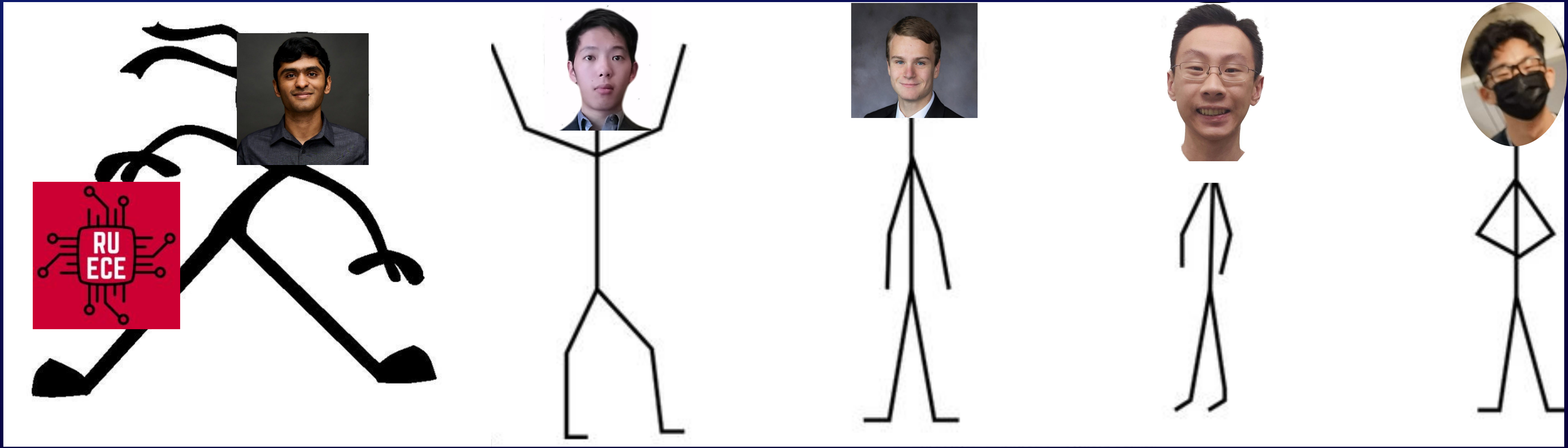
5G Edge Cloud Application

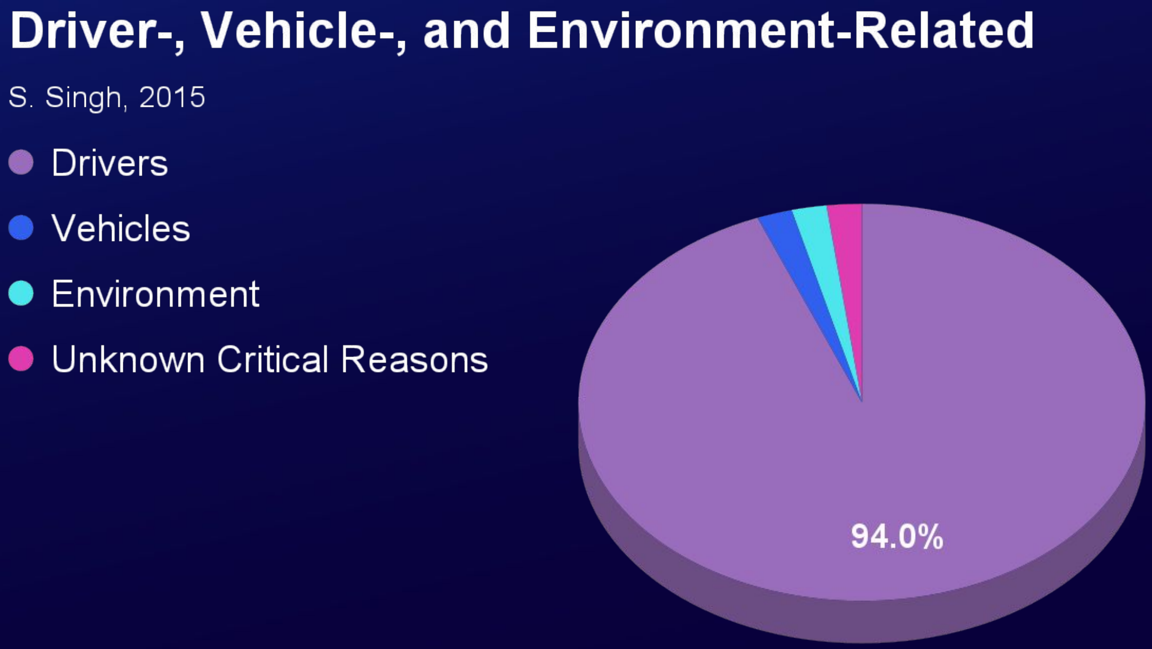
Ji Wu, Damon Lin, Vineal Sunkara, Steven Nguyen, Matt Arigo

Meet the Team



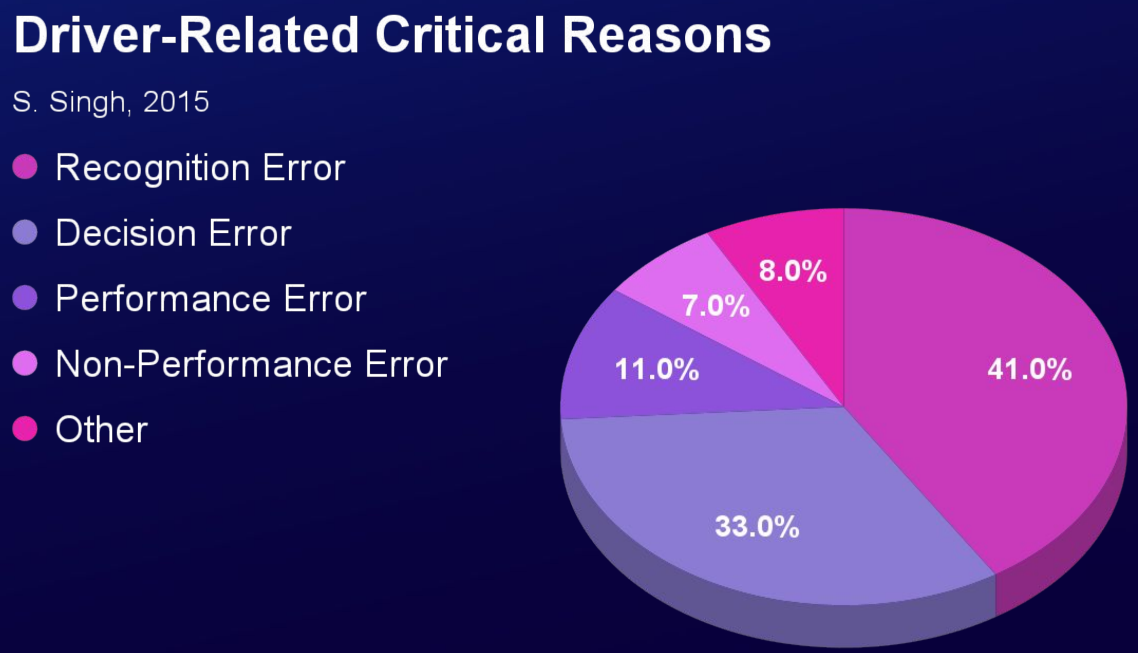
From left to right: Vineal Sunkara, Ji Wu, Matt Arigo, Steven Nguyen, Damon Lin

Humans cause majority of accidents



Singh, Santokh. Critical reasons for crashes investigated in the national motor vehicle crash causation survey. No. DOT HS 812 115. 2015.

Humans cause majority of accidents



Singh, Santokh. Critical reasons for crashes investigated in the national motor vehicle crash causation survey. No. DOT HS 812 115. 2015.

Why connect vehicles together?

Blind corner

Obscured sensor
(fog ↔ cameras)

Icy roads
(road conditions)

Self-driving cars will improve safety

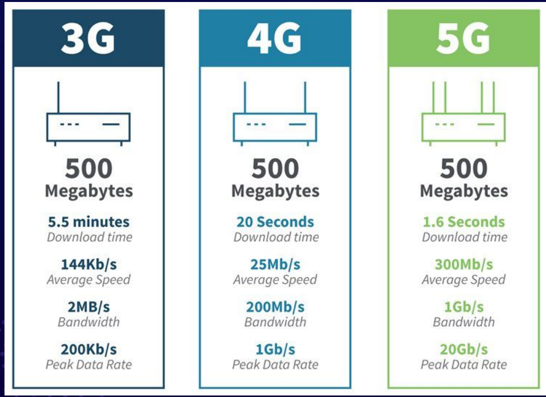
- Alkis et. al. designed a control algorithm for self driving that improves road safety significantly

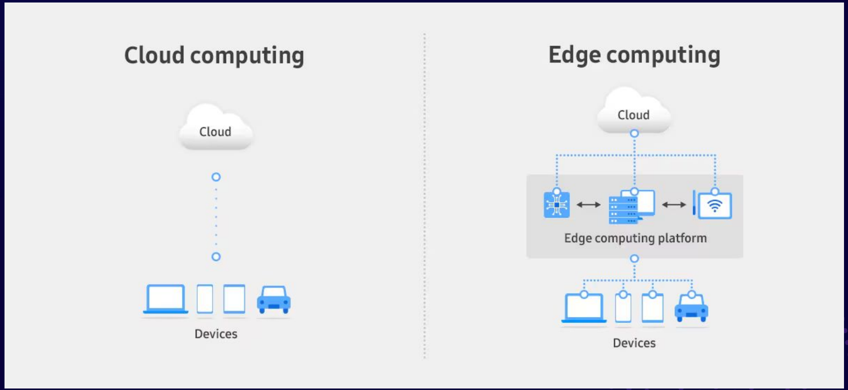
	Percent of Self-Driving Cars on Roads			
	25%	50%	75%	100%
Reduction of Conflicts	12-47%	50-80%	82-92%	90-94%

Alkis Papadoulis, Mohammed Quddus, Marianna Imprialou, Evaluating the safety impact of connected and autonomous vehicles on motorways, Accident Analysis & Prevention, Volume 124, 2019, Pages 12-22, ISSN 0001-4575, https://doi.org/10.1016/j.aap.2018.12.019.

What is 5G Edge Computing?

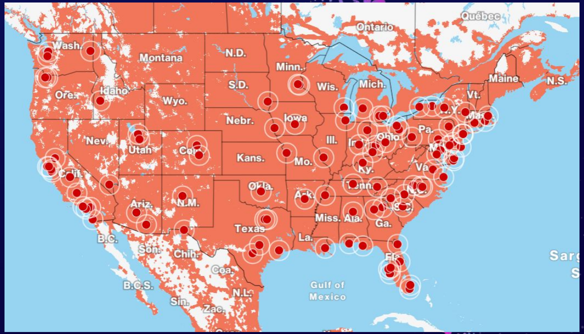
- 5G is the next generation of cellular communication
- Edge computing moves cloud computers close to the 5G base station
  - Cloud computing is done in data centers that can be far from vehicles

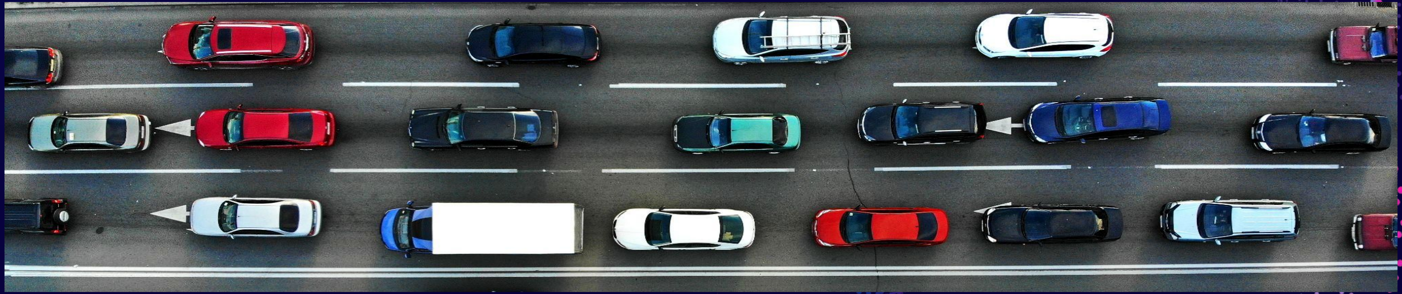


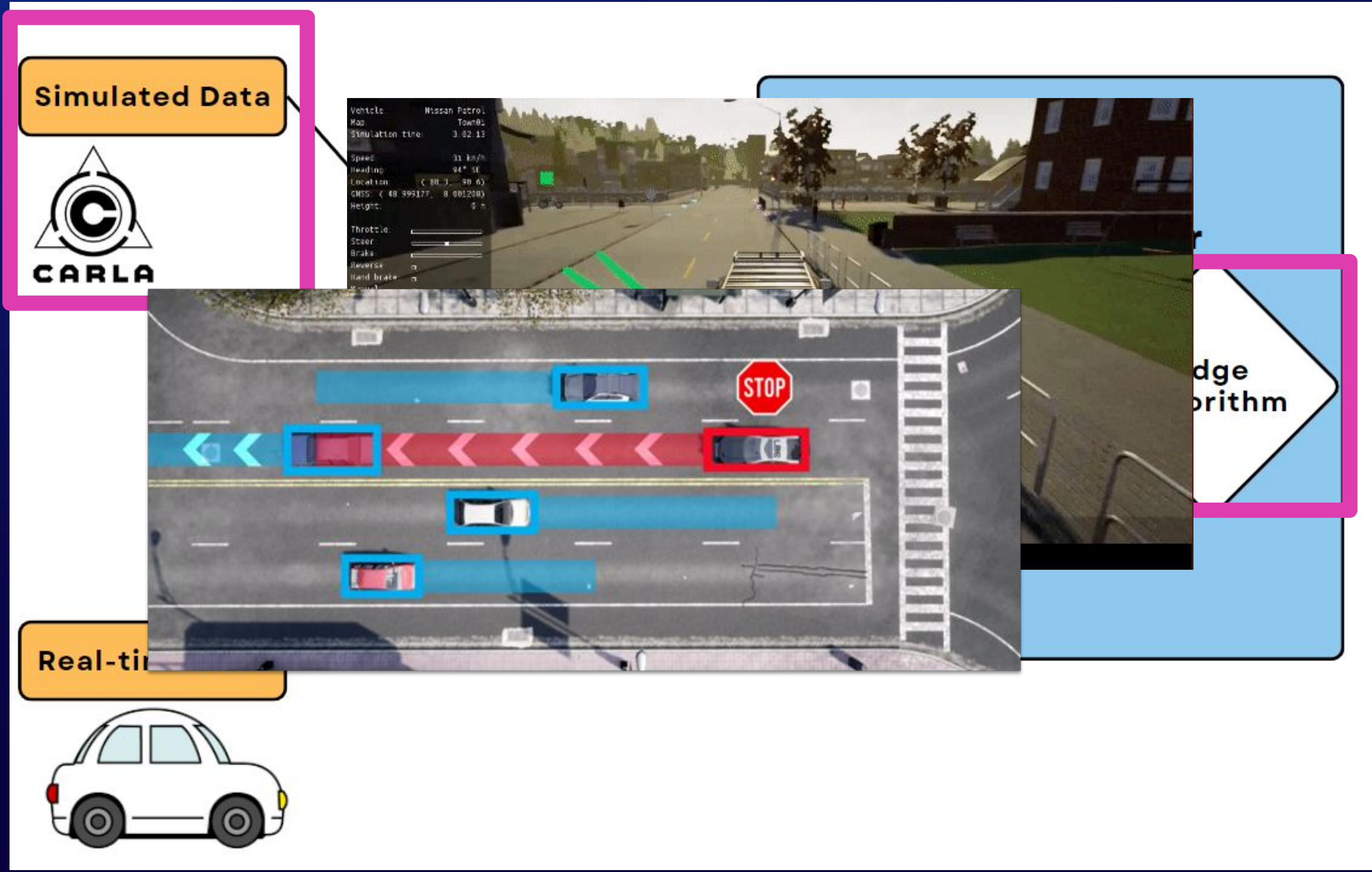


Project Goals

- Experimentally test safety parameters
    - Minimum latency
    - Reliability guarantees
    - Scalability
- Load test profile network performance
    - High density of cars



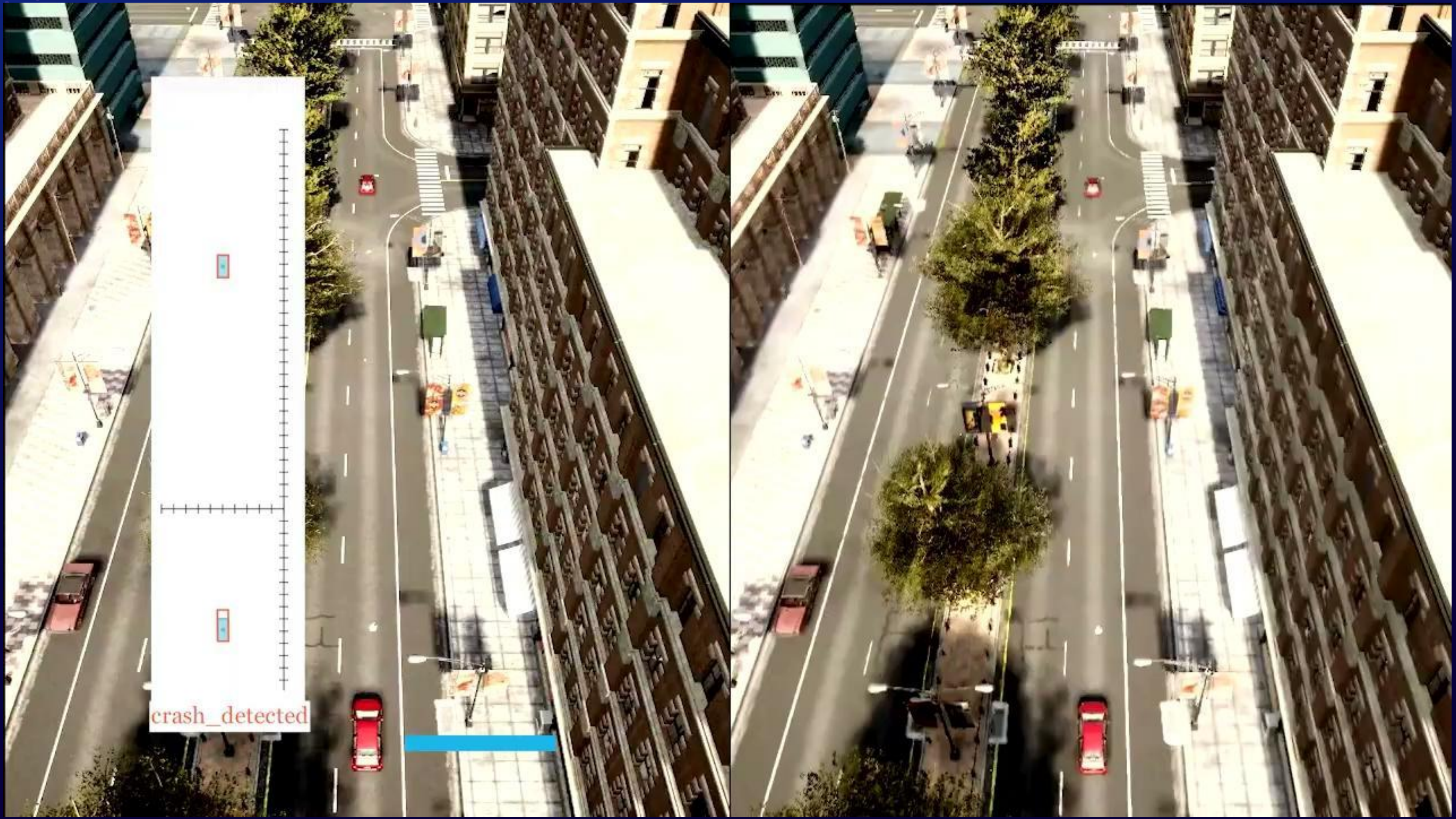



Simulated Data
CARLA
STOP

What do we have to show?

- Two scenarios with functional edge algorithm.
- Built Dockerfile to help with deployment of broker, subscribers, and publishers.
- Fully documented aforementioned components to guide and support future students and researchers

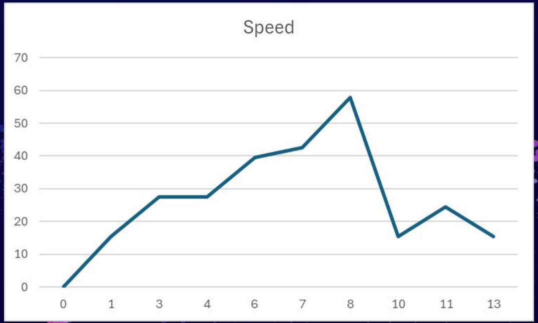
Case 1: Following Vehicle



Case 2: Head-on Collision

Bonus Work: Real Time Data

- OBD-II emulators can simulate vehicle diagnostics in real time
- Sent live data from the emulator to the broker
- Subscriber received data

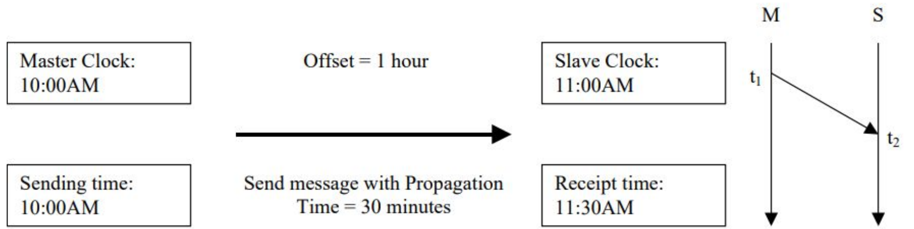


This is the car

Measuring Time

MS_difference = slave's receipt time – master's sending time

90 minutes = 11:30 – 10:00




```
AVG OFFSET:  -1536785.364151001ns
AVG DELAY:  1353586.4353179932ns


MIN OFFSET:  -17216563.22479248ns
MIN DELAY:  -3390312.1948242188ns


MAX OFFSET:  14008402.824401855ns
MAX DELAY:  22832870.483398438ns

Done!
pi@raspberrypi:~/IEEE1588-PTP/master $
```

Future

- Integrating a **machine learning** algorithm with our kinematical model.
    - Lane changes, weather condition, road work
- **Scale up** current system to handle more vehicles and external factors.
    - Could utilize large datasets or traffic simulations

THANK YOU!

Questions?

Special thanks to Ivan Seskar, Jenny Shane, Anthony Magnan, and verizon