# Benjamin Zhao

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Carleton College Senior Integrated Comprehensive Capstone (Comps)

**Background**

For my senior capstone project, or comps as Carleton likes to call it, exploration took place in two specific tasks for the perception step of an autonomous driving car: semantic segmentation and instance segmentation. Then I investigated the impact of adverse weather on the performance of these tasks and implemented multiple mitigation strategies to bring performance back up to the baseline. At the heart of this project was also the usage of the simulator CARLA to produce an image dataset with semantic segmentation ground truth values and a video dataset (of frames at 6 fps) with instance segmentation ground truths.

**Abstract**

Autonomous vehicles rely on computer vision to perceive their environment and operate safely within it, but the effects of weather and lighting such as rain, fog, and night can significantly impact the performance of vision systems. For reliable integration into traffic, autonomous vehicles' computer vision must be robust to the varying effects of weather. We measured the effects of weather on semantic segmentation and tracking models with simulated data, and then implemented three approaches to mitigate the effects of weather: domain adaptation with fine tuning, de-weathering model input, and multimodal sensor fusion. We collected image and lidar data on city driving scenes in the CARLA simulator across four scenarios: clear day, foggy day, rainy day, and clear night. After obtaining baseline performance for models trained on each of these scenarios, we evaluated our mitigation strategies. We show improvements in cross-domain performance for each of these methods and compare the merits and demerits of each approach.