DEPARTMENT NAME	Biomedical Engineering
PROJECT TITLE	Computational Systems Biology: Predicting Cancer Signaling Dynamics
FACULTY NAME	Stacey Deleria Finley
WEBSITE	http://csbl.usc.edu

DESCRIPTION

The Computational Systems Biology Laboratory at USC welcomes motivated undergraduate students to work with us to develop predictive mathematical models of signaling pathways important in tumor growth. We study tumor angiogenesis, the formation of new blood capillaries from pre-existing blood vessels, which enables a tumor to generate its own blood supply and obtain oxygen and nutrients needed for growth. We aim to predict the effects of cancer therapies that aim to inhibit angiogenesis.   We also study T cell signaling related to cancer immunotherapy. In this area, we aim to predict the signaling dynamics of T cells required to target and kill cancer cells.   Students will build upon the models that the research laboratory is developing, and predict the dynamics of these signaling pathways. Students will have the opportunity to complete computational studies and will work closely with experimental collaborators. Additionally, prospective students will be able to apply the mathematical and quantitative analytical tools they are learning in core biomedical and chemical engineering courses.

PREREQ   Differential Equations; Some familiarity with MATLAB programming; Cellular Biology

RELATED BACKGROUND   Biomedical Engineering; Chemical Engineering; Bioengineering

DEPARTMENT NAME	Computer Science
PROJECT TITLE	In-Home Socially Assistive Robotics
FACULTY NAME	Maja Mataric
WEBSITE	http://robotics.usc.edu/interaction

DESCRIPTION

The Interaction Lab is a research lab at USC dedicated to developing socially assistive robotics; that is, robots that help people achieve some goal through social interaction. The students on this project would assist in developing software and infrastructure for in-home deployment of a socially assistive robot, capable of interacting with inter-generational groups of people, from young children to older adults. The students will design one or more game- or activity-based interactions, using a tablet interface and tabletop socially assistive robot. The students will be invited to attend project meetings, and will collect requirements and design guidelines based on those meetings and the results of existing focus groups. Students will learn about in-home deployment of research technologies and the process of developing state-of-the-art research code for human-robot interaction, as well as gaining experience in the research process.

PREREQ   Great communication skills and some programming experience.

RELATED BACKGROUND   Experience with Linux/Ubuntu OS, JavaScript and/or Python, and robotics.

DEPARTMENT NAME	Computer Science
PROJECT TITLE	Mobile Remote Presence Robots as Gateways to Access to K-12 In-School Education
FACULTY NAME	Maja Mataric
WEBSITE	http://robotics.usc.edu/interaction

DESCRIPTION

The Interaction Lab is a research lab at USC dedicated to developing socially assistive robotics; that is, robots that help people achieve some goal through social interaction. For this project, the lab seeks a student to assist with the development and evaluation of mobile remote presence (MRP) robots for classroom settings. Our research leverages MRP robots to support remote learning and socializing by K-12 students who need to miss extended amounts of school. Since existing commercial MRP platforms lack certain needed capabilities for remote learning and social interactions, we are striving to develop and test new MRP robot capabilities such as nonverbal expressiveness, semi-autonomous social navigation, and enhanced remote self-awareness for robot operators. The students involved in this project will gain experience working on a large-scale human-robot interaction investigation with real-world impact. Members of the team will gain experience with state-of-the-art robotic platforms and cutting-edge robotic technologies like Robot Operating System (ROS), computer vision, and machine learning.

PREREQ   Ability to program in either Python or JavaScript. Experience with robotics, Robot Operating System

RELATED BACKGROUND   Experience with Linux/Ubuntu OS, JavaScript and/or Python, and robotics.

DEPARTMENT NAME	Computer Science
PROJECT TITLE	Auditing Algorithmic Fairness
FACULTY NAME	Aleksandra Korolova
WEBSITE	http://korolova.com

DESCRIPTION

Data-driven algorithms and machine learning are increasingly used in systems that make decisions about and on behalf of people. As these algorithms become more common and more complex, it is crucial to understand their inherent risks, such as codifying and entrenching biases, reducing accountability, and creating new types of discrimination.   In this project, we will take a principled approach to auditing the algorithms used by a major online service provider with an eye to identifying unexpected risks. We will quantify the identified risks and factors influencing them, and research algorithmic modifications and transparency options that could help remedy them. An expected outcome of the project is a publication in a venue focused on algorithmic fairness, accountability and transparency, such as https://www.fatml.org/

PREREQ   Solid knowledge of algorithms; strong programming skills; familiarity w/ machine learning

RELATED BACKGROUND   Passion for using Computer Science to make a positive difference in the world a plus.

DEPARTMENT NAME	Computer Science
PROJECT TITLE	Differential Privacy - from Theory to Practice
FACULTY NAME	Aleksandra Korolova
WEBSITE	http://korolova.com

DESCRIPTION

Differential privacy has emerged as the most promising approach to privacy-preserving data collection and analysis. Although recently differentially-private algorithms have been deployed by Google (https://github.com/google/rappor) and Apple, those deployments are limited in the kinds of use cases they can address. In this project, we will address several of the barriers to making differentially private algorithms universally useful. We will develop new algorithms for differentially-private on-device machine learning while making modeling assumptions appropriate for medium-sized companies collecting data. The project will consist of algorithm design and analysis, prototype implementation, and experiments measuring performance under various assumptions. We'll aim to have the project's findings published in a top-tier privacy or machine learning venue and adopted in practice by companies interested in providing strong privacy guarantees.

PREREQ   Strong knowledge of algorithms & machine learning; familiarity with differential privacy

RELATED BACKGROUND   Strong knowledge of probability and statistics and strong data analysis skills

DEPARTMENT NAME	Computer Science
PROJECT TITLE	Multi-Agent Path Finding
FACULTY NAME	Sven Koenig
WEBSITE	http://idm-lab.org/project-p.html

DESCRIPTION

Consider several agents (such as robots or game characters) that need to move from their current locations on a grid with blocked and unblocked cells to given goal locations without obstructing each others' movement. This problem, is faced by warehousing robots (like those from Kiva that are, for example, being used in the Amazon fulfillment centers, e.g. www.wimp.com/kivarobots) and requires path planning but, different from single-agent path planning, is NP-hard and thus requires extreme smart algorithms to result in good performance. We are looking for students who are interested in helping us to develop the next generation of such algorithms. (This is not a robotics project and will not use robot hardware. Rather, it is a software project that will use a gridworld simulation where each robot can move in one of the four main compass directions. However, we are collaborating with robotics researchers to run the algorithms on robots.) This is a project for strong AI students who are interested in algorithms and/or strong theory/algorithms students who are interested in AI.

PREREQ   junior or senior

RELATED BACKGROUND   Aptitude for AI algorithms, computer science theory (or mathematics) will be helpful. Programming (likely in C/C++) is required.

DEPARTMENT NAME	Epstein Dept of Industrial & Systems Engineering
PROJECT TITLE	Training Binary Neural Networks
FACULTY NAME	Meisam Razaviyayn
WEBSITE	N/A

DESCRIPTION

In this project, we study the training problem of binary neural networks. Our goal to use deep learning to check the similarity of long-read RNA sequencing reads. We want to improve the computational efficiency of our current network by binarizing the weights and the hidden layers in the network.

PREREQ

Coding, algorithms

RELATED BACKGROUND

Coding, algorithms, probability

DEPARTMENT NAME	Signal & Image Processing
PROJECT TITLE	Human-centered Signal Processing and Informatics
FACULTY NAME	Shrikanth Narayanan
WEBSITE	http://sail.usc.edu

DESCRIPTION

The Signal Analysis and Interpretation Laboratory (sail.usc.edu) has several interdisciplinary research projects that are ongoing that welcome undergraduate researchers as a part of the teams. Three specific research teams with openings include 1. Media Informatics and Content Analysis (MICA) [sail.usc.edu/mica] R&D on a wide variety of media related tasks including the analysis of movie content to answer questions ranging from social science (e.g., gender representations) to business (e.g.., predicting impact/outcome of content).   2. Health Behavioral Informatics [sail.usc.edu/bsp] R&D on a variety of topics in signal processing and computing related to health research and applications in domains such as Autism, Depression, and Addiction 3. Speech Production and Articulation Knowledge Group [sail.usc.edu/span] R&D on novel imaging and modeling of human speech and song production, and applications in biometric and speech recognition technology development, and clinical applications (head/neck cancer).

PREREQ

None

RELATED BACKGROUND

Curiosity, Initiative and Follow through. Background in EE, CS, Math and related interests. Interdisciplinary interests e.g., human behavior, affect, emotions, health. Programming experience.

COMMENTS

Be a part of a team of Electrical Engineers, Computer Scientists, Psychologists and Linguists to create human centered science and engineering advances. Help in various ways from system testing, data collection/analysis, and small programming designs. Learn a variety of skills in the process related to multimedia processing, machine learning, user interface design, AI applications.   Attend group meetings, read and critique papers, contribute to publications and presentations.

DEPARTMENT NAME	Information Sciences Institute
PROJECT TITLE	Whole-Internet RTT estimation
FACULTY NAME	John Heidemann
WEBSITE	https://ant.isi.edu/

DESCRIPTION   The ANT project has written and maintains the program icmptrain. It does high-rate scans of the Internet, producing Internet censuses as described on the home website and latency maps. Currently latency is computed best-effort. In this project a student will extend the existing code to provide accurate estimates of latency while minimizing the amount of network traffic.

ADDITIONAL INFORMATION   https://ant.isi.edu/address/browse/?kind=round-trip-time&source=w&date=2017-06-28%20(it76)&scale=4&center=42.170.170.170

PREREQ   Completed 1st year CS (or equivalent)

RELATED BACKGROUND   Computer Science. Knows C++.

DEPARTMENT NAME	Information Sciences Institute
PROJECT TITLE	Anycast visualization for B-Root
FACULTY NAME	John Heidemann
WEBSITE	https://b.root-servers.org/

DESCRIPTION   USC operates B-Root, one of the 13 DNS servers that operate at the root of the Internet Domain System (above .com and .edu is the DNS root). B-Root has a number of operational questions, like visualizing and understanding which of the multiple B-Root sites computers around the world use (part of IP anycast), and automating evaluation of performance to support automatic patching. An undergraduate student could visualize B's IP anycast, or help automate performance evaluation.

PREREQ   Completed 1st year CS (or equivalent)

RELATED BACKGROUND   Completed 1st year CS (or equivalent). Should be familiar with C or scripting languages.