DARPA Challenges

- 2004, 2005: 100+ miles across the desert
- 2007: 60+ miles with other cars, on roads
Cornell’s Autonomous Car

Feb 18, 2007: First drive

Feb 24, 2007: Fast Reverse
A Typical Self-Driving Car

- Lidar
- Camera
- Radar
- GPS
- Antenna (for maps)
- Computers
- Microcontroller rack
- Servers
- Actuation controllers
Software Pipeline for Autonomous Driving

Sensor Data → Perception → Information → Planning → Actions
Technology: Perception (Data -> Info)
Technology: Mapping
Technology: Planning (Info -> Actions)
Technology: Deep Learning
Levels of Automation: Dept of Transportation

HUMAN DRIVERS MONITOR THE DRIVING ENVIRONMENT

0. No Automation
1. Driver Assistance
2. Partial Automation

AUTOMATED DRIVING SYSTEM MONITORS THE DRIVING ENVIRONMENT

3. Conditional Automation
4. High Automation
5. Full Automation
Current Technical Challenges

- reliance on maps
- environments: poor weather, at night, sunlight
- more/faster learning
- driver-autonomy transitions
- security
Current Non-Technical Challenges

- trust
- regulations
- insurance
- cost
- driving abilities atrophy
- mixtures of human driven and automated cars
Key Players

- Car companies
  - Tesla, GM, Ford, Mercedes, Toyota, Volvo, ...
- Electronics/software companies
  - Google/Waymo, Uber, Nvidia, Samsung, Baidu, ...
- Startup companies
  - particularly electric vehicle (EV)
- Sensor technology
  - particularly lidar, radar
How will our lives change?

- Safer
- More time
- Enable some populations (e.g. elderly, disabled)
How will our lives change?

• More efficient cities
  – Fewer cars, garages
• Less fuel
• More green space
What jobs will be impacted?

- taxis, uber/lyft, bus, truck drivers
- shipping, delivery
- battery/storage tech
- ad/sales
- lawyers
- car support: dealers, washes, mechanics, gas stations, financing...
When will all this happen?

• Near term (structured)
  – taxis in cities
  – trucks on highways

• Longer term (unstructured)
  – multiple functions (highway AND city)
  – L5 (no steering wheel)