# Autonomous vehicles

Questions will focus on:

- **E**thical
- **E**nvironmental
- **L**egal

# Autonomous vehicles

Autonomous vehicles include self-driving cars and other road vehicles.

In principle they could include other vehicle types, for example drones etc…

- technology relies on sensing the wider world
- algorithms then determine the action the vehicle should take
- creates a set of legal and ethical issues

# Autonomous vehicles

**How they work:**

Create a "map" of their surroundings based on sensors:

- radar sensors monitor the position of nearby vehicles;
- video cameras detect traffic lights, read road signs, track other vehicles, and look for pedestrians;
- lidar (light detection and ranging) sensors bounce pulses of light off the car's surroundings to measure distances, detect road edges, and identify lane markings;
- ultrasonic sensors in the wheels detect curbs and other vehicles when parking

# Autonomous vehicles

Software processes all the inputs, plots a path, and sends instructions to the car's actuators, which control acceleration, braking, and steering.

Hard-coded rules, obstacle avoidance algorithms, **predictive modeling**, and object recognition help the software follow traffic rules and navigate obstacles.

This is complex software which requires the vehicle to be able to respond in similar ways to humans. Essentially it's using a form of AI.

# Autonomous vehicles

Such vehicles already exist - to a greater or less degree.

- cruise control
- self parking systems
- the DLR - has operated autonomously since 1987
- aircraft autopilot  - can land a plane under supervision

- companies such as Google (Waymo), Tesla, Honda and Mercedes all have significantly autonomous vehicles in development
- in 2021 Honda and Mercedes both got US legal approval for a level 3 vehicle; other manufacturers are at level 2 or below

# Autonomous vehicles

Levels of autonomy:
- Level 0 = 100% human control
- Level 1 = hands on shared control - e.g. cruise control
- Level 2 = "hands off" control - although usually the driver still need to show they are in control. e.g. cruise control and lane keeping technology
- Level 3 = "eyes off" - full control in routine conditions, although driver must still be able to respond with a timed gap
- Level 4 = "mind off" - car must be able to abort the journey if necessary
- Level 5 = no steering wheel required

# Autonomous vehicles

**Advantages:**

- safety - good algorithms should mean autonomous vehicles are safer than human drivers
- fuel efficiency
- handles tricky jobs - like parking
- time efficient at high levels

**Disadvantages:**

- legal and ethical issues
- expensive
- algorithms are complex
- risk of hacking - Computer Misuse Act
- data protection - Data Protection Act

# Autonomous vehicles

"Automated driving systems could prevent 47,000 serious accidents and save 3,900 lives over the next decade through their ability to reduce the single largest cause of road accidents – human error," - 88% of accidents caused by driver error

UK Society of Motor Manufacturers and Traders - April 2021

https://www.bbc.co.uk/news/technology-56906145

**Two die in Tesla car crash in Texas with 'no one' in driver's seat, police say**

Car ran off road and hit a tree north of Houston, before bursting into flames, local media says

**Tesla Autopilot crash driver 'was playing video game'**

🕘 26 February 2020

# Autonomous vehicles

If auto-updates are necessary, when does a car's life end?

## Tesla software glitch prompts safety recall for nearly 12,000 US vehicles

Tue 2 Nov 2021 14.33 GMT

**Communication error may cause a false forward-collision warning or unexpected activation of the emergency brakes**

The California automaker said the concern over 11,704 Model S, X, 3 and Y vehicles was prompted after a software update on 23 October to vehicles in its limited early access version 10.3 Full-Self Driving (FSD) (Beta) population.

FSD is an advanced driver assistance system that handles some driving tasks but Tesla says does not make vehicles autonomous.

NHTSA said Tesla "uninstalled FSD 10.3 after receiving reports of inadvertent activation of the automatic emergency braking system" and then "updated the software and released FSD version 10.3.1 to those vehicles affected".

# Autonomous vehicles

Beta testing…

## Tesla recalls 50,000 cars that disobey stop signs in self-driving mode

The "rolling stop" feature introduced by Tesla in October meant that cars rolled past stop signs instead of stopping, as many states require by law

**TECHNOLOGY** 3 February 2022

Despite the name of the Full Self-Driving feature, the company requires owners to watch at all times and be ready to step in and take control if the software acts dangerously. The code remains in beta, which means it is still undergoing testing, but more than 50,000 people are currently testing it, Tesla told investors last month – most of them in the US.

# Autonomous vehicles

**Legal issues:**

UK law commission report January 2022 recommends:

- driver becomes the "user-in-charge"
- if anything goes wrong, the company behind the driving system would be responsible, rather than the driver
- user-in-charge cannot be prosecuted for offences arising directly from the driving task, such as dangerous driving, speeding or running a red light, but remains responsible for other tasks, including insurance and checking people are wearing seatbelts

https://www.bbc.co.uk/news/technology-60126014

# Autonomous vehicles

UK law commission report January 2022 recommends:

- data to understand fault and liability following a collision must be accessible
- sanctions for carmakers who fail to reveal how their systems work

What impact does this have for data protection or design and patents?

https://www.bbc.co.uk/news/technology-60126014

# Autonomous vehicles

**The big ethical issue:**

How do you program the algorithm?

A self-driving car with one person in it is headed towards a group of 5 pedestrians. If it crashes into them, they will all die. If it takes avoiding action, the driver will die.

What should the algorithm do?

# Autonomous vehicles

What if the pedestrians are drunk and have wandered into the street?

What if they're pensioners?

What if they're children?

What if there's one pedestrian and a family in the car?

What happens if you put a human driver in the same situation?

# Autonomous vehicles

**Key questions:**

- What sort of technology is needed
- Pros and Cons
- **EEL – ethical and legal particularly**