FACULTY MENTOR
Sujit Dey

PROJECT TITLE
Virtual Physical Therapy

PROJECT DESCRIPTION
Description: Using Machine Learning to power a mobile application that patients can use to perform exercises and receive feedback.

This project can accommodate both remote and in-person students.

INTERNS NEEDED
4 Students

PREREQUISITES
1. Computer problem solving skills: interns should have basic programming experience to be able to reason through the problem at hand, create a plan, and be resourceful in finding the technologies needed. Experience preferred with: tensorflow, pytorch, mobile development, and unity.
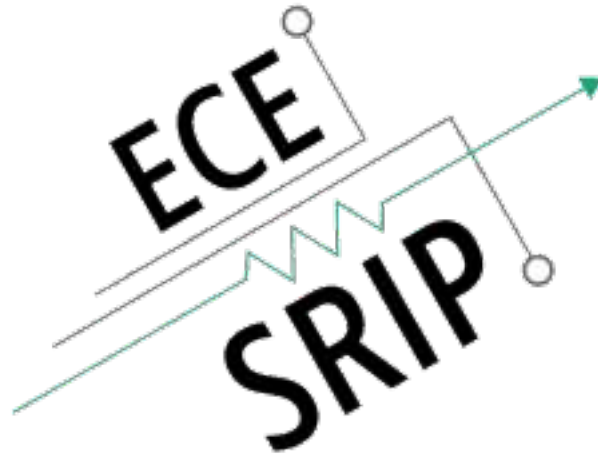
FACULTY MENTOR
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PROJECT TITLE
Behavioral Coaching and Guidance for People with ASD

PROJECT DESCRIPTION
Description: Future of Work is a multidisciplinary project that aims to provide behavioral coaching and guidance to high-functioning individuals with Autism Spectrum Disorder (ASD). One of two engineering groups of the project is working on providing coaching on appropriate head and body orientations, in a room surveilled by LiDAR sensors. Over the last 2 years, head and body orientation estimation models have been developed and a large dataset with 14 subjects with ASD have been collected. Next objectives involve the automated detection of inappropriate behaviors and machine learning based behavioral coaching.
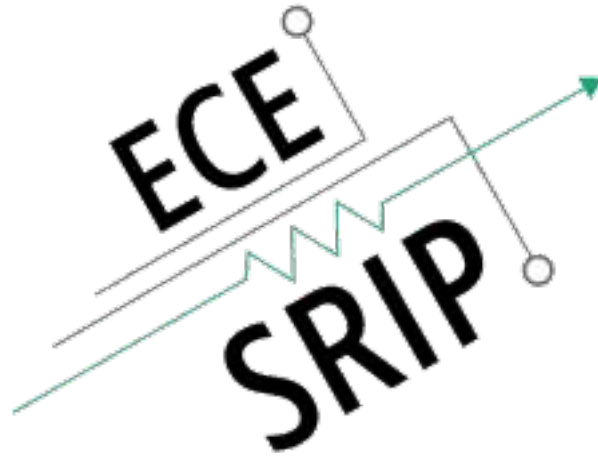
This project can accommodate both remote and in-person students.

INTERNS NEEDED
2 Students

PREREQUISITES
1. Python (Fluent and familiar with ML libraries), Machine Learning, Strong data analysis skills Sequential ML models (Not required but could be useful)

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PROJECT TITLE
Creating a Digital Twin of UCSD's CV2X Testbed

PROJECT DESCRIPTION
Description: UCSD researchers, in partnership with Qualcomm and CommSignia, have deployed commercial CV2X radios on campus, both at the roadside and on research vehicles. The project aims to push the boundaries of their communications capabilities to demonstrate the ability to share sensor data between vehicles and the roadside edge in order to enable collaborative perception - a multi-source sensor fusion technology that enables safer and more efficient roadways through enhanced environmental awareness. Real world characterizations are invaluable but are also expensive to scale and modify. Juxtaposing the physical testbed with its digital twin will lower development and integration times while enabling verification that UCSD's proposed algorithms still work at scale - which would otherwise be cost prohibitive. This SRIP project will seek to integrate multiple disparate works on simulating Connected Vehicles in order to enable end-to-end simulations of specific scenarios that can be replicated both in the physical and virtual worlds.

Principle activities will include:
1.) Create a custom map of a subset of UCSD's campus in the popular Autonomous Vehicle simulator CARLA (carla.org)
2.) Integrate results from Wireless Ray Tracing (remcom.com/wireless-insite-em-propagation-software) into NS3 for full stack simulation of V2X links (github.com/NXPmicro/V2X-PC5)
3.) Cross validate simulation and physical testbed application layer metrics and perform root cause analysis of any observed disparities
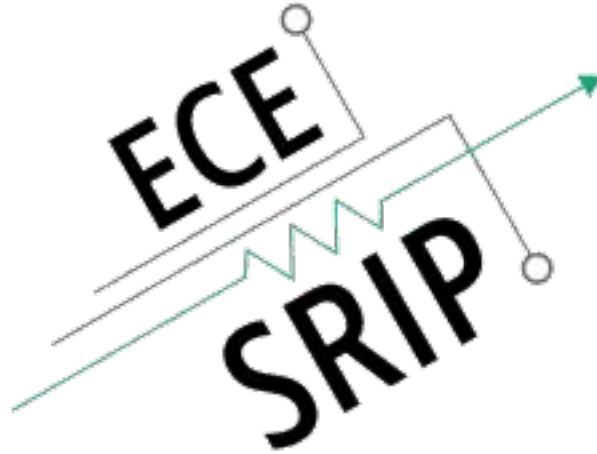
This project can accommodate both remote and in-person students.

INTERNS NEEDED
2 Students

PREREQUISITES
1. This project is heavy on software development and thus proven experience of working on large scale Python and/or C++ team projects will be highly beneficial.

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PROJECT TITLE
Explaining Wireless Protocols Learned via Reinforcement Learning

PROJECT DESCRIPTION
Description: Many position papers on 6G state that future networks will be driven by AI/ML. To this end, emerging research has explored inclusion of techniques such as Deep Reinforcement Learning (RL) across all layers of the protocol stack and showed their empirical benefits. However, a key impediment to their wide scale adoption will be the inability to theoretically analyze the machine designed protocols due to their inherent black box nature - this makes it difficult to determine when the developed protocols will fail and thus presents a high level of risk to their adoption. This SRIP project seeks to explore whether this can be remedied. Can we explain why the RL agent makes certain decisions? Can we use that explanation to simplify the policy into something more intuitive to a human engineer?

Principle activities will include:
1.) Reviewing literature on RL (e.g. spinningup.openai.com), its applications to wireless communications, and techniques for eXplainable AI (XAI) (e.g. github.com/slundberg/shap)
2.) Reproduction of a paper applying RL to wireless communications (e.g. arxiv.org/pdf/2108.07144.pdf)
3.) Distilling the RL policy into a human interpretable one - such as a Finite State Machine - via novel application of XAI techniques

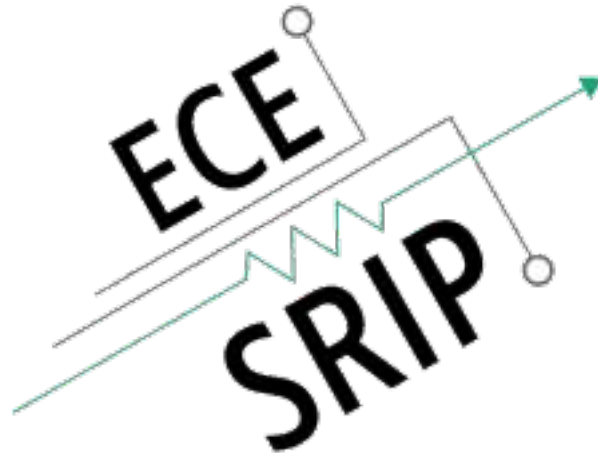This project can accommodate both remote and in-person students.

INTERNS NEEDED
1 Student

PREREQUISITES
1. The ideal intern will have prior research experience and completed projects involving neural networks and/or wireless communications.

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PROJECT TITLE
Using Wearables and Machine Learning to Enable Personalized Lifestyle Recommendations to Improve Blood Pressure

PROJECT DESCRIPTION
Description: The aim of this project is to investigate the relationship between blood pressure (BP) and health behavior (e.g. sleep, exercise, diet, stress, etc.) and to develop personalized health analytics and precision lifestyle recommendations. Using consumer wearable devices (which provide detailed health behavior like walking, exercise, stress, heart rate and sleep) and wireless BP monitors, we collect data from patients and use personalized machine learning techniques to understand how their BP is affected by certain lifestyle factors, and recommend specific lifestyle changes to implement via our mobile app.

This project can accommodate both remote and in-person students.

INTERNS NEEDED
2 Students

PREREQUISITES
1. The first position will involve: 1. Assisting with data collection and processing from patients in our ongoing trial 2. Investigating and implementing new modeling techniques for lifestyle and BP data 3. Reviewing literature/existing solutions related to the research. The ideal candidate will have completed a large-scale software design project, as part of a team of developers, during a course project, industry internship, or prior research experience. Beyond that, the candidate should be proficient in Python and have prior experience with machine learning projects.

2. The second position will focus on the research and development of a mobile application which enables engagement between our ML platform, patients and physicians. The ideal candidate will have completed a large-scale software design project and have iOS app development experience.
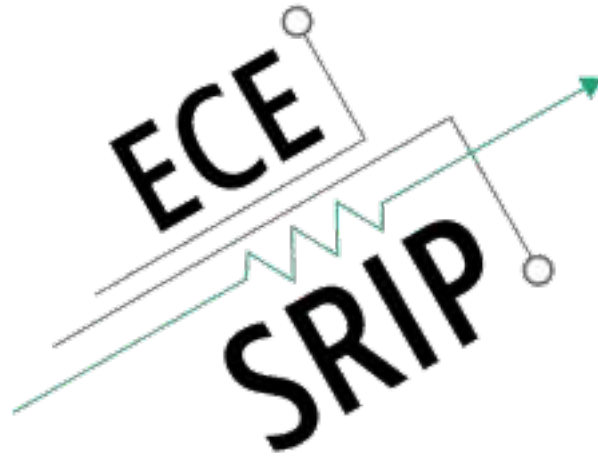
FACULTY MENTOR
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PROJECT TITLE
Driver's State of Mind and Intent Detection using Multiple Sensors and Machine Learning

PROJECT DESCRIPTION
Description: In this project, based on computer vision and deep learning (DL) techniques, we plan to develop a system for driver's state of mind (emotions, distraction, fatigue, etc) and intent detection. Towards this goal, we need to collect data from human subjects in laboratory and vehicle experiments, using sensors such as 3D and infrared cameras and wearable devices. And DL models will be trained on the collected data. Video sequences will be fed into the model and the driver's facial expressions will be detected to understand the driver's state of mind. Besides, vehicle telemetry data will also be used to determine the driver's intent. Early detection of negative states of mind and the driver's intent would be helpful to improve traffic safety.

This project can accommodate both remote and in-person students.

INTERNS NEEDED
1 Student

PREREQUISITES
1. The intern is expected to be skilled in ML/DL in Python. Beyond that, the candidate should have prior experience, or a desire to learn the following topics:
   - Image processing and computer vision techniques
   - Facial attributes/expressions analysis
   - Deep neural networks