FACULTY MENTOR
Nuno Vasconcelos

PROJECT TITLE
Visual Grounding for Robotics

PROJECT DESCRIPTION
Description: Visual grounding (VG) is a computer vision problem, where the goal is to localize an object mentioned in a sentence within the 3D world. 3D computer vision is becoming increasingly important, due to its potential application in VR and robotic navigation. Unlike VG for 2D images, 3D VG requires the model to be robust to viewpoint shifts and object occlusion. Moreover, most 3D VG models should be deployed on edge devices, which have limited computing resources. The goal of this project is to design a 3D VG model with lightweight computation. Students will use language libraries like Hugging Face and 3D datasets like ReferIt3D. The project aims for top-tier conference publication.

Mentor: John Ho [Chih-Hui Ho <chh279@eng.ucsd.edu>]

This project will be remote in principle buts students will also have access to a lab, if they prefer it.

INTERNS NEEDED
2+ Students

PREREQUISITES

1. MS students

2. Experience with Python, Linux and at least one popular deep learning framework such as PyTorch is an advantage

3. Stronger candidates will also have some knowledge in computer vision or natural language processing
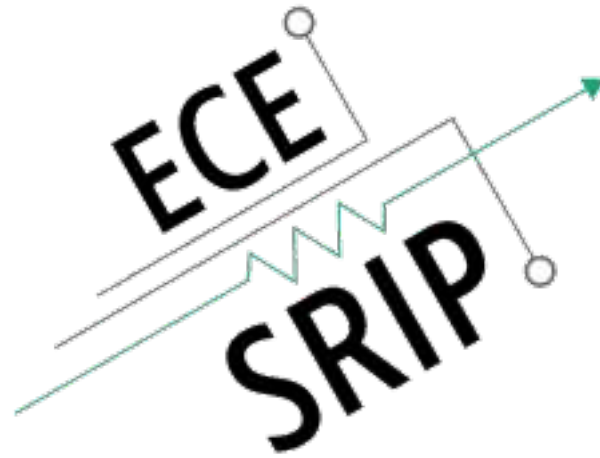
FACULTY MENTOR
Nuno Vasconcelos

PROJECT TITLE
An Iterative Framework for Dataset Collection

PROJECT DESCRIPTION
Description: While a wide spectrum of automated tools have been created for building deep learning

models in the past decade, dataset collection has remained a largely manual process with little systematic effort to account for bias in raw data or human annotations. The goal of this project is to build an iterative framework for dataset collection, annotator teaching and model training. Under this unified framework, new examples are automatically selected for human annotation, cleaned for label bias, and added to the dataset progressively. Neural network models are trained on each iteration of data, and model explanation techniques are used to create teaching examples that reduce the bias of crowd-source annotators. The whole framework aims to produce datasets that are optimal for machine learning, under multiple objectives, including classification accuracy and fairness. The project aims for top-tier conference publication.

Mentor: Yi Li <yil898@eng.ucsd.edu>

This project will be remote in principle buts students will also have access to a lab, if they prefer it.

INTERNS NEEDED
2+ Students

PREREQUISITES
1. MS and undergraduate students

2. Experience with Python, Linux and at least one popular deep learning framework such as PyTorch is an advantage

3. Stronger candidates will also have some knowledge in computer vision or natural language processing
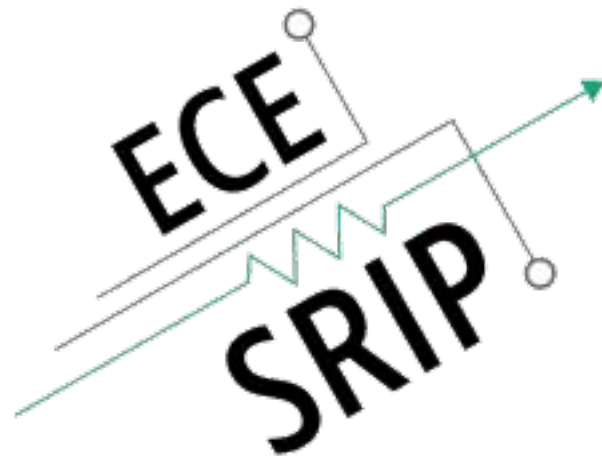
FACULTY MENTOR
Nuno Vasconcelos

PROJECT TITLE
Larger Vocabulary Few-Shot Classification for Machine Teaching

PROJECT DESCRIPTION
Description: Few-shot image classification is a popular computer vision problem. It aims to learn a

classifier from a limited number of labeled examples. Although well-studied in recent years, current solutions are unsuitable for many real world applications. This is, in large part, due to evaluation benchmarks that emphasize problems involving a few classes (5-way classification everyday categories. It is unclear if these methods will generalize to problems involving larger class vocabularies or fine-grained expert domains. In fact, existing experimental data suggests they will not. The goal of the project is to comprehensively explore this problem, develop large-vocabulary few shot classification algorithms, and apply them to the development of human-in-the-loop machine teaching systems, capable of teaching non-experts to annotate images of expert domains. The project aims for a top-tier conference publication.

Mentor: Pei Wang [Pei Wang <pew062@eng.ucsd.edu>]

This project will be remote in principle buts students will also have access to a lab, if they prefer it.

INTERNS NEEDED
2+ Students

PREREQUISITES
1. MS or undergraduate students, familiar with Python, Linux or having significant experience in HTML and JavaScript development
2. Experience with at least one popular deep learning framework, such as PyTorch, and some knowledge of computer vision is a plus
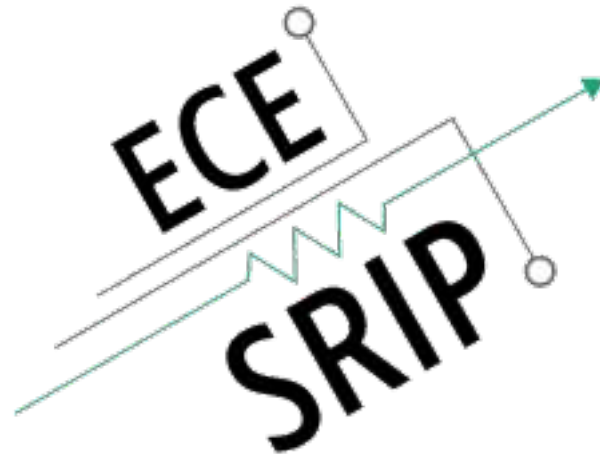
FACULTY MENTOR
Nuno Vasconcelos

PROJECT TITLE
Generalized Bird's-Eye View (BEV) Perception with Monocular Images

PROJECT DESCRIPTION
Description: The navigation of autonomous agents (e.g. smart home robots, cars) requires reasoning

about the 3D world. However, 3D sensors like LiDAR may not always be available, due to high cost and robustness problems. For most agents that work at a fixed height (e.g. on the ground), a bird's-eye view representation is sufficient to identify the navigable area. In this project, we are interested in training deep learning systems to estimate the BEV map from monocular images. We will investigate how to leverage geometric priors (e.g. door heights, object sizes) to map the 2D to this 3D representation. The project aims for a top-tier conference publication.

Mentor: Gina Wu [Tz-Ying Wu <tzw001@eng.ucsd.edu>]

This project will be remote in principle buts students will also have access to a lab, if they prefer it.

INTERNS NEEDED
2+ Students

PREREQUISITES
1. MS candidates are expected to be adept with Python and Linux
2. Stronger candidates will also have some knowledge in computer vision and experience with at least one popular deep learning framework such as PyTorch
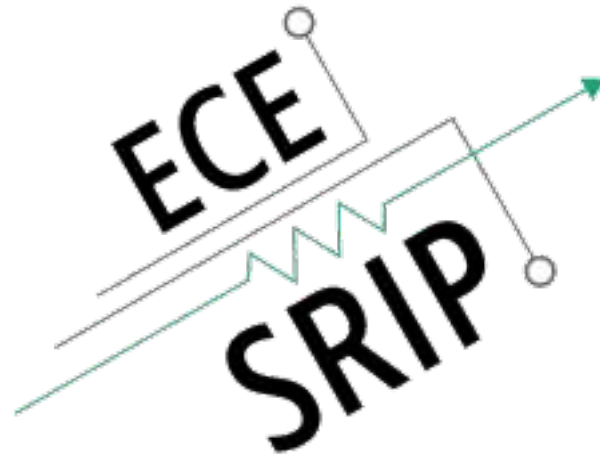
FACULTY MENTOR
Nuno Vasconcelos

PROJECT TITLE
Continual Taxonomic Learning

PROJECT DESCRIPTION
Description: People and animals learn continuously, without forgetting what they already know. This

is known as continual learning (CL), and of interest for many applications of computer vision and machine learning. While the CL problem is attracting attention from these communities, current definitions of the problem are quite narrow and have limited application. In this project, we want to develop methods for CL that learn in the same way as humans. A central component of human learning is the use of taxonomies and a taxonomic definition of CL, where we learn a little about many things first and then learn specific sub-areas in more detail. This gradual specialization is not captured by current CL tasks and systems. The project will both address the mathematical formulation of the problem and its solution using taxonomic CL, implemented with deep learning algorithms. The project aims for a top-tier conference publication.
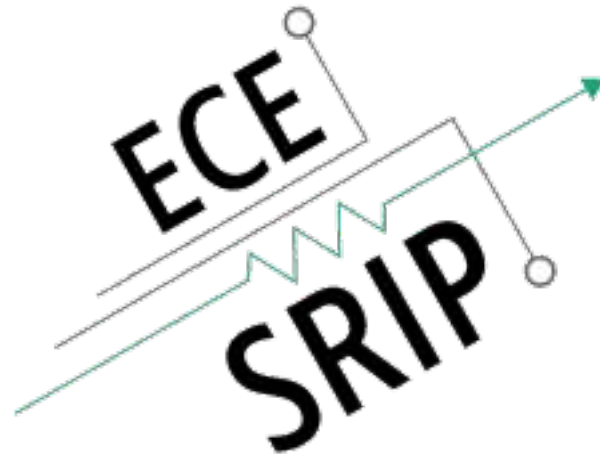
Mentor: Zhiyuan Hu <z8hu@ucsd.edu>

This project will be remote in principle buts students will also have access to a lab, if they prefer it.

INTERNS NEEDED
2+ Students

PREREQUISITES
1. MS students. Experience with Python, Linux and at least one popular deep learning framework such as PyTorch is an advantage
2. Stronger candidates will also have some knowledge in computer vision

FACULTY MENTOR
Nuno Vasconcelos

PROJECT TITLE
Action Induced 3D Detection

PROJECT DESCRIPTION
Description: Explainability is an important research topic for autonomous driving, due to the need to

build mutual trust between user and autonomous vehicle. Prior work (https://twizwei.github.io/bddoia_project/) has demonstrated that multi-task learning of vehicle action predictions improves 2D object detection and provides intuitive explanations for the actions performed by the autonomous vehicle. In this project, we extend the prior work from 2D to 3D sensors, such as LIDAR. We have collected an internal dataset that contains the intended driver's actions and corresponding explanations. Students will use large autonomous datasets like Waymo, along with our internal datasets, towards the training of deep neural networks. The project aims for top-tier conference publication.

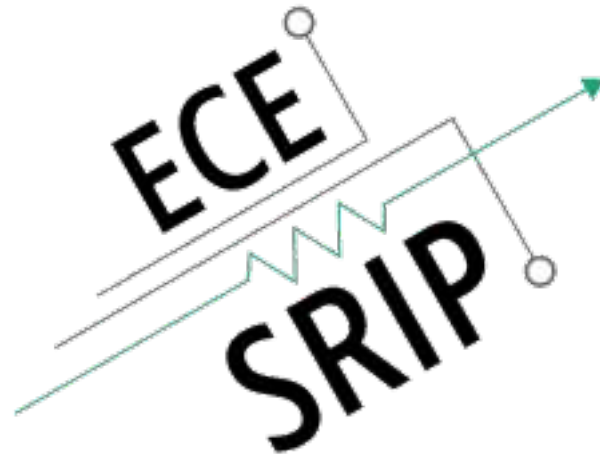Mentors: John Ho [Chih-Hui Ho <chh279@eng.ucsd.edu>], Gina Wu [Tz-Ying Wu <tzw001@eng.ucsd.edu>]

This project will be remote in principle buts students will also have access to a lab, if they prefer it.

INTERNS NEEDED
2+ Students

PREREQUISITES
1. MS students. Experience with Python, Linux and at least one popular deep learning framework such as PyTorch is an advantage
2. Stronger candidates will also have some knowledge in computer vision or autonomous driving

FACULTY MENTOR
Nuno Vasconcelos

PROJECT TITLE
Tire Defect Detection

PROJECT DESCRIPTION
Description: Automatic optical inspection (AOI) has been widely applied in the industry for

inspecting defects in the production line. In this project, we aim to design an AOI algorithm based on deep learning techniques to detect tire defects. This is a joint project with Prof. Nguyen and a Korean tire company. Students will use existing deep learning based detection algorithms to design an end-to-end AOI framework.

Mentor: John Ho [Chih-Hui Ho <chh279@eng.ucsd.edu>]

This project will be remote in principle buts students will also have access to a lab, if they prefer it.

INTERNS NEEDED
2+ Students

PREREQUISITES
1. BS, MS students
2. Experience with Python, Linux and at least one popular deep learning framework such as PyTorch is an advantage
3. Stronger candidates will also have some knowledge in computer vision