



Self-driving Cars: Transporting people in a safe and efficient way.



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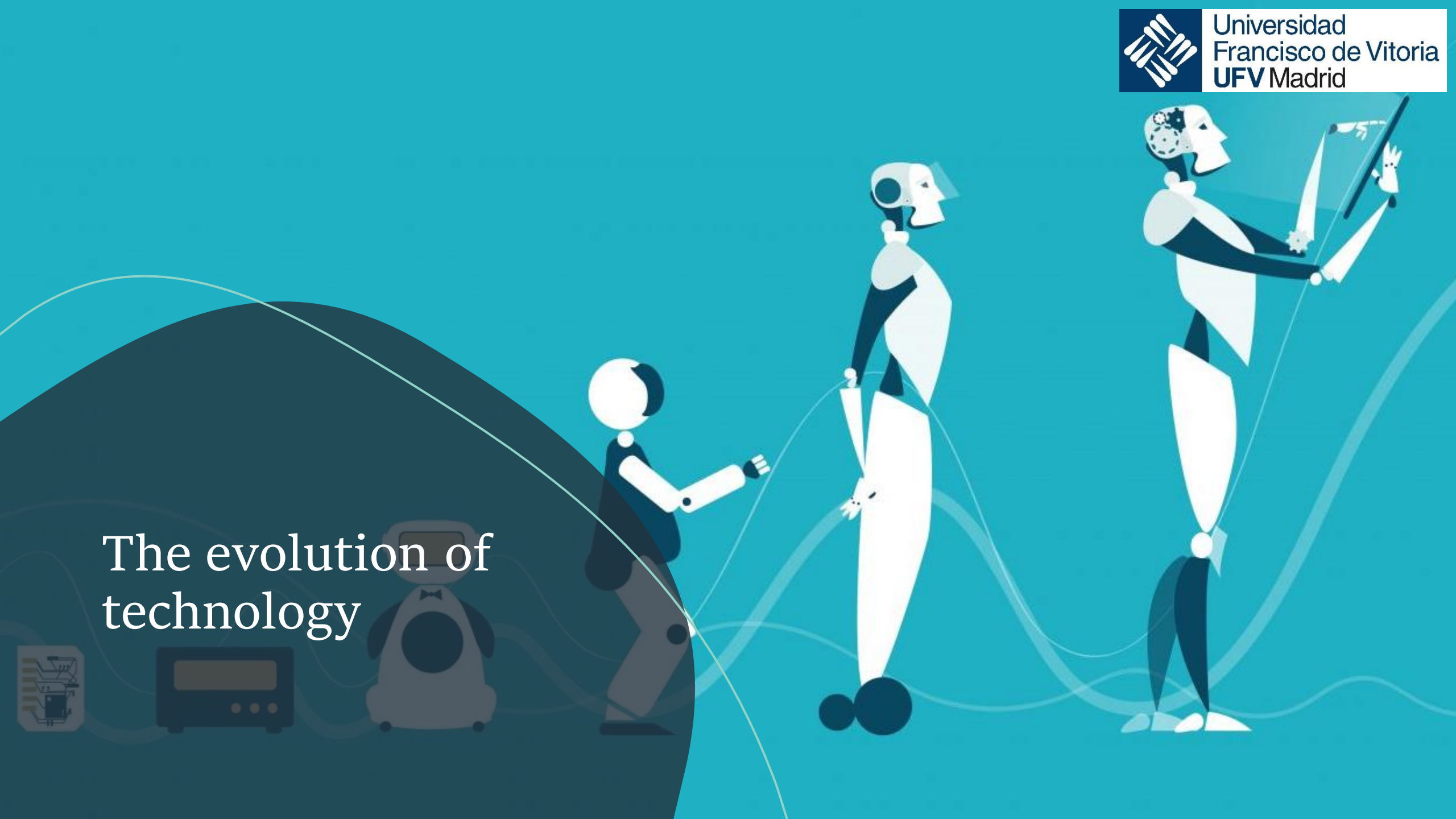
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The evolution of technology

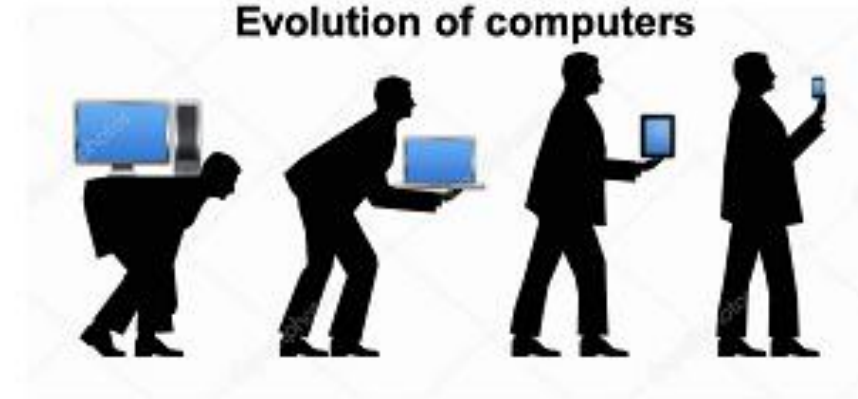


Evolution of TECHNOLOGY...

Evolution of phones



Evolution of computers



Evolution of communication





Different generations of computer systems

- First generation (1940 - 1958) --> Programming using punched cards
- Second generation (1959 - 1964) --> The arrival of transistors
- Third generation (1964 - 1971) --> Combining transistors to create integrated circuits
- Fourth generation (1971 - 1981) --> Microprocessors and computer networks
- Fifth generation (1981 - 1995) --> Rise of Internet
- Sixth generation (1995 - Now) --> Mobile phones, robots and AI.



Maximum speed: 100km/h



1900



1950



1980



2020



2000



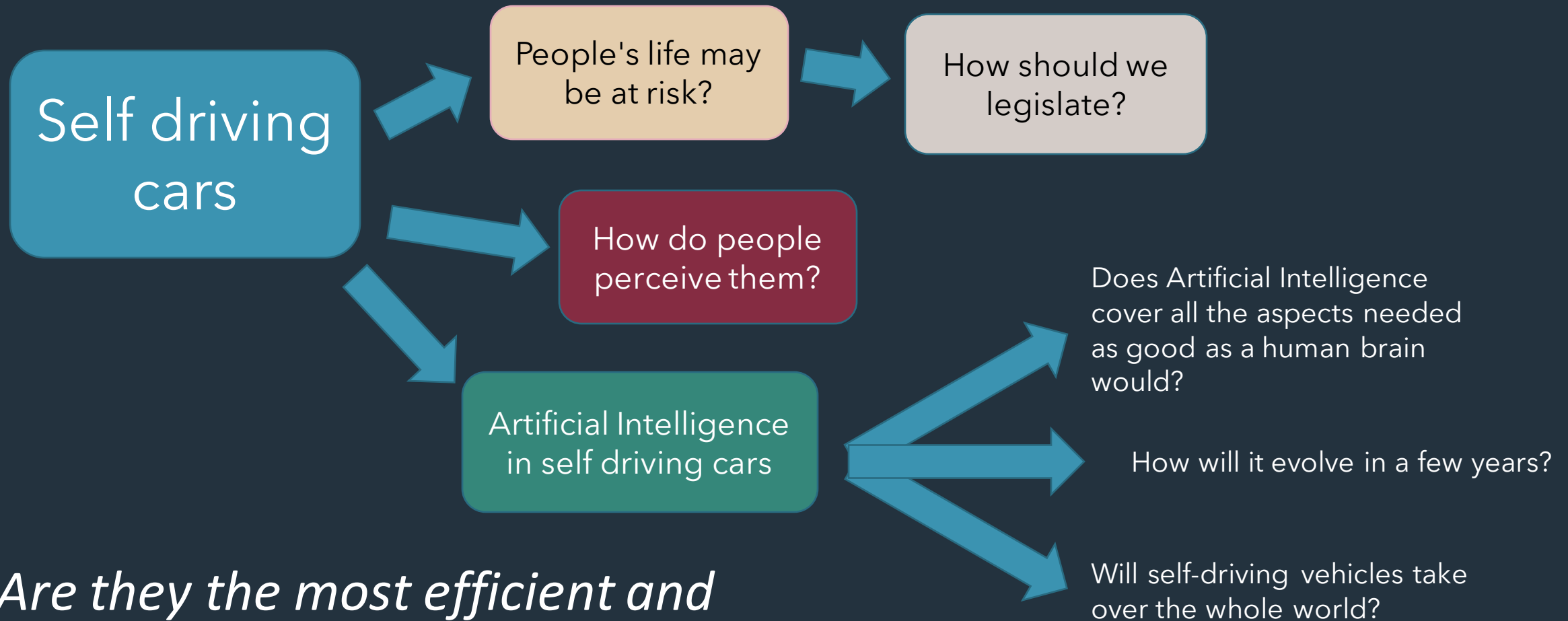
Then...

Why this would not be the next step?



Self Driving Cars

We are going to be talking about...



Are they the most efficient and accessible way of transporting humans?



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We will be
talking about
this and much
more



Motivation

Why choosing this topic?

Incredible growth

Autonomous vehicles have had incredible growth in the past decade, and it won't stop anytime soon

Involving computer science

Makes it even more enticing for us, that is because it's something we can find passion and interest in

A lot of potential

If we can make this possible, the world will become simpler to live in



Objectives

Our general objective is investigating the influence of computer science and artificial intelligence for the development of autonomous vehicles and making this method the safest and most efficient way of human transportation.

More specific ones:

- 1.- Studying the influence of Artificial Intelligence in self-driving and autonomous cars.
- 2.- Evaluating their accesibility and freedom of use
- 3.- Investigating the laws that regulate the autopilot
- 4.- Estimating how they will evolve throughout the years.
- 5.- Evaluating if autonomous cars will replace regular vehicles, and the different benefits they bring to the world.
- 6.- Studying the different techniques that can be implemented to autonomous and self-driving cars.



AUTONOMOUS VEHICLES

Differences between
Autonomous vehicles and self-
driving



Differences

The difference between driving an autonomous car and a self-driving car.

au·tono·mous

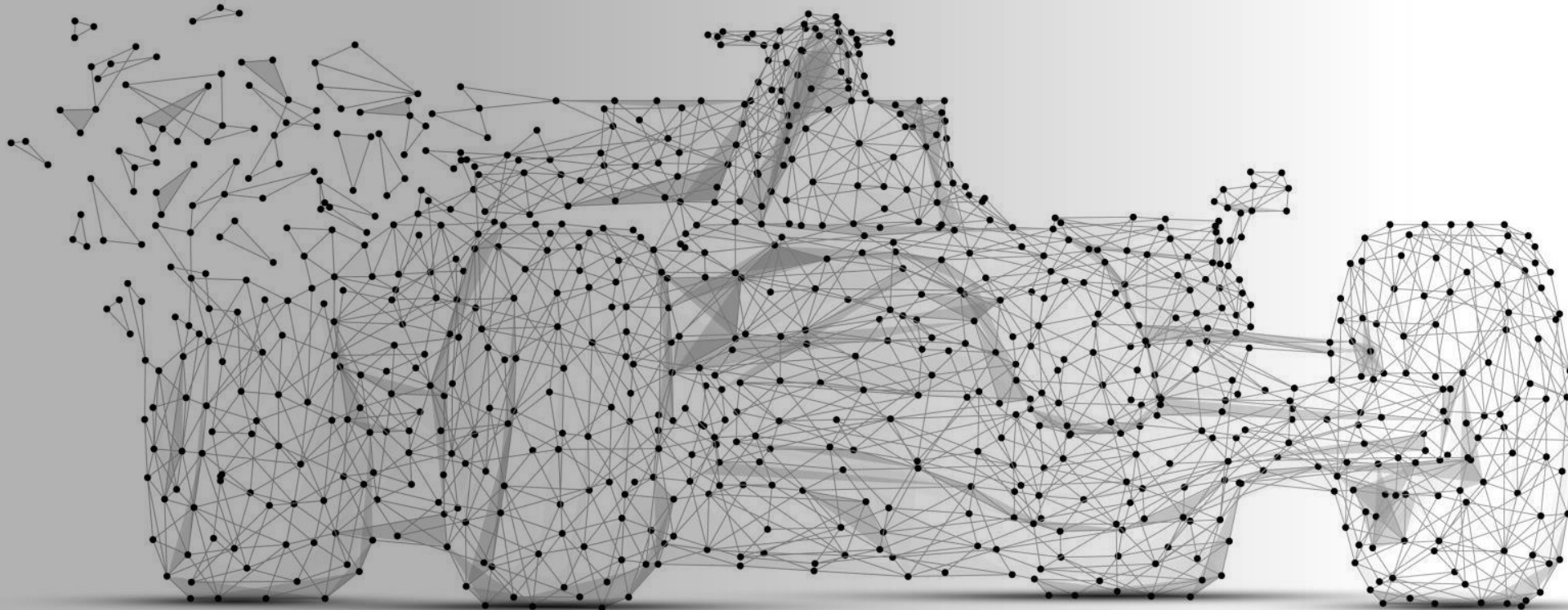
[ɔ:ˈtɒnəməs] 

ADJETIVO

1. (of a country or region) having the freedom to govern itself or control its own affairs:
"the federation included sixteen autonomous republics"
 - having the freedom to act independently:
"school governors are legally autonomous"
sinónimos: self-governing · independent · sovereign · free · self-ruling · self-determining · autarchic · self-sufficient
 - denoting or performed by a device capable of operating without direct human control:
"autonomous underwater vehicles" · [\[más\]](#)
2. (in Kantian moral philosophy) acting in accordance with one's moral duty rather than one's desires. Compare with [heteronomous](#).

Self-driving: refers to vehicles that have the technology to drive themselves, but depending on the situation human involvement is required.

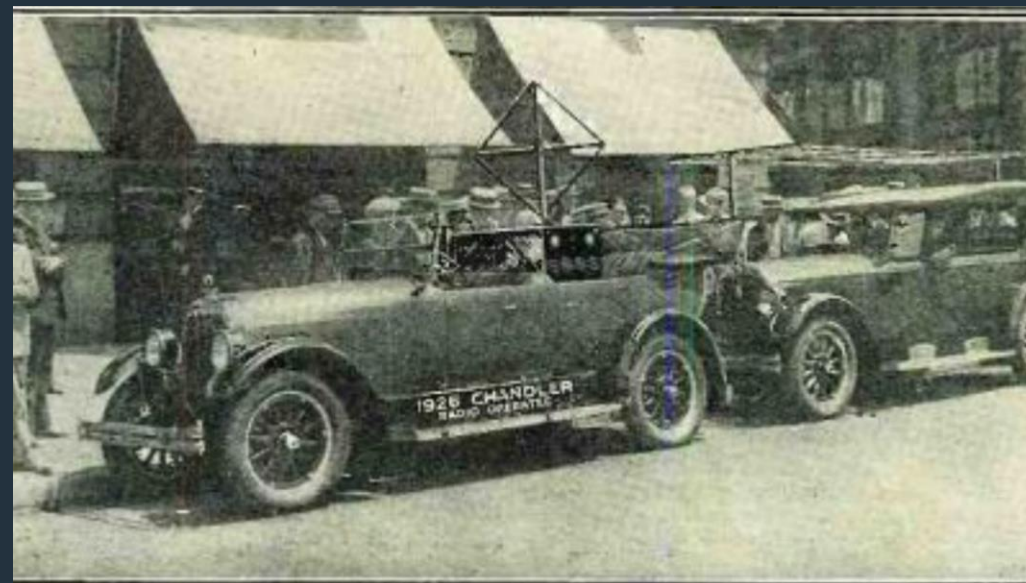
HISTORY OF AUTONOMOUS VEHICLES



History of autonomous vehicles

The idea of an autonomous vehicle was first presented in **1925** by an electric engineer called Francis Houdina, who built a car which could be controlled by radio. It was tested in Manhattan and drove along 19 kilometers between the Fifth Avenue and Broadway.

It became popular by **1939** at the New York World's Fair by Norman Bel Geddes representing General Motors, a multinational that manufactures, assemblies, and distributes facilities throughout North America, Canada, and other countries around the world.



History of autonomous vehicles

In 1958, General Motors made this idea a real concept. The car was supplied with pick-up coils, a component that answers to a change in magnetic flux by generating voltage, at the front end of the vehicle that detected the current flowing through a wire placed in the road. The flow could be changed in order to tell the vehicle to move the steering wheel left or right.



And yes, this was its design

History of autonomous vehicles

Autonomous vehicles were upgraded in the late 70's by the Japanese, they added a system with a camera that transferred all the information recorded of the highway. The addition of the camera caused a disadvantage in the car as it could only travel at maximum speed of 20 miles per hour, or 32 kilometres per hour.

This problem was then solved by the Germans who design and built an autonomous car that could travel at a speed of 56 miles per hour or 90 kilometres per hour.



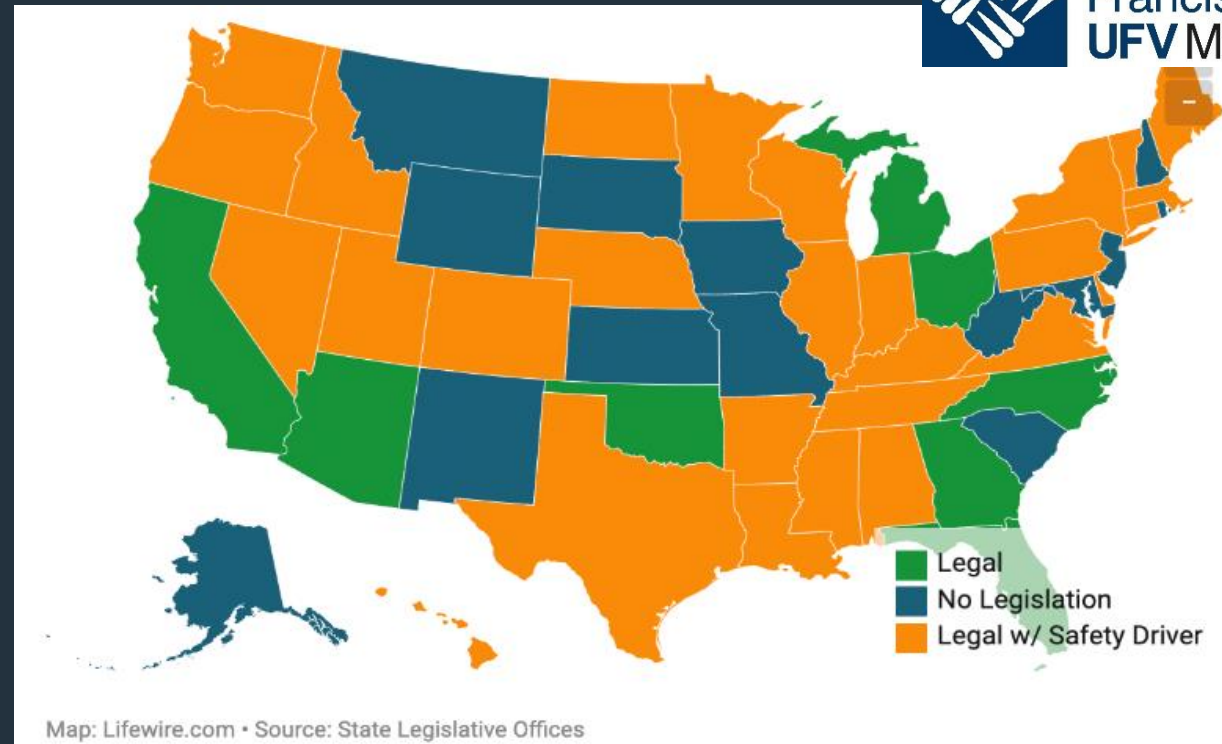


SELF DRIVING CARS LEGISLATION

Many different laws have been created to regulate the use of autonomous vehicles. In the European Union, the autopilot system is forbidden to use, this is because of the *UN/ECE R79* regulation.



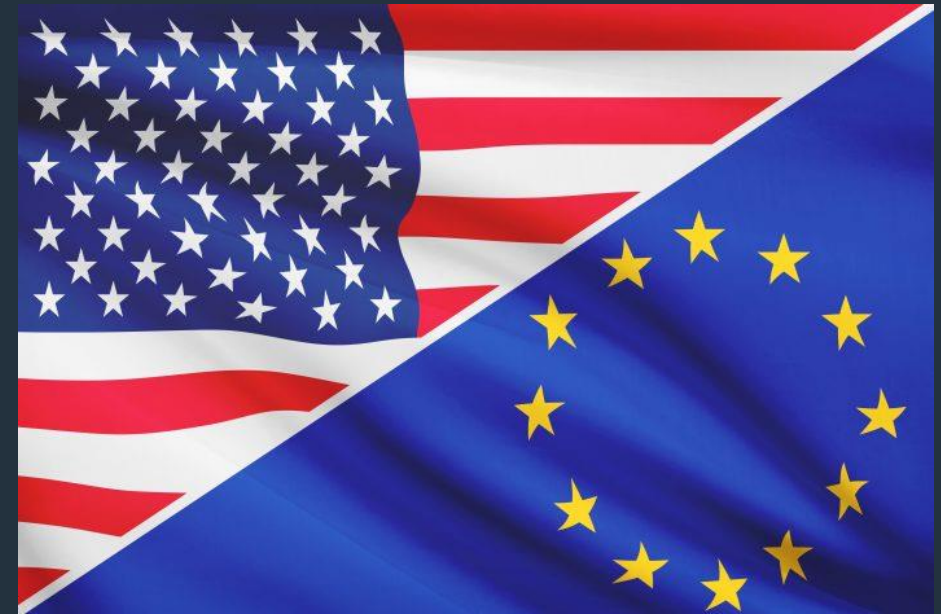
Consequently, many companies have been developing software updates to get adapted to this restrictive laws



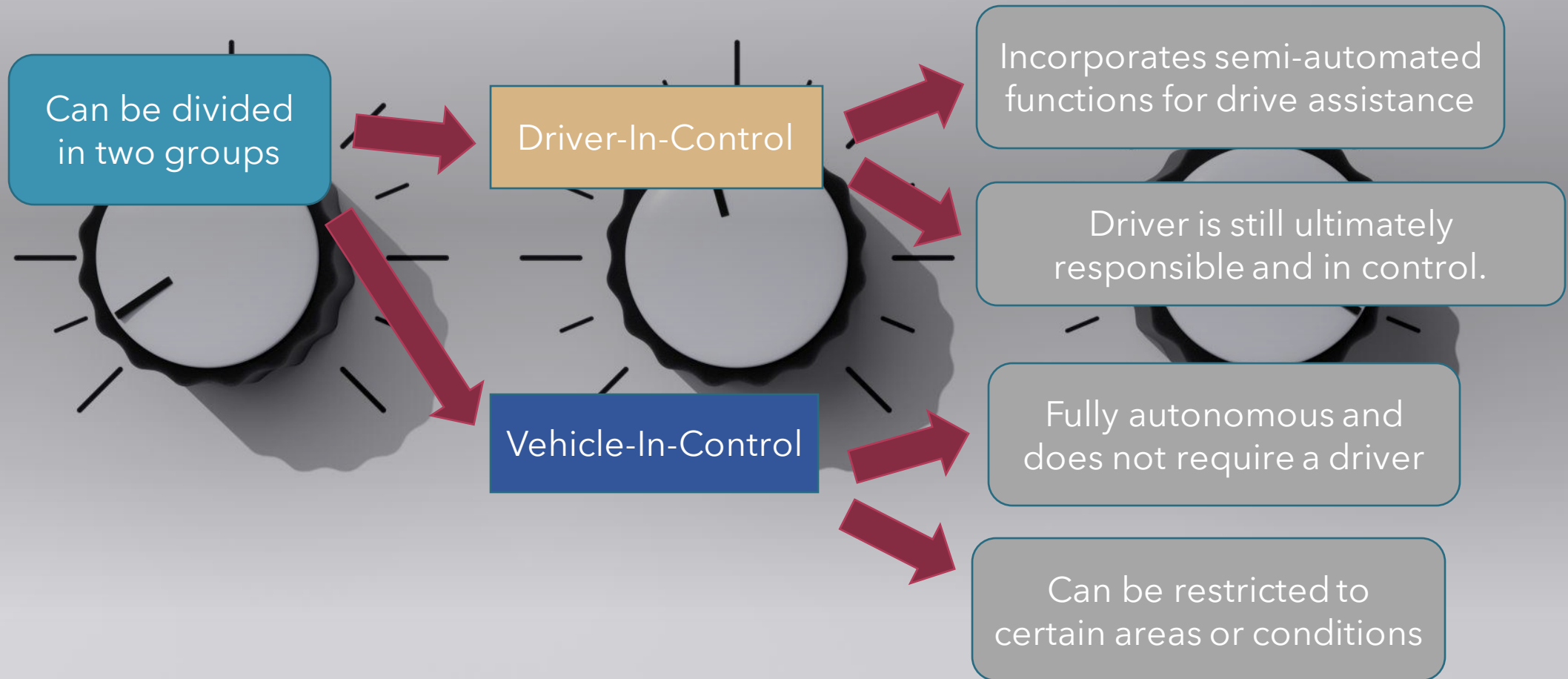
In the United States, as each State has a different legislation, we can take this map

Then we can conclude:

- 1.- Self driving cars are way more accesible at the United States than in the European Union
- 2.- Self driving cars are more accesible than autonomous ones



CONTROL SYSTEMS



More about...

Level 0: Complete manual control. The driver of the vehicle performs every task.

Level 1: The vehicle has semi-automated features for example speed monitoring through cruise control, but the driver is still responsible.

Level 2: The vehicle is able to perform steering and acceleration tasks, but the driver is still responsible and can take control at any point.

Level 3: The vehicle can detect its environment and can perform most tasks, but human override is still needed.

Level 4: The vehicle is able to perform all driving tasks based on condition restrictions like weather or limited areas. Human involvement is optional.

Level 5: The vehicle can perform all driving tasks under all type of conditions. No human intervention is necessary.



Advantages and disadvantages

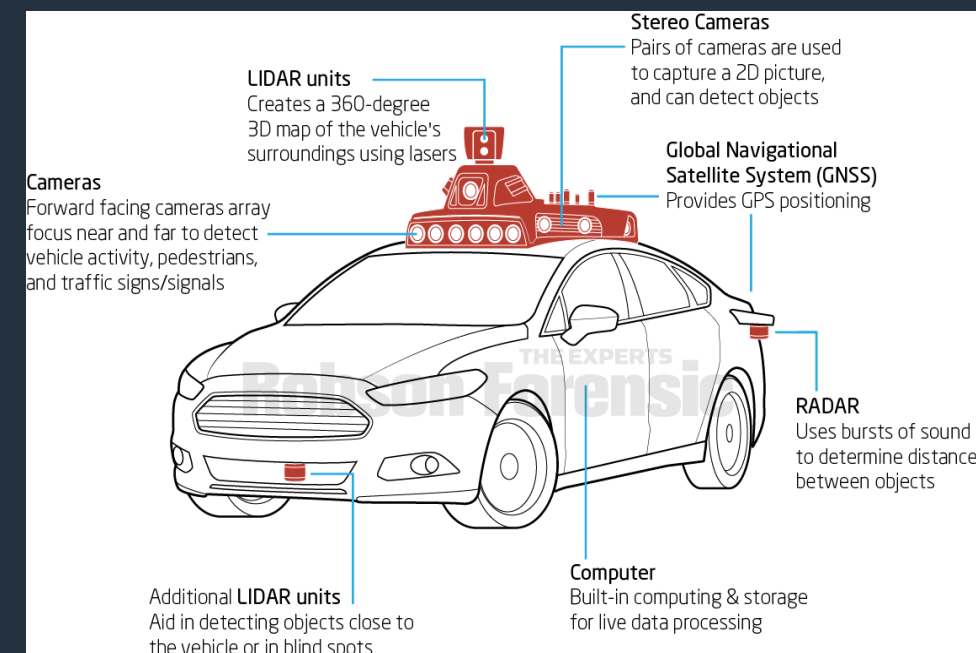
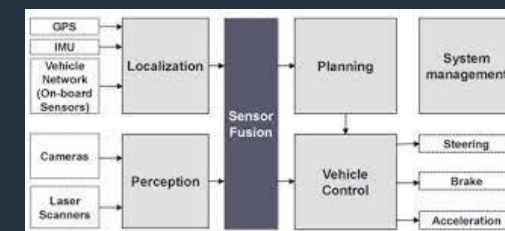


Elements of autonomous and self-driving vehicles

ESSENTIAL ELEMENTS OF THE AUTONOMOUS VEHICLE FUNCTION

Fundamental Hardware and Software units that ensure their operation

- **Camera:** captures images of the environment and different objects the vehicle is currently in. This information collected by the camera is then transferred to other components, to make the vehicle work smoothly and safely.
- **GPS:** Global Positioning System, also known as a GPS, used for precisely locating any person or object in the world, evaluating your current position, and allowing you to move from point A to point B without having to know the address; the system can provide you with it in case you are clueless.
- **Vehicle Network:** fundamental element of autonomous cars. It interconnects the different components of the car, working similarly to a computer bus. This allows exchange of information between the elements.



ESSENTIAL ELEMENTS OF THE AUTONOMOUS VEHICLE FUNCTION

- **16inc LiDAR:** Light Detection and Ranging o Laser Imaging Detection and Ranging, also known as LiDAR, it's a sensor capable of detecting different distances using laser signals.
- **Planning PC:** this feature is extremely important because it can evaluate the surroundings of the autonomous vehicle and choosing a path that it can follow properly, without crashing, with the information captured by the cameras and sensors.
- **VCU:** Vehicle Control Unit, also known as VCU, receives different instructions and information from the sensors to detect obstacles on the road.

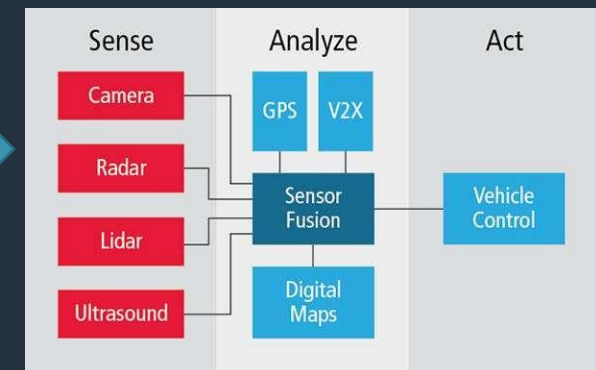


ESSENTIAL ELEMENTS OF THE AUTONOMOUS VEHICLE FUNCTION

□ **Logging PC:** This is considered the memory storage of the vehicle. This component stores the data and information captured by the CAN Transceivers, cameras, sensors and the bus and it retrieves them when needed in a short period of time.



□ **Sensor Fusion and perception:** this feature can combine all the information retrieved from various sensors and compiling it to assure the most certain and safe navigation of the vehicle; making the passenger safe.



□ **CAN Transceivers:** they can receive different signals emulated by the vehicle network and sending or executing different set of instructions in return to the bus. They include lateral control transceivers and longitudinal control transceivers.





TECNOLOGY USED IN SELF- DRIVING CARS (HARDWARE)





Hardware in self-driving

The control system of a Self-Driving car is principally based on an artificial neural network capable of sending signal between them in a small period of time.

Artificial neural networks are trained with situations and photos of real life, so they can react in a specific moment in the less time possible avoiding a disaster or a crash



Hardware in self-driving

The computer is divided into three modules that at the same time create clusters (NODOS) connecting all the information and deciding over the entry information. These are the following components:

- **Operator Cluster:** The operator cluster it's the man-machine interface, it could be a keyboard or a screen. You communicate with the machine with this hardware.

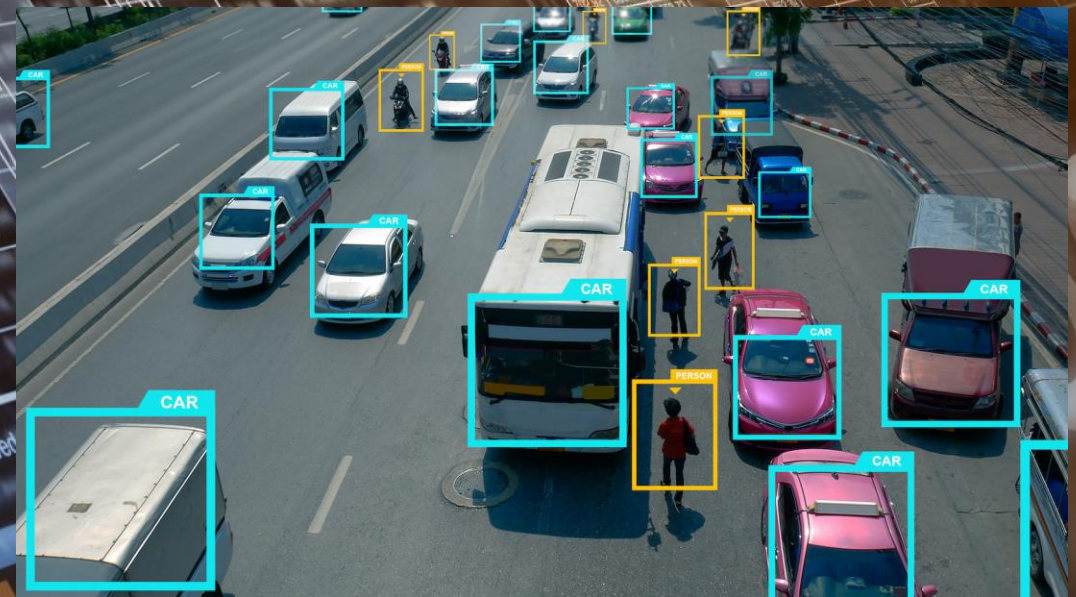
On the other hand, the car needs hardware outside the car which gives information to the central computer, one of them is the sensors, as cameras, radars, LiDAR's, GPS, and the Planning and Logging computers



SOFTWARE INSIDE AN AUTONOMOUS CARS

Self-driving cars use the most advanced technology in the market to ensure safety and comfort, leaning in hardware and software. Despite the incredible advancements in hardware, software has had a huge impact with all the new complex algorithms.

A self-driving car uses software with image recognition to establish the difference between objects, people, as well as the road.



An example about this



A great example and perhaps the most popular, is Tesla's algorithm which is implemented in all their cars. Although autonomous cars are illegal in most countries as mentioned before. However, it has been proven to be effective. It can detect different lanes as well as traffic lights and moving objects, such as pedestrians and cars. Elon's cars use cameras to detect all this, however other brands such as Nissan use LIDAR sensors.

The A.I. uses machine learning (Deep Learning) to improve its software, collecting data from all the Tesla's around the world, using all these scenarios to improve and avoid any future collision and make this A.I. as close to perfection as possible.

Development of self-driving cars in enterprises and countries

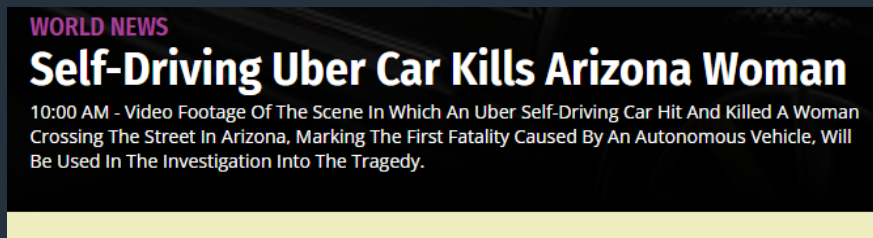


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Uber

Uber is also trying to replace their in-person drivers to the idea of autonomous cars only that it is still a bit in development as they tried a few years ago and there was a problem with this new technology.

Unfortunately...



March 2018 in Arizona

This happened because the software of the did not correctly detect the woman as a pedestrian

The idea that Uber had of autonomous driving was put into question whether it would be good to do it or not.

During the following years...

- Uber has managed to sell the entire group of autonomous cars that Uber built to Aurora for 4,000 million which is a start-up founded by former employees of Uber and Google that is being funded by Amazon.
- Uber has not been able to make money in the last few years, in fact it only has losses in 2020 it was estimated that Uber would have losses of more than 1.1 billion dollars. This sale managed to save itself from those losses.
- In this same 2022 Uber has reached an agreement with Hyundai to turn them into autonomous cars and is the Hyundai IONIQ 5 known as the Robotaxi



It has 30 sensors through the car, radars, and LIDAR cameras, which gives the car a 360° sight. It has already made more than 100,000 successful trips on public roads in Los Angeles, Las Vegas, and Singapore.

Waymo (Google)

Google and Waymo are companies that receive the services of the multinational Alphabet Inc. since this company is dedicated to give them a series of products which are electronic services, software, and internet.

This project was launched by Google in 2017 and would be responsible for developing and manufacturing the sensors necessary for this self-driving car to work.

What Waymo had planned to do from the beginning was to be able to manufacture a car without steering wheels and even without pedals and many engineers thought it was crazy, what the engineers said is that they should manufacture the cars like Tesla. Anyway the co-founder, Larry Page was not in favour of this project.



Waymo (Google)

However, Waymo wanted to continue its project and has continued to strengthen its strategy. As a consequence...

Waymo and Fiat Chrysler Automobiles have inked a deal to **develop and test autonomous cargo vans** and other light commercial vehicles designed to shuttle goods. The agreement is an expansion of a partnership that kicked off four years ago with a focus on self-driving Pacifica hybrid minivans meant to transport people.

Waymo and Fiat Chrysler's next big project is to develop self-drivin...
techcrunch.com/2020/07/21/waymo-and-fiat-chrysler-expand-partnership-to-de...



Waymo relies on the development of the hardware necessary for the vehicle to be effective, as well as the necessary sensors.

It has been achieved the creation of an automated driving ecosystem, which can be integrated into some vehicles, only if the manufacturers are willing to reach an agreement with Waymo.





Waymo cabs

Waymo has already developed its own cabs, which charge you their own fares. Now, they have already been used in some suburbs of Phoenix and they are also all over California Arizona Texas New Mexico and in a while, they will also be in Los Angeles

China

2016

Banned autonomous cars testings, since Baidu (chinese Google) started tests without permission



Home > News > Cars & Auto

China Bans Autonomous Car Testing (for Now)

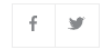
China wants car makers to stop testing until new regulations are in place.

HEALTHCARE MARCH 30, 2021 / 11:26 AM / UPDATED 2 YEARS AGO

China plans new rules for autonomous vehicles -ministry

By Reuters Staff

1 MIN READ



designed by freepik.com



Baidu

2018



Among other Chinese companies as NIO or SAIC Motors, received authorization to test their models in urban-traffic conditions, as Pekín or ShangHai.



Baidu's APOLLO

Nowadays

In the Shougang park where the 2022 Winter Olympic Games would take place, Baidu will deploy their "**APOLLO**", a vehicle which would serve as a taxi inside the place, but without a driver.





Xiong'an

The Chinese government has ordered the creation of a city specially created for autonomous vehicles to circulate in it. They are planning to introduce to everyday life traffic lights with artificial intelligence vision, among other new technologies.



Conclusions:

General conclusions:

Despite having many complications through the process, as harmonizing points of view, dividing the tasks among members, and researching in as many sources as we could...

We could finally compare and consider other members ideas, managing to finish successfully the topic!



Conclusions:

Topic conclusions:

After investigating on different factors of self-driving cars and autonomous vehicles, we have concluded on the general and specific objectives of the project, finding the pursued answers to prove the hypothesis.

AI

There are many elements in which this technology takes place (Computer image vision, sensor fusion, etc). We can conclude that AI is an essential feature of autonomous and self-driving cars, and that they wouldn't be able to work efficiently and safely without it.



Conclusions:

Topic conclusions:

ACCESSIBILITY

Laws regulating the auto pilot take an important part at research. We have concluded that the complete use of autonomous cars and autopilot is not fully accessible in the whole world, as in many places it is not legal to use

THEIR FUTURE

As we have seen, there are many projects and research planned for the following years, like for example "Robo-Taxis", which tell us about the promising future ahead them



Conclusions:

Topic conclusions:

SAFETY AND BENEFITS

It would be logical to say that autonomous vehicles will most likely replace regular ones in some years from now on. Many ideas are being brought to the table that will not require human control anymore.

And also, when it comes to the benefits they can bring, we could talk about:

- Safer driving
- Better management of fuel and battery
- Better use of passengers time
- Traffic fluidity

Among many others...



Finally...

It's safe to say that this new wave will make a lot of improvements for humans and the way we move around the world, doing it in a safer and more efficient way.



*"Real progress is what
makes technology available
to everyone"*

(Henry Ford)



**THANK YOU FOR YOUR
ATTENTION!**

And, any questions?