Project Title: **Rules of Failure**
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EECS 149/249A Project Proposal, Fall 2020

## Project Goal
Falsify a perception module conducting segmentation labeling in a dynamic environment in order to identify rules of scenarios leading to falsifications and successes.

## Project Approach
This project will train a perception module, generate data based on whether the model is already trained to a satisfactory enough level for our environment or not, model and generate dynamic occlusion scenarios, and falsify dynamic environments, to eventually achieve the project's goal of identifying rules causing falsifications and success.

## Resources
We will use a to-be-determined publicly available pre-made perception module with a detailed description of its task and evaluation metric, and a simulation environment using Edward Kim's server. The first step in the project would be to train the perception module using segmentation labeling and/or bounding box, and have the perception module running in CARLA (see https://carla.readthedocs.io/en/latest/). Then, depending on if the pre-trained model is trained to a satisfactory enough level for our environment or not, the second step will be to generate data. For the third step we will then model and generate dynamic occlusion scenarios in SCENIC (see https://scenic-lang.readthedocs.io/en/2.x/tutorials/dynamics.html), and then use SCENIC in conjunction with VerifAI (see https://verifai.readthedocs.io/en/latest/) to falsify dynamic environments using the above-mentioned scenarios, in order to eventually identify rules of scenarios leading to perfect labelling with the highest probability and of those leading to failure in labelling with the highest probability. Time permitting, we will create a white-box perception module analysis for rule definition as well. We will also be utilising Edward Kim's paper on "A Programmatic and Semantic Approach to Explaining and Debugging Neural Network Based Object Detectors" (see https://arxiv.org/pdf/1912.00289.pdf) as a guide and reference tool for our project.

## Schedule
- October 26: Meet with Edward Kim regarding this project's scope and ideas
- October 28: Project Proposal Submission (this document)
- November 4: Successfully be running perception module in CARLA
- November 6: Milestone 1 Submission
- November 13: Prepared outline for behaviors of agents in simulation
- November 15: Milestone 2 Submission
- November 17/19: Milestone 2 Presentation

- November 25: Modelled and implemented dynamic occlusion scenarios in SCENIC
- December 2: Falsified (high-depth) the perception module using those scenarios
- December 6: Identified rules causing falsifications/successes based on their probability
- December 9: (TBC) Prepared white-box perception module analysis for rule definition
- December 14: Project Poster and Demo Prepared
- December 15: Project Expo, Project Poster and Demo Presentation
- December 18: Project Report and Peer Evaluations Submission

**Risk and Feasibility**

There are many unknowns and challenges, The Perception Module might not be accurate in a simulation environment, which could hinder progress until accurate predictions can be made. Running falsification on a dynamic environment will be exceptionally time-consuming and power-intensive (requiring GPUs). Rules might be difficult to identify in dynamic environments.

**Github Link:** https://github.com/arjunsd/perception-falsification