

**Module 1, Lesson 1**

# Taxonomy of Driving Automation



UNIVERSITY OF TORONTO  
FACULTY OF APPLIED SCIENCE & ENGINEERING

# In this module ...

- Taxonomy of driving automation
- Requirements for perception
- Driving decisions and actions

# In this lesson ...

- Basic definitions
- Requirements for automation classification
- The driving task
- Taxonomy for driving automation (levels)
- Limitations of this taxonomy

# Terms and Definitions

- Driving task
  - Perceiving the environment
  - Planning how to reach from point A to point B
  - Controlling the vehicle
- Operational Design Domain (**ODD**)  
*operating conditions*

# How to classify driving system automation?

- Driver attention requirements
- Driver action requirements    *steer, change lanes, ...*
- What exactly makes up a driving task?

# What makes up a driving task?

- **Lateral control** - steering



# What makes up a driving task?

- Lateral control - steering
- Longitudinal control - braking,  
accelerating



# What makes up a driving task?

- **Lateral control** - steering
- **Longitudinal control** - braking, accelerating
- **Object and Event Detection and Response (OEDR)**: detection, reaction



# What makes up a driving task?

- **lateral control** - steering
- **longitudinal control** - braking, accelerating
- **object and event detection and response (OEDR)**: detection, reaction
- **planning**
  - long term (route)
  - short term



# What makes up a driving task?

- **lateral control** - steering
- **longitudinal control** - braking, accelerating
- **object and event detection and response (OEDR)**: detection, reaction
- **planning**
  - long term (route)
  - short term
- **miscellaneous**  
*signaling indicators  
hand waving...*



www.shutterstock.com • 317843138

# Autonomous Capabilities

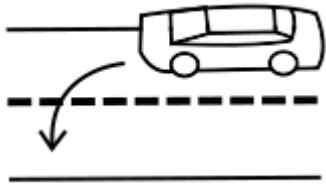
- Automated lateral control?
- Automated longitudinal control?
- OEDR
  - Automatic emergency response
  - Driver supervision
- Complete vs Restricted ODD

# Level 0 - No Automation

- Regular vehicles, no automation

# Level 1 - Driving Assistance

Lateral Control



Longitudinal Control

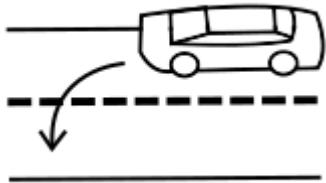


Either, but  
not both

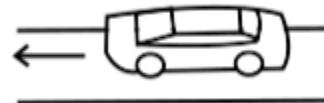
- Examples
- **Adaptive Cruise Control**
    - can control speed, driver has to steer
  - **Lane Keeping Assistance**
    - can help you stay in your lane, if you drift

# Level 2 - Partial Driving Automation

Lateral Control



Longitudinal Control



Both

*Driver monitoring always required.*

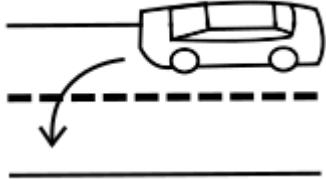
- Examples
- GM Super Cruise
  - Nissan ProPilot Assist
  - ... *Tesla*



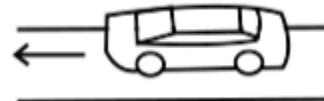
www.shutterstock.com • 682215370

# Level 3 - Conditional Driving Automation

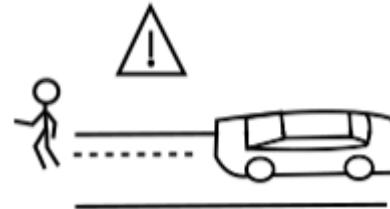
Lateral Control



Longitudinal Control



OEDR



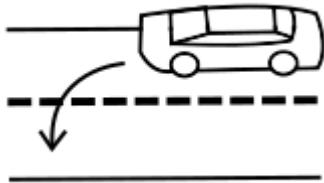
Includes automated object and event detection and response

Examples { : Audi A8 Sedan  
...}



# Level 4 - High Driving Automation

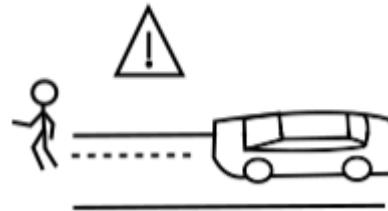
Lateral Control



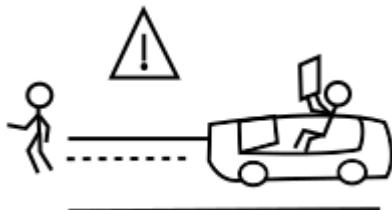
Longitudinal Control



OEDR



Fallback



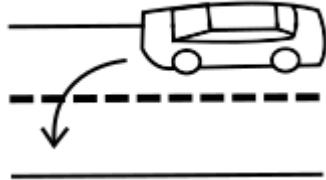
Handles emergencies autonomously, driver can entirely focus on other tasks.

Limited ODD

# Level 4 - High Driving Automation

No need for  
human driver

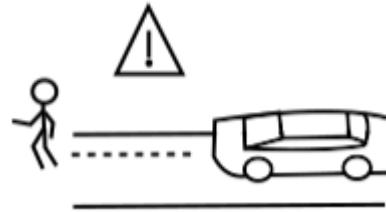
Lateral Control



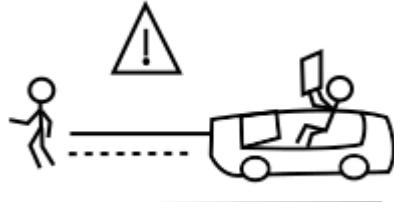
Longitudinal Control



OEDR



Fallback

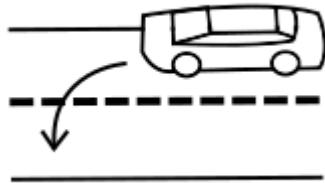


Example



# Level 5 - Full Driving Automation

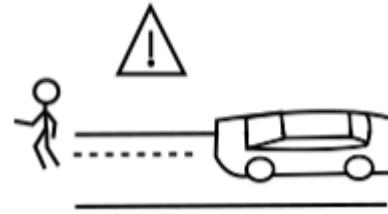
Lateral Control



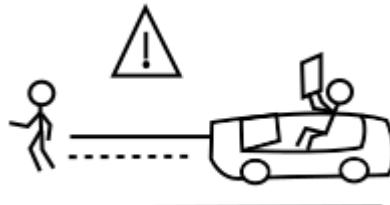
Longitudinal Control



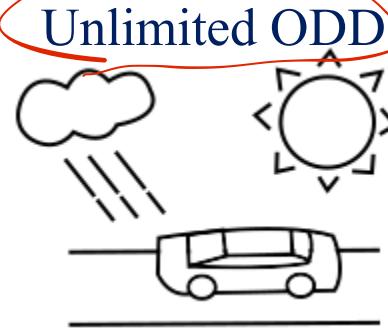
OEDR



Fallback



Unlimited ODD



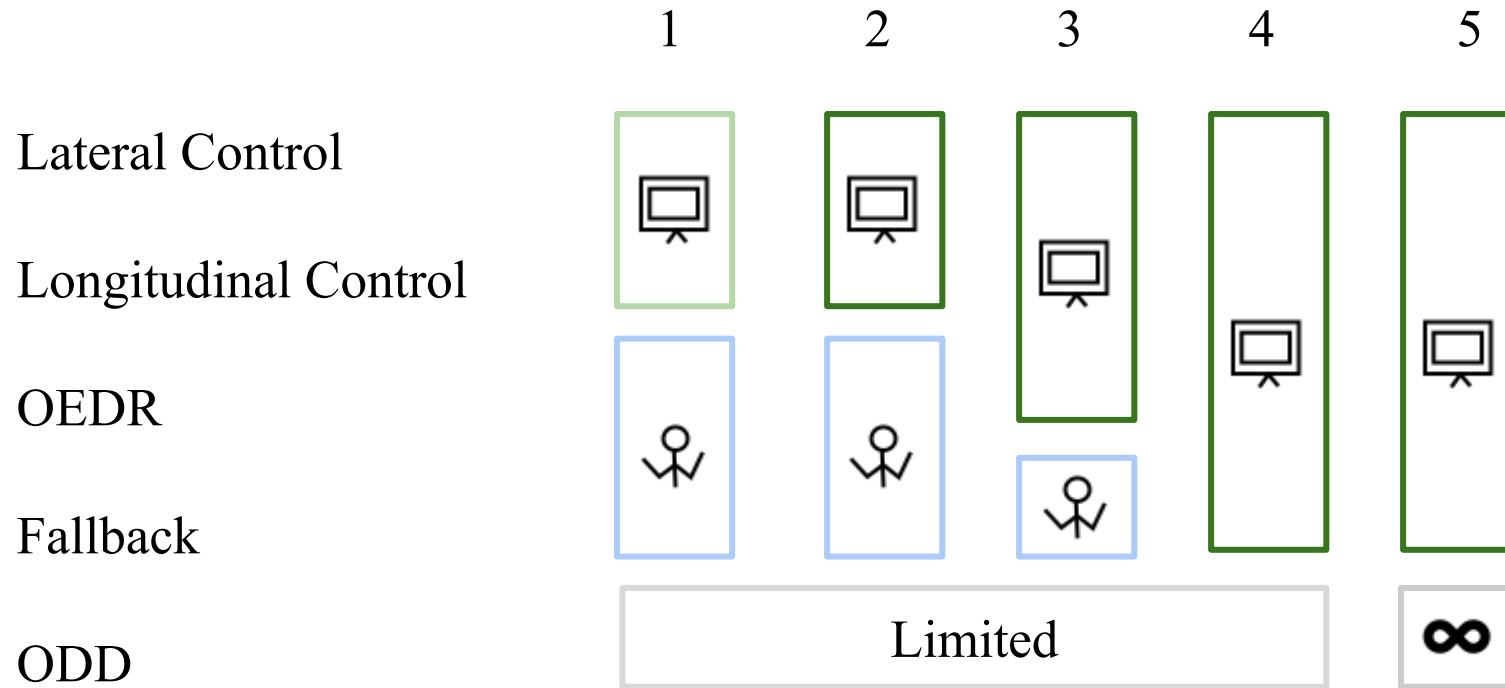
# Limitations of this taxonomy

- ODD and safety record are more important!

# Summary

- Basic definitions
- Driving task
- Taxonomy requirements
- Levels of automation, taxonomy

# Summary: Levels of Driving Automation



# Extra Slides

# Object and Event Detection and Response

Includes:

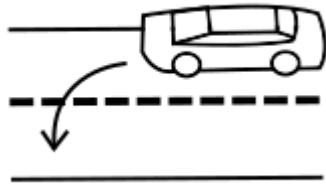
- monitoring the driving environment
  - detection, recognition and classification of
    - objects on road
    - events happening
- executing an appropriate response to these objects and events





# The Taxonomy: Questions

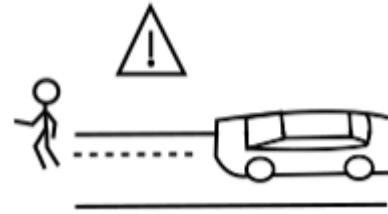
Lateral Control



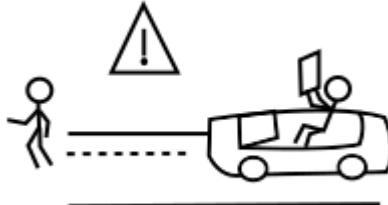
Longitudinal Control



OEDR



Fallback



Unlimited ODD

