2020 Research Tracks

Track 1 – The Final Frontier
Dissecting the Circuits of the Brain
Disciplines: Neural Circuits, Artificial Neural Network Modeling, Neurobehavioral Methods, Learning and Memory, Neurobiology of Disease

The human brain represents one of the final frontiers for scientific understanding. It holds a notable complexity that challenges us to be creative in our experimental approaches. This complexity relates to our brains integrating the ability of sensation such as hearing and sight, memory and learning, and the capability to pursue goal-directed actions within various environments. Further, injury and disease assail these abilities, comprising them, but also providing us a window into comprehending the guiding principles that undergird the brain. Therefore, this class seeks to introduce students to basic principles of neuroscience, and foster within them an understanding that will stimulate their curiosity, and empower them to solve problems with innovative techniques. Students will actively be trained via case studies with appropriate labs in four progressive modules: exploring "elementary particles" of neural circuits - neurons and synapses; modeling simple neural circuits using motor central pattern generators and artificial neural networks; investigating complex neural circuits with system approaches to learning and memory; and probing dysfunction of neural circuits through brain malady with special focus on dementias such as Parkinson's Disease and Alzheimer's Disease.

Track 2 – A House of Cards
U.S. National Security Dilemmas in the Twenty First Century
Disciplines: International Relations, Political Science, Global Studies, International Law, U.S. Government and Politics

As the 2020 U.S. Presidential Elections draws closer, voters must judge how candidates respond to the ethics and urgencies of contemporary security dilemmas: How can American policy makers protect American citizens and residents against real and perceived threats of foreign and domestic terrorism without resorting to profoundly damaging racial, religious, and ethnic stereotypes? How do you ensure public safety without compromising the principles of freedom of speech and individual right to privacy? How do you protect American communities against the threat of environmental degradation without undermining economic growth and prosperity? This course aims to introduce students to the theoretical and practical challenges that have dominated the security agenda of American policy-makers in the twenty first century such as these mentioned. Taught under the context of the upcoming U.S. presidential election, the course aims to arm students with the tools needed to critically engage with the political discourse unfolding on the campaign stage, ensuring they are able to understand the implications of the policies candidates are proposing.

Track 3 – Sensing the World
Exploring Wearable Technology through Soft Robotics
Disciplines: Sensory, Biomimicry, Pneumatic Architecture, Media Arts & Technology, Human-Computer Interaction

Conventional wearable robots designed with rigid materials, such as metal and hard plastic, are often limited by their lower flexibility, functionality, and biological compatibility. With sensory technology and novel materials, can we rethink the wearable device as a soft and organic interface? Sensing the world is connecting the body (or mechanics), the brain (or controller), and the environment. In this course, we will focus on the emerging field of soft robotics, bringing together research and applications of wearable technology. We will introduce the concept of computational morphology in soft robotics and study the design principles using 3D modeling tools. Specific topics include body architecture, pneumatic architecture, soft mechanism, smart material, biomimicry design, geometrical morphology, sensory technology, embodied intelligence, wearable computing, and human-robot interaction. We will also discuss the soft wearable applications in art, communication, fitness, entertainment, medicine, and sports, and so on. Through a series of hands-on activities, students will explore digital fabrication, soft motion mechanisms, soft actuation, and wearable sensors. By the end of the course, students will design, modeling, and build of a wearable device, and analysis the human-robot interaction.

Track 4 – Our Dynamic Earth
Understanding Human Impacts on Environmental Processes
Disciplines: Biogeography, Terrestrial Ecology, Plant physiology, Geography, Climate Change

Earth's landscapes are changing and the role that humans play is transformative. The decimation of forests, diversion of dams, and rapid urbanization, drastically transform natural landscapes around the world. With the advancement of technology, scientists can monitor and measure the impact that humans have on the natural cycles of earth's processes. This course will explore the physical conditions of energy, hydrology, and vegetation that combine to form patterns of distinct land types. Topics include earth's energy balance, the water cycle, and plant processes such as photosynthesis and evapotranspiration. We will dive into the different ways that humans alter landscapes, and how we can maintain and protect natural processes. With Santa Barbara as a backdrop, we will investigate coastal to mountainous ecosystems, urban to rural gradients, and everything in between to explore the relationships between water, energy, and vegetation. We will examine how environmental scientists measure and estimate these processes and learn new tools including GIS and data analysis in Excel and R. We will use the campus's ideal proximity to these different ecosystem types, field work from the Geography department and the Bren School, and much more to explore these interdisciplinary themes.

Track 5 – Freedom Fighters
Studying the Science of Social Movements
Disciplines: Sociology, Qualitative Methods, History

From the founding of our nation through the Black Lives Matter and #MeToo movement, the battle for justice and equality have long been fought through social movements. Though they are in part responsible for many important gains in history, the amorphous nature of their development and organization can often make them seem difficult to study. Their multifacetedness, however, actually makes them an especially interesting lens through which to learn social sciences methodology. This course seeks to introduce students to the essentials of conducting interdisciplinary research in the social sciences disciplines, through a focus on social movements. Lectures will explore the following topics: understanding the history of social movements and theories of social change; when and why do social movements occur, movement networks and analysis, who join and support movements, how movements are organized, the role of social media and technology, and framing and identity. As part of their project, students will conduct primary data collection, which could include conducting 2 to 3 interviews, a focus group, participant observation, document analysis or a survey. Through both lectures and labs, students will receive an overview of the major methodologies used in the social sciences and get to practice them out in the real world.

Track 6 – Thinking Machines
A Dive Into Modern Artificial Intelligence
Disciplines: Computer Science, Machine Learning, Computer Vision, Mathematics

We live currently in a golden era of AI – where machine learning algorithms are used in everything from smart assistants and self-driving cars to artificially-generated TV news anchors and Snapchat filters. AI algorithms are extremely good at noticing important features and their interactions in very complex scenarios either involving multiple stimuli combined with a quick-decision making (as in driving) or ones involving seemingly meaningless data that otherwise would require years of expertise to understand (as in cancer detection in CT scans). In this course, we will focus on understanding the concepts of the modern AI research field based on the applications in computer vision such as face recognition, car detection and image segmentation for autonomous driving, image generation, and many others. This course will help participants understand the current limits and possibilities of the AI systems in the computer vision field along with practical examples ranging from object recognition to fake-image generation. This is a great opportunity for students interested in getting to know the tools of present-day AI as well as ones just willing to better understand the surrounding world of modern technology.

Track 7 – Media Forensics:
A Probe into Multilayered Communication Flows
Disciplines: Media and Communication Studies, New Media Technologies, Journalism, Propaganda, Media Ethics

The early 2000s called it an "emerging discipline." However, the controversies surrounding WikiLeaks, News of the World, Facebook, Cambridge Analytica, Mossack Fonseca, and fake news have, yet again, prompted scholars-activists to critically evaluate mass media, and their impact on political power and the global economy. We often see media as drivers of political and social change, but these very technologies embody the values and assumptions as well as conflicts of the societies that produce them. What do they tell us about our globalizing world? Do they "rewire" society and drive social (information access), political (revolutions), economic (e-currency), or technological (machine learning, augmented reality, self-driving cars) change? Or do they do the opposite? This course prompts critical ways of thinking about major developments of the 21st century as driven by communication flows which, when deconstructed, can help us understand the world around us. Grounded in Media and Science & Technology Studies, we will get our feet wet with the inherent relationships among society, media and technology, to progressively examine media institutions, audiences and effects in the context of propaganda, labor, privacy, social media networks, online hate, fake news and virality as well as contemporary threats to journalism and liberal world order.