Rules & Requirements

Repeat Rules: May be repeated for credit; may be repeated in the same term for different topics; 9 total credits. 3 total completions. **Grading Status:** Letter grade.

DATA 992. Master's (Non-Thesis). 3 Credits.

Team based project in final term of program.

Rules & Requirements

Requisites: Prerequisites, DATA 710, DATA 715, DATA 720, DATA 730, DATA 750, and DATA 780. **Repeat Rules:** May be repeated for credit. DATA 993. Master's Research and Thesis. 3 Credits. Rules & Requirements Repeat Rules: May be repeated for credit.

DATA 994. Doctoral Research and Dissertation. 3 Credits.