Self-Driving Vehicular Project

Team Members:
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Introducing the Team

Adarsh Narayanan
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Christopher Sawicki
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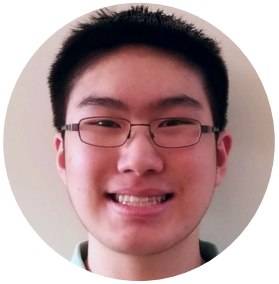

Brandon Cheng
Rutgers ECE UG

Aleicia Zhu
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Suhani Sengupta
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Joshua Menezes
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Tommy Chu
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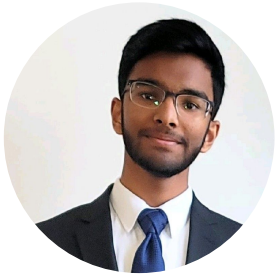

Ruben Alias
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Ranvith Adulla
High School

Arya Chhabra
High School

Goal:

Build two model cars that are able to drive through the miniature smart city

RASCAL

Robotic Autonomous Scale Car for Adaptive Learning

- Restricted to real car movement
- Use machine learning to drive autonomously

SCAMP

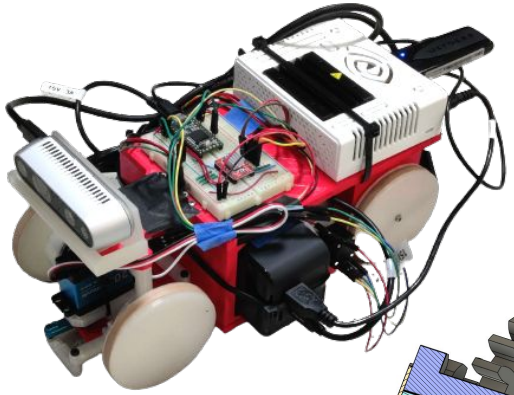
Self-guided Computer Assisted Mecanum Pathfinder

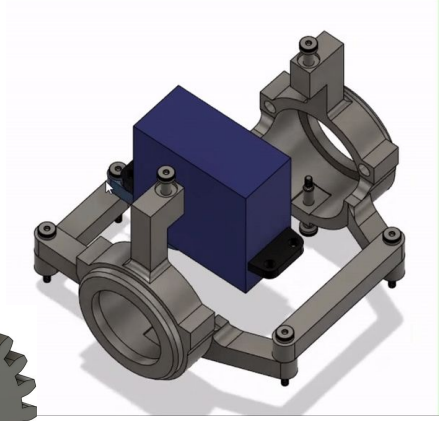
- Mimic a real car's path
- Simulate traffic for autonomous car

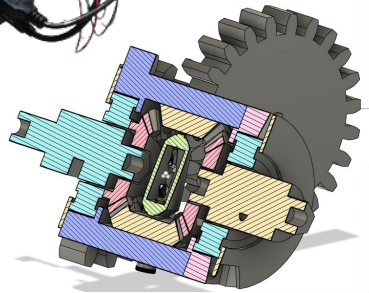
RASCAL

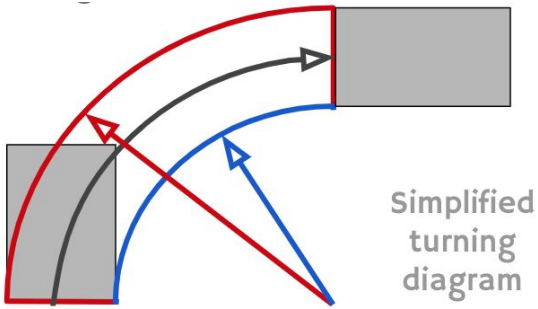
(Robotic Autonomous Scale Car for Adaptive Learning)

- Ackerman Steering
- Differential gear system
- Imitate a real car's motion

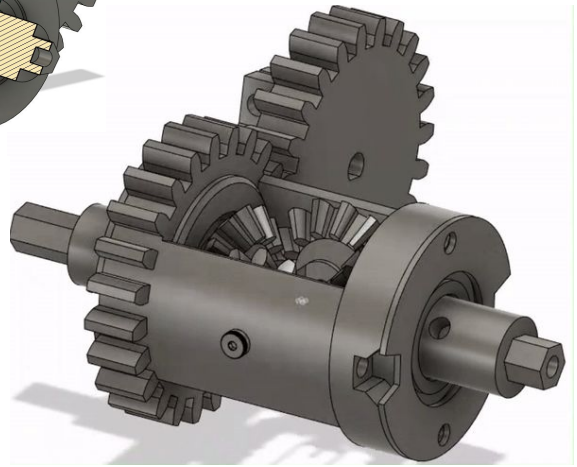




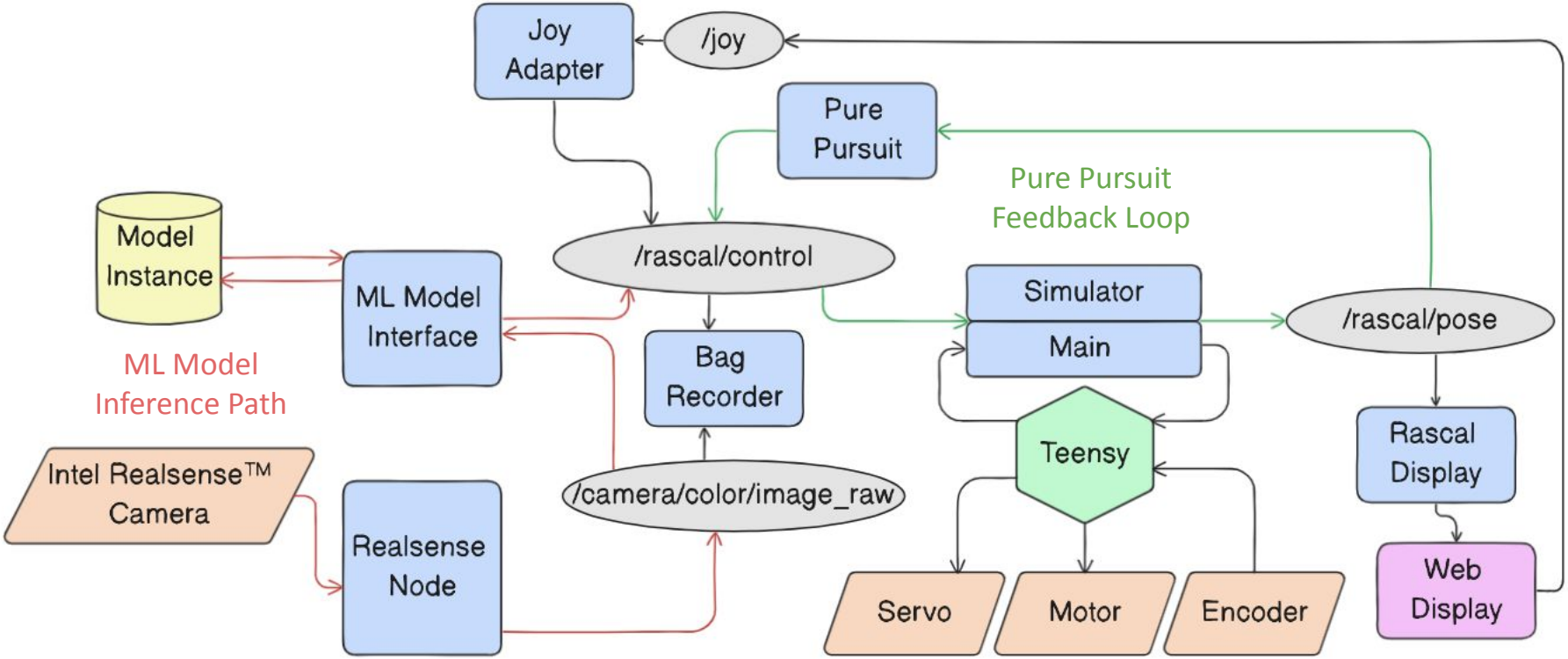




Simplified turning diagram



Software Architecture



Web Display

- Provides visual interface
- ROS node runs Flask server
- Add commands and points from any ROS node

e.g. city outline,

commands for car parameters (speed & pos),

editing paths/pure-pursuit

Commands

get commands

Path/AddPoint

x: 0 y: 0 Run Command

Path/DeletePoint

index: 0 Run Command

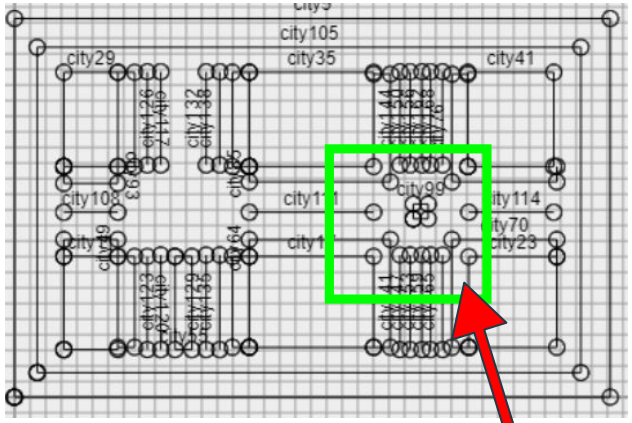
Path/GetLookahead

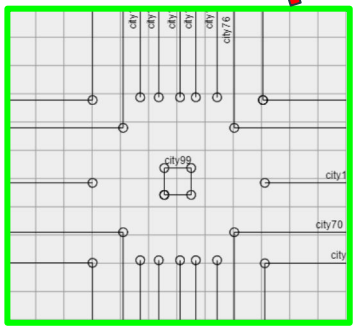
lookahead_dist: 1 start_index: 0 x: 0 y: 0 Run Command

Path/InsertPoint

index: 0 x: 0 y: 0 Run Command

Graphs

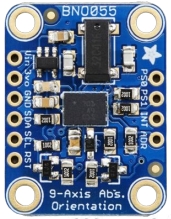


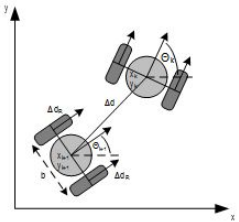


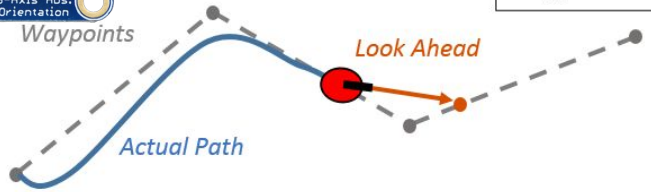
Intersection

Pure Pursuit

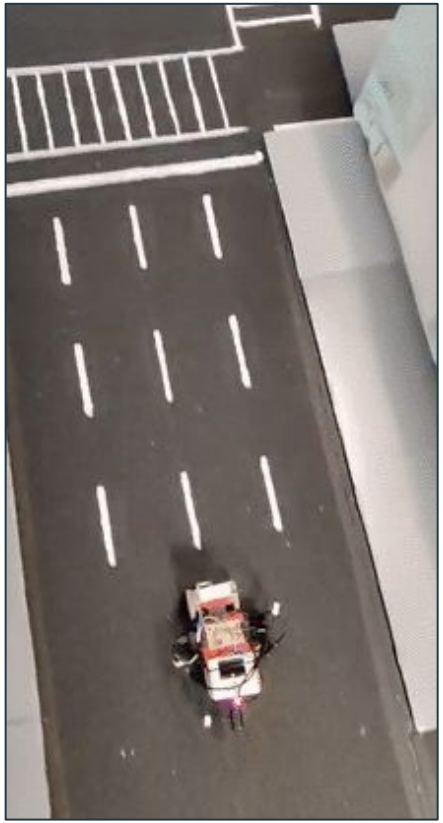
- Goal: Consistently follow a path
- Path following algorithm
  - Create path on web display
  - Car self-adjusts to stay on path
- Odometry to track car position





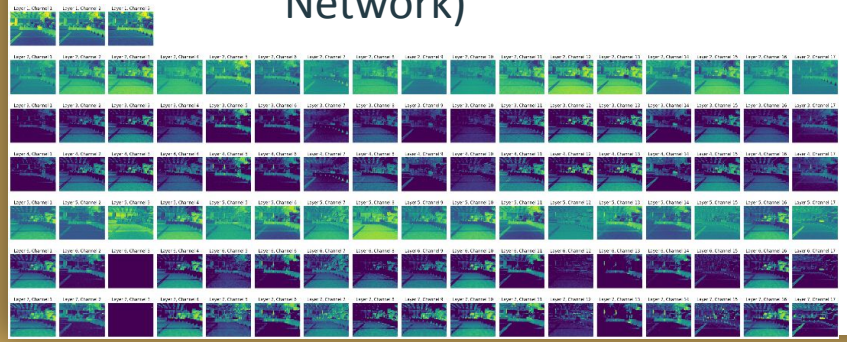


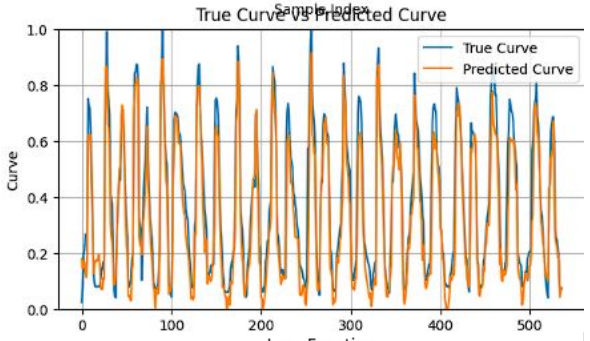
Results:

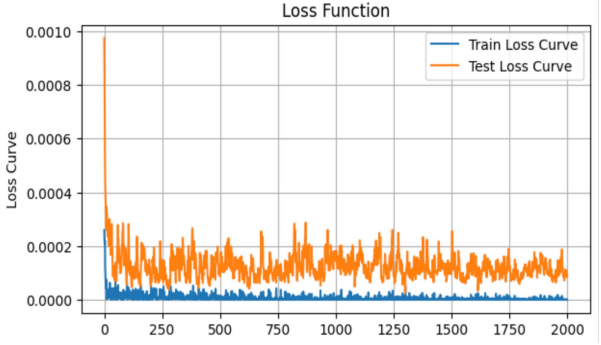


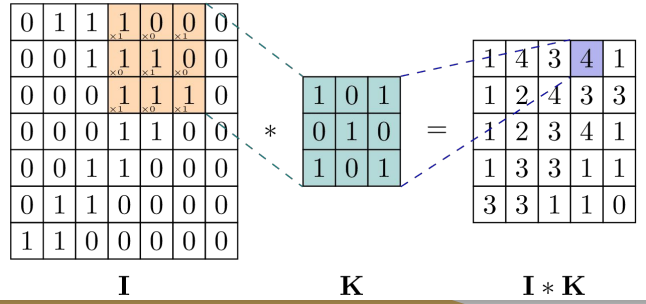
Machine Learning

- Goal: drive using just camera feed
- Does **not** require pre-programmed path
- Learns from example data collected by pure pursuit
- Pytorch
  - Imitation Learning Model
  - CNN (Convolutional Neural Network)

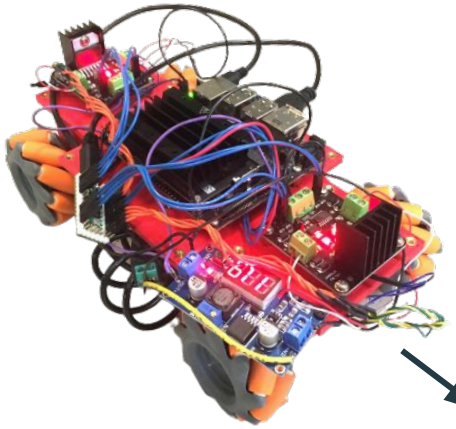




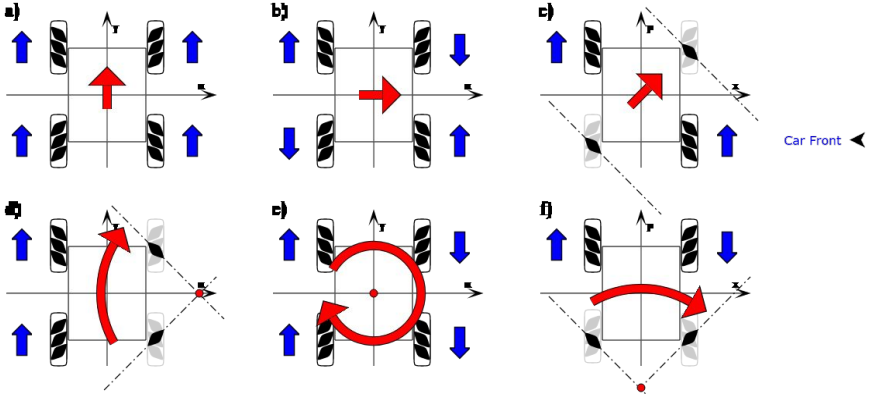


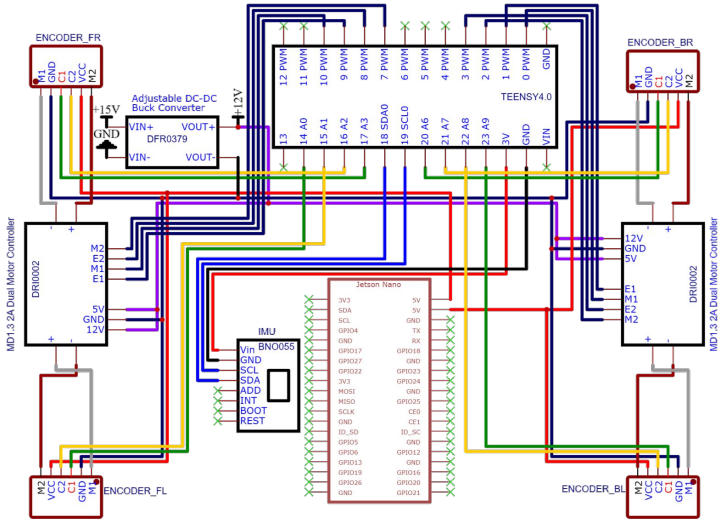


SCAMP
(Self-guided Computer Assisted Mecanum Pathfinder)



- Path following
- Mecanum wheels
- Documentation to replicate





SCAMP: Data Flow

Jetson Nano Computer

world (x, y)

Flask Server

goal (x, y)

Web server

goal (x, y, θ)

Serial

world (x, y)

Motor + Encoder

relative (x, y, θ)

Teensy 4.0 Microcontroller

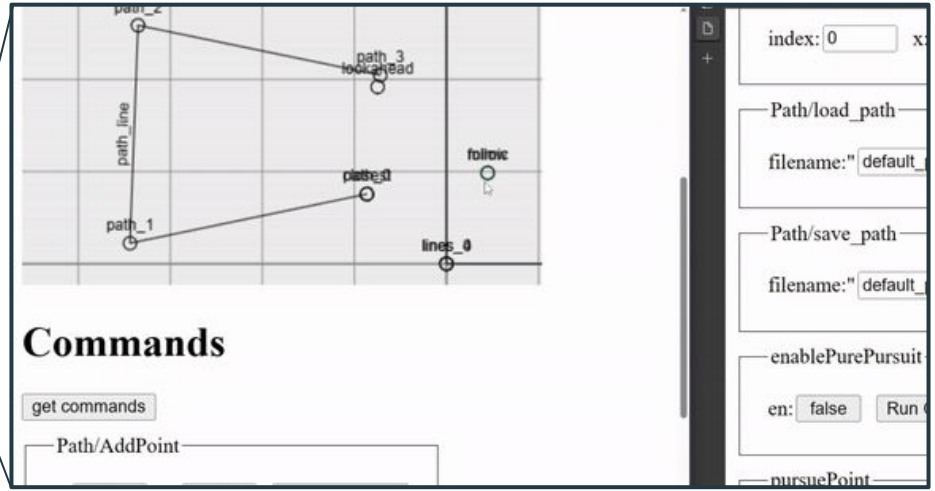
θ

Inertial Mass Unit (IMU)

Raw motor signal

Motor Driver

Motor power + motor direction



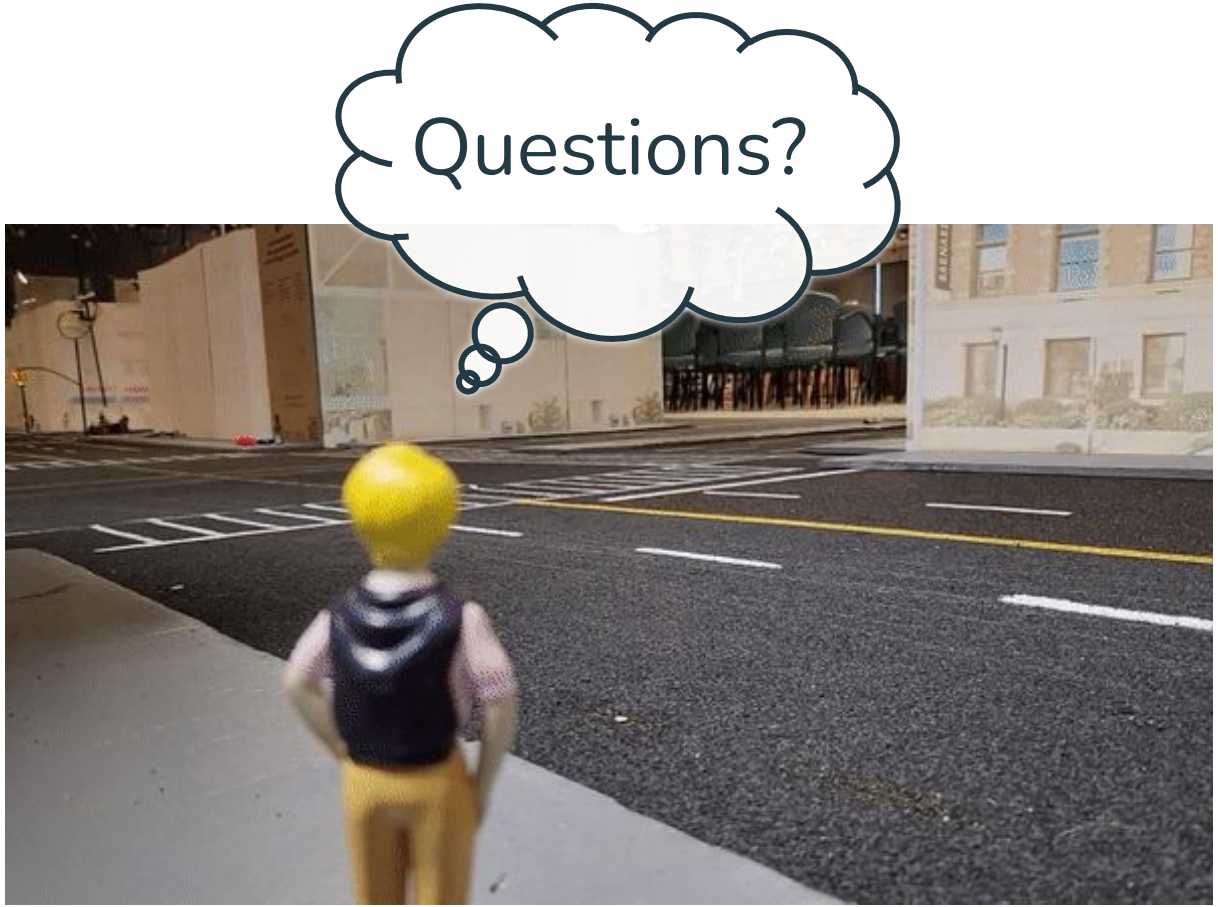
Future

RASCAL

- Simultaneous localization and mapping (SLAM)
- Integration with intersection cameras or larger field of view

SCAMP

- Self orientation (SLAM/Intersection Cameras)
- Path extraction from video
- Instantaneous speed


Questions?