Lesson 1

Taxonomy of Driving

Driving Task:

1. Perceiving the environment
    1. The first sub-task is **perception**, or **perceiving the environment** that we're driving in. This includes **tracking a car's motion** in identifying the various elements in the **world around us**, like the **road surface**, **road signs**, **vehicles**, pedestrians and so on. We also need to **track all moving objects and predict their future motions**.
2. Planning how to reach from point A to point B
3. Controlling the vehicle
    1. we need to operate the vehicle itself with vehicle control. So we need to take the **appropriate steering, break** and **acceleration decisions** to control the vehicle's **position and velocity on the road.**

Operational Design Domain (ODD):

As per IEEE standard known as J3016, **ODD** is operating conditions under which a given driving automation system or feature thereof is specifically designed to function, including, but not limited to, environmental, geographical, and time-of-day restrictions, and/or the requisite presence or absence of certain traffic or roadway characteristics."

Even I din't understand what the heck it is. I found a good article from medium and the author saying that " I might define an **ODD that consists of smooth roads, absence of rain and the roads must be dry, and there must be high visibility in terms of being able to see around the ca**r. That's my declared ODD. It's just one such ODD. I might define a second ODD, **for which it consists of smooth and bumpy roads, light rain allowed, roads can be wet but not slick, and the visibility can range from high to mediocre.**
I could continue declaring various ODD's. Each of the ODD's would have some particular set of indicators about what it includes. This might also include exclusions, thus I can probably be clearer about my ODDs by not only saying what it includes but also what it excludes. That being said, the number of exclusions could be rather vast and perhaps exhausting to try and list them all".

How to classify driving system automation?

1. Driver attention requirements. For example, can you watch a movie while driving to work? Or do you need to keep your attention on the steering wheel at all times? Driver attention is one of the crucial questions to consider when defining the level of autonomy.
2. Driver action requirements. For example, can you watch a movie while driving to work? Or do you need to keep your attention on the steering wheel at all times? Driver attention is one of the crucial questions to consider when defining the level of autonomy.
3. What exactly makes up a driving task.

What makes up a driving task?

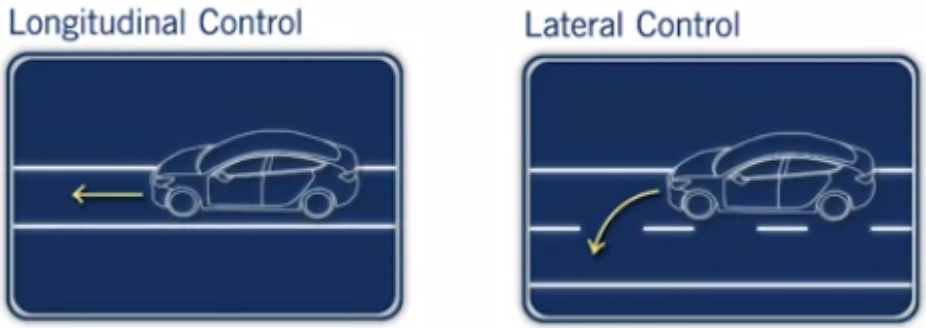
1. **Lateral control - Steering**
2. **Longitudinal control - Braking, Accelerating**
3. **Object and Event Detection and Response (OEDR): detection, reaction**
4. Planning - Long term and Short term
    1. Planning is primarily concerned with the long and short term plans needed to travel to a destination or execute maneuvers **such as lean changes and intersection crossings.**
5. Miscellaneous
    1. There are some miscellaneous tasks that people do while driving as well. These include actions like **signaling with indicators**, **hand-waving**, **interacting with other drivers** and so on. Now we have a clear description of what tasks we expect a self-driving car to perform.

Autonomous Capabilities:

1. Does the system has Automated lateral control?
2. Does the system has longitudinal control?
3. Does the system support OEDR (Object and Event Detection and Response).
    1. Can system take **own decision** when **there is emergency** or **it needs the driver supervision.**
4. Complete vs Restricted ODD.
    1. Can the system support **all kind of scenario** as we discussed in the ODD.

Autonomous Level:
Level 0 - No Automation
Regular vehicles, no automation

Level 1 - Driving Assistance

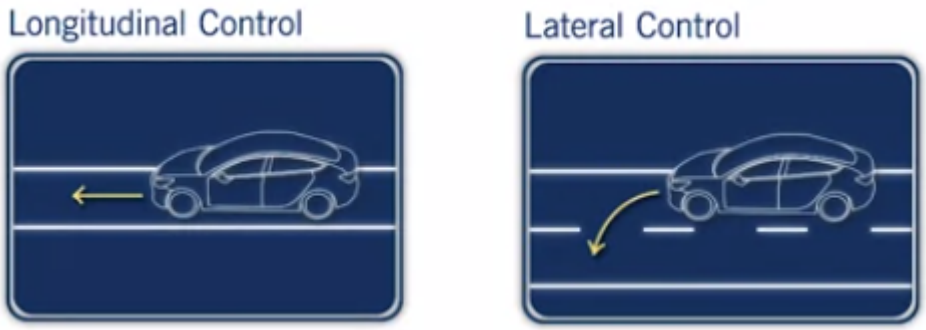


Either **longitudinal control** or **lateral control** not both.

Example:

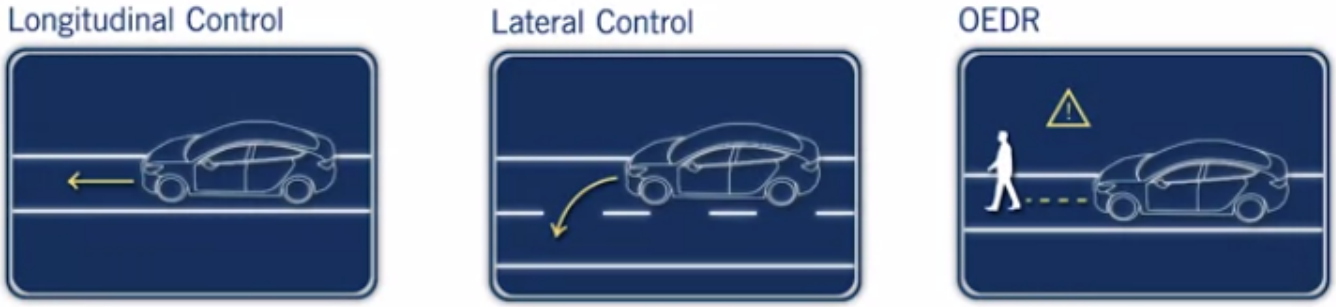
1. **Adaptive Cruise Control:**
    1. Can **control speed** and **driver has to steer.**
2. **Lane Keeping Assistance**
    1. Can help you **stay in your lane**, You get **warning if your drift.**

Level 2 - Partial Driving Automation



This system supports both **longitudinal control** and **lateral control.** But, **Driver monitoring is required.**
Example:
GM Super Cruise
Nissan Pro-Pilot Assist

Level 3 - Conditional Driving Automation

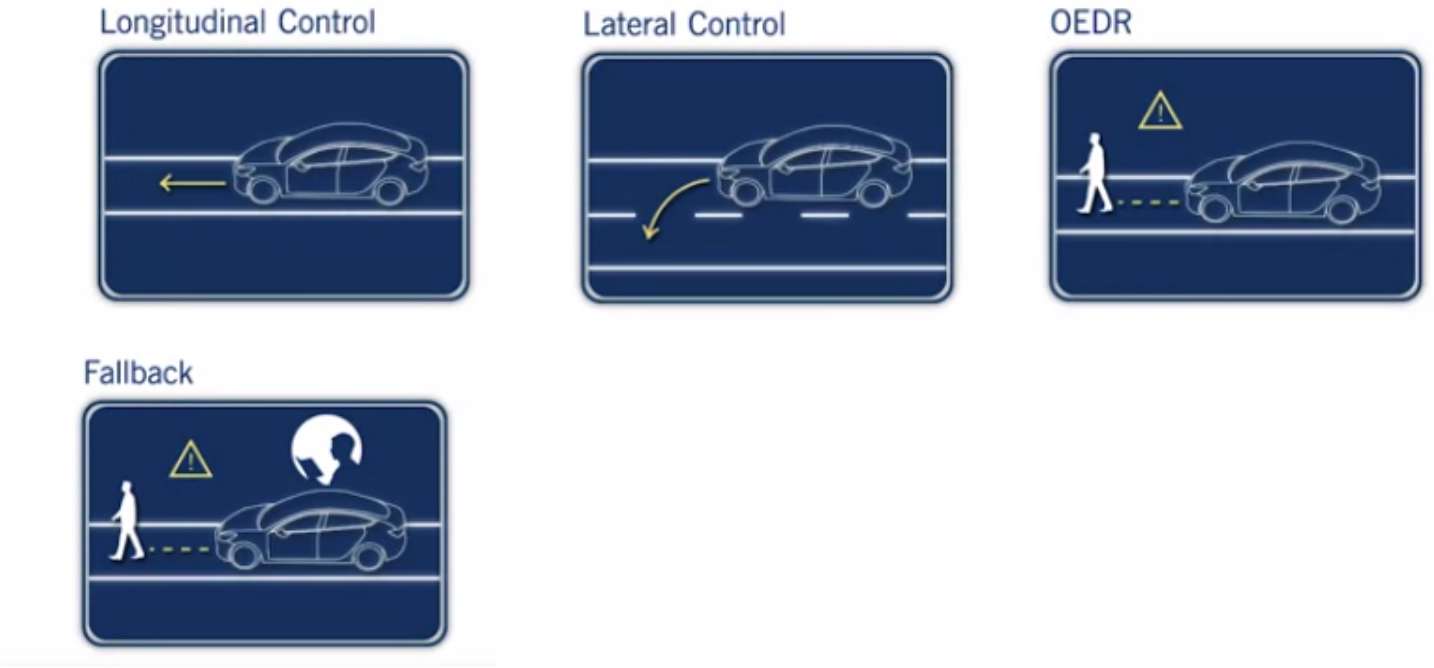


This system supports both **longitudinal control**, **lateral control** and **automated object and event detection and response (OEDR).** It still needs a driver monitoring.

Example:

Example:
Audi A8 Sedan

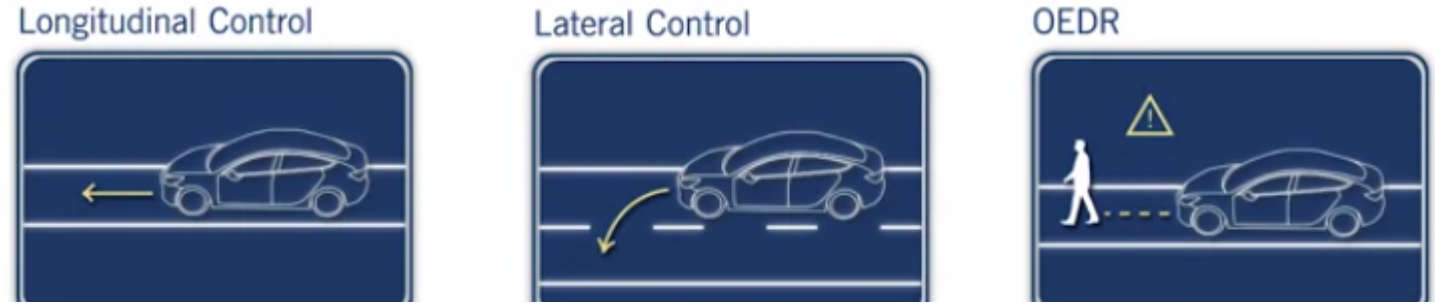
Level 4 - High Driving Automation



This system **Handles emergencies autonomously**, driver can entirely focus on other tasks. But, **limited ODD**.

Example:
Waymo

Level 5 - Full Driving Automation



Fallback

Unlimited ODD