FACULTY MENTOR
Nuno Vasconcelos

PROJECT TITLE
Datasets for Natural World 3D Computer Vision

PROJECT DESCRIPTION
Description: The last few years have shown that a critical component in the design of effective image classification systems is the availability of large training datasets. Additionally, 3D computer vision has become increasingly important with uses in VR and robotic navigation. We are interested in collecting datasets of objects under different 3D representations (eg mesh, point cloud, RGBD, multiview). These will then be used to train deep learning systems for 3D vision tasks such as 3D retrieval, classification, domain adaptation, and reconstruction. Furthermore, the dataset will be further used for the study of continuous learning for 3D object recognition. The project aims for top-tier conference publication.
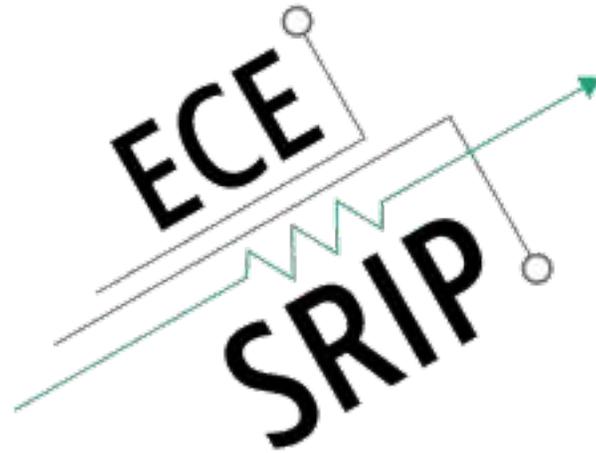
INTERNS NEEDED
MS & BS

PREREQUISITES
Required Qualifications:
1. Knowledge of one or more of the following: Python, Linux, computer vision, machine learning.
2. For master candidates, experience with deep learning is a plus.

FACULTY MENTOR

Nuno Vasconcelos

PROJECT TITLE

Long-tailed recognition of visual relationships

PROJECT DESCRIPTION

Description: Detecting visual relationships in images of the form of triplets t= (subject, predicate, object), such as "person eating an apple" or "person cutting an apple" is an important computer vision problem. It requires more reasoning and substantial training data compared to object detection. The long-tailed distribution of relations in existing datasets make this problem even harder. We will investigate on detecting meaningful visual relationships for such unbalanced datasets, especially semantic relationships with very few examples. This project is an on-going collaboration with Intel Research. The project aims for top-tier conference publication.
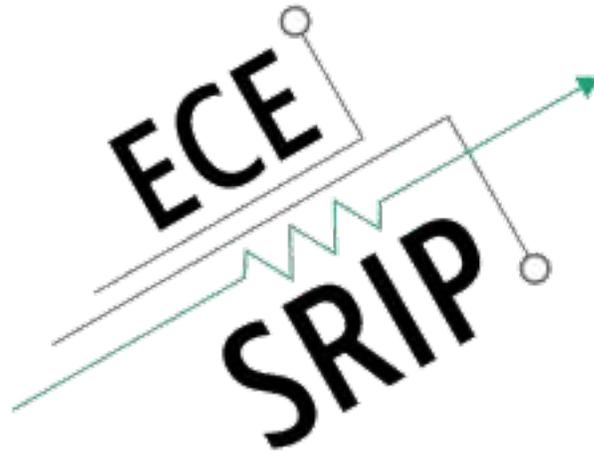
INTERNS NEEDED

MS only

PREREQUISITES

Required Qualifications:
1. Basic knowledge of mathematics, and to be adept with at least one commonly used programming language, such as C++, Python, Matlab
2. Stronger candidates will also have some knowledge in computer vision, and/or machine learning.
3. Experience with deep learning is a plus.

FACULTY MENTOR
Nuno Vasconcelos

PROJECT TITLE
Visualization guided machine teaching

PROJECT DESCRIPTION
Description: Deep learning has achieved great performance in many computer vision tasks in the recent past. However, it is still too hard to train systems for expert domains, such as medicine or biology, due to the limited ability of labeled training data. While platforms like Amazon Turk could solve this problem, the human labelers that they use frequently lack the expertise to annotate domain specific data. This project will focus on how to leverage visualization based explanations from deep networks to teach humans to label images from domains where they have no expertise. We will develop training algorithms algorithms, a platform to do this training on, and conduct experiments with human labelers to determine the effectiveness of machine teaching. This project aims both application and top-tier conference publication.
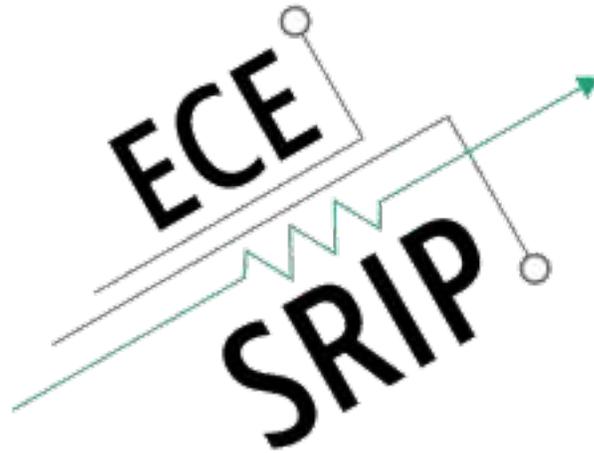
INTERNS NEEDED
MS or BS

PREREQUISITES
Required Qualifications:
1. Basic knowledge of mathematics, machine learning and computer vision, have APP and Web development experience
2. Experience with PyTorch is a plus.

FACULTY MENTOR
Nuno Vasconcelos

PROJECT TITLE
3D object detection with monocular images and radar data in Autonomous driving

PROJECT DESCRIPTION
Description: Accurate 3D object detection is critical for many autonomous driving tasks such as behavior planning and motion control. Past efforts have been exploiting accurate depth information in point cloud data collected from expensive LiDAR sensors or inferring depth using visual cues in RGB images obtained with ubiquitous low-cost cameras. However, neither method is both practical and reliable to deploy in mass production. Millimeter-wave automotive radar is a sensor equipped in many modern cars that can provide sparse yet accurate depth information. In this project, we aim to gain better 3D understanding of the autonomous driving environment by performing 3D object detection with both camera and radar data. The students will learn about current state-of-the-art methods in 3D object detection and the characteristics of automotive radar data. They will leverage deep learning systems and computer vision to effectively fuse the complementary information in camera and radar for 3D object detection. The project will explore the recently released public dataset with radar data NuScenes. This project aims for both application and top-tier conference publication
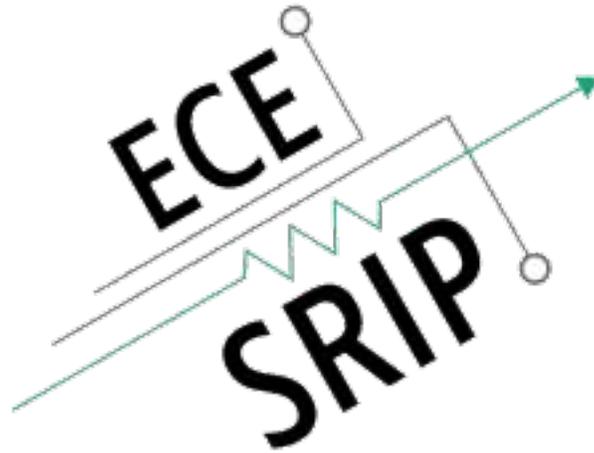
INTERNS NEEDED
MS only

PREREQUISITES
Required Qualifications:
1. Adept with Python, Linux operating system and at least one popular deep learning framework such as PyTorch, TensorFlow or MXNet.
2. Knowledge in computer vision and image processing is a plus

FACULTY MENTOR
Nuno Vasconcelos

PROJECT TITLE
Computational Cancer ImmunoPathology

PROJECT DESCRIPTION
Description: Biomarkers for cancer immunotherapy remain flawed, in part due to lack of spatial context and inability to profile immune cell populations in situte. Large scale annotated datasets are critical for learning effective classification networks. We will utilize novel spatial microscopic methods that incorporate transcriptional and proteomic information to isolate structural and functional information about immune cell populations from cancer specimens and utilize deep learning frameworks to train algorithms to understand the tumor immune microenvironment. The students will learn to operate the imaging apparatus for data collection, design protocols for analysing the resulting datasets, and train deep learning systems to understand how pose variability influences classification performance of immune cell populations in the tumor micro environment. This is an on-going project in collaboration with the UCSD Moores Cancer Center. This project aims for both application and top-tier conference publication.
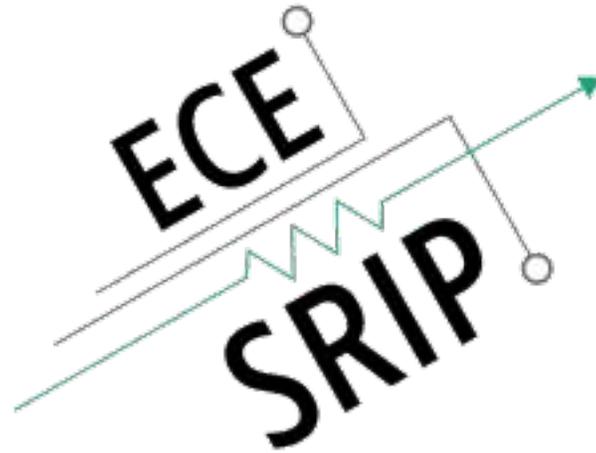
INTERNS NEEDED
MS or BS

PREREQUISITES
Required Qualifications:
1. Adept with at least one commonly used programming language, such as C/C++, Java, Python, or Matlab
2. Stronger candidates will also have some knowledge in computer vision, image processing, and/or machine learning
3. Familiarity with statistical software such as R may be beneficial.

FACULTY MENTOR
Nuno Vasconcelos

PROJECT TITLE
Reinforcement Learning for Underwater Communications

PROJECT DESCRIPTION
Description: In the last few years, reinforcement learning has emerged as a powerful techniques for addressing problems involving agents in adversarial or game playing environments. The project will develop reinforcement learning algorithms for improving communication in underwater environments, where agents have to communicate with minimum disruption to the environment and communication channels are complex. The students will learn about advanced machine learning techniques and advanced simulation environments. This is an on-going project in collaboration with the Scripps Institute of Oceanography. This project aims for both application and top-tier conference publication.
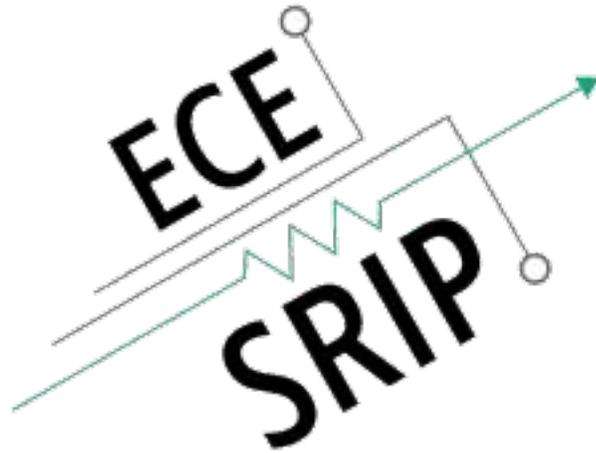
INTERNS NEEDED
MS only

PREREQUISITES
Required Qualifications:
1. Expected to be adept with at least one commonly used programming language, such as C/C++, Java, Python, or Matlab
2. Knowledge in Unit and game development is a plus

FACULTY MENTOR
Nuno Vasconcelos

PROJECT TITLE
Classification of point cloud data

PROJECT DESCRIPTION
Description: Various point cloud datasets have been recently introduced in computer vision. This data is quite important for applications such as smart cars, which rely on LIDAR data and similar sensors to improve sensing performance over what is possible with just cameras. We will investigate techniques for object recognition, detection, and segmentation of this type of data, using deep learning. This project aims for both application and top-tier conference publication.
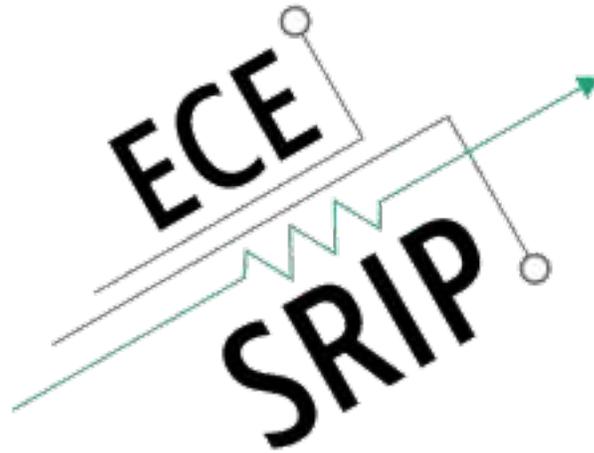
INTERNS NEEDED
MS only

PREREQUISITES
Required Qualifications:
1. Basic knowledge of mathematics, and to be adept with at least one commonly used programming language, such as C++, Python, matlab.
2. Stronger candidates will also have some knowledge in Linux, computer vision, image processing, and/or machine learning
3. Experience with deep learning is a plus

FACULTY MENTOR
Nuno Vasconcelos

PROJECT TITLE
Biological Imaging

PROJECT DESCRIPTION
Description: Large scale annotated datasets are critical for learning effective classification networks. To improve the scalability of the collection process, images are typically gathered using online search engines. However, these sources can be biased with respect to characteristics such as the object's pose. In this project, we aim at validating this hypothesis by collecting a large-scale dataset of plankton species with densely sampled poses. The students will learn to operate the imaging apparatus for data collection, design protocols for analysing the resulting datasets, and train deep learning systems to understand how pose variability influences classification performance of plankton images. This is an on-going project in collaboration with the Scripps Institute of Oceanography. This project aims for both application and top-tier conference publication.
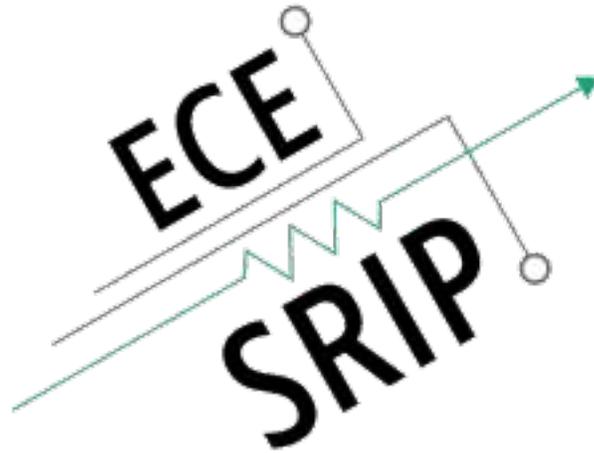
INTERNS NEEDED
MS or BS

PREREQUISITES
Required Qualifications:
1. Adept with at least one commonly used programming language, such as C/C++, Java, Python, or Matlab
2. Stronger candidates will also have some knowledge in Linux, computer vision, image processing, and/or machine learning

FACULTY MENTOR
Nuno Vasconcelos

PROJECT TITLE
Machine Learning for Clinical Decision Support

PROJECT DESCRIPTION
Description: When patients are admitted to health care facilities there is frequently a need to conduct imaging, which is expensive and sometimes inconvenient. There is interest, throughout the health-care system, in reducing the costs of unnecessary exams, but this is frequently difficult to implement. In this project we will investigate the design of machine learning algorithms to inform decisions regarding appropriate use of imaging based on individual patient data. The development of an algorithm which can be adapted for varied clinical scenarios could serve as a rapid first-pass procedure in response to a client request, and ultimately provide patient-centered care decisions regarding imaging. The students will learn about advanced machine learning and its deployment in the healthcare environment. This is an on-going project in collaboration with Neuroradiologists at UCSD Health.

INTERNS NEEDED
MS only

PREREQUISITES
Required Qualifications:
1. Adept with at least one commonly used programming language, such as C/C++, Java, Python, or Matlab
2. Stronger candidates will also have some knowledge in Linux, computer vision, image processing, and/or machine learning.