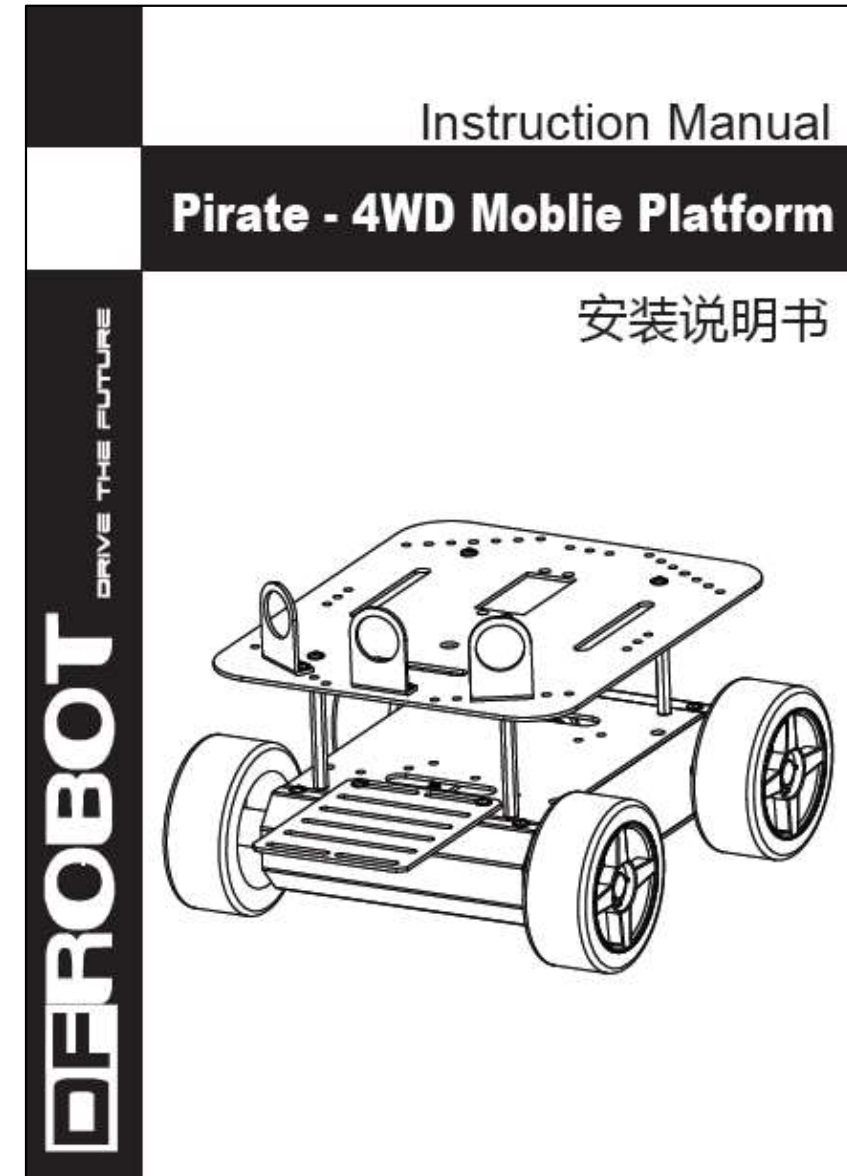# ENPM 809T

UMCP, Mitchell

ENPM809T: Autonomous Robotics

- Learn the theoretical, algorithmic, & **implementation** aspects of the main techniques of robot autonomy
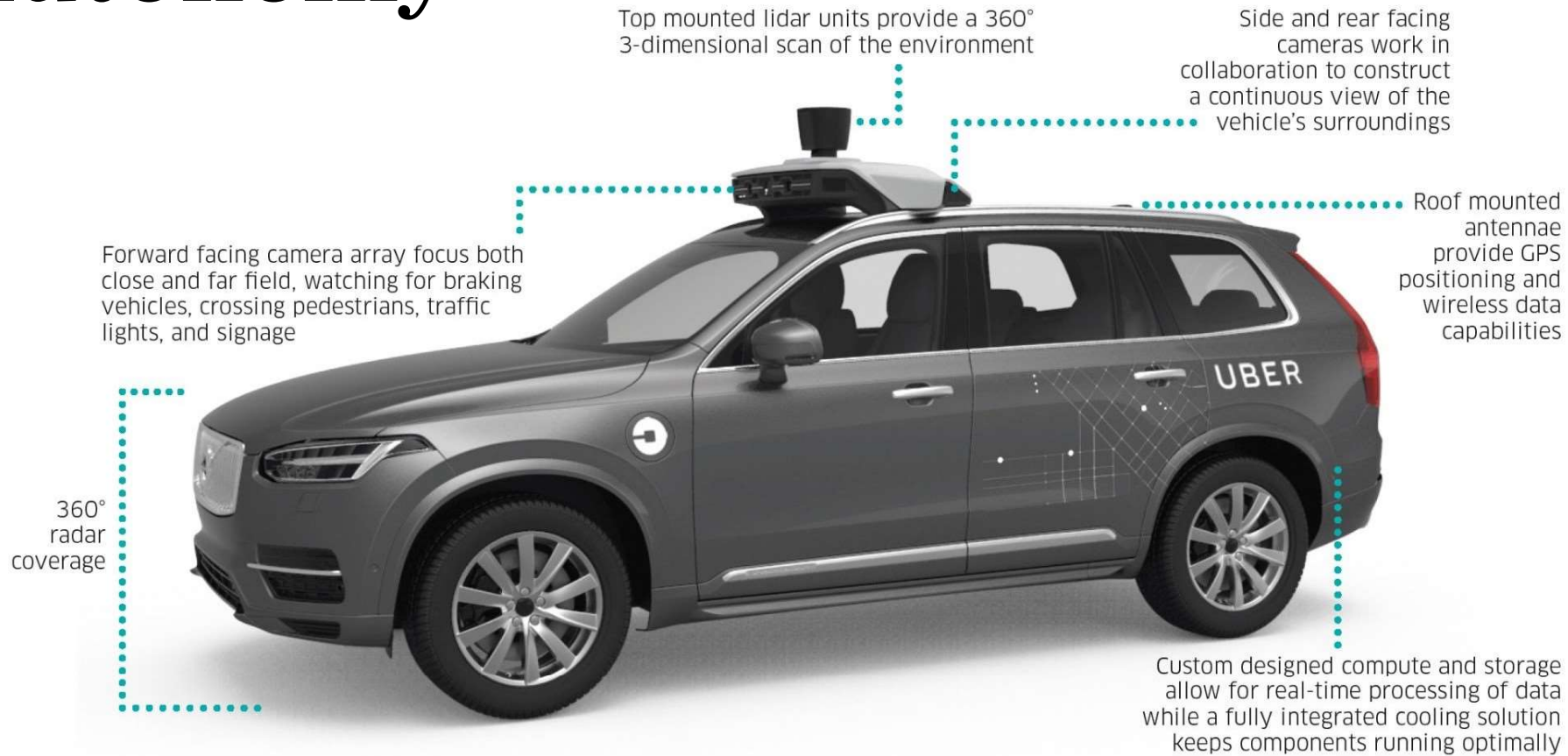
- **Bring** hardware & software **to life**

Instruction Manual
Pirate - 4WD Moblie Platform
安装说明书

DFROBOT
DRIVE THE FUTURE

Automation

Autonomy

Autonomy

Top mounted lidar units provide a 360° 3-dimensional scan of the environment

Side and rear facing cameras work in collaboration to construct a continuous view of the vehicle's surroundings

Forward facing camera array focus both close and far field, watching for braking vehicles, crossing pedestrians, traffic lights, and signage

Roof mounted antennae provide GPS positioning and wireless data capabilities

360° radar coverage

Custom designed compute and storage allow for real-time processing of data while a fully integrated cooling solution keeps components running optimally

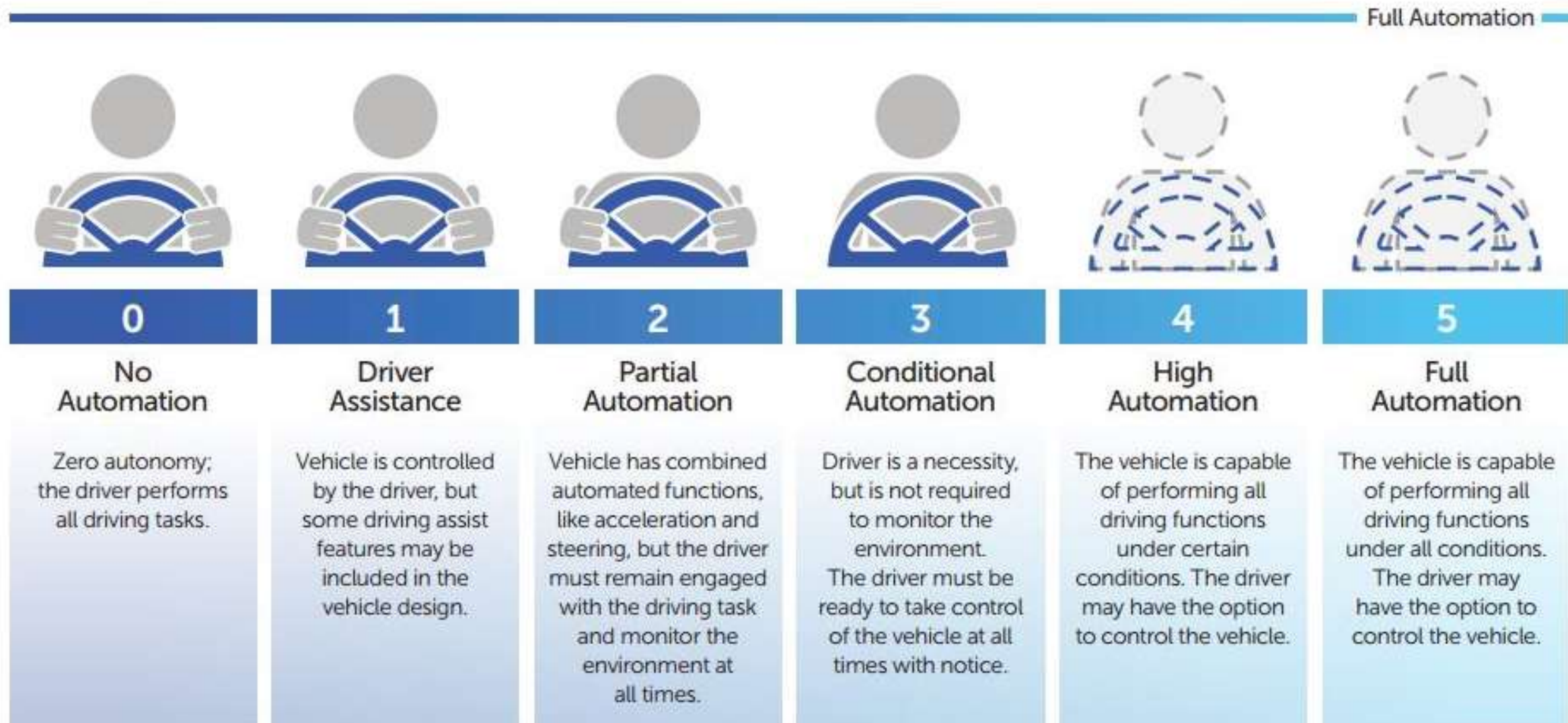## Self Driving Uber sensor suite

7 Cameras
1 Laser
Inertial Measurement Units

Custom compute and data storage
360° radar coverage

Autonomy
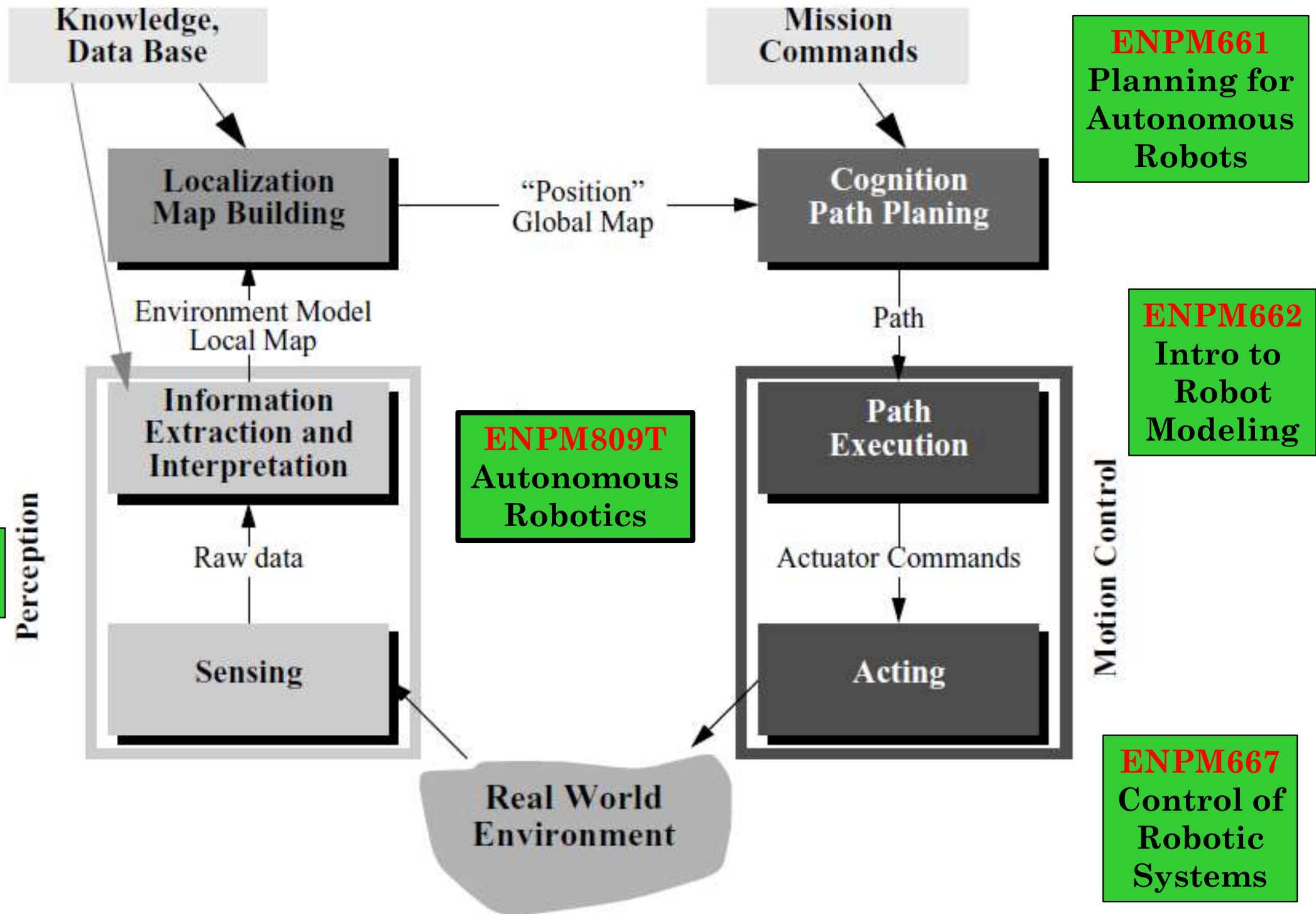
0	1	2	3	4	5
No Automation	Driver Assistance	Partial Automation	Conditional Automation	High Automation	Full Automation
Zero autonomy; the driver performs all driving tasks.	Vehicle is controlled by the driver, but some driving assist features may be included in the vehicle design.	Vehicle has combined automated functions, like acceleration and steering, but the driver must remain engaged with the driving task and monitor the environment at all times.	Driver is a necessity, but is not required to monitor the environment. The driver must be ready to take control of the vehicle at all times with notice.	The vehicle is capable of performing all driving functions under certain conditions. The driver may have the option to control the vehicle.	The vehicle is capable of performing all driving functions under all conditions. The driver may have the option to control the vehicle.

Autonomy

- AV's changing our definition of mobility now
  - Waymo in Phoenix
  - nuTonomy & Lyft in Boston

- 46 corporations working on AV's (as of April 2019)

- Expected market growth from $54 billion in 2019 to **$556 billion** in 2026

Knowledge, Data Base

Mission Commands

ENPM661 Planning for Autonomous Robots

Localization Map Building

"Position" Global Map → Cognition Path Planing

ENPM662 Intro to Robot Modeling

Environment Model Local Map

Path

Information Extraction and Interpretation

ENPM809T Autonomous Robotics

Path Execution

Raw data

Actuator Commands

ENPM673 Perception

Perception

Sensing

Acting

Motion Control

Real World Environment

ENPM667 Control of Robotic Systems

ENPM 809T: Autonomous Robotics

8

Course structure

- Lecture
  - Tuesdays or Thursdays, 4:00pm to 6:40pm
  - Notes posted on ELMS, (hopefully) in advance

- Homework
  - Roughly weekly

- In-class activities

- Project

UNIVERSITY OF
MARYLAND

ENPM 809T Course Syllabus
Mitchell, Spring 2021 v.1

ENPM 809T – Autonomous Robotics: Spring 2021 Syllabus

Master of Engineering Program in Robotics

Lecture Details	Section 0201	Section 0101
	Mondays from 4:00 pm to 6:40 pm	Thursdays from 4:00 pm to 6:40 pm
	Online only	Online only
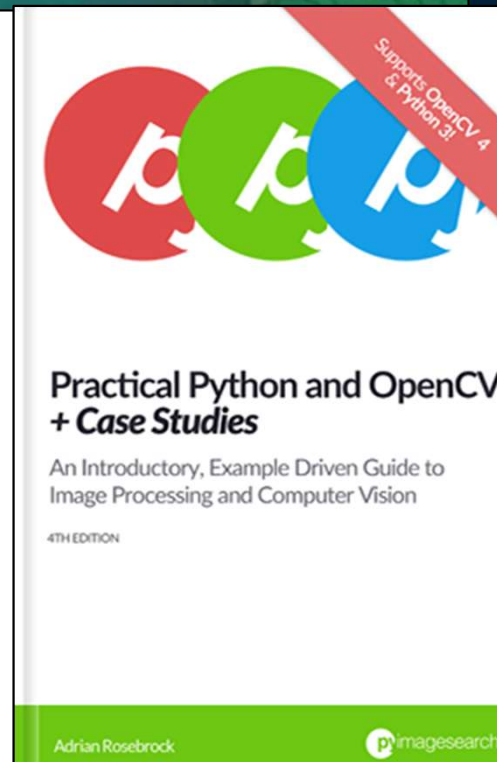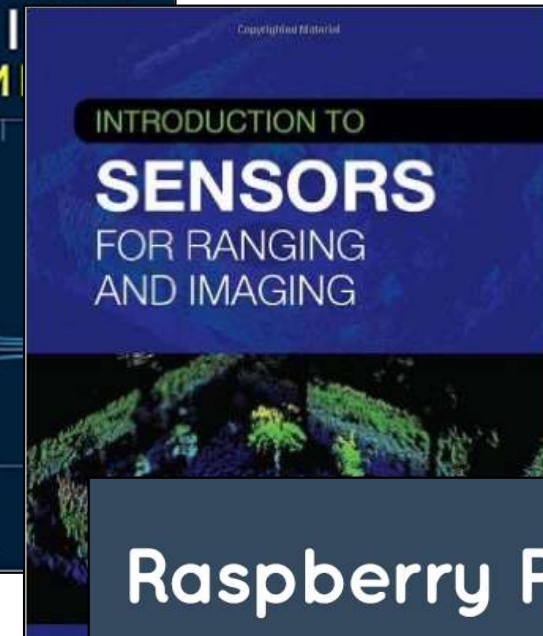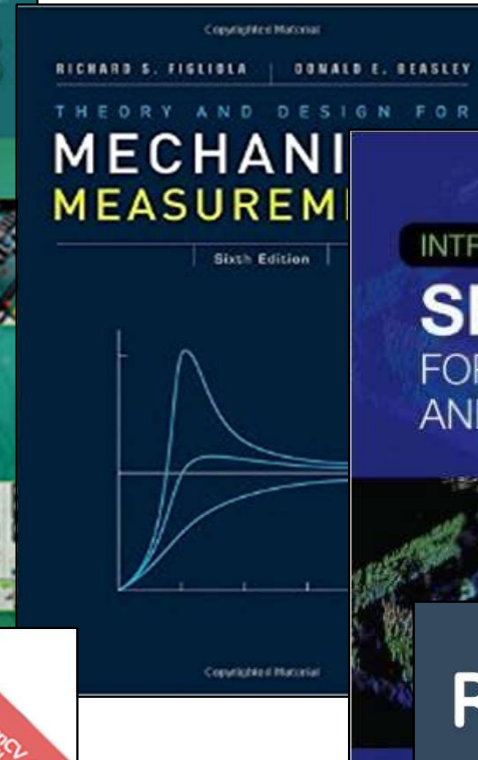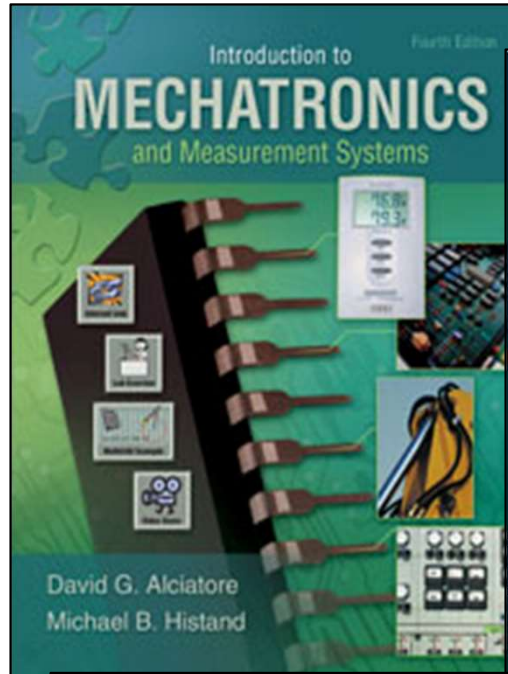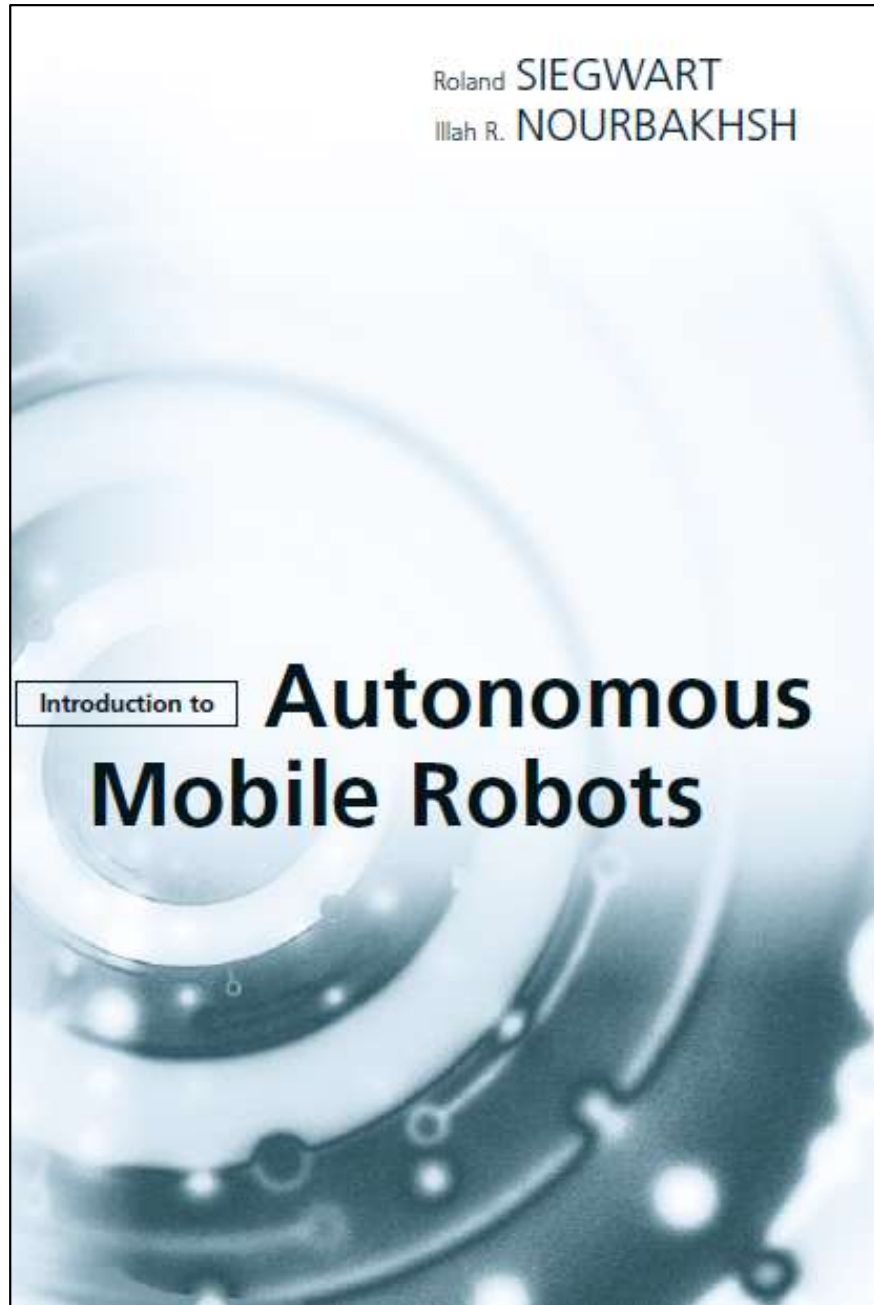
Grading policy

- 80%   Assignments & Exercises

- 20%   Final Project

Course structure

- All homework submitted, graded, and returned via Gradescope

- Head to **Gradescope.com** and ensure you can access the course

Course outline

Perception

Locomotion & Kinematics

Localization

Planning & Navigation

Final Project

Knowledge, Data Base

Mission Commands

Localization Map Building

"Position" Global Map

Cognition Path Planing

Environment Model Local Map

Path

Information Extraction and Interpretation

Path Execution

Raw data

Actuator Commands

Sensing

Acting

Perception

Motion Control

Real World Environment

809T Parts Kit

- Available from OAEE office

- Ensure all **batteries** are **charged** prior to lecture

- Laptop

- Raspberry Pi

References

- *Autonomous Driving Lvels 0-5 and Implications*
  - https://cleantechnica.com/2017/12/02/autonomous-driving-levels-0-5-implications/

- *AA 274: Principles of Robotic Autonomy*, Marco Pavone
  - http://asl.stanford.edu/aa274/

- *The importance of sensor data fusion for autonomous driving*, Andreas Haja
  - https://www.linkedin.com/pulse/importance-sensor-data-fusion-autonomous-driving-andreas-haja/

- *Lyft and nuTonomy form strategic partnership to optimize passenger experience in self-driving cars*
  - https://www.nutonomy.com/press-release/nutonomy-lyft-partnership/