INSTITUTE FOR DATA, SYSTEMS, AND SOCIETY

The mission of the Institute for Data, Systems, and Society (IDSS) is to advance education and research in state-of-the-art, analytical methods in information and decision systems; statistics and data science; and the social sciences, and to apply these methods to address complex societal challenges in a diverse set of areas such as energy systems, finance, healthcare, social networks, and urban science. Its mission also includes the creation of an MIT-wide focal point for advancing research and educational programs related to statistics and data science.

Technology advances in areas such as smart sensors, big data, communications, computing, and social networking are rapidly scaling the size and complexity of interconnected systems and networks and, at the same time, are generating massive data that can lead to new insights and understanding. Research at IDSS will aim to understand and analyze data from across these systems, which present unique and substantial challenges due to scale, complexity, and the difficulties of extracting clear, actionable insights.

Our ability to understand data and develop models across complex, interconnected systems is at the core of our ability to uncover new insights and solutions.

Spanning all five schools at MIT, IDSS embraces the collision and synthesis of ideas and methods from analytical disciplines including statistics, data science, information theory and inference, systems and control theory, optimization, economics, human and social behavior, and network science. These disciplines are relevant both for understanding complex systems and for presenting design principles and architectures that allow for the systems’ quantification and management. IDSS seeks to integrate these areas, fostering new collaborations, introducing new paradigms and abstractions, and utilizing the power of data to address societal challenges.

Undergraduate Study

Minor in Statistics and Data Science
The Minor in Statistics and Data Science (http://catalog.mit.edu/interdisciplinary/undergraduate-programs/minors/statistics-data-science) provides students with a working knowledge base in statistics, probability, and computation, along with an ability to perform data analysis. For a description of the minor, see Interdisciplinary Programs (http://catalog.mit.edu/interdisciplinary/undergraduate-programs).

Graduate Study
IDSS provides educational programs anchored in the following intellectual pillars: statistics, information and decision sciences, and human and institutional behavior.

IDSS’s academic programs embrace the collision and synthesis of ideas and methods from analytical disciplines, including statistics, stochastic modeling, information theory and inference, systems and control theory, optimization, economics, human and social behavior, and network science. Each of these fields in isolation is an insufficient basis for a deep understanding of complex interactions and systems. However, the intersections of these disciplines provide new tools and perspectives for understanding complex systems, addressing overarching challenges (including sustainability and systemic risk), and presenting design principles and architectures that enable those systems’ quantification, management, and regulation.

Inquiries about IDSS academic programs may be directed to the Academic Office (idss_academic_office@mit.edu).

Admission Requirements for Graduate Study
Application forms for all programs (http://web.mit.edu/admissions/graduate) are available online. Applicants whose first language is not English must offer evidence of written and oral proficiency in English by registering for the International English Language Testing System (IELTS) exam (http://www.ielts.org), academic format, and achieving a score of 7.5 or better. Information about the Graduate Record Examinations (GRE) (https://idss.mit.edu/academics) can be obtained through the IDSS website. Applicants should refer to the details of each program concerning specific requirements for admission.

Master of Science in Technology and Policy
The Technology and Policy Program (TPP) (http://tpp.mit.edu) educates students seeking leadership roles in the constructive development and use of technology—an area that is not well served by the traditional education of technical or social science specialists. TPP focuses on meeting the need for leaders who are engineers and scientists—people with not only strong technical foundations but also the skills and abilities to deal cogently and effectively with the economic, political, and administrative dimensions of the technological challenges of the 21st century.

The Master of Science in Technology and Policy is an engineering research degree with a focus on the increasingly central role of technology in the framing, formulation, and resolution of policy problems. Many students combine TPP’s curriculum with complementary subjects to obtain dual degrees in TPP and either a specialized branch of engineering or an applied social science, such as political science or urban studies and planning.
TPP’s coursework provides a solid grounding in technology and policy by combining advanced subjects in the student’s chosen technical field with courses in economics, politics, modern quantitative methods, and social science. All students must complete a satisfactory research thesis that has a substantial technology and policy component. In order to prepare students for effective professional practice, TPP stresses leadership and communication. It also encourages students to participate in TPP’s summer internship program, which places students in government and industry in the US and around the world.

The TPP curriculum consists of three blocks of subjects and a research thesis. The first block is a required integrative subject in technology and policy and a subject in applied quantitative methods. The second block focuses on training in formal frameworks for policy development and consists of subjects in microeconomics, political economy, and one core restricted elective that treats problems of technology and policy from a domain that is outside of the students’ area of research concentration and deepens the students’ understanding of framings and rationales for governance in this area. The third block comprises a minimum of three coherent electives that fulfill professional and research objectives. The research thesis is the culmination of scholarship integrating technology and policy.

Completion of the academic and research requirements of the TPP SM typically takes four terms.

The TPP curriculum normally begins in September; applications are due by December 15. TPP seeks applicants with relevant work or research experience as well as the ability to demonstrate evidence of leadership and initiative in their professional or other activities. All applicants should have a strong basis in engineering or science. For the 2023 admissions cycle, the GRE General Test will not be accepted.

Contact the TPP program office (tpp@mit.edu), Room E17-373, 617-258-7295, for additional information.

**Doctor of Philosophy in Social and Engineering Systems**

The Doctor of Philosophy in Social and Engineering Systems (SES) ([http://idss.mit.edu/academics/SES_doc](http://idss.mit.edu/academics/SES_doc)) is focused on addressing concrete and societally significant problems by combining methods from engineering and the social sciences. A student’s doctoral program includes coursework that prepares them for advanced, rigorous, and original research leading to a doctoral thesis. Both coursework and research must include breadth and depth in engineering and quantitative methods, as well as in the social sciences, and in a particular application domain.

Student research in SES is characterized by the following traits:

- It is driven by problems of societal interest, in areas such as energy, finance, health care, social networks, urban science, as well as in policy-related topics.
- It involves quantitative methods. The program is focused on problems that can be addressed through mathematical modeling and data analysis.
- It relies on real-world data. Research is expected to analyze data from the application domain of interest, and draw upon the training provided in statistics, etc., through the program’s coursework.
- It engages societal aspects of the problem. The research incorporates theories and tools from the social sciences.

The program’s subject requirements follow. Waivers for some of the requirements are possible in special circumstances.

### Core

Select 12 units from each of three areas below:

**Probability**


**Statistics**

- 18.6501 Fundamentals of Statistics
- 18.655 Mathematical Statistics
- IDS.131[J] Statistics, Computation and Applications

**Social Science**

- 17.850 Political Science Scope and Methods
- 21A.809 Designing Empirical Research in the Social Sciences
- 21A.819 Ethnographic Research Methods

**Microeconomics / Causal Inference**

- 14.121 Microeconomic Theory I
- 14.122 Microeconomic Theory II
- 14.320 Econometric Data Science
- 14.386 New Econometric Methods
- 14.388 Inference on Causal and Structural Parameters Using ML and AI
- 17.802 Quantitative Research Methods II: Causal Inference

**Information Systems and Decision Science**

Five subjects in the areas of probabilistic modeling, statistics, optimization, or systems/control theory, including:

- One subject from the list of Statistical Processing of Data Subjects below
- One subject of substantial mathematical content
- Two subjects belonging to a sequence that provides increasing depth on a particular topic

**Social Science**
Four subjects that create a coherent and rigorous program of study in the social sciences, providing necessary background for research, including:

Three subjects comprising a coherent collection that builds depth in a particular social science focus area.

**Problem Domain**

Two subjects in the application domain of the student’s research.

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**Statistical Processing of Data Subjects**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.7810</td>
<td>Algorithms for Inference</td>
<td>12</td>
</tr>
<tr>
<td>6.7900</td>
<td>Machine Learning</td>
<td>12</td>
</tr>
<tr>
<td>14.382</td>
<td>Econometrics</td>
<td>12</td>
</tr>
<tr>
<td>15.077[J]</td>
<td>Statistical Machine Learning and Data Science</td>
<td>12</td>
</tr>
<tr>
<td>16.391[J]</td>
<td>Statistics for Engineers and Scientists</td>
<td>12</td>
</tr>
<tr>
<td>17.802</td>
<td>Quantitative Research Methods II: Causal Inference</td>
<td>12</td>
</tr>
<tr>
<td>17.804</td>
<td>Quantitative Research Methods III: Generalized Linear Models and Extensions</td>
<td>12</td>
</tr>
<tr>
<td>17.806</td>
<td>Quantitative Research Methods IV: Advanced Topics</td>
<td>12</td>
</tr>
</tbody>
</table>

The program begins in September and applications are due by December 15 of the preceding year.

Further information about SES is available on the program website (http://idss.mit.edu/academics/ses_doc) or by contacting the IDSS Academic Office (idss_academic_office@mit.edu), Room E17-375, or 617-253-1182.

**Research Centers**

Research in IDSS addresses overarching challenges, including the modeling and prediction of system behavior and performance; systems design and architecture; and issues including social welfare, monetization, and regulation, as well as sustainability and resilience, cascades and contagion phenomena, and systemic risk.

IDSS will sustain this research agenda by fostering and prioritizing several types of strong connections, including:

- A community of experts, at MIT and elsewhere, with demonstrated success performing impactful, multidisciplinary research in these domains.
- A close connection between research and domain expertise, to enable a contextually-informed understanding of the challenges and opportunities in complex systems.
- Educational and research methodologies, not considered in isolation, but instead anchored in one or several of the cross-disciplinary fields of statistics, information and decision sciences, the science of interconnections, as well as the study of social and institutional behavior.

**Laboratory for Information and Decision Systems**

The Laboratory for Information and Decision Systems (LIDS) (http:// lids.mit.edu) is an interdepartmental laboratory devoted to research and education in systems, networks, control, and data science, staffed by faculty, research scientists, and graduate students from many departments and centers across MIT. The mission of LIDS is to develop and apply rigorous approaches and tools for system modeling, analysis, design, and optimization. It encompasses the development of novel analytical methodologies, as well as the adaptation and application of advanced methods to specific contexts and application domains. LIDS research addresses physical and man-made systems, their dynamics, and the associated information processing. Some of the lab’s core research areas are: statistical inference and machine learning; optimization; systems theory, control, and autonomy; and networks.

Further information about LIDS (http://catalog.mit.edu/mit/research/laboratory-information-decision-systems) can be found in the Research and Study (http://catalog.mit.edu/mit/research) section.

**Sociotechnical Systems Research Center**

The Sociotechnical Systems Research Center (SSRC) (http:// ssrc.mit.edu) is an interdisciplinary research center that focuses on the study of high-impact, complex, sociotechnical systems that shape our world.

SSRC brings together faculty, researchers, students, and staff from across MIT to study and seek solutions to complex societal challenges that span healthcare, energy, infrastructure networks, the environment, and international development.

For further information on SSRC and its programs (http:// catalog.mit.edu/mit/research/sociotechnical-systems-research-center), see the Research and Study (http://catalog.mit.edu/mit/ research) section.
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Professors Emeriti
Daniel Roos, PhD
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Professor Emeritus of Civil and Environmental Engineering
IDS.012[J] Statistics, Computation and Applications
Same subject as 6.3730[J]
Subject meets with 6.3732[J], IDS.131[J]
Prereq: ((2.087, 6.100B, 6.9080, 18.03, or 18.06) and (6.3700, 6.3800, 14.30, 16.09, or 18.05)) or permission of instructor
U (Spring)
3-1-8 units

Hands-on analysis of data demonstrates the interplay between statistics and computation. Includes four modules, each centered on a specific data set, and introduced by a domain expert. Provides instruction in specific, relevant analysis methods and corresponding algorithmic aspects. Potential modules may include medical data, gene regulation, social networks, finance data (time series), traffic, transportation, weather forecasting, policy, or industrial web applications. Projects address a large-scale data analysis question. Students taking graduate version complete additional assignments. Enrollment limited; priority to Statistics and Data Science minors, and to juniors and seniors.
C. Uhler, S. Jegelka

IDS.013[J] Statistical Thinking and Data Analysis
Same subject as 15.075[J]
Prereq: 6.041B or 15.0791
U (Spring)
3-1-8 units. Institute LAB
Credit cannot also be received for 18.650[J], 18.6501, IDS.014[J]

See description under subject 15.075[J].
R. Mazumder

IDS.014[J] Fundamentals of Statistics
Same subject as 18.650[J]
Subject meets with 18.6501
Prereq: 6.3700 or 18.600
U (Fall, Spring)
4-0-8 units
Credit cannot also be received for 15.075[J], IDS.013[J]

See description under subject 18.650[J].
Fall: P. Rigollet. Spring: P. Ghosal

IDS.045[J] System Safety
Same subject as 16.63[J]
Prereq: None
U (Fall)
Not offered regularly; consult department
3-0-9 units. REST

See description under subject 16.63[J].
N. Leveson

IDS.050[J] Cybersecurity (New)
Same subject as 17.447[J]
Subject meets with 17.448[J], IDS.350[J]
Prereq: None
U (Spring)
3-0-9 units. HASS-S

See description under subject 17.447[J].
N. Choucri, S. Pentland

IDS.055[J] Science, Technology, and Public Policy
Same subject as 17.309[J], STS.082[J]
Prereq: None
U (Spring)
4-0-8 units. HASS-S; CI-H
Credit cannot also be received for 17.310[J], IDS.412[J], STS.482[J]

See description under subject 17.309[J].
K. Oye, N. Selin

IDS.057[J] Data and Society
Same subject as 11.155[J], STS.005[J]
Prereq: None
Acad Year 2022-2023: U (Spring)
Acad Year 2023-2024: Not offered
3-0-9 units. HASS-H

See description under subject STS.005[J].
E. Medina, S. Williams
IDS.060[J] Environmental Law, Policy, and Economics: Pollution Prevention and Control
Same subject as 1.801[J], 11.021[J], 17.393[J]
Subject meets with 1.814[J], 11.630[J], 15.663[J], IDS.540[J]
Prereq: None
U (Spring)
3-0-9 units. HASS-S
Analyzes federal and state regulation of air and water pollution, hazardous waste, greenhouse gas emissions, and production/use of toxic chemicals. Analyzes pollution/climate change as economic problems and failure of markets. Explores the role of science and economics in legal decisions. Emphasizes use of legal mechanisms and alternative approaches (i.e., economic incentives, voluntary approaches) to control pollution and encourage chemical accident and pollution prevention. Focuses on major federal legislation, underlying administrative system, and common law in analyzing environmental policy, economic consequences, and role of the courts. Discusses classical pollutants and toxic industrial chemicals, greenhouse gas emissions, community right-to-know, and environmental justice. Develops basic legal skills: how to read/understand cases, regulations, and statutes. Students taking graduate version explore the subject in greater depth.
N. Ashford, C. Caldart

IDS.061[J] Regulation of Chemicals, Radiation, and Biotechnology
Same subject as 1.802[J], 11.022[J]
Subject meets with 1.812[J], 10.805[J], 11.631[J], IDS.436[J], IDS.541[J]
Prereq: IDS.060[J] or permission of instructor
U (Spring)
Not offered regularly; consult department
3-0-9 units
Focuses on policy design and evaluation in the regulation of hazardous substances and processes. Includes risk assessment, industrial chemicals, pesticides, food contaminants, pharmaceuticals, radiation and radioactive wastes, product safety, workplace hazards, indoor air pollution, biotechnology, victims’ compensation, and administrative law. Health and economic consequences of regulation, as well as its potential to spur technological change, are discussed for each regulatory regime. Students taking the graduate version are expected to explore the subject in greater depth.
N. Ashford, C. Caldart

IDS.062[J] Global Environmental Negotiations
Same subject as 12.346[J]
Subject meets with 12.846[J], IDS.525[J]
Prereq: Permission of instructor
U (Fall)
Not offered regularly; consult department
2-0-4 units
Practical introduction to global environmental negotiations designed for science and engineering students. Covers basic issues in international negotiations, such as North-South conflict, implementation and compliance, trade, and historical perspective on global environmental treaties. Offers hands-on practice in developing and interpreting international agreements through role-play simulations and observation of ongoing climate change negotiating processes. Students taking graduate version complete additional assignments.
N. E. Selin

IDS.063[J] People and the Planet: Environmental Governance and Science
Same subject as 12.387[J], 15.874[J]
Prereq: None
U (Fall)
3-0-6 units
See description under subject 12.387[J].
N. Selin, S. Solomon, J. Sterman

IDS.064 Engineering, Economics and Regulation of the Electric Power Sector
Prereq: None
U (Spring)
3-0-9 units
Credit cannot also be received for 6.695[J], 15.032[J], IDS.505[J]
Presents an in-depth interdisciplinary look at the electric power sector, with regulation providing the link among engineering, economic, legal and environmental viewpoints. Topics include electricity markets, incentive regulation of networks, service reliability, renewable energy sources, network issues, retail competition, tariff design, distributed generation, rural electrification, multinational electricity markets, environmental impacts, and the future of utilities and strategic sustainability issues under traditional and competitive regulatory frameworks. Covers engineering, economic and legal basis to evaluate worldwide regulatory instruments. Regulatory approaches apply in other industrial sectors such as fuel gases, telecoms, transportation, water supply. Provides the basis for research or professional activities in energy sectors in industry, government, and consulting.
IDS.065[J] Energy Systems for Climate Change Mitigation
Same subject as 1.067[J], 10.421[J]
Subject meets with 1.670[J], 10.621[J], IDS.521[J]
Prereq: (Calculus I (GIR), Chemistry (GIR), and Physics I (GIR)) or permission of instructor
U (Fall)
3-0-9 units
Reviews the contributions of energy systems to global greenhouse gas emissions, and the levers for reducing those emissions. Lectures and projects focus on evaluating energy systems against climate policy goals, using performance metrics such as cost, carbon intensity, and others. Student projects explore pathways for realizing emissions reduction scenarios. Projects address the climate change mitigation potential of energy technologies (hardware and software), technological and behavioral change trajectories, and technology and policy portfolios. Background in energy systems strongly recommended. Students taking the graduate version complete additional assignments and explore the subject in greater depth. Preference to students in the Energy Studies or Environment and Sustainability minors.
J. Trancik

IDS.066[J] Law, Technology, and Public Policy (New)
Same subject as 11.122[J]
Subject meets with 11.422[J], 15.655[J], IDS.435[J]
Prereq: None
U (Fall)
3-0-9 units. HASS-S
Examines how law, economics, and technological change shape public policy, and how law can sway technological change; how the legal system responds to environmental, safety, energy, social, and ethical problems; how law and markets interact to influence technological development; and how law can affect wealth distribution, employment, and social justice. Covers energy/climate change; genetic engineering; telecommunications and role of misinformation; industrial automation; effect of regulation on technological innovation; impacts of intellectual property law on innovation and equity; pharmaceuticals; nanotechnology; cost/benefit analysis as a decision tool; public participation in governmental decisions affecting science and technology; corporate influence on technology and welfare; and law and economics as competing paradigms to encourage sustainability. Students taking graduate version explore subject in greater depth.
N. Ashford, C. Caldart

IDS.131[J] Statistics, Computation and Applications
Same subject as 6.3732[J]
Subject meets with 6.3730[J], IDS.012[J]
Prereq: (6.100B or 6.9080), (2.087, 18.03, 18.06, or 18.C06), and (6.3700, 6.3800, 14.30, 16.09, or 18.05) or permission of instructor
G (Spring)
3-1-8 units
Hands-on analysis of data demonstrates the interplay between statistics and computation. Includes four modules, each centered on a specific data set, and introduced by a domain expert. Provides instruction in specific, relevant analysis methods and corresponding algorithmic aspects. Potential modules may include medical data, gene regulation, social networks, finance data (time series), traffic, transportation, weather forecasting, policy, or industrial web applications. Projects address a large-scale data analysis question. Students taking graduate version complete additional assignments. Limited enrollment; priority to Statistics and Data Science minors and to juniors and seniors.
C. Uhler, S. Jegelka

Same subject as 6.7820[J]
Prereq: 6.3702 and 18.06
Acad Year 2022-2023: Not offered
Acad Year 2023-2024: G (Fall)
3-0-9 units
Provides instruction in the geometric, algebraic and combinatorial perspective on graphical models. Presents methods for learning the underlying graph and inferring its parameters. Topics include exponential families, duality theory, conic duality, polyhedral geometry, undirected graphical models, Bayesian networks, Markov properties, total positivity of distributions, hidden variables, and tensor decompositions.
C. Uhler

IDS.145[J] Data Mining: Finding the Models and Predictions that Create Value
Same subject as 15.062[J]
Subject meets with 15.0621
Prereq: 15.060, 15.075[J], or permission of instructor
G (Fall; second half of term)
2-0-4 units
See description under subject 15.062[J].
R. E. Welsch
IDS.147[J] Statistical Machine Learning and Data Science
Same subject as 15.077[J]
Prereq: Permission of instructor
G (Spring)
4-0-8 units
See description under subject 15.077[J].
R. E. Welsch

Same subject as 9.521[J], 18.656[J]
Prereq: (6.7700[J], 18.06, and 18.6501) or permission of instructor
G (Spring)
3-0-9 units
See description under subject 9.521[J].
S. Rakhlin, P. Rigollet

IDS.190 Doctoral Seminar in Statistics and Data Science
Prereq: None
G (Fall)
1-0-2 units
Interdisciplinary seminar explores diverse topics in statistics and data science. Restricted to students in the Interdisciplinary Doctoral Program in Statistics.
Consult D. Shah

IDS.200[J] Optimization Methods
Same subject as 6.7200[J], 15.093[J]
Subject meets with 6.7201
Prereq: 18.06
G (Fall)
4-0-8 units
See description under subject 15.093[J].
D. Bertsimas, P. Parrilo

Same subject as 1.271[J], 15.764[J]
Prereq: (6.7210[J] and 6.7700[J]) or permission of instructor
G (Spring)
3-0-9 units
Can be repeated for credit.
See description under subject 15.764[J].
D. Simchi-Levi, N. Trichakis, K. Zheng

IDS.305[J] Business and Operations Analytics
Same subject as 1.275[J]
Prereq: Permission of instructor
G (Spring; first half of term)
2-0-4 units
Provides instruction on identifying, evaluating, and capturing business analytics opportunities that create value. Also provides basic instruction in analytics methods and case study analysis of organizations that successfully deployed these techniques.
D. Simchi-Levi

IDS.330[J] Real Options for Product and Systems Design
Same subject as EM.424[J]
Prereq: IDS.333[J] or permission of instructor
G (Fall; second half of term)
3-0-3 units
Focuses on implementation of flexibility (real options) in the design of products, start-ups, ongoing management of operations, or policy plans. Applies the methods presented in IDS.333[J]: recognition of uncertainty, identification of best opportunities for flexibility, and valuation of these options and their effective implementation. Students work on their own project concept, for which they develop a dynamic business plan for design, deployment, and most beneficial implementation of their system over time. Useful complement to thesis or research projects. Class is "flipped" to maximize student engagement and learning.
R. de Neufville

IDS.332 Engineering Systems Analysis for Design
Engineering School-Wide Elective Subject.
Offered under: 1.146, 16.861, EM.422, IDS.332
Prereq: Permission of instructor
G (Fall)
3-0-9 units
Credit cannot also be received for EM.423[J], IDS.333[J]
Practical-oriented subject that builds upon theory and methods and culminates in extended application. Covers methods to identify, value, and implement flexibility in design (real options). Topics include definition of uncertainties, simulation of performance for scenarios, screening models to identify desirable flexibility, decision analysis, and multidimensional economic evaluation. Students demonstrate proficiency through an extended application to a system design of their choice. Complements research or thesis projects. Class is "flipped" to maximize student engagement and learning. Meets with IDS.333[J] in the first half of term. Enrollment limited.
R. de Neufville
IDS.333[J] Risk and Decision Analysis
Same subject as EM.423[J]
Prereq: None
G (Fall; first half of term)
3-0-3 units
Credit cannot also be received for 1.146, 16.861, EM.422, IDS.332
Focuses on design choices and decisions under uncertainty.
Topics include identification and description of uncertainties using probability distributions; the calculation of commensurate measures of value, such as expected net present values; Monte Carlo simulation and risk analysis; and the use of decision analysis to explore alternative strategies and identify optimal initial choices.
Presents applied analysis of practical examples from a variety of engineering systems using spreadsheet and decision analysis software. Class is “flipped” to maximize student engagement and learning. Meets with IDS.332 first half of term.
R. de Neufville

IDS.336[J] Systems Architecting Applied to Enterprises
Same subject as 16.855[J]
Prereq: Permission of instructor
G (Spring)
3-0-9 units
Focuses on principles and practices for architecting new and evolving sociotechnical enterprises. Includes reading and discussions of enterprise theory, contemporary challenges, and case studies of evolving enterprises. Covers frameworks and methods for ecosystem analysis, stakeholder analysis, architecture design and evaluation, and implementation strategies. Students work in small teams on projects to design a future architecture for a selected real-world enterprise.
D. Rhodes

IDS.337[J] Aerospace Biomedical and Life Support Engineering
Same subject as 16.423[J], HST.515[J]
Prereq: 16.06, 16.400, or permission of instructor
Acad Year 2022-2023: Not offered
Acad Year 2023-2024: G (Fall)
3-0-9 units
See description under subject 16.423[J].
D. J. Newman

IDS.338[J] Multidisciplinary Design Optimization
Same subject as 16.888[J], EM.428[J]
Prereq: 18.085 or permission of instructor
Acad Year 2022-2023: G (Spring)
Acad Year 2023-2024: Not offered
3-1-8 units
See description under subject 16.888[J].
O. de Weck

IDS.339[J] Space Systems Engineering
Same subject as 16.89[J]
Prereq: 16.842, 16.851, or permission of instructor
G (Spring)
4-2-6 units
See description under subject 16.89[J].
E. F. Crawley

IDS.340[J] System Safety Concepts
Same subject as 16.863[J]
Prereq: Permission of instructor
G (Fall)
3-0-9 units
See description under subject 16.863[J]. Enrollment may be limited.
N. G. Leveson

IDS.341[J] Concepts in the Engineering of Software
Same subject as 16.355[J]
Prereq: Permission of instructor
G (Spring)
3-0-9 units
See description under subject 16.355[J]. Enrollment may be limited.
N. G. Leveson

IDS.345[J] Digital Evolution: Managing Web 3.0
Same subject as 15.565[J]
Prereq: Permission of instructor
G (Fall)
Not offered regularly; consult department
3-0-6 units
See description under subject 15.565[J].
S. Madnick
IDS.350[J] Cybersecurity (New)
Same subject as 17.448[J]
Subject meets with 17.447[J], IDS.050[J]
Prereq: Permission of instructor
G (Spring)
3-0-9 units
See description under subject 17.448[J].
N. Choucri, S. Pentland

IDS.410 Modeling and Assessment for Policy
Prereq: None
G (Fall)
Not offered regularly; consult department
3-0-6 units
Explores how scientific information and quantitative models can be used to inform policy decision-making. Develops an understanding of quantitative modeling techniques and their role in the policy process through case studies and interactive activities. Addresses issues such as analysis of scientific assessment processes, uses of integrated assessment models, public perception of quantitative information, methods for dealing with uncertainties, and design choices in building policy-relevant models. Examples focus on models and information used in Earth system governance.
N. E. Selin

IDS.411 Concepts and Research in Technology and Policy
Prereq: Permission of instructor
G (Fall)
3-0-6 units
Core integrative subject, with substantive participation from a series of guest faculty lecturers, examines key technology-policy concepts. Explores alternative framings of roles of technology in policy, emphasizing the implications of these alternatives upon problem-solving in the area. Exercises prepare students to apply these concepts in the framing of their thesis research. Preference to first-year students in the Technology and Policy Program.
F. Field

IDS.412[J] Science, Technology, and Public Policy
Same subject as 17.310[J], STS.482[J]
Prereq: Permission of instructor
G (Spring)
4-0-8 units
Credit cannot also be received for 17.309[J], IDS.055[J], STS.082[J]
See description under subject 17.310[J].
K. Oye, N. Selin

IDS.435[J] Law, Technology, and Public Policy
Same subject as 11.422[J], 15.655[J]
Subject meets with 11.122[J], IDS.066[J]
Prereq: None
G (Fall)
3-0-9 units
Examines how law, economics, and technological change shape public policy, and how law can sway technological change; how the legal system responds to environmental, safety, energy, social, and ethical problems; how law and markets interact to influence technological development; and how law can affect wealth distribution, employment, and social justice. Covers energy/climate change; genetic engineering; telecommunications and the role of misinformation; industrial automation; effect of regulation on technological innovation; impacts of intellectual property law on innovation and equity; pharmaceuticals; nanotechnology; cost/benefit analysis as a decision tool; public participation in governmental decisions affecting science and technology; corporate influence on technology and welfare; and law and economics as competing paradigms to encourage sustainability. Students taking graduate version explore subject in greater depth.
N. Ashford, C. Caldart

Same subject as 10.805[J]
Subject meets with 1.802[J], 1.812[J], 11.022[J], 11.631[J], IDS.061[J], IDS.541[J]
Prereq: Permission of instructor
G (Spring)
Not offered regularly; consult department
3-0-6 units
Addresses relationship between technology-related problems and the law applicable to work environment. National Labor Relations Act, Occupational Safety and Health Act. Toxic Substances Control Act, state worker’s compensation, and suits by workers in the courts discussed. Problems related to occupational health and safety, collective bargaining as a mechanism for altering technology in the workplace, job alienation, productivity, and the organization of work addressed. Prior courses or experience in the environmental, public health, or law-related areas.
N. A. Ashford, C. C. Caldart
IDS.437[J] Technology, Globalization, and Sustainable Development
Same subject as 1.813[J], 11.466[J], 15.657[J]
Prereq: Permission of instructor
G (Fall)
3-0-9 units
Investigates sustainable development, taking a broad view to include not only a healthy economic base, but also a sound environment, stable employment, adequate purchasing power and earning capacity, distributional equity, national self-reliance, and maintenance of cultural integrity. Explores national, multinational, and international political and legal mechanisms to further sustainable development through transformation of the industrial state. Addresses the importance of technological innovation and the financial crisis of 2008 and the emergence of the Covid-19 pandemic, as well as governmental interventions to reduce inequality.
N. Ashford

IDS.449 Technology Policy Internship and Professional Perspectives Seminar
Prereq: IDS.411 or permission of instructor
G (Fall, Spring)
1-1-1 units
Can be repeated for credit.
Seminar examines what technology policy is in practice. Considers the question of “Who achieves what, when, how, and why?” regarding technology and policy. Students who completed summer internships present and dissect their experiences with special reference to specific cases in which they participated. Develops perspectives on practice in the field through sessions with alumni, other practitioners, and development professionals within MIT.
Staff

IDS.505[J] Engineering, Economics and Regulation of the Electric Power Sector
Same subject as 6.695[J], 15.032[J]
Prereq: None
G (Spring)
3-0-9 units
Credit cannot also be received for IDS.064
Presents an in-depth interdisciplinary look at the electric power sector, with regulation providing the link among engineering, economic, legal and environmental viewpoints. Topics include electricity markets, incentive regulation of networks, service reliability, renewable energy sources, network issues, retail competition, tariff design, distributed generation, rural electrification, multinational electricity markets, environmental impacts, and the future of utilities and strategic sustainability issues under traditional and competitive regulatory frameworks. Covers engineering, economic and legal basis to evaluate worldwide regulatory instruments. Regulatory approaches apply in other industrial sectors such as fuel gases, telecoms, transportation, water supply. Provides the basis for research or professional activities in energy sectors in industry, government, and consulting.

IDS.521[J] Energy Systems for Climate Change Mitigation
Same subject as 1.670[J], 10.621[J]
Subject meets with 1.067[J], 10.421[J], IDS.065[J]
Prereq: Permission of instructor
G (Fall)
3-0-9 units
Reviews the contributions of energy systems to global greenhouse gas emissions, and the levers for reducing those emissions. Lectures and projects focus on evaluating energy systems against climate policy goals, using performance metrics such as cost, carbon intensity, and others. Student projects explore pathways for realizing emissions reduction scenarios. Projects address the climate change mitigation potential of energy technologies (hardware and software), technological and behavioral change trajectories, and technology and policy portfolios. Background in energy systems strongly recommended. Students taking the graduate version complete additional assignments and explore the subject in greater depth.
J. Trancik
**IDS.522 Mapping and Evaluating New Energy Technologies**

Prereq: Permission of instructor  
Acad Year 2022-2023: Not offered  
Acad Year 2023-2024: G (Fall)  
3-0-9 units

Project-based seminar covers recent developments in energy conversion and storage technologies. Merits of alternative technologies are debated based on their environmental performance and cost, and their potential improvement and scalability. Project teams develop quantitative models and interactive visualization tools to inform the future development of these technologies. Models may probe how the impact of a technology depends on assumptions about future advancements in materials or device design. Other projects may develop models for rational design choices (the selection of a particular material or processing technique) based on economic and environmental performance and physical constraints.

*J. Trancik*

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**IDS.524[J] People and the Planet: Environmental Histories and Engineering**

Same subject as 11.204[J]  
Subject meets with 11.004[J], STS.033[J]  
Prereq: None  
G (Spring)  
Not offered regularly; consult department  
3-3-6 units

See description under subject 11.204[J].  
*A. Slocum, R. Scheffler, J. Trancik*

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**IDS.525[J] Global Environmental Negotiations**

Same subject as 12.846[J]  
Subject meets with 12.346[J], IDS.062[J]  
Prereq: None  
G (Fall)  
Not offered regularly; consult department  
2-0-4 units

Practical introduction to global environmental negotiations designed for science and engineering students. Covers basic issues in international negotiations, such as North-South conflict, implementation and compliance, trade, and historical perspective on global environmental treaties. Offers hands-on practice in developing and interpreting international agreements through role-play simulations and observation of ongoing climate change negotiating processes. Students taking graduate version complete additional assignments.

*N. Selin*

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**IDS.526[J] Sustainability Science and Engineering**

Same subject as 12.845[J]  
Prereq: None  
G (Fall)  
Not offered regularly; consult department  
3-0-6 units

Introduces and develops core ideas and concepts in the field of sustainability science and engineering from an engineering systems perspective. Takes an interdisciplinary approach to discuss case studies of sustainability systems research. Exposes students to techniques for sustainability research across engineering, natural and social science disciplines. Term projects focus on applying techniques.

*N. E. Selin*

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**IDS.540[J] Environmental Law, Policy, and Economics: Pollution Prevention and Control**

Same subject as 1.811[J], 11.630[J], 15.663[J]  
Subject meets with 1.801[J], 11.021[J], 17.393[J], IDS.060[J]  
Prereq: None  
G (Spring)  
3-0-9 units

Analyzes federal and state regulation of air and water pollution, hazardous waste, greenhouse gas emissions, and production/use of toxic chemicals. Analyzes pollution/climate change as economic problems and failure of markets. Explores the role of science and economics in legal decisions. Emphasizes use of legal mechanisms and alternative approaches (i.e., economic incentives, voluntary approaches) to control pollution and encourage chemical accident and pollution prevention. Focuses on major federal legislation, underlying administrative system, and common law in analyzing environmental policy, economic consequences, and role of the courts. Discusses classical pollutants and toxic industrial chemicals, greenhouse gas emissions, community right-to-know, and environmental justice. Develops basic legal skills: how to read/understand cases, regulations, and statutes. Students taking graduate version explore the subject in greater depth.

*N. Ashford, C. Caltart*
**IDS.541[J] Regulation of Chemicals, Radiation, and Biotechnology**  
Same subject as 1.812[J], 11.631[J]  
Subject meets with 1.802[J], 10.805[J], 11.022[J], IDS.061[J], IDS.436[J]  
Prereq: IDS.540[J] or permission of instructor  
G (Spring)  
Not offered regularly; consult department  
3-0-9 units  
Focuses on policy design and evaluation in the regulation of hazardous substances and processes. Includes risk assessment, industrial chemicals, pesticides, food contaminants, pharmaceuticals, radiation and radioactive wastes, product safety, workplace hazards, indoor air pollution, biotechnology, victims' compensation, and administrative law. Health and economic consequences of regulation, as well as its potential to spur technological change, are discussed for each regulator regime. Students taking the graduate version are expected to explore the subject in greater depth.  
*N. Ashford, C. Caldart*

**IDS.620[J] Principles and Practice of Drug Development**  
Same subject as 10.547[J], 15.136[J], HST.920[J]  
Prereq: Permission of instructor  
G (Fall)  
3-0-6 units  
See description under subject 15.136[J].  
*S. Finkelstein, A. J. Sinskey, R. Rubin*

**IDS.670[J] Planning and Design of Airport Systems**  
Same subject as 1.231[J], 16.781[J]  
Prereq: None  
Acad Year 2022-2023: G (Fall)  
Acad Year 2023-2024: Not offered  
3-0-9 units  
Focuses on current practice, developing trends, and advanced concepts in airport design and planning. Considers economic, environmental, and other trade-offs related to airport location, as well as the impacts of emphasizing "green" measures. Includes an analysis of the effect of airline operations on airports. Topics include demand prediction, determination of airfield capacity, and estimation of levels of congestion; terminal design; the role of airports in the aviation and transportation system; access problems; optimal configuration of air transport networks and implications for airport development; and economics, financing, and institutional aspects. Special attention to international practice and developments.  
*R. de Neufville, A. R. Odoni*

**IDS.700[J] Applied Probability and Stochastic Models**  
Same subject as 1.203[J], 15.073[J]  
Prereq: 6.041B or 18.600  
G (Fall)  
Not offered regularly; consult department  
3-0-9 units  
See description under subject 15.073[J].  
*A. Barnett*

**IDS.720[J] Tools for Analysis: Design for Real Estate and Infrastructure Development**  
Same subject as 11.434[J], 15.428[J]  
Prereq: None  
G (Spring; second half of term)  
2-0-4 units  
See description under subject 11.434[J].  
*D. Geltner, R. de Neufville*

**IDS.730[J] Logistics Systems**  
Same subject as 1.260[J], 15.770[J], SCM.260[J]  
Subject meets with SCM.271  
Prereq: Permission of instructor  
G (Fall)  
3-0-9 units  
See description under subject SCM.260[J].  
*C. Caplice, D. Correll*

**IDS.735[J] Supply Chain: Inventory Analytics**  
Same subject as 1.273[J], 15.762[J]  
Prereq: 15.761 or SCM.260[J]  
G (Spring; first half of term)  
2-0-4 units  
See description under subject 15.762[J].  
*S. Graves, N. Trichakis, S. Willems*

**IDS.736[J] Supply Chain: Capacity Analytics**  
Same subject as 1.274[J], 15.763[J]  
Prereq: 15.761, 15.778, or SCM.260[J]  
G (Spring; second half of term)  
2-0-4 units  
See description under subject 15.763[J].  
*S. Graves, N. Trichakis, S. Willems*
**IDS.900 Doctoral Seminar in Social and Engineering Systems**  
Prereq: Permission of instructor  
G (Fall)  
2-0-1 units  
Introduces doctoral students to IDSS research areas. Preference to first-year students in SES.  
A. Jadbabaie

**IDS.910 Leadership Development**  
Prereq: Permission of instructor  
G (Fall; partial term)  
Not offered regularly; consult department  
1-1-1 units  
Seminar environment created to develop leadership capabilities, and to take advantage of leadership opportunities. An initial Outward Bound experience builds trust, teamwork and communications. Readings and assignments emphasize the characteristics of desired leadership skills. Global leaders participate in the Leadership Lunch series to share their experiences and recommendations. Discussions explore leadership development. Culminates in a personal leadership plan. Restricted to entering students in the Technology and Policy program or instructor permission.  
Staff

**IDS.950 Independent Study in Data, Systems, and Society**  
Prereq: Permission of IDSS Academic Office  
G (Fall, IAP, Spring, Summer)  
Units arranged [P/D/F]  
Can be repeated for credit.  
For graduate students in IDSS. Individual study in data, systems, and society. Intended to expose student to expert-level domain material. Supervised by a member of MIT’s teaching staff.  
Consult IDSS Academic Office

**IDS.951 Independent Study in Technology and Policy**  
Prereq: Permission of TPP Education Office  
G (Fall, IAP, Spring, Summer)  
Units arranged [P/D/F]  
Can be repeated for credit.  
For graduate students in TPP. Individual study in technology and policy. Intended to expose student to expert-level domain material. Supervised by a member of MIT’s teaching staff.  
Consult TPP Education Office

**IDS.955 Practical Experience in Data, Systems, and Society**  
Prereq: None  
G (Fall, IAP, Spring, Summer)  
Units arranged [P/D/F]  
Can be repeated for credit.  
For IDSS doctoral students participating in off-campus practical experiences in data, systems, and society. Before registering for this subject students must have a training offer from a company or organization, must identify a research supervisor, and must receive prior approval from the IDSS Academic Office. Upon completion of the experience students must submit a letter from the company or organization describing the goals accomplished and a substantive final report to the MIT supervisor.  
Consult IDSS Academic Office

**IDS.956 Practical Experience in Technology and Policy**  
Prereq: None  
G (Fall, IAP, Spring, Summer)  
Units arranged [P/D/F]  
For TPP students participating in off-campus internship experiences in technology and policy. Before registering for this subject, students must have an employment offer from a company or organization, must identify a research supervisor, and must receive prior approval from the TPP Education Office. Upon completion of the internship, student must submit a letter from the employer describing the work accomplished, along with a substantive final report from the student approved by the MIT supervisor.  
Consult TPP Education Office

**IDS.960 Teaching in Data, Systems, and Society**  
Prereq: None  
G (Fall, IAP, Spring)  
Units arranged [P/D/F]  
Can be repeated for credit.  
For Teaching Assistants in IDSS, in cases where teaching assignment is approved for academic credit. Laboratory, tutorial, or classroom teaching under supervision of a faculty member. Credit for this subject may be used to satisfy the teaching requirement for the Doctor of Philosophy in Social and Engineering Systems in IDSS. Otherwise, credit for this subject may not used for any other degree requirement or degree in IDSS.  
Consult IDSS Academic Office
IDS.961 Teaching in Technology and Policy
Prereq: None
G (Fall, IAP, Spring)
Units arranged [P/D/F]
Can be repeated for credit.

For Teaching Assistants in TPP, in cases where teaching assignment is approved for academic credit. Laboratory, tutorial, or classroom teaching under supervision of a faculty member. Credit for this subject may not be used for any degree granted by IDSS.
*Consult TPP Academic Office*

IDS.970 Research in Data, Systems, and Society
Prereq: None
G (Fall, Spring, Summer)
Units arranged [P/D/F]
Can be repeated for credit.

For Research Assistants in IDSS when assigned research is not used for thesis, but is approved for academic credit. Credit for this subject may not be used for any degree granted by IDSS.
*Consult IDSS Academic Office*

IDS.971 Research in Technology and Policy
Prereq: None
G (Fall, Spring, Summer)
Units arranged [P/D/F]
Can be repeated for credit.

For research assistants in TPP when assigned research is not used for thesis, but is approved for academic credit. Credit for this subject may not be used for any degree granted by IDSS.
*Consult TPP Academic Office*

IDS.S00 Special Undergraduate Subject in Data, Systems, and Society
Prereq: Permission of instructor
U (Fall, IAP, Spring, Summer)
Units arranged [P/D/F]
Can be repeated for credit.

Opportunity for study of topics in Data, Systems, and Society not otherwise included in the curriculum. Offerings initiated by faculty on an ad-hoc basis subject to IDSS approval.
*Consult IDSS Academic Office*

IDS.S01 Special Undergraduate Subject in Data, Systems, and Society
Prereq: Permission of instructor
U (Fall, IAP, Spring, Summer)
Not offered regularly; consult department
Units arranged
Can be repeated for credit.

Opportunity for study of topics in Data, Systems, and Society not otherwise included in the curriculum at MIT. Offerings are initiated by faculty on an ad-hoc basis subject to IDSS approval.
*Consult IDSS Academic Office*

IDS.S10 Special Undergraduate Subject in Data, Systems, and Society
Prereq: Permission of instructor
U (Fall, IAP, Spring, Summer)
Not offered regularly; consult department
Units arranged [P/D/F]
Can be repeated for credit.

Opportunity for study of topics in Data, Systems, and Society not otherwise included in the curriculum at MIT. Offerings are initiated by faculty on an ad-hoc basis subject to IDSS approval.
*Consult IDSS Academic Office*

IDS.S11 Special Undergraduate Subject in Data, Systems, and Society
Prereq: None
U (Fall, IAP, Spring, Summer)
Not offered regularly; consult department
Units arranged [P/D/F]
Can be repeated for credit.

Opportunity for study of topics in Data, Systems, and Society not otherwise included in the curriculum. Offerings initiated by faculty on an ad hoc basis subject to IDSS approval.
*Consult IDSS Academic Office*

IDS.S20 Special Graduate Subject in Data, Systems, and Society
Prereq: Permission of instructor
G (Fall, IAP, Spring, Summer)
Not offered regularly; consult department
Units arranged
Can be repeated for credit.

Opportunity for study of advanced topics in Data, Systems, and Society not otherwise included in the curriculum at MIT. Offerings are initiated by faculty on an ad-hoc basis subject to IDSS approval.
*Consult IDSS Academic Office*
IDS.S21 Special Graduate Subject in Data, Systems, and Society
Prereq: Permission of instructor
G (Fall, IAP, Spring, Summer)
Not offered regularly; consult department
Units arranged
Can be repeated for credit.

Opportunity for study of advanced topics in Data, Systems, and Society not otherwise included in the curriculum at MIT. Offerings are initiated by faculty on an ad-hoc basis subject to IDSS approval.
Information: Consult IDSS Academic Office

IDS.S22 Special Graduate Subject in Data, Systems, and Society
Prereq: Permission of instructor
G (Fall, IAP, Spring, Summer)
Not offered regularly; consult department
Units arranged
Can be repeated for credit.

Opportunity for study of advanced topics in Data, Systems, and Society not otherwise included in the curriculum at MIT. Offerings are initiated by faculty on an ad-hoc basis subject to IDSS approval.
Consult IDSS Academic Office

IDS.S23 Special Graduate Subject in Data, Systems, and Society
Prereq: Permission of instructor
G (Fall, IAP, Spring, Summer)
Not offered regularly; consult department
Units arranged
Can be repeated for credit.

Opportunity for study of advanced topics in Data, Systems, and Society not otherwise included in the curriculum at MIT. Offerings are initiated by faculty on an ad-hoc basis subject to IDSS approval.
Consult IDSS Academic Office

IDS.S24 Special Graduate Subject in Data, Systems, and Society
Prereq: Permission of instructor
G (Fall)
Units arranged
Can be repeated for credit.

Opportunity for study of advanced topics in Data, Systems, and Society not otherwise included in the curriculum at MIT. Offerings are initiated by faculty on an ad-hoc basis subject to IDSS approval.
Consult IDSS Academic Office

IDS.S30 Special Graduate Subject in Data, Systems, and Society
Prereq: None
G (Fall, IAP, Spring)
Not offered regularly; consult department
Units arranged [P/D/F]
Can be repeated for credit.

Opportunity for study of advanced topics in Data, Systems, and Society not otherwise included in the curriculum. Offerings are initiated by faculty on an ad-hoc basis subject to IDSS approval.
Staff

IDS.S31 Special Graduate Subject in Data, Systems, and Society
Prereq: None
G (Fall, IAP, Spring, Summer)
Not offered regularly; consult department
Units arranged [P/D/F]
Can be repeated for credit.

Opportunity for individual or group study of advanced topics in Data, Systems, and Society not otherwise included in the curriculum at MIT. Offerings are initiated by faculty on an ad-hoc basis subject to IDSS approval.
Consult IDSS Academic Office

IDS.S32 Special Graduate Subject in Data, Systems, and Society
Prereq: None
G (Fall, IAP, Spring, Summer)
Not offered regularly; consult department
Units arranged [P/D/F]
Can be repeated for credit.

Opportunity for individual or group study of advanced topics in Data, Systems, and Society not otherwise included in the curriculum at MIT. Offerings are initiated by faculty on an ad-hoc basis subject to IDSS approval.
Consult IDSS Academic Office

IDS.THG Graduate Thesis
Prereq: Permission of instructor
G (Fall, IAP, Spring, Summer)
Units arranged
Can be repeated for credit.

Program of research, leading to the writing of an SM or PhD thesis to be arranged by the student with a member of the IDSS faculty. A minimum of 24 thesis units are required for the SM degree.
Consult IDSS Academic Office
IDS.UR Undergraduate Research
Prereq: None
U (Fall, IAP, Spring, Summer)
Units arranged [P/D/F]
Can be repeated for credit.

Undergraduate research opportunities in Data, Systems, and Society.
IDSS Academic Office

IDS.URG Undergraduate Research
Prereq: None
U (Fall, IAP, Spring, Summer)
Units arranged
Can be repeated for credit.

Undergraduate research opportunities in Data, Systems, and Society.
Consult IDSS Academic Office