

2022 Research Tracks

Track 1 – Blueprints of the Brain

Advancing Neuroscience with Genetics

Disciplines: Neuroscience, Optogenetics, Quantitative Genetics, Neurological Disorders and Disease

With over 100 billion cells and 125 trillion synapses, the brain is the most complex organ in the human body. Today's neuroscientists are faced with an overwhelming challenge: to understand how this dense collection of neurons and glia allows for sensation, cognition, and behavior as well as disorder and disease. This course will examine how researchers can break the brain into its basic components using genetics as a guide. Students will explore the molecular mechanisms that drive development, neuronal function, and more. They will compare nervous systems from across the animal kingdom to understand where our brains came from as well as the power of model organisms. Students will model human behavior and neurological disorders using tardigrades and transgenic animals. The course will include learning about cutting-edge genetic tools, including CRISPR and optogenetics, that are changing the way we think about neuroscience and medicine.

Track 2 – Creative Industries

Exploring the Hidden World of Media and the Forces that Govern It

Disciplines: Media Studies, Film Studies, Economics, Philosophy, Communications, Anthropology

The entertainment industries have seen remarkable transformation in their ownership, distribution, and content due to the emergence of new technologies and global distribution flows. Media is the site of billions of dollars in investment, the subject of elaborate corporate strategy, and the source of livelihoods for hundreds of thousands of workers that include freelance news reporters, film directors, and streaming service executives. This course introduces students to the core methods of media studies, imparting a diversity of approaches for students' own academic development. Students will engage with issues that include production, labor, distribution, consumption, financialization, and globalization as they immerse themselves in the field of media. Through the construction of a collaborative research project, students will ultimately develop the essential skills for critical consumers and practitioners in today's media-saturated environment.

Track 3 – Turning Tides

Marine Biology in a Changing Ocean

Disciplines: Ecology, Physiology, Aquaculture, Climate Change, Environmental Science, Marine Biology

The world's ideas are changing at unprecedented rates. Rising temperatures and sea levels are devastatingly affecting the benefits that humans and animals derive from the ocean. This course will explore topics based upon the foundational concepts of marine biology, ranging from the effects of climate change on local ecosystems to solutions addressing the increasing food demands of a rapidly growing global population. Students will learn various research and data collection techniques from experts in the field that will become applicable to their research projects. While acquiring laboratory techniques and visiting local field sites, they will measure environmental conditions, conduct ecological surveys, and analyze large sets of data. By the end of this course, students will have a deeper understanding of marine ecosystems and gain hands-on experience researching solutions to some of the oceans' most challenging problems.

Track 4 – Mind Matters*An Exploration Into Clinical Psychology from Assessment to Intervention*

Disciplines: Clinical Psychology, Counseling, Mental Health, Identities, Autism, Mood Disorders

Different aspects of a person's identity, including cultural identity, sexuality, neurodiversity, and gender identity, play a crucial role in shaping who they are. This course examines contemporary theories, techniques, and literature to understand the convergence of psychopathology, mental health experiences, and identity. Students will explore specific areas of clinical psychology, including cognitive and personality assessment and therapy helping skills. Students will also gain a better understanding of themselves, those around them, and how the environment, such as social media, friendships, intimate relationships, families, and stressors can have a significant impact on mental health. Additionally, this course includes experimental training on research methodology (quantitative and qualitative), data analysis using SPSS and R, and interpreting data while applying cultural humility.

Track 5 – Critical Intelligence*Informing the Public in the Digital Age*

Disciplines: History, Sociology, Global Studies, Political Science, Public Policy, Journalism

This course will allow students to play an active role in not just recording the past, but making sense of the present. From the insurrection at the Capitol to the ongoing debates over Critical Race Theory in schools, this tumultuous year has demonstrated the necessity of understanding the past and the dangers we risk when it is not communicated properly by the very experts who seek to propagate knowledge. The abrupt shift to virtual learning due to COVID-19 has made digital communication and the rapid sharing of ideas, including "fake news," even more closely felt. By employing historical tools including oral history interviews, students will learn qualitative research skills and best ethical practices in the digital age. Students will explore why our world needs policy experts on the deeper histories of topics like medicine, colonialism, and social movements, as well as leaders who can communicate their research to a public-facing audience in creative and succinct ways.

Track 6 – Soft Robotics*Engineering Bioinspired Compliance from Artificial Muscles to Novel Locomotion*

Disciplines: Materials Science, Engineering, Robotics, Physics, Computational Fabrication

Soft robotics mimic biological systems through its use of deformable structures. The flexibility that these machines offer is crucial in systems that concern dynamic task environments, such as the manipulation of unknown objects, locomotion in rugged terrains, and physical contact with living cells. This course will connect bioinspiration to the engineering and construction of soft robotics. Students will learn about innovative applications of bioinspired robots alongside the technical details on actuation principles (e.g. cable-driven actuation, fluidic actuation, shape memory alloys), sensing principles (e.g. capacitive sensing, resistive sensing), and fabrication techniques (e.g. 3D printing, soft lithography). They will explore the meaningful contributions that researchers are currently making in this thriving field. Additionally, this course will give students the opportunity to gain hands-on experience through solving a real-world research problem by designing and fabricating a partial or full soft robot.

Track 7 – The Science of Persuasion

Investigating the Complex Cognitive Resources to Mass Communication

Disciplines: Mass and Interpersonal Comm., Social Psychology, Persuasion Neuroscience, Media Theory

Persuasion is ubiquitous, and we often engage in it without awareness of its fundamental mechanisms. It can be found through emotional appeals in advertisements or posts with compromised credibility to flat platforms such as YouTube and TikTok. In the era of heightened polarization, understanding persuasion through interpersonal and media-mediated communication is critical to studying human behavior. In this course, students will explore the theories and concepts behind persuasion and its intersection with neuroscience and psychology. They will examine topics such as the Lasswellian perspective, language expectancy theory, and the dual processing model to cultivate a foundational understanding of cognitive and affective persuasion. They will learn how to design experimental and survey studies, as well as build computational methods and perform quantitative data analysis using Python. By the end of the course, students will be able to explain how the neuroscientific perspective of persuasion can be applied to digital communication.

Track 8 – Intelligent Algorithms

A Deep Dive into Machine Learning and Artificial Intelligence

Disciplines: Computer Science, Machine Learning, Artificial Intelligence, Mathematics

Today's world is living in a golden era of artificial intelligence; it is becoming significantly more dependent on machine learning models in many aspects of every day life. With growing access to data, humanity's interest in machine learning is quickly increasing and changing every industry. This course is designed to provide a deep understanding of a wide variety of machine learning models such as linear and logistic regressions, neural networks, support vector machines, genetic programming, and reinforcement learning. The course will focus on both the theory and applications of machine learning where students will develop a preliminary understanding of the mathematical theories behind each of these techniques. They will explore how to implement the methods to real-world problems in various labs that apply popular machine learning packages. Finally, students will dive into a research project that will help them understand the current limits and possibilities of machine learning.