# How artificial intelligence impact the car industry

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« ITI »


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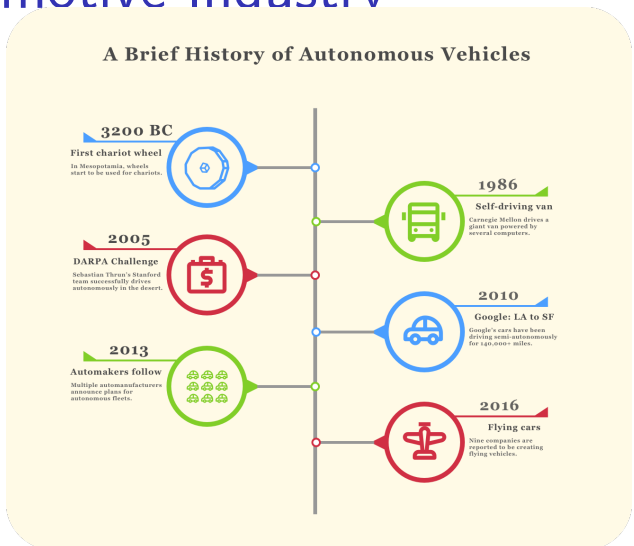
# Road map

1. A very brief history of autonomous vehicles
2. How has this happened? (Deep Learninng)
3. Data to train the deep network
4. How Artificial Intelligence will change the Automotive Industry
5. Conclusion



# Artificial intelligence breakthroughs

2005 How to drive
DARPA Gran Challenge

2012 How to recognize objects
ImageNet competition

2016 How to play games
AlphaGO

2022 Question answering – generating natural language
GPT -> chatGPT

Specific AI using a particular machine learning tool: deep learning

# Artificial intelligence and autonomous vehicles

**Artificial intelligence is about doing things better than human**

$\rightarrow$ It can do a lot of things better than a human driver

https://www.forbes.com/sites/lauriewinkless/2016/05/02/is-tomorrows-car-just-a-case-of-history-repeating-itself

# NavLab: the autonomous vehicle of the 80s


1 M \$ , 10 km/h

http://www.rediscoverthe80s.com/2016/11/navlab-the-selfdriving-car-of-the-80s.html/

# DARPA Grand Challenge 2004

- for American autonomous vehicles only
- 1 million $
- 140 miles (225km) from Barstow, California to Primm, Neveda


None of the 15 finalists completes more than 12 km of the race

# DARPA Grand Challenge 2005

- 2 million $ – 132 miles (213 km) in the desert, Primm, Neveda.



Stanford vs Carnegie Mellon

212.7 km at an average speed of 30.7 km/h

## Key issue

"The specific transfer function emulates human driving characteristics, and is learned from data gathered through human driving."

# CMU autonomous vehicles

## Carnegie Mellon University
### 30 Years of Self-Driving Car Research

Happy Birthday!

**1984**
- The Terregator's top speed was a few centimeters per second; it could avoid obstacles.
- NavLab launched. Its goal: apply computer vision, sensors and high-speed processors to create vehicles that drive themselves.

**1986**
Humans or computers controlled NavLab1, a Chevy van. Top speed: 20 mph.

**1990**
NavLab 2, a US Army HMMWV, wrangled rough terrain at 6 mph. Highway speed: 70 mph.

**1995**
NavLab 5, a Pontiac Trans Sport, traveled from Pittsburgh to San Diego in the "No Hands Across America Tour."

**2000**
NavLab 11, a Jeep, was equipped with Virtual Valet.

**2005**
Sandstorm and Highlander placed 2nd and 3rd in the DARPA Grand Challenge.

**2007**
Carnegie Mellon's "Boss" won the DARPA Grand Urban Challenge by outmaneuvering other vehicles along the 55-mile course.

**2014**
Carnegie Mellon's **14th self-driving vehicle** is a Cadillac SRX that:
- avoids pedestrians and cyclists
- takes ramps and merges
- recognizes and obeys traffic lights
- looks like other Cadillac SRXs

**www.engineering.cmu.edu**

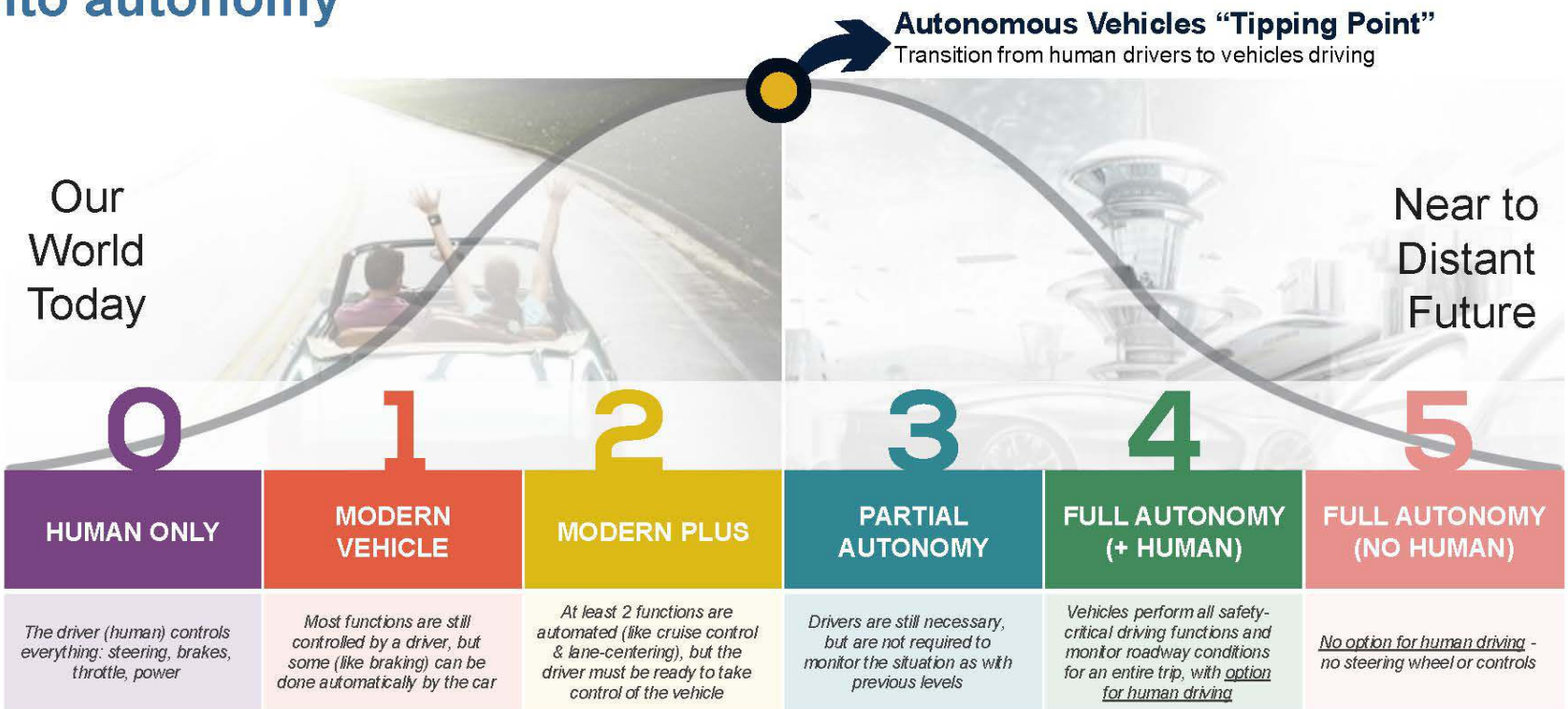
# Autonomous vehicles: when?

Tesla : prévues en 2014, 2015, 2016, 2018, 2019, 2020, 2021 et 2022, les voitures autonomes sont maintenant promises pour 2023


Un jour, Elon Musk aura raison.

**Elon Musk removing his hands from the wheel with Autopilot engaged during an interview (Bloomberg, 2014).**
numerama.com/vroom/972975-tesla-prevues-en-2014-2015-2016-2018-2019-2020-2021-et-2022-les-voitures-autonomes-sont-maintenant-promises-pour-2023.html

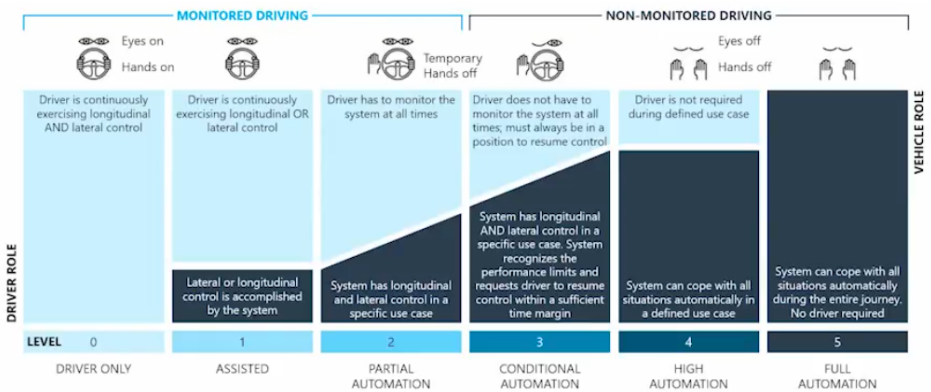
# Level 3 Partial Autonomy adoption is when the market "tips" into autonomy




Kelley Blue Book KBB.COM The Trusted Resource

http://www.techrepublic.com/article/autonomous-driving-levels-0-to-5-understanding-the-differences/





# Level 2/3 Autonomous vehicles for sale

100 000 $


Tesla Model X

vs.

Audi A8

## Motivations

- Today:
  - driver comfort (12,000 €)
- Tomorrow
  - save lives (safety)
  - environmental issues

https://https://www.vehie.com/c/audi-a3-2019-sedan--tesla-model+s-2018

# Level 2/3 = ADAS Ratings

Consumer Reports' for major Advanced Driver Assistance Systems (2020)

| SYSTEM NAME | SCORE | CAPAB. & PERF. | KEEPING DRIVER ENGAGED | EASE OF USE | CLEAR WHEN SAFE TO USE | UNRE-SPONSIVE DRIVER |
|---|---|---|---|---|---|---|
| **Comma Two** Open Pilot | 78 | 8 | 9 | 8 | 6 | 8 |
| **Cadillac** Super Cruise | 69 | 8 | 7 | 3 | 8 | 9 |
| **Tesla** Autopilot | 57 | 9 | 3 | 7 | 2 | 6 |
| **Ford/Lincoln** Co-Pilot 360 | 52 | 8 | 4 | 3 | 4 | 5 |
| **Audi** Driver Assistance Plus | 48 | 8 | 3 | 3 | 2 | 6 |
| **Mercedes-Benz** Driver Assistance | 46 | 6 | 4 | 4 | 2 | 5 |
| **Subaru** Eyesight | 46 | 7 | 4 | 3 | 4 | 5 |
| **Hyundai** Smart Sense, **Kia** Drive Wise | 46 | 5 | 4 | 5 | 4 | 4 |
| **BMW** Active Driving Assistance Pro | 44 | 7 | 3 | 3 | 2 | 6 |
| **Porsche** Active Safe | 41 | 4 | 3 | 6 | 2 | 5 |
| **Volvo** Pilot Assist | 41 | 6 | 3 | 3 | 2 | 5 |
| **Toyota/Lexus** Safety Sense 2.0 | 40 | 5 | 4 | 2 | 4 | 5 |
| **Honda/Acura** Sensing | 40 | 6 | 4 | 2 | 4 | 4 |
| **Nissan/Infiniti** ProPILOT Assist | 40 | 5 | 3 | 3 | 4 | 7 |
| **Volkswagen** Driver Assistance | 39 | 4 | 3 | 6 | 2 | 5 |
| **Land Rover** Driver Assist | 38 | 4 | 3 | 6 | 2 | 4 |
| **Buick/Chevy** Driver Confidence | 36 | 3 | 3 | 5 | 2 | 6 |
| **Mazda** i-ACTIVSENSE | 27 | 3 | 2 | 5 | 2 | 1 |

Some players:

- OpenPilot (open source 50 k)
- Super Cruise (Cadillac 110 k)
- AutoPilot (Tesla, 2M)
- Mobil Eye (54 M)

https://www.thedrive.com/news/37833/consumer-reports-ranks-this-aftermarket-driver-assistance-kit-above-tesla-autopilot-cadillac-super-cruise

# Level 4 experences in Rouen, Phoenix, 13 cities in China...



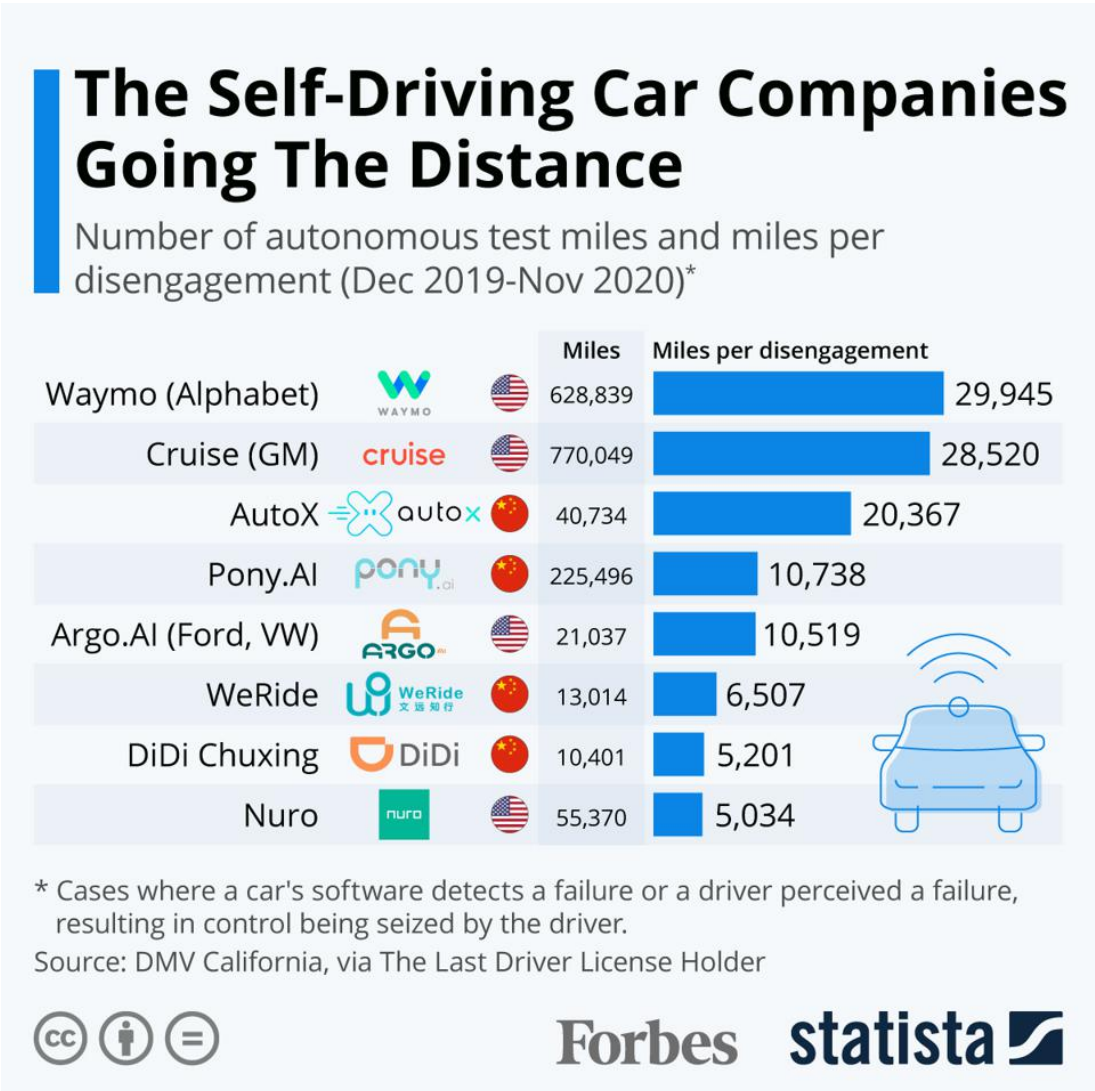
Waymo's cars (Google) hit the 10 million-mile milestone on public roads

## New uses

- public transportation (last kilometer)
- isolated people
- autonomous ride services (taxi)
- ...

pole-moveo.org/actualites/rouen-normandy-autonomous-lab-la-metropole-rouen-normandie-teste-un-service-de-mobilite-autonome/
https://waymo.com/

# Autonomous vehicle performance ranking




Some player:

- Waymo (Google)
- Cruise (GM)
- Apollo (Baidu)
- ...

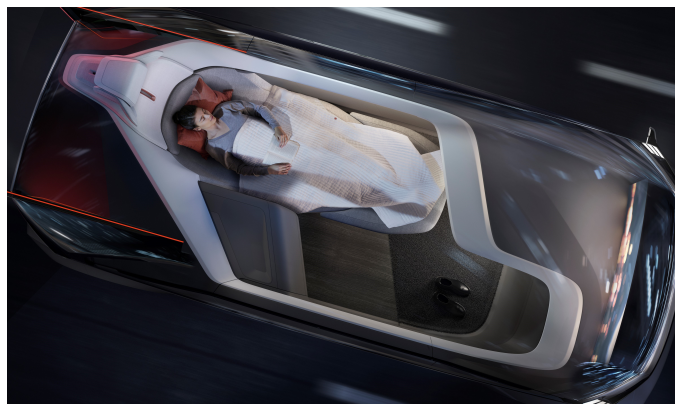
Related initiatives:

- La stratégie nationale de développement de la mobilité routière automatisée
- L3 Pilot (European project)
- ...

forbes.com/sites/niallmccarthy/2021/02/15/the-self-driving-car-companies-going-the-distance-infographic

# Two kind of AI systems for cars

1. Driver assistance — Driver is responsible
   - Level 2/3 autonomy
   - Specific intelligence
   - it works: how many seconds for take-over?



2. Full Autonomous driving — Car is responsible
   - Level 4/5 autonomy
   - Generic Intelligence
   - Experience level: it doesn't scale yet!

**Lex Fridman long term vision**

When will we have more than 10,000 Full Autonomous cars?

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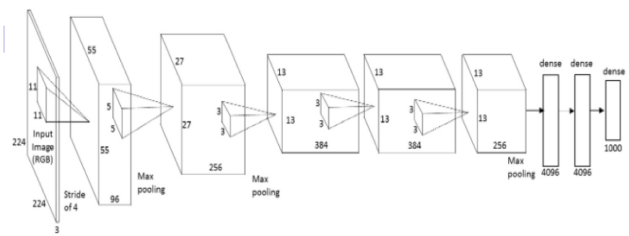
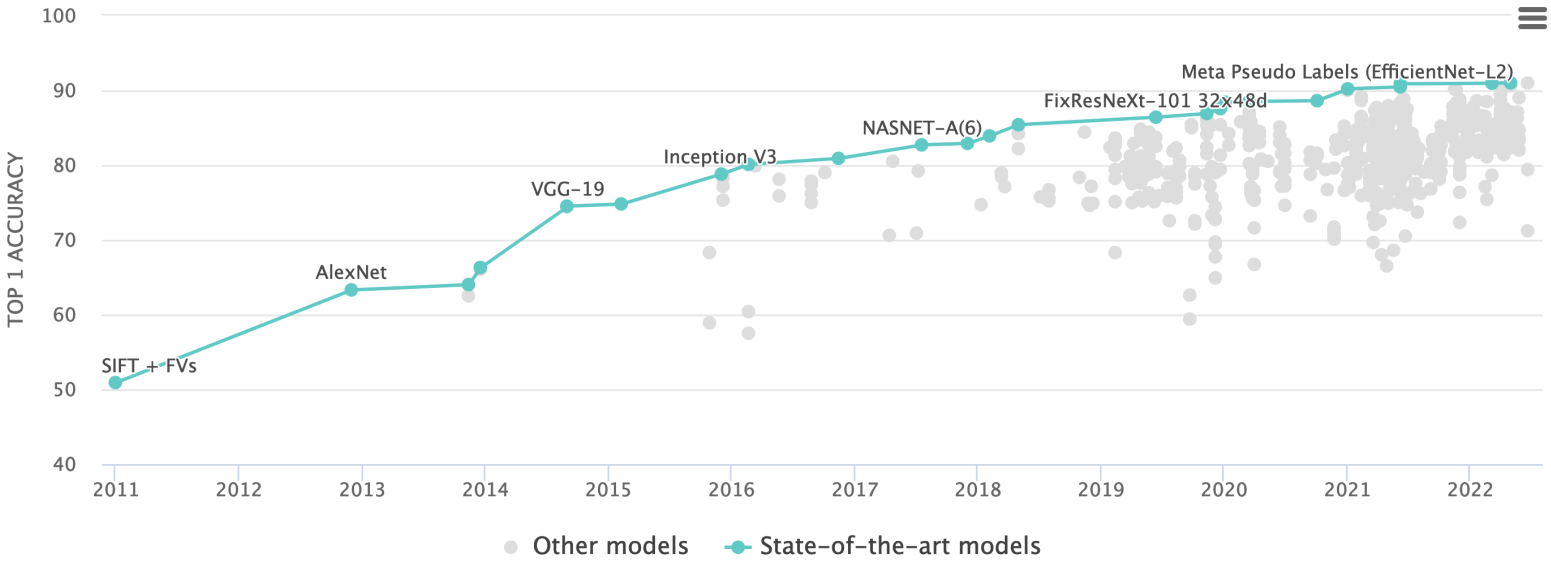


# ImageNet results: from 50% to 91%




2012 Alex Net

2014 VGG

2015 GoogLeNet / Inception

2016 Residual Network

2018 NAS Network

2020 EfficientNet (Transformers)

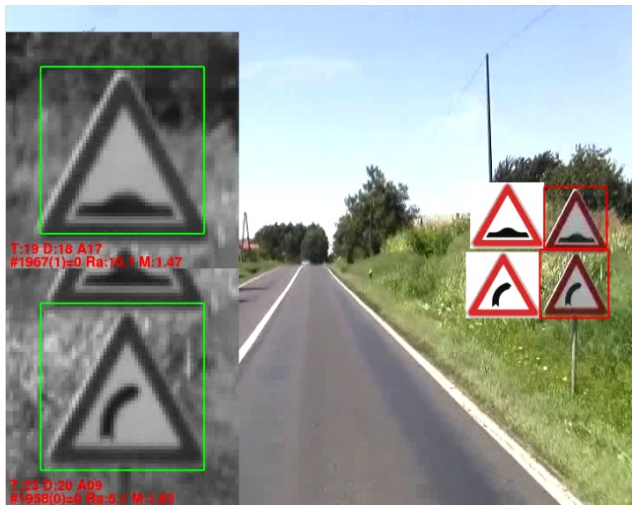
2022 CoCa (Contrastive Captioners = Image-Text Foundation Models)

https://paperswithcode.com/sota/image-classification-on-imagenet

# Detection, tracking and recognition of traffic signs (2011-13)

**Recognition** German Traffic Sign Recognition Benchmark (GTSRB) data set, containing 51839 labelled images of real-world traffic signs.

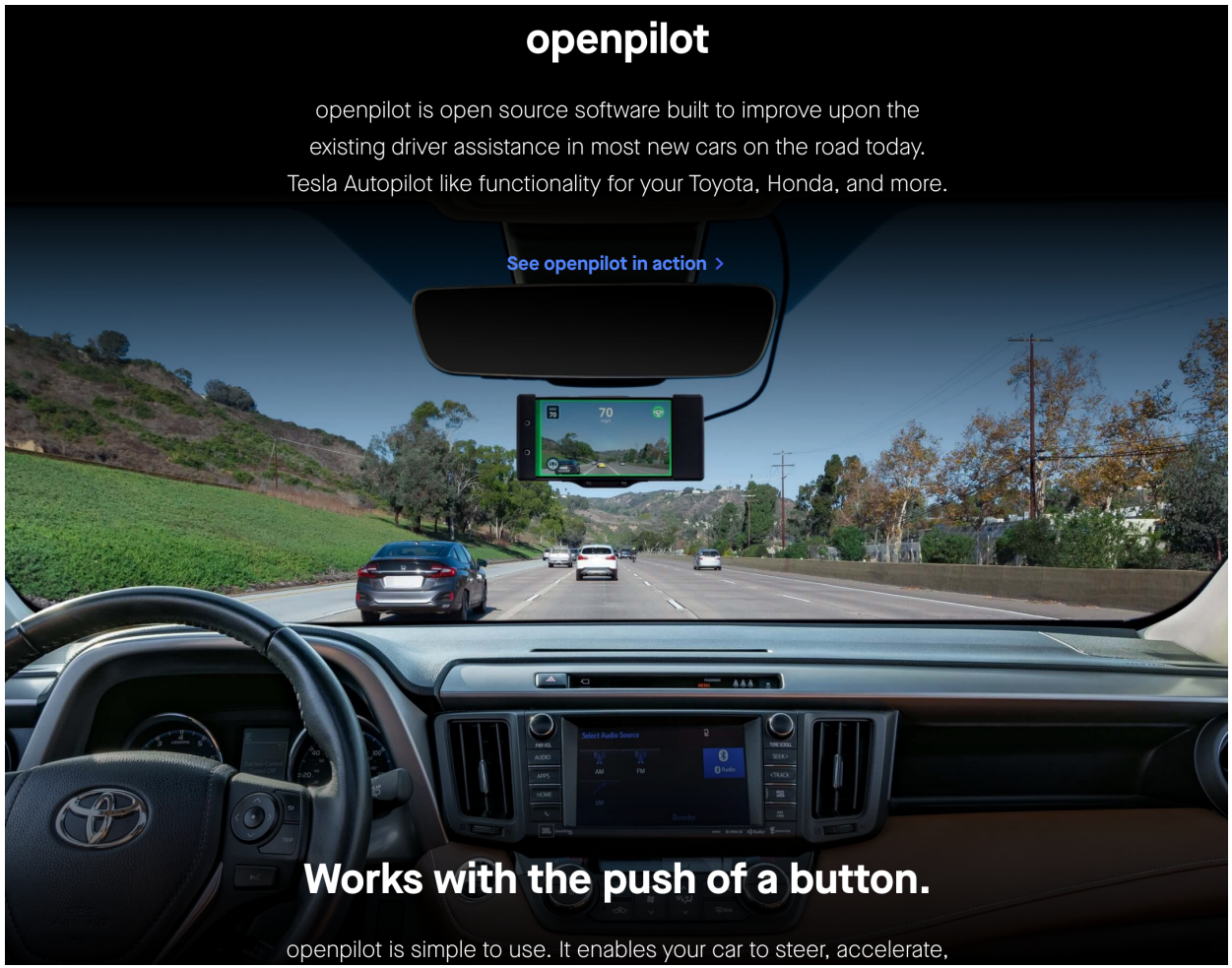
**Detection** The German Traffic Sign Detection Benchmark is a single-image detection assessment 900 images (600 for training and 300 for test)



**and the winner is**

$\rightarrow$ Deep learning gives very good results on both tasks

# Open Pilot: 2200 $




openpilot is the Android

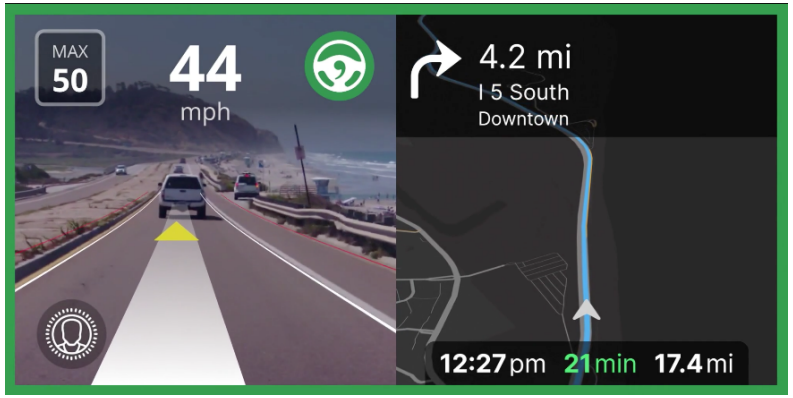
https://github.com/commaai/openpilot

THIS IS ALPHA QUALITY SOFTWARE FOR RESEARCH PURPOSES ONLY. THIS IS NOT A PRODUCT. YOU ARE RESPONSIBLE FOR COMPLYING WITH LOCAL LAWS AND REGULATIONS.

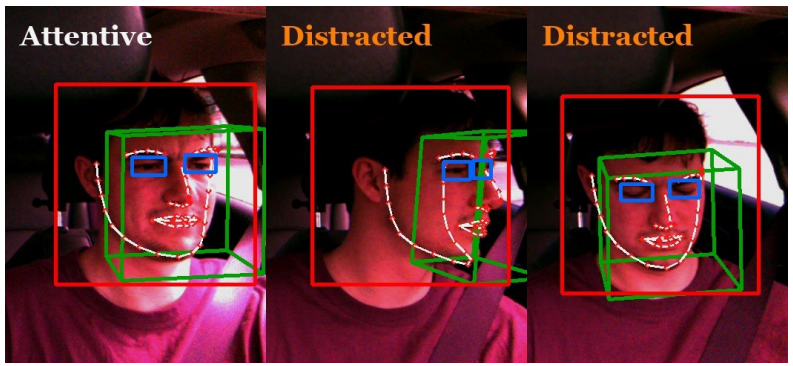
# Openpilot AI features

Two AI

- Diving agent
  - Automated lane-centering
  - Adaptive cruise control
    OpenStreetMap inside
  - Assisted lane change




- Driver monitoring system (DMS)
  - Safety concerns



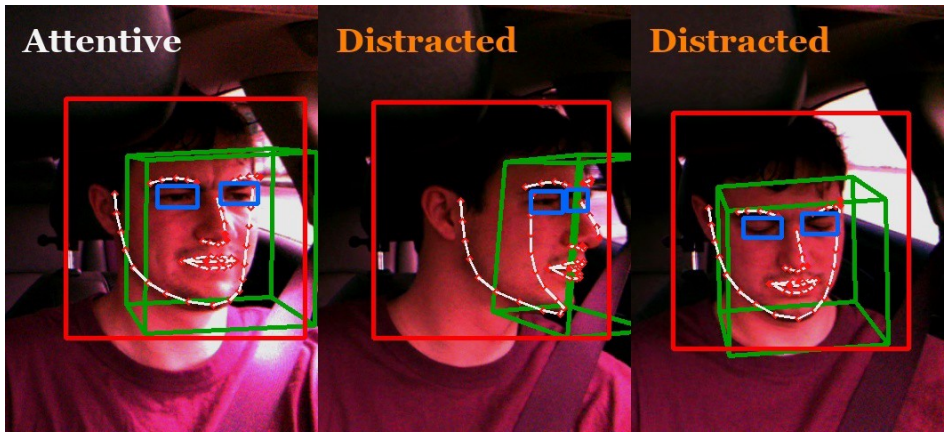

software update

https://comma-ai.medium.com/towards-a-superhuman-driving-agent-1f7391e2e8ec

# Openpilot 's driver monitoring system (DMS)

Three components

- Face localization
  - openCV -> cropping
- Feature generation
  - EfficentNet b0 architecture
  - Fine tuning
- Decision module
  - Treshold based decision

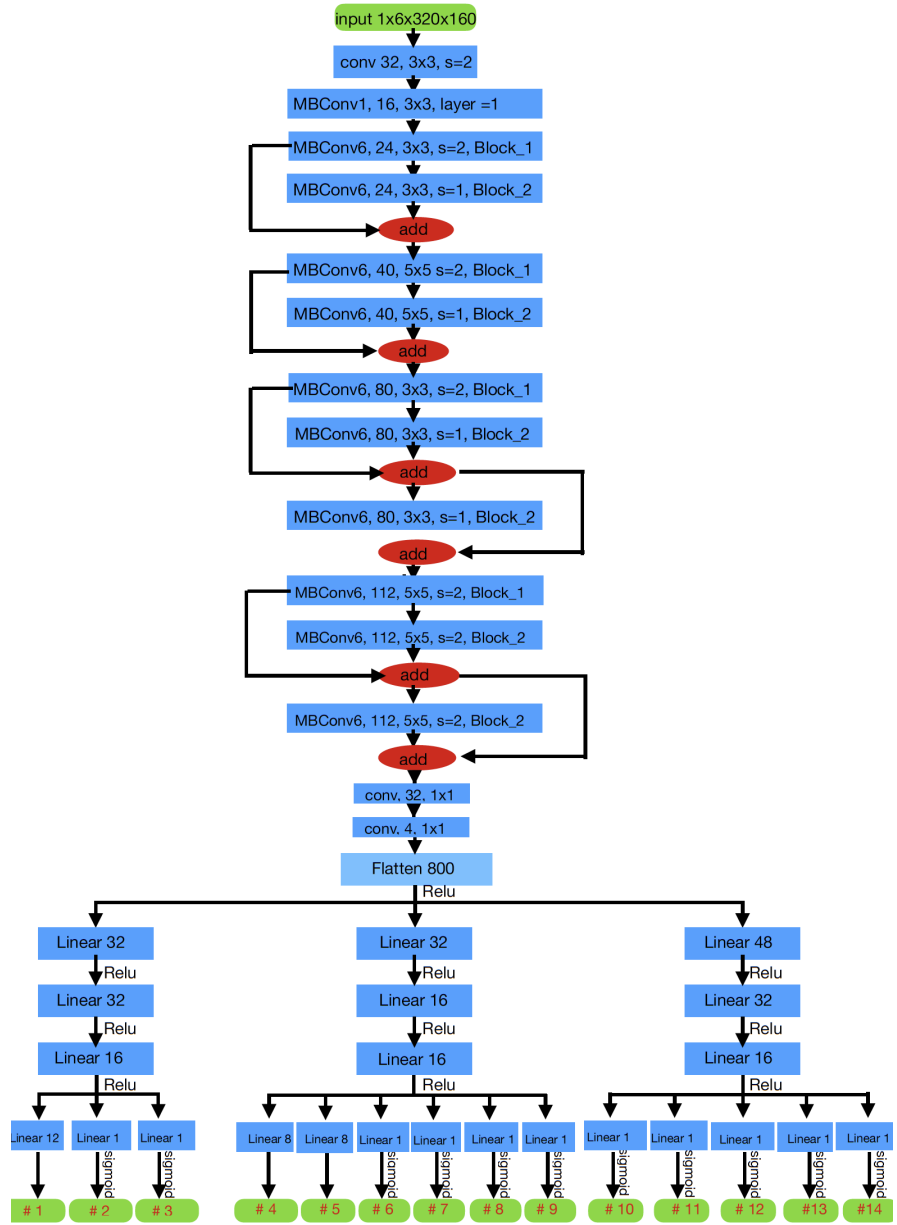




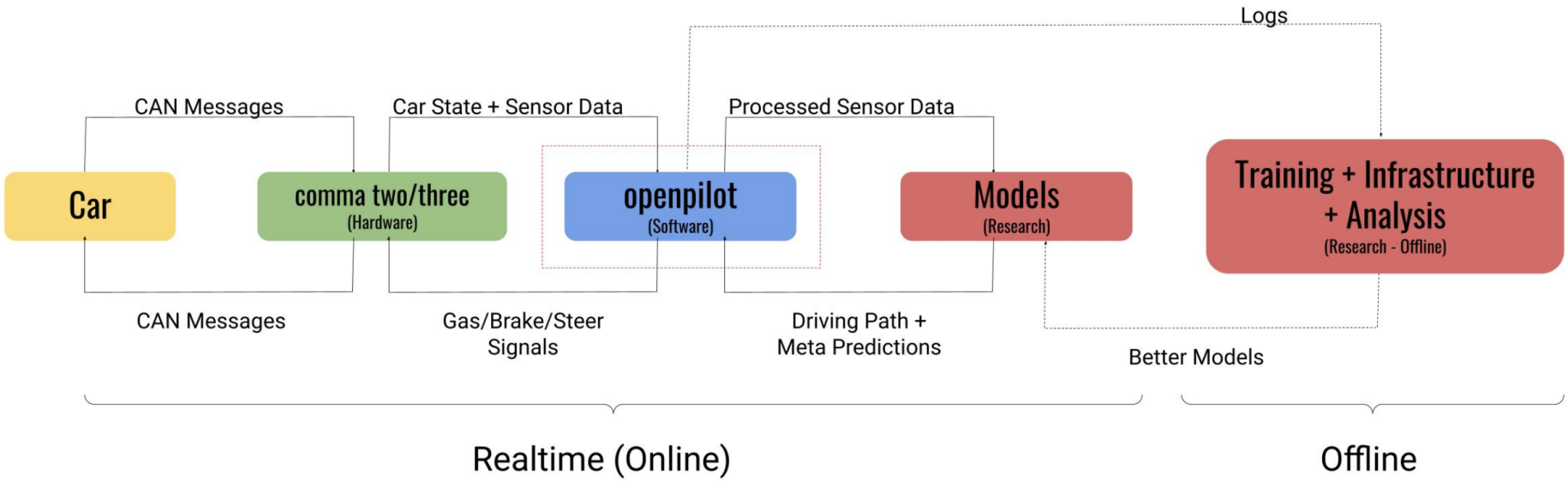
https://github.com/commaai/openpilot

# Architecture of the feature generator of openpilot's DMS

- Input: YUV 420 (6 channels)
  - EfficentNet b0 architecture
  - Tan et. al. (Google), ICML 2019
- Output: 45-features (03/22)
  - Face position (12 values)
  - Eyes positions (8 values)
  - sunglasses
  - visible face probability
  - blinking
  - ...
- Training data: fine tuning
  - pytorch inside
  - Qualcomm Snapdragon 845



# Openpilot's components

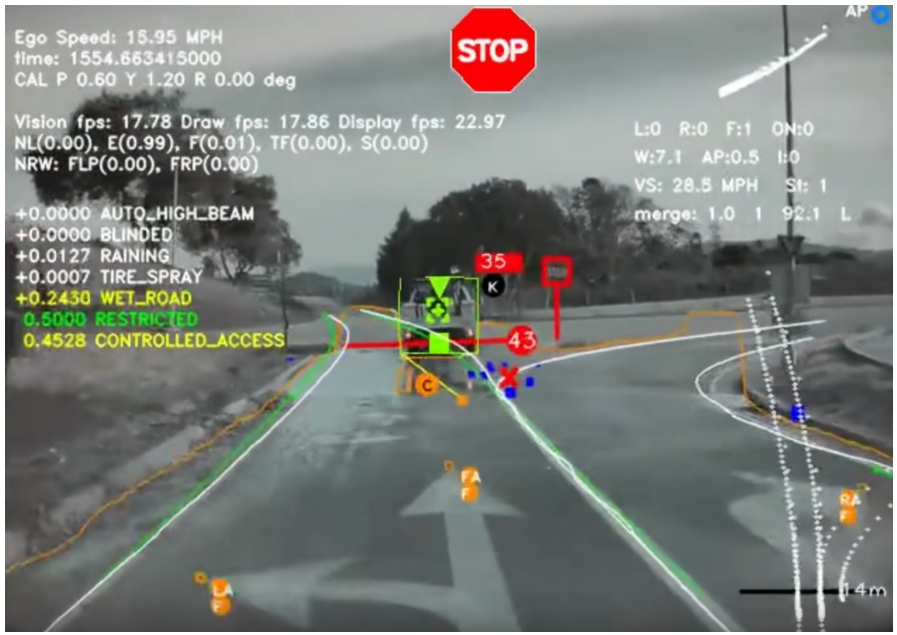



## AI inside: uses data

(Deep) learning based programming

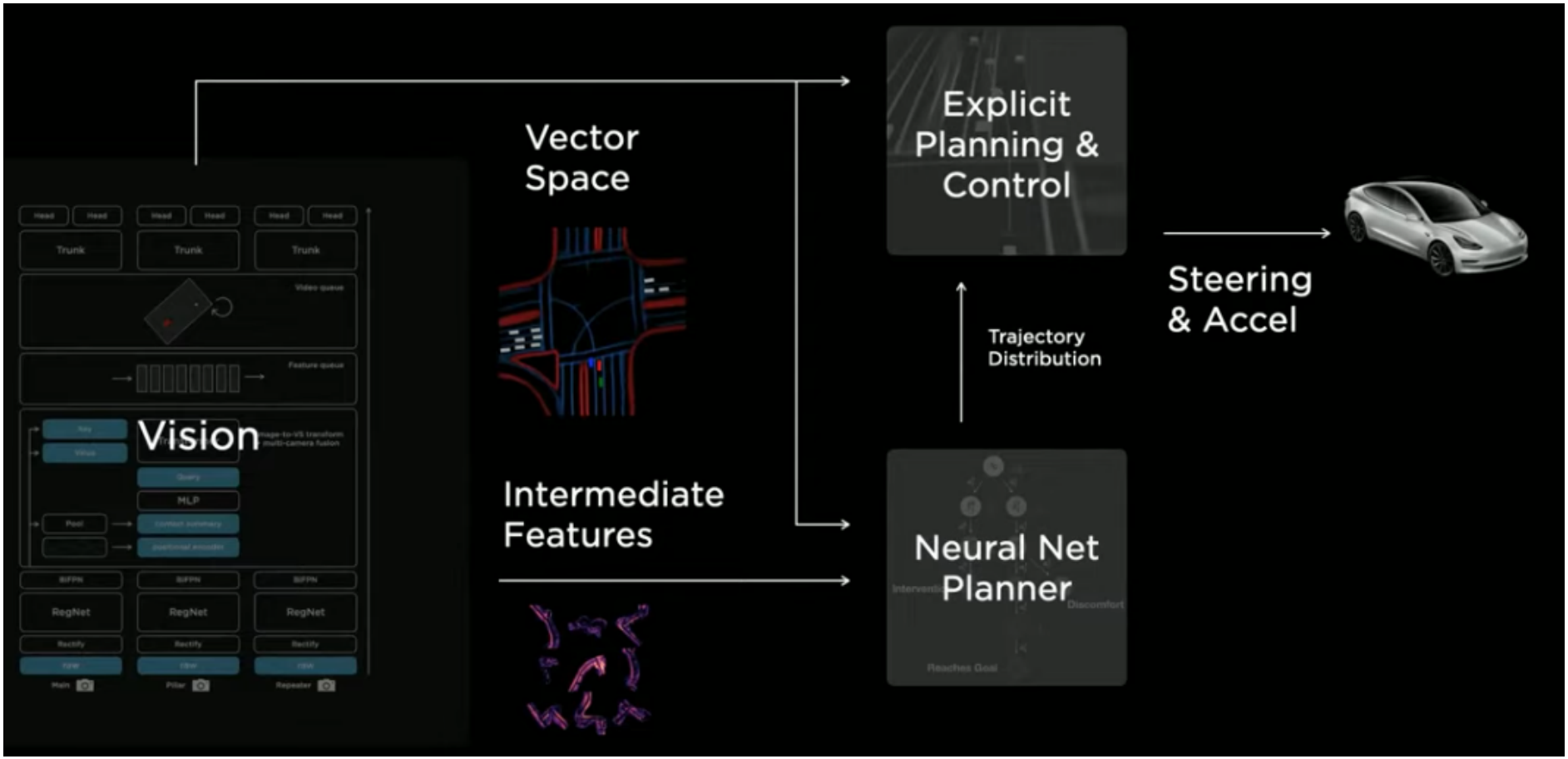
# Tesla's autopilot components

- Driving agent
  - Automatic lane change
  - Adaptive cruise control
  - Autosteer
  - Navigate on Autopilot (Freeway)
  - Traffic Light and Stop Sign Control
  - ...
  - FSD (limited-access Beta)
- Parking Summon




- Driver monitoring system (DMS)

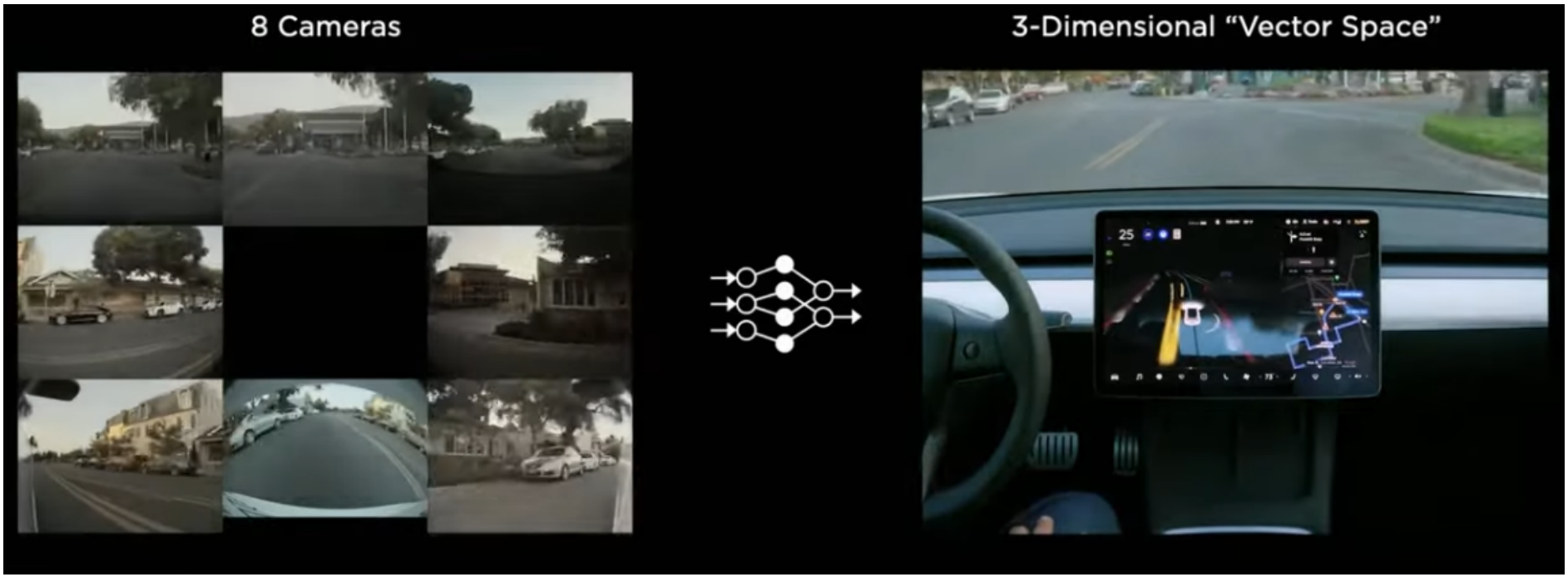
# Summarizing the driving agent architecture




## Two AI components = two deep networks

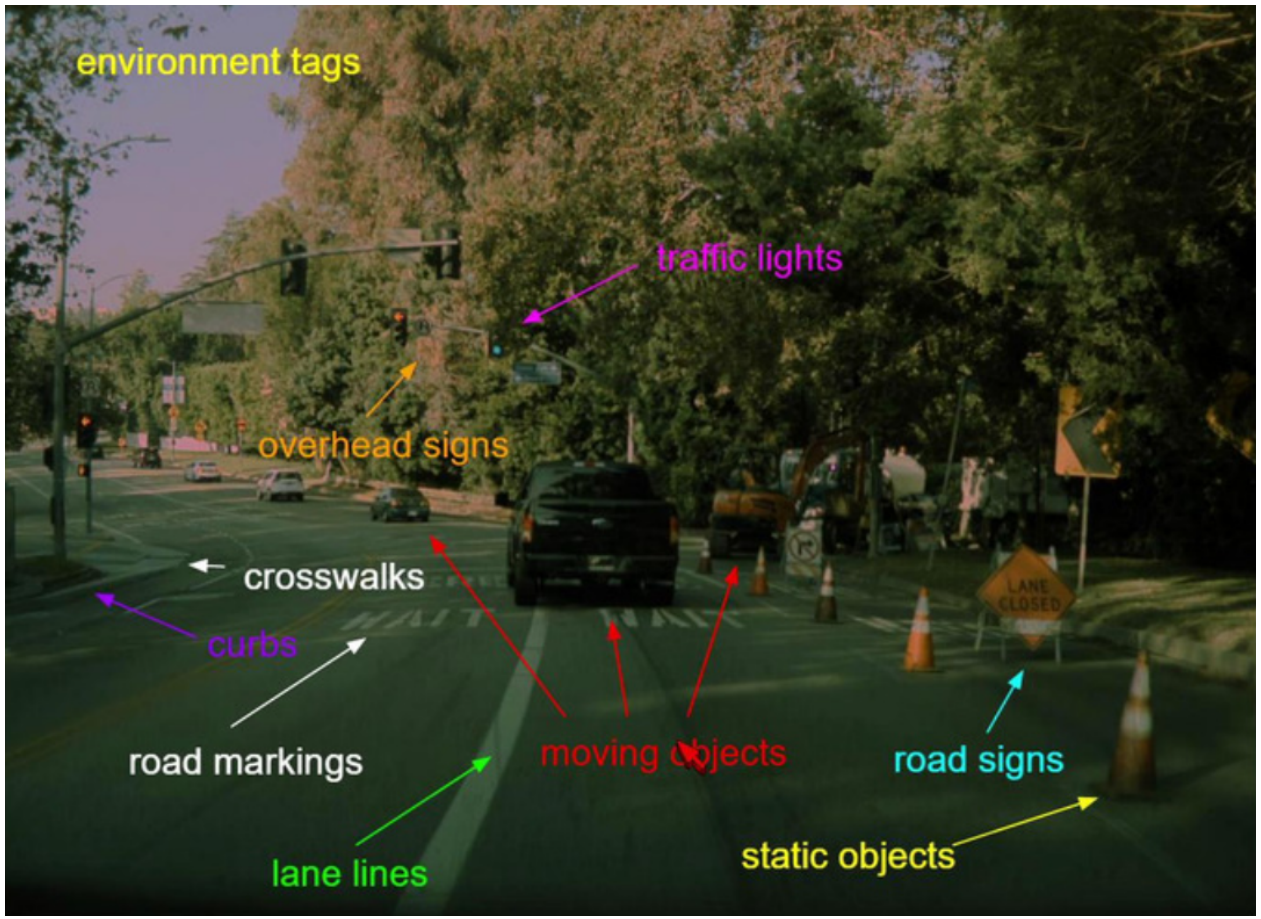
- perception module
- decision module (planner) using deep reinforcement learning

# Tesla's autopilot perception module




- input: 8 cameras
- output: $640 \times 460$ 3D map of the surroundings

# Perception is scene understanding

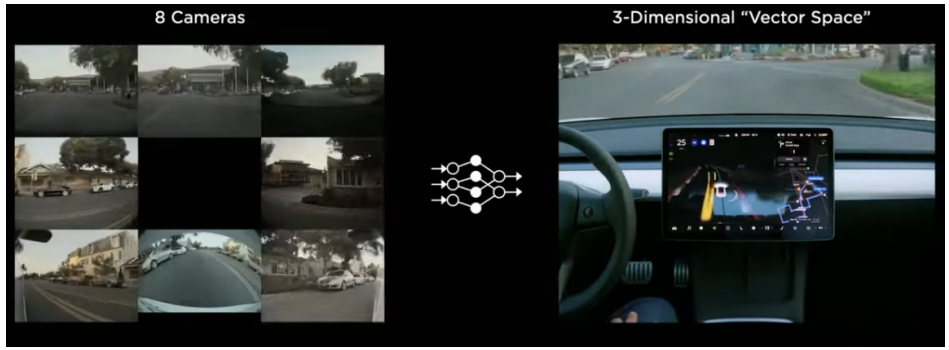



## Scene understanding is

Multi-task learning

**Andrej Karpathy, Multi-Task Learning in the Wilderness, ICML 2019**
https://slideslive.com/38917690/multitask-learning-in-the-wilderness

# The 5 components of Tesla's perception module




input: 8 cameras

1. feature generator: backbone
2. multi scale feature fusion
3. multi camera fusion
4. time filtering
5. multi task decision module per pixel on the output map (one per task)
   - item location (cars, pedestrian...)
   - traffic signs (Stop sign, traffic light...
   - lane prediction
   - ...

output: $640 \times 460$ 3D map of the surroundings

# 1. and 2. Tesla's feature extractor

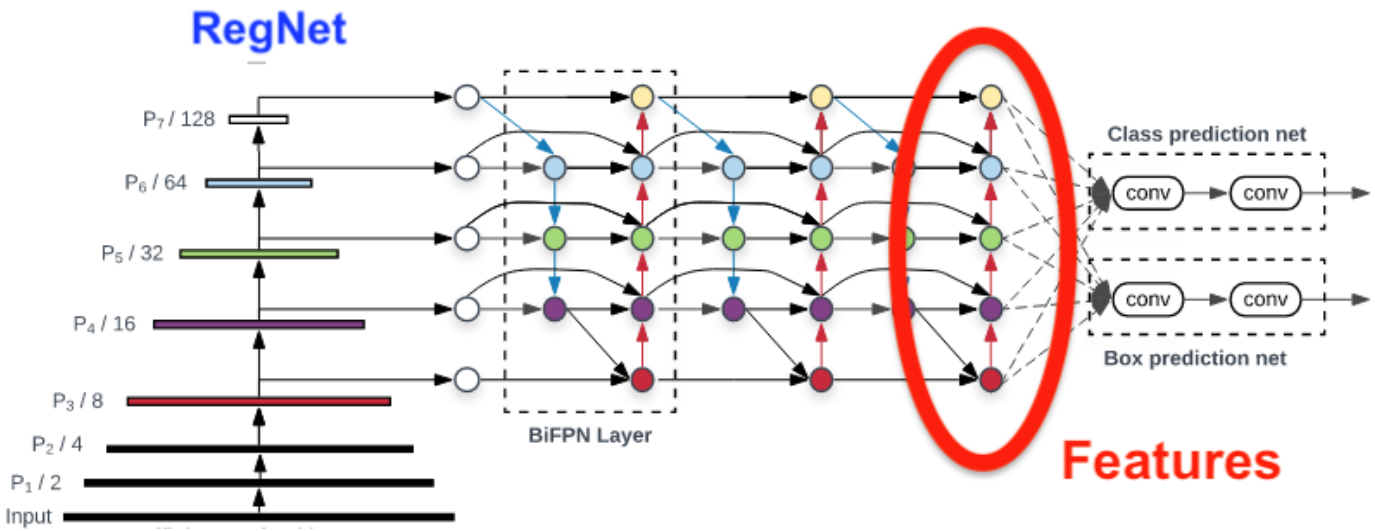


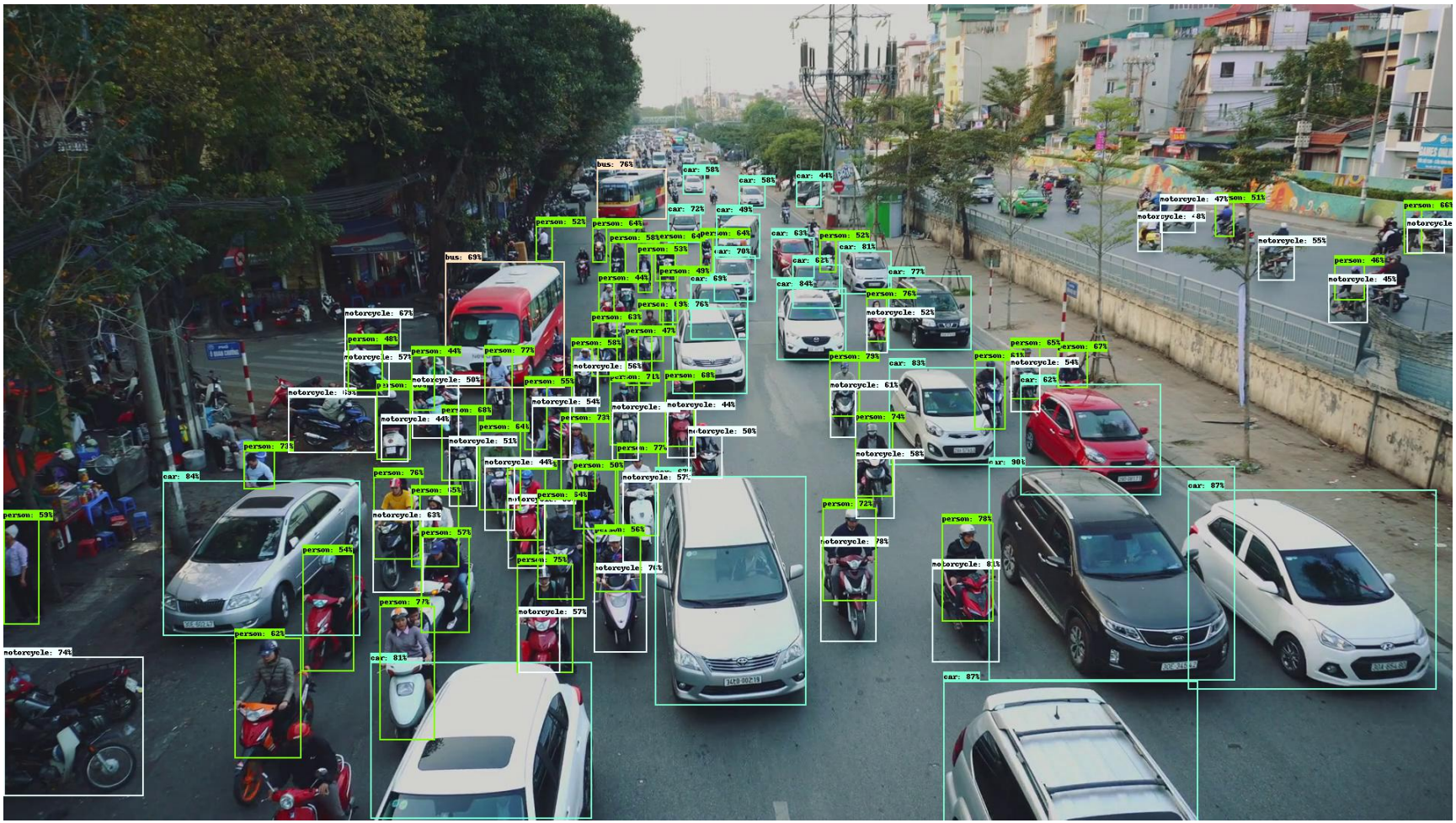

image 1280× 960 12 bits

## Multiscale latency/accuracy trade off

- ResNet50 (2020), RegNet (2021) - different resolution/different scale
- EfficientDet - bi-directional feature pyramid net (BiFPN)

Andrej Karpathy , Tesla FULL self driving explained by an engineer, Tesla's AI day, Aug 20, 2021

# 1. and 2. Tesla's feature extractor

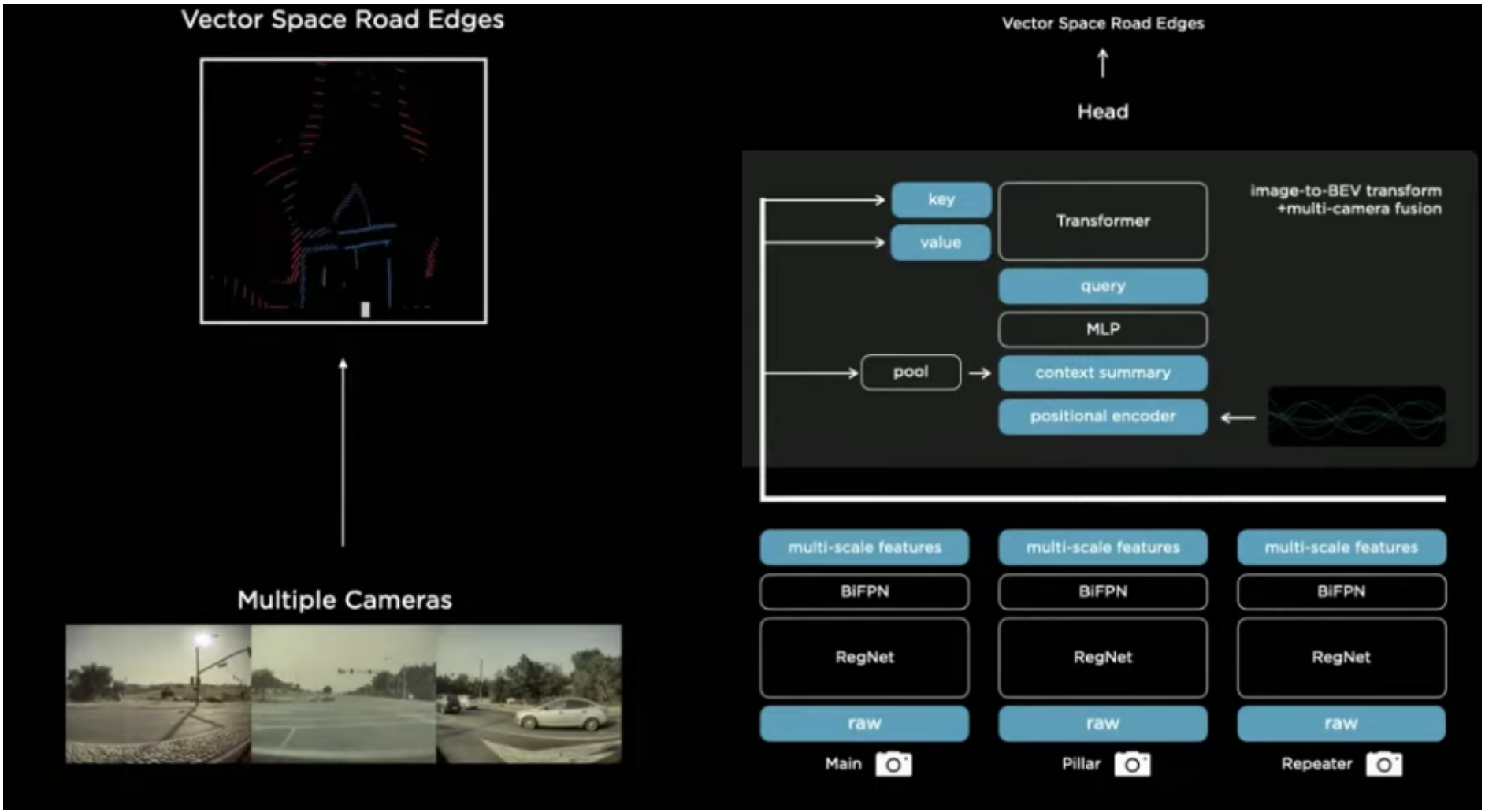


Mingxing Tan et al., EfficientDet: Scalable and Efficient Object Detection, CVPR 2020

Ok but Tesla has got 8 cameras !

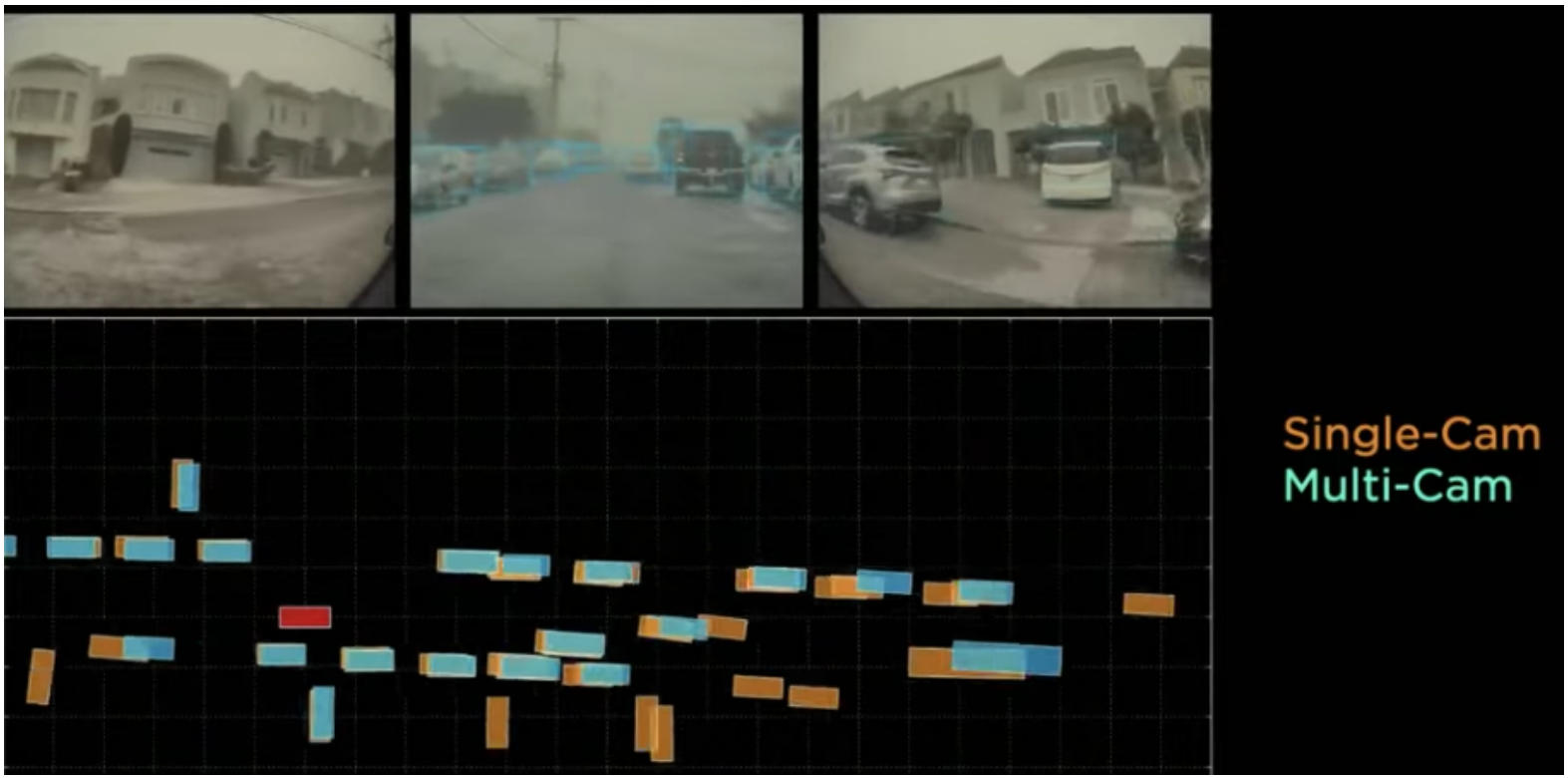
# 3. Sensor fusion

## To deal with uncertainties



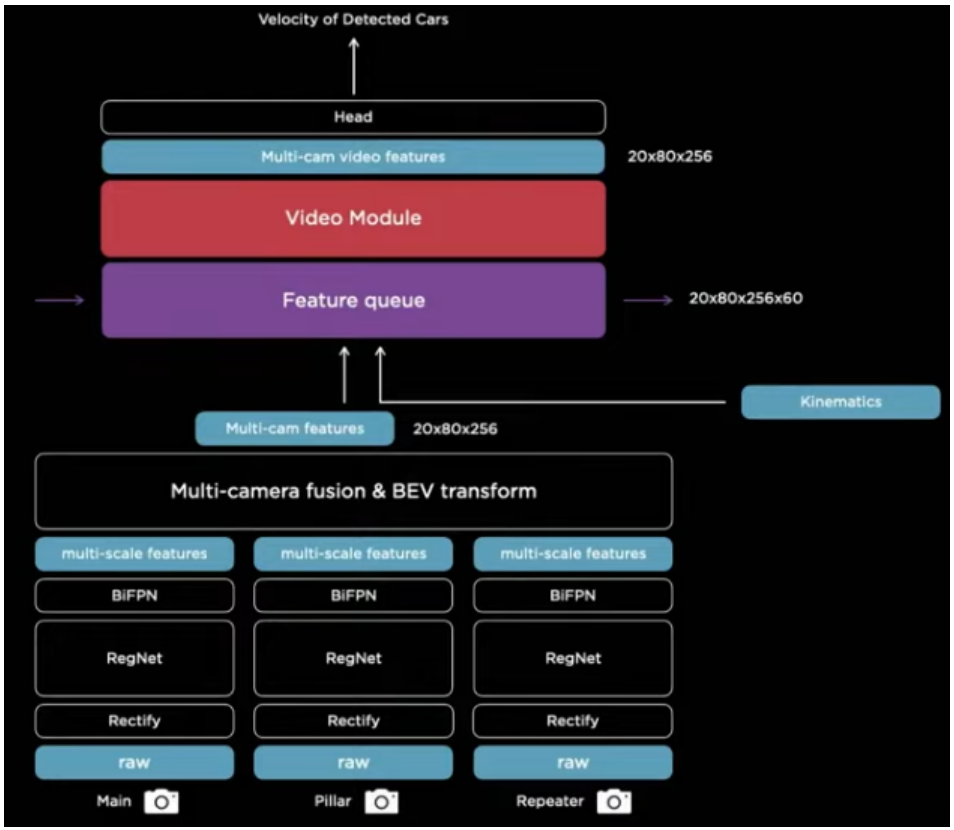

Nicolas Carion et al. "End-to-end object detection with transformers." ECCV 2020.

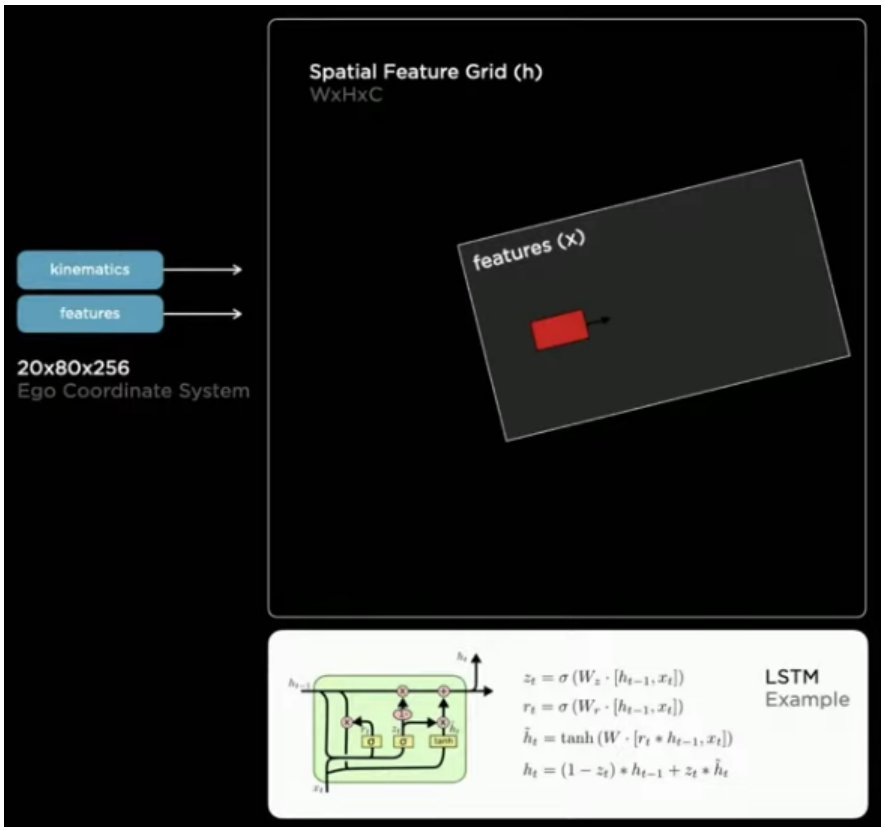
# 3. Sensor fusion results



# 4. Time filtering

to deal with time (occlusion, past traffic signs...)

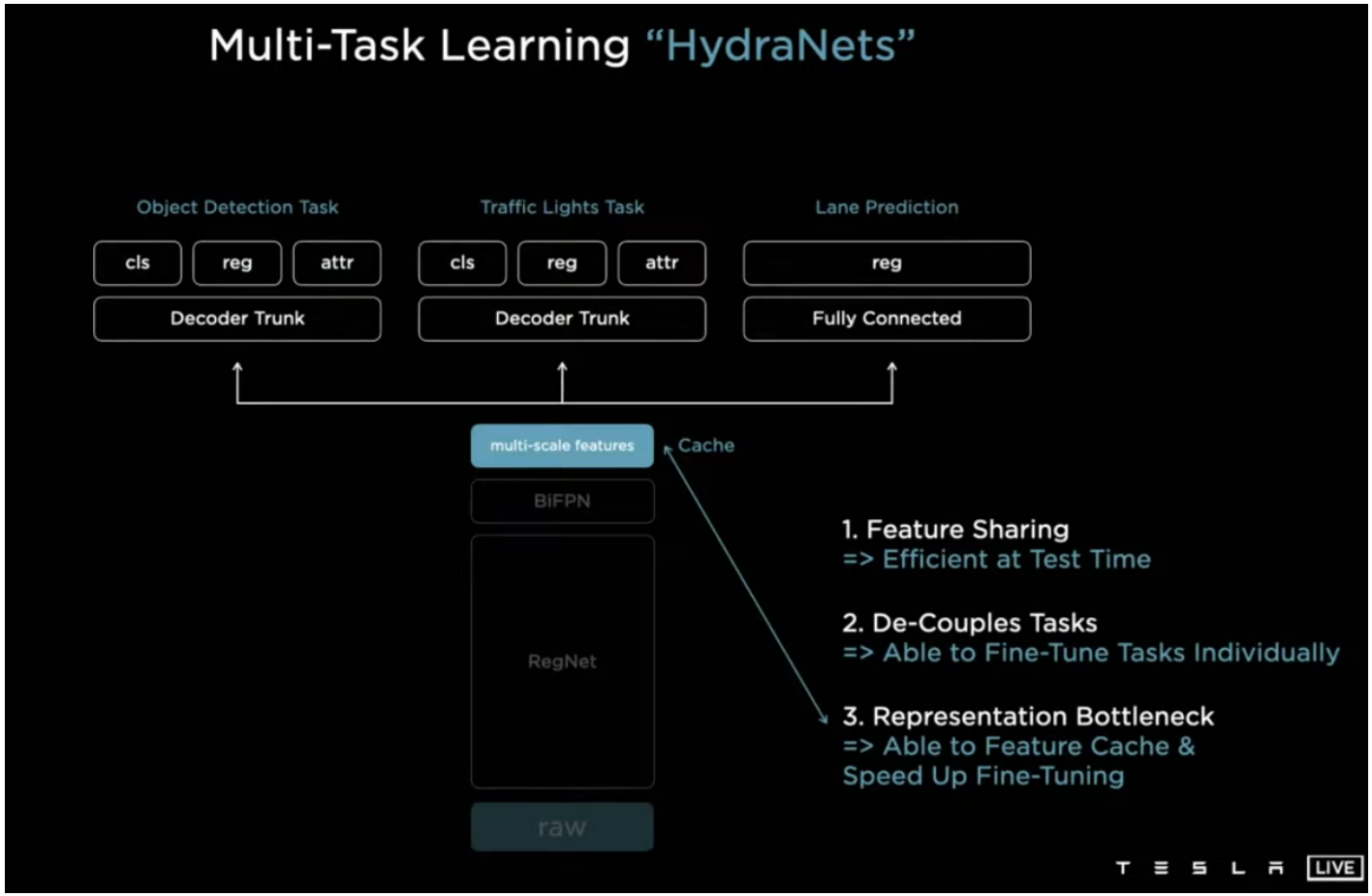



## Video module preforming spatio temporal filteing

- 36 frames per second
- spatio temporal LSTM (Liu et al, ECCV 2016)

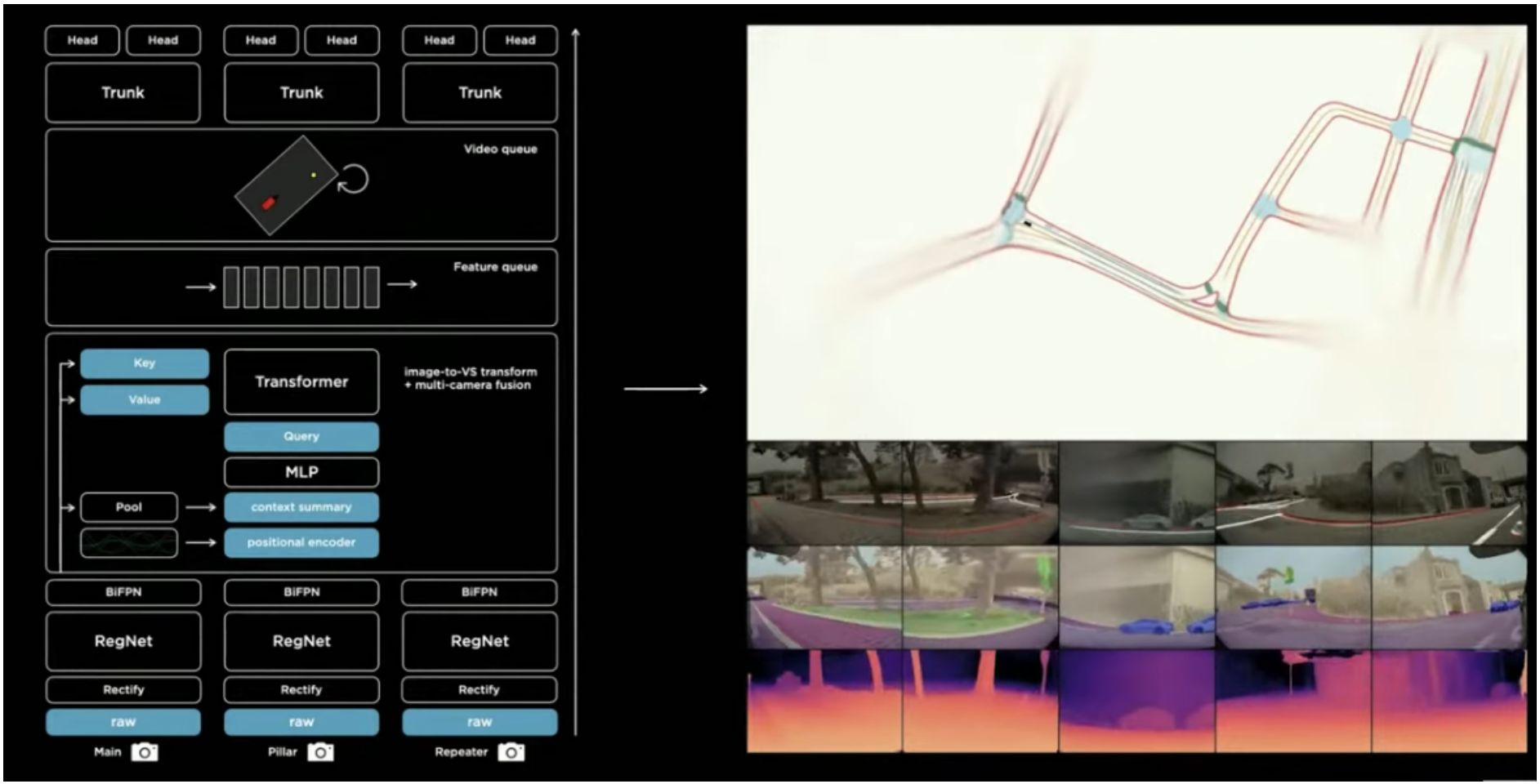
# 5. Decision modules




## HydraNets, Mullapudi et al, 2018

- Multi task learning
- Specialized shared feature (to reduce inference computing time)

# Tesla perception module



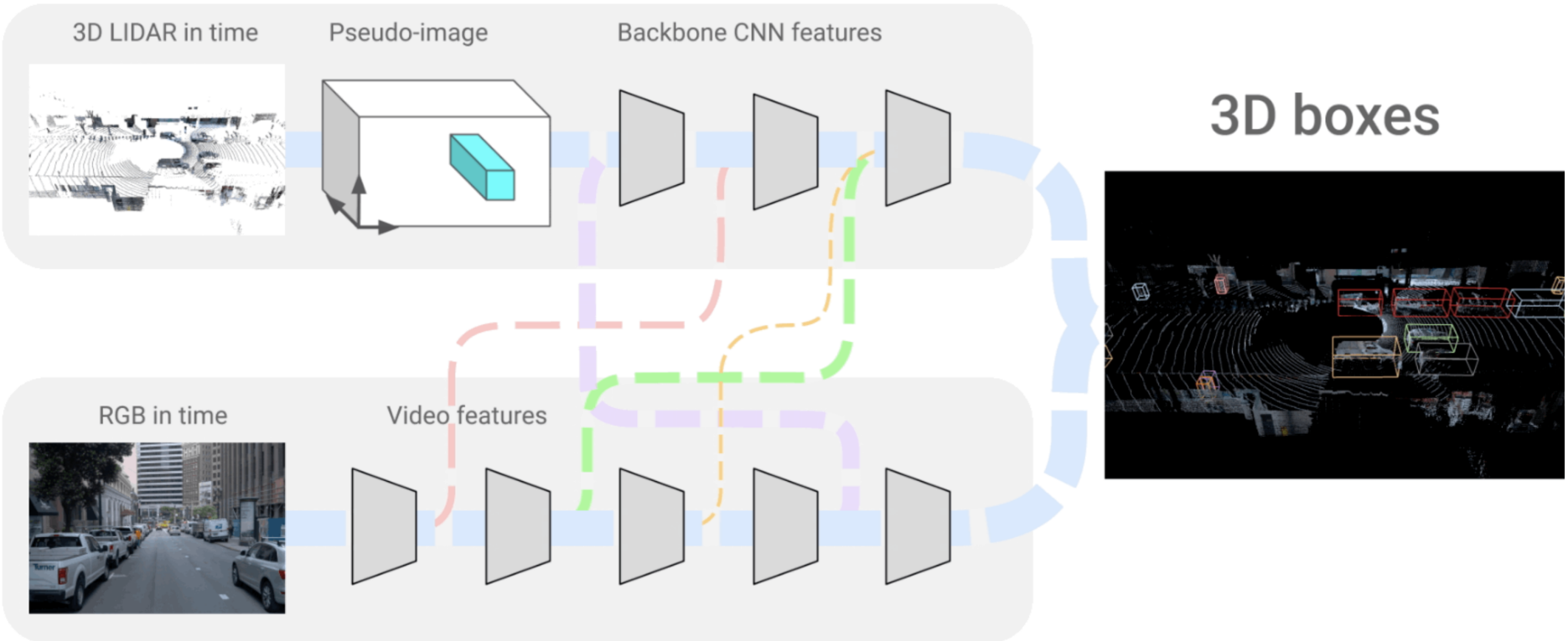
# Tesla perception module

1. feature generator: backbone — ResNet50 (2020), RegNet (2021) (from a CVPR 2020 Facebook paper)
2. multi scale feature fusion — EfficientDet (from a 2019 Google paper)
3. multi camera fusion — Transformers (from a 2020 Facebook paper)
4. time filtering — LSTM (recurrent neural network)
5. multi task decision module — Hydranet
   - item location (cars, pedestrian...)
   - traffic signs (Stop sign, traffic light...
   - lane prediction
   - ...

## This perception module contains

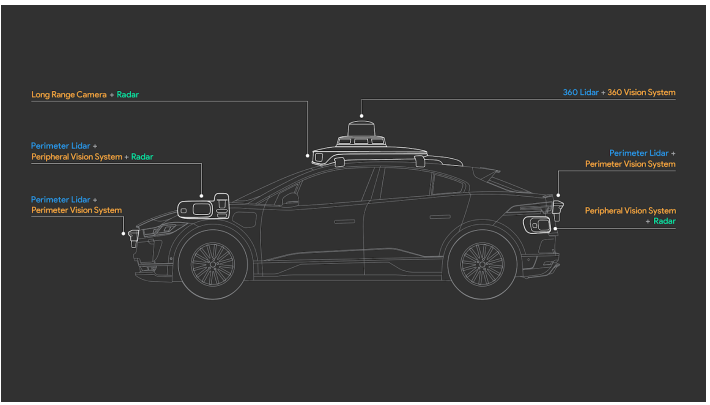
1. 48 networks, 1,000 outputs tensors, 70,000 GPU h to train
2. performs 40 prediction per second

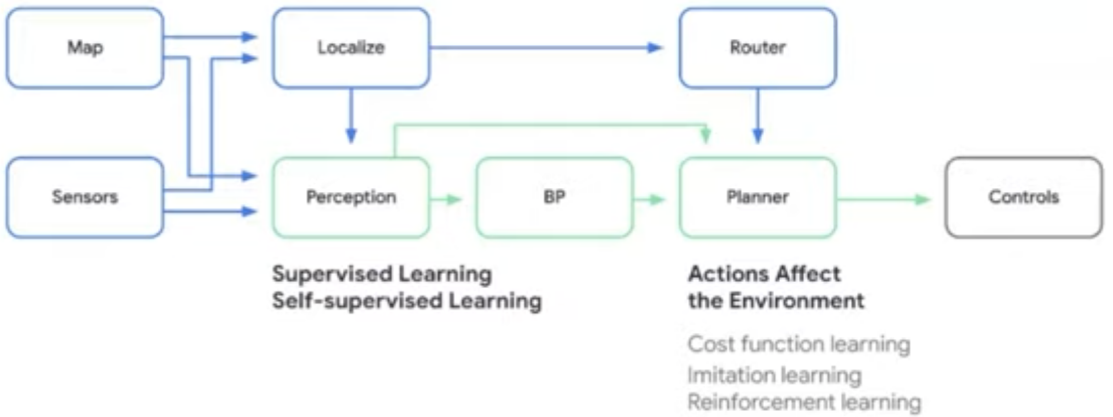
# Perception module at Waymo




"4D-Net for Learned Multi-Modal Alignment", ICCV 2021
https://ai.googleblog.com/2022/02/4d-net-learning-multi-modal-alignment.html

# Waymo's point of view

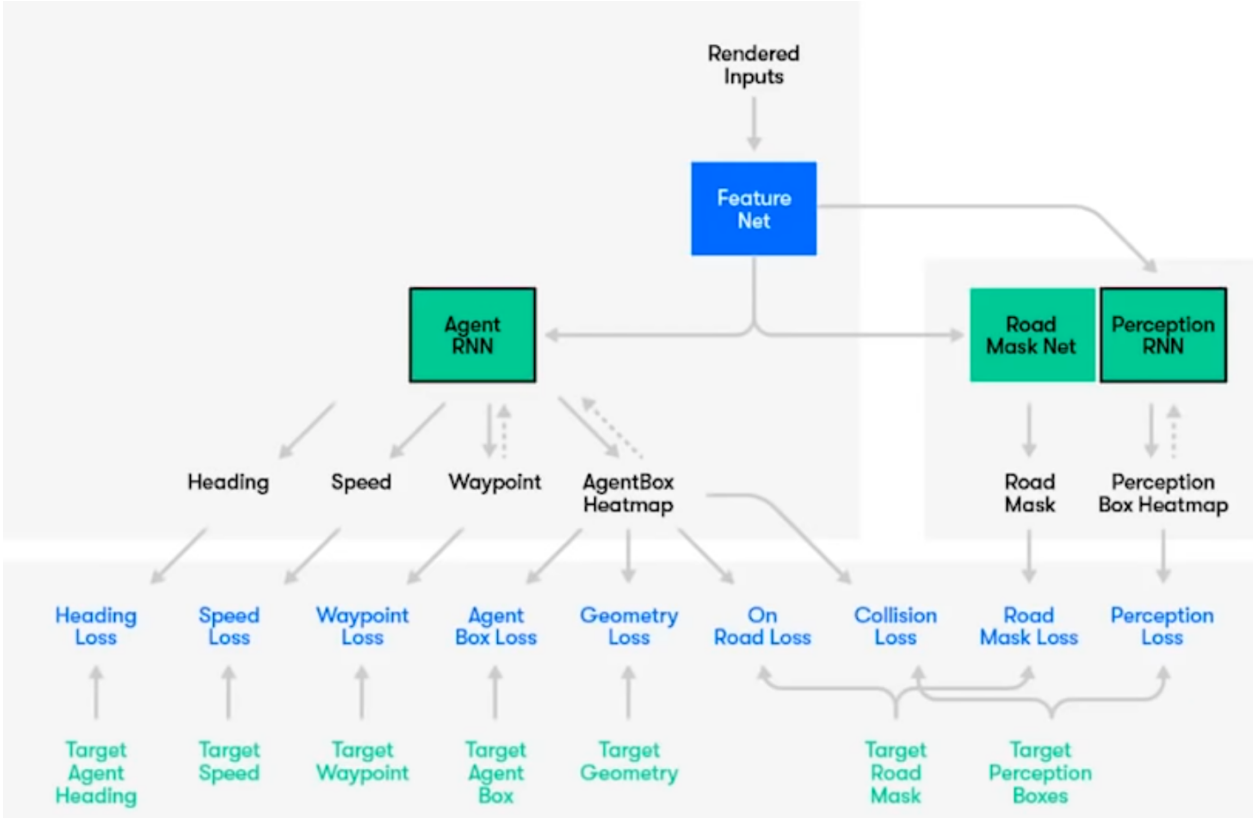



Active research

- Stinet: Spatio-temporal-interactive network for pedestrian detection and trajectory prediction, CVPR 2020
- Vectornet: Encoding hd maps and agent dynamics from vectorized representation, CVPR 2020
- Taskology: Utilizing Task Relations at Scale, CVPR 2021
- ChauffeurNet: Learning to Drive by Imitating the Best and Synthesizing the Worst, ICML 2019

# Decision making using deep reinforcement learning

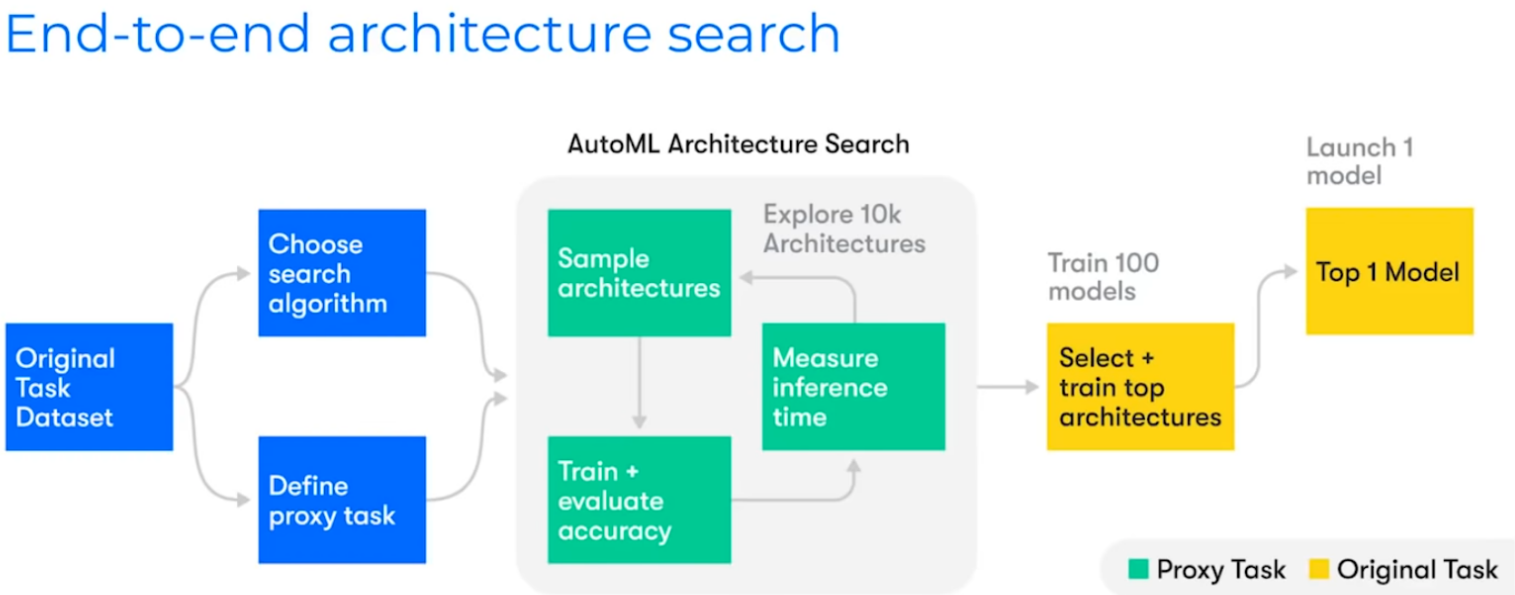



## Imitation model providing safety, confort and efficiency

Multi-Task and multi objective learning

**Mayank Bansal , ChauffeurNet: Learning to Drive by Imitating the Best and Synthesizing the Worst, ICML 2019**
https://slideslive.com/38917927/chauffeurnet-learning-to-drive-by-imitating-the-best-and-synthesizing-the-worst

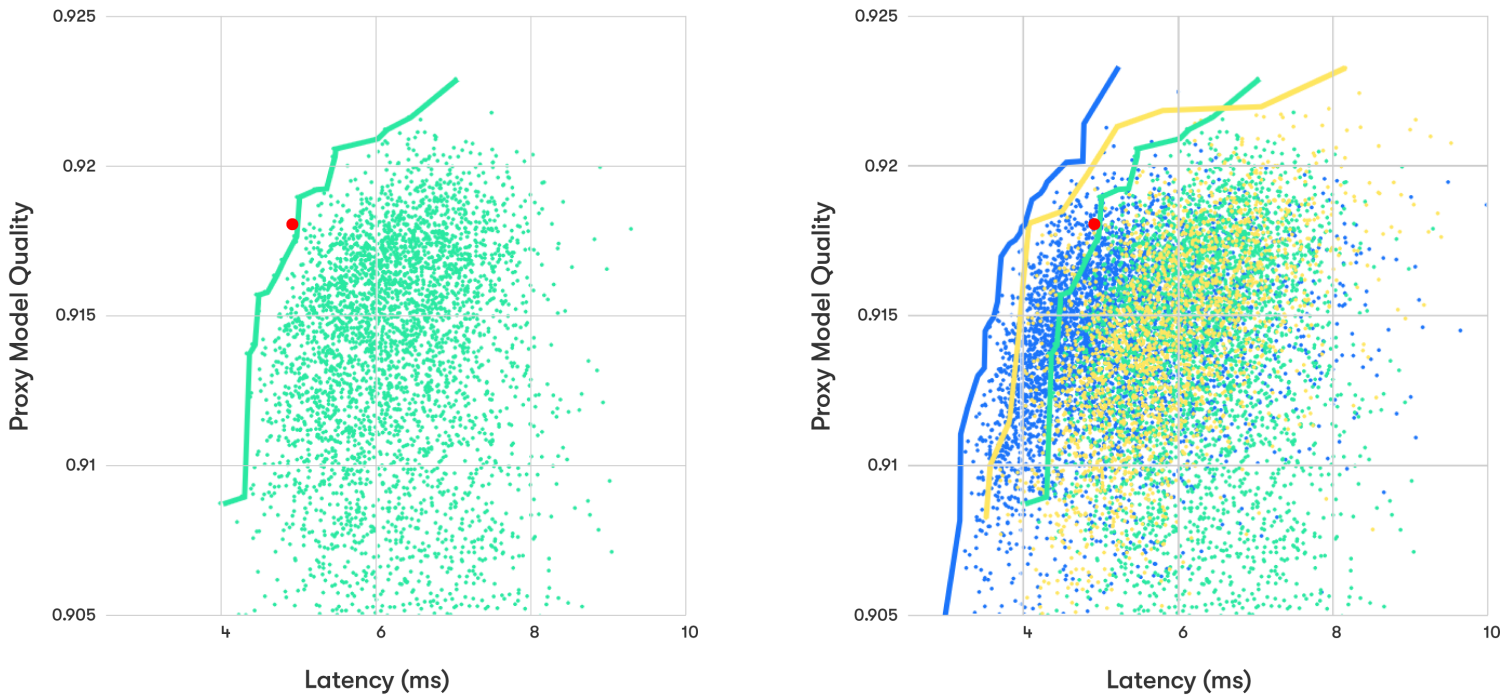
# Waymo's AutoML




Proxy end-to-end search: Explore thousands of architecture on a scaled-down proxy task, apply the 100 best ones to the original task, validate and deploy the best of the best architectures on the car.

**Drago Anguelov (Waymo) - MIT Self-Driving Cars lectures**
https://medium.com/waymo/automl-automating-the-design-of-machine-learning-models-for-autonomous-driving-141a5583ec2a

# Waymo's AutoML

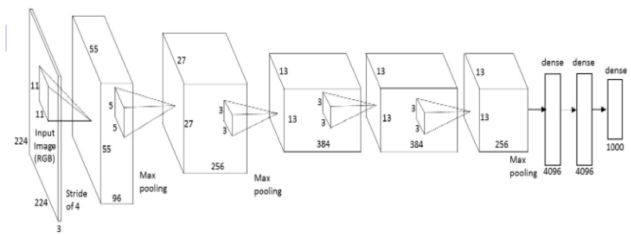



1) The first graph shows about 4,000 architectures discovered with a random search on a simple set of architectures. Each point is an architecture that was trained and evaluated. The solid line marks the best architectures at different inference time constraints. The red dot shows the latency and performance of the net built with transfer learning. In this random search, the nets were not as good as the one from transfer learning. 2) In the second graph, the yellow and blue points show the results of two other search algorithms. The yellow one was a random search on a refined set of architectures. The blue one used reinforcement learning as in [1] and explored more than 6,000 architectures. It yielded the best results. These two additional searches found nets that were significantly better than the net from transfer learning.

**AutoML: Automating the design of machine learning models for autonomous driving**
https://medium.com/waymo/automl-automating-the-design-of-machine-learning-models-for-autonomous-driving-141a5583e2a

# Road map

1. A very brief history of autonomous vehicles
2. How has this happened? (Deep Learninng)
3. Data to train the deep network
4. How Artificial Intelligence will change the Auto
5. Conclusion

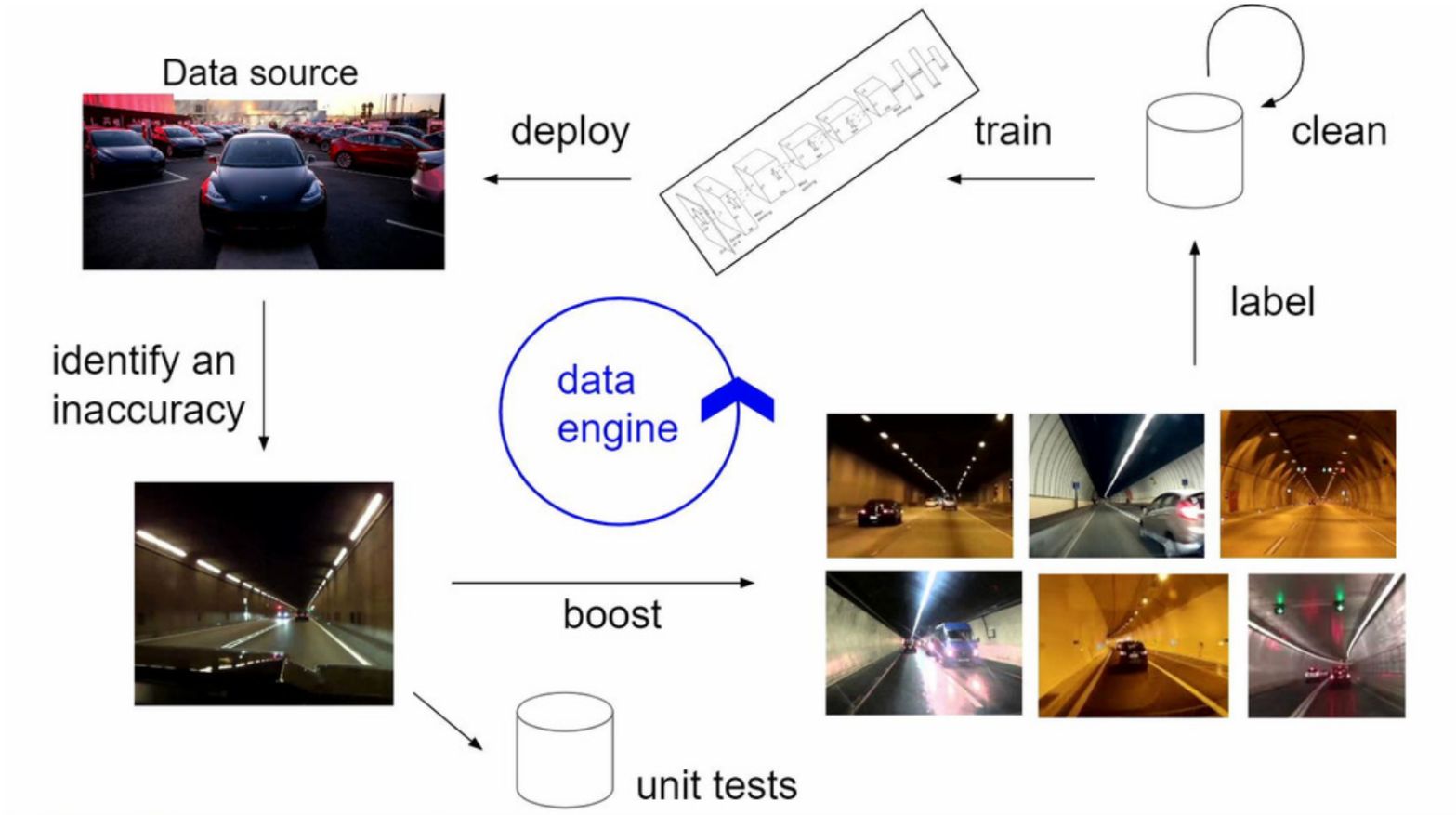


# Data: the long tail of situations

Taïwan, june 2020,


Andrej Karpathy - AI for Full-Self Driving at Tesla, Scaled ML, feb 2020,

# Improving the autopilot: iterative process

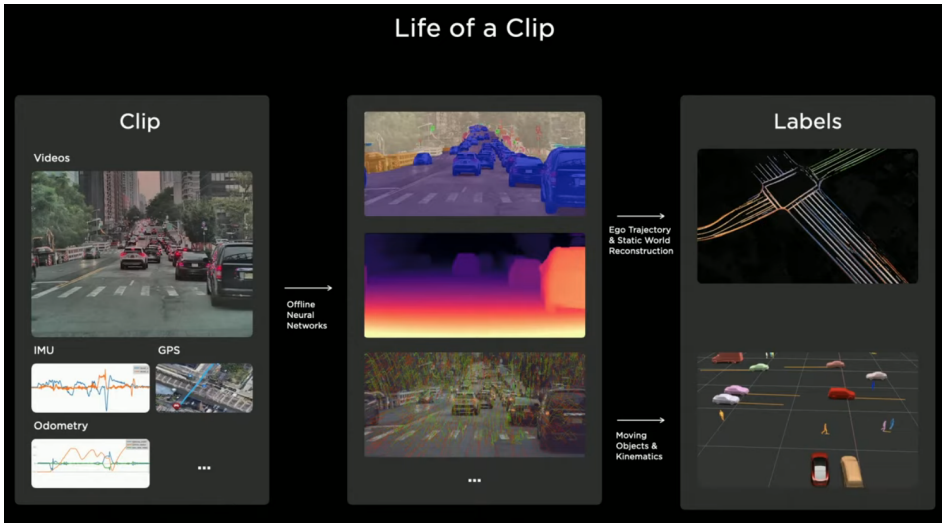


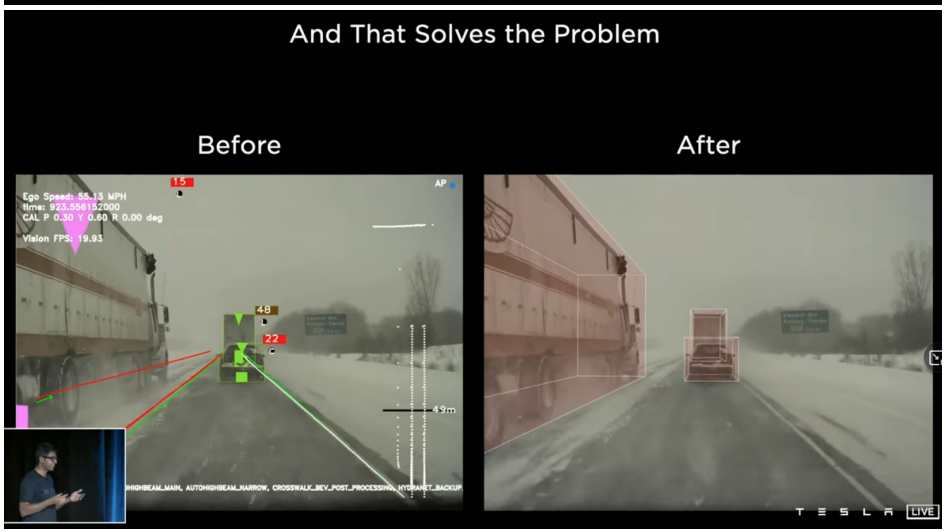

- fleet learning
- testing = shadow mode for more training data

Karpathy (Tesla) ICML 2019

# Tesla's point of view on data

- Gathering process
  - 221 triggering situations
- manual labelling (1000 person)
  - 2d -> 3d
  - reconstruction labelling
- auto labelling
  - use specificly trained networks
  - human to clean
- simulation
  - rare event
  - sensor robustness
  - adversarial exemples




**Tesla's AI day** youtube.com/watch?v=j0z4FweCy4M

# Openpilot : l'étiquetage des données par crowd sourcing

## comma10k

Count and Percentage of Available Images Labeled 6344 out of 9874, 64.25%

This is the first 2,000 images of our internal comma10k dataset. After we clean up these new labels, we'll release more. Learn more from the Medium post, or on the comma.ai discord in the #comma-pencil channel.

It's 10,000 pngs of real driving captured from the comma fleet. It's MIT license, no academic only restrictions or

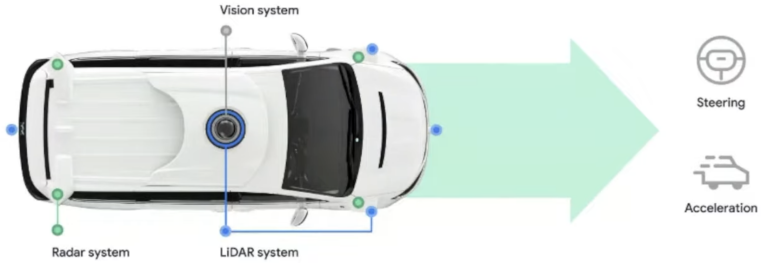
https://github.com/commaai/comma10k

# Waymo's open data set

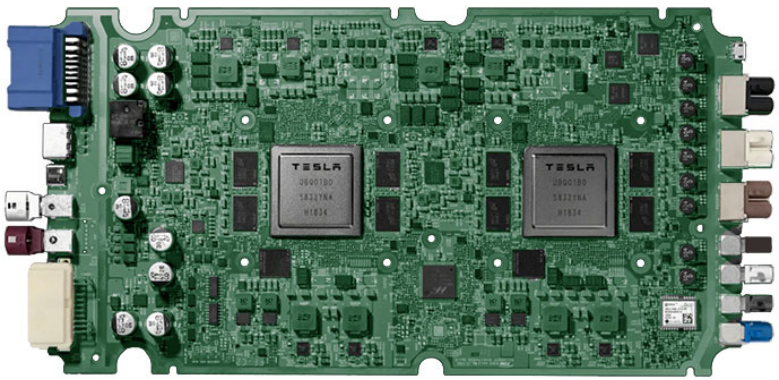

574 hours of data

`https://github.com/waymo-research/waymo-open-dataset`

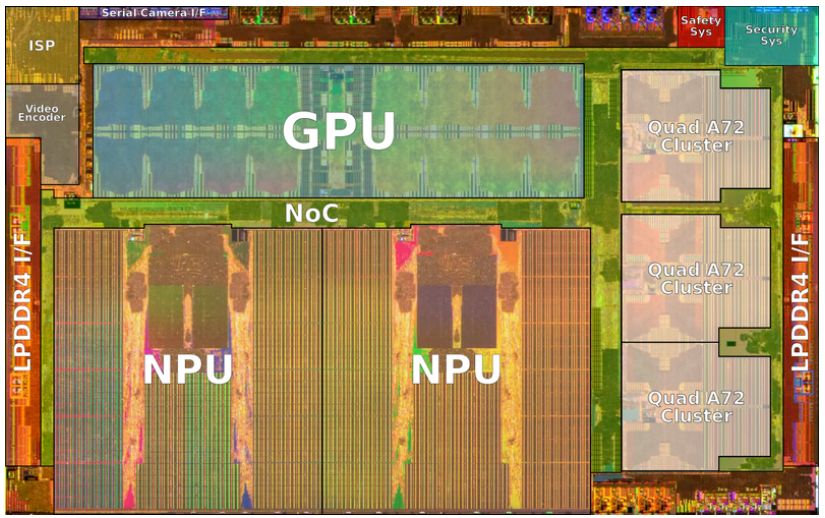
# AI issues in self driving




- modular end-to-end differential programming
- multi task, multi objective
- architecture design issues
- scene understanding: the never ending learning (long tails events)
- under budget



Tesla Full self-driving computer



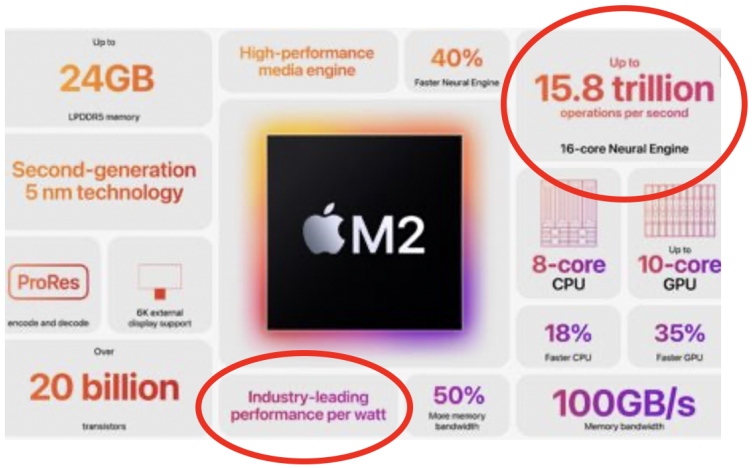

Tesla Full Self-Driving Chip

144 TOPS / 2300 Frames per second

# AI hardware

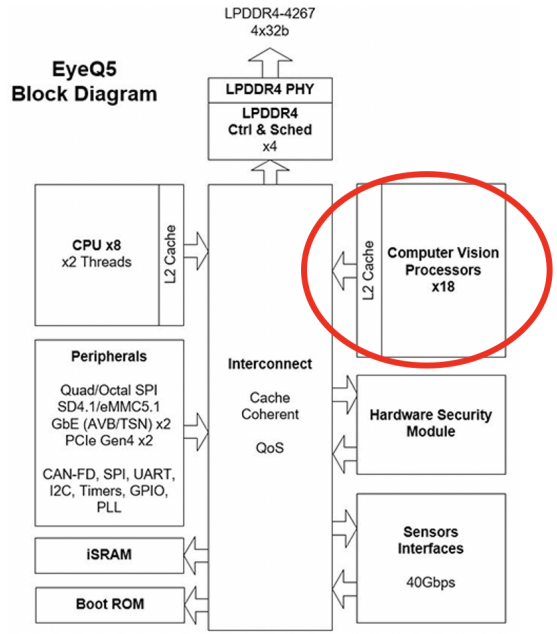
Apple

2022



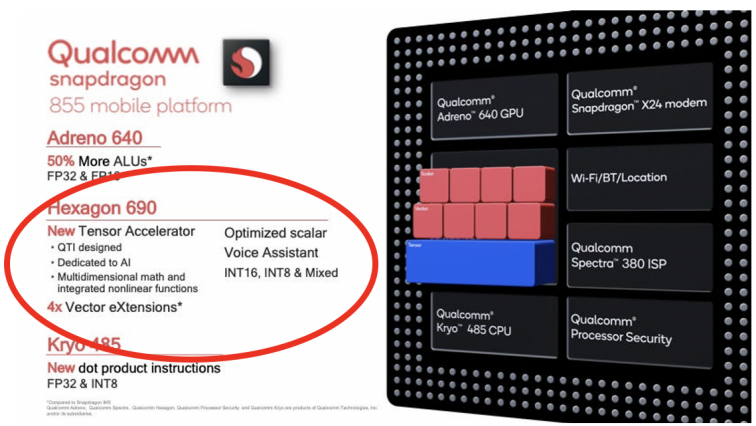

MobilEye

2018



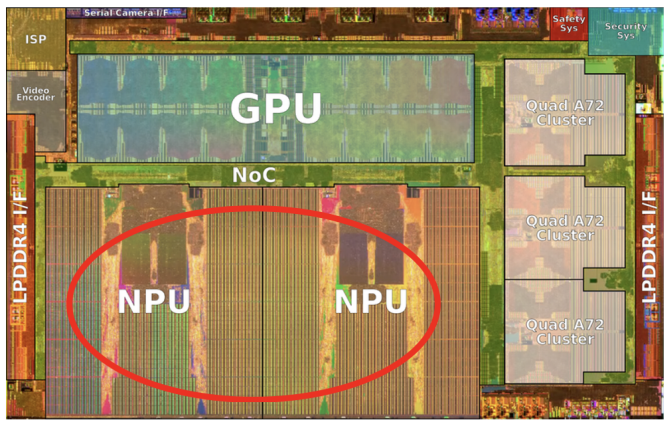

Qualcom

2019




Tesla

2019

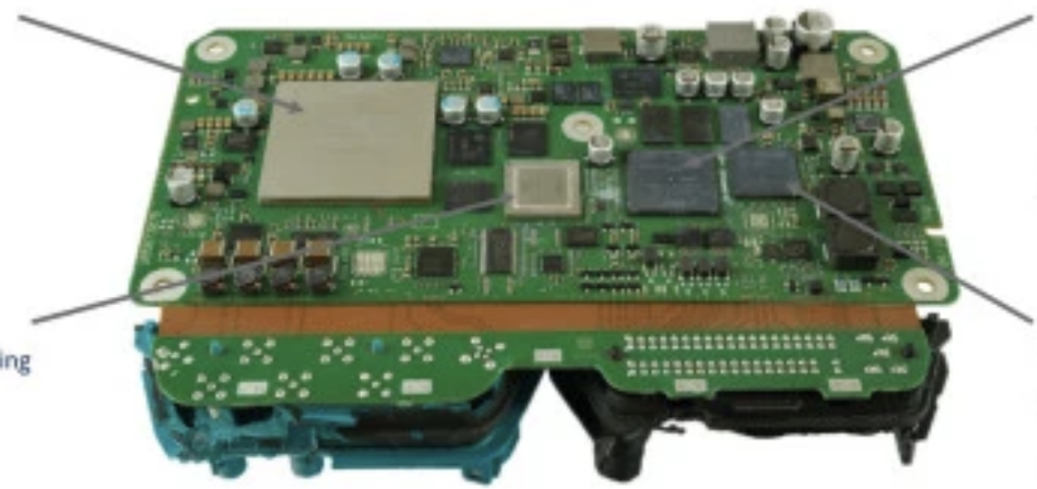


# The Audi A8 hardware

## Automotive tracks – Audi A8
## Level 3: Aptiv zFAS controller

*(Source: www.reverse-costing.com, System Plus Consulting)*

- **NVIDIA Tegra K1**
  - Traffic sign recognition
  - Pedestrian detection
  - collision avoidance warning
  - Light detection
  - Lane recognition
- **MobilEye EyeQ3**
  - Traffic sign recognition
  - 360° camera images & processing



- **Altera Cyclone**
  - Object fusion
  - Map fusion
  - Parking pilot
  - Pre-crash
  - Sensor data pre-processing
- **Infineon Aurix Tricore**
  - Traffic jam pilot
  - Assistance systems
  - Matrix beam
  - Road graph

*Functions: Courtesy of Aptiv*

# Comparizon

| Company | DL framework | sensors | hardware (chip) |
|---|---|---|---|
| Openpilot | Meta Pytorch? | cameras + radar | Qualcomm (M1?) |
| Tesla | Meta Pytorch | 8 cameras | Tesla's FSD chip |
| Mobil eye | Tensorflow on AWS | 11 cameras (vidar) | ST microelectronic |
| Waymo | Google Tensorflow | cameras + Lidars + radars | Intel -> Samsung ? |
| Cruise | Microsoft Azure | 4 cameras + Lidar + radar + audio | origin cruise chip |

# Road map

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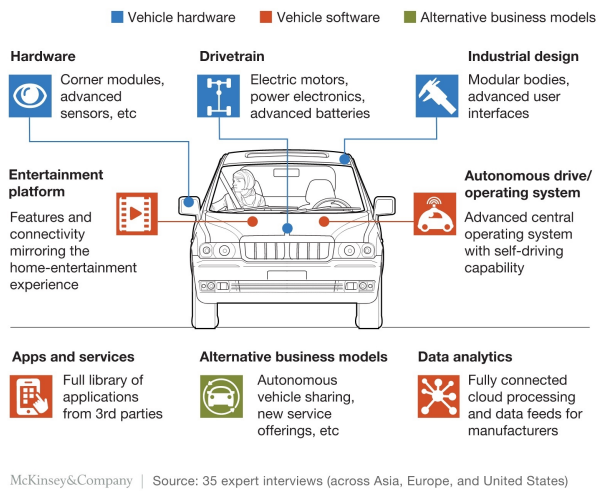
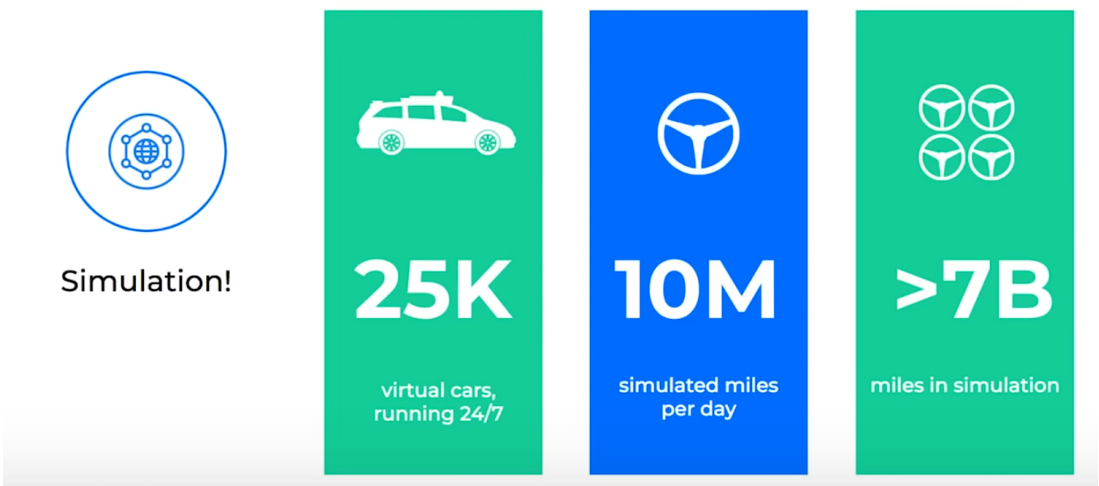


# Programmation par l'exemple : le pari de Tesla & Waymo

Tesla is collecting "just over 3 million miles [of data] per day."

Waymo train the car with 6 million miles driven on public roads and 5 billion driven in simulation




Learn agent for driving situation simulations

**ChauffeurNet: Learning to Drive by Imitating the Best and Synthesizing the Worst Mayank Bansal, Alex Krizhevsky, Abhijit Ogale**

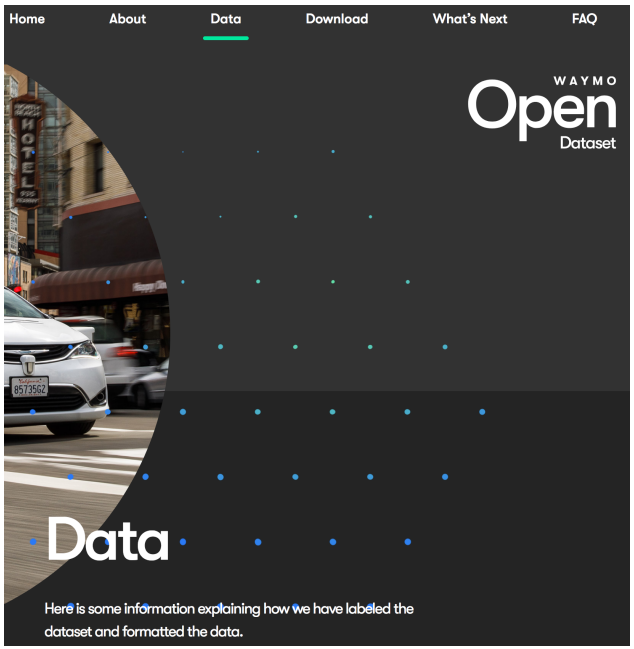
# Massive open data sets

## BDD100K: A Large-scale Diverse Driving Video Database

*Fisher Yu* *May 30, 2018*

**Update 06/18/2018**: please also check our follow-up blog post after reading this.

TL;DR, we released the largest and most diverse driving video dataset with rich annotations called BDD100K. You can access the data for research now at http://bdd-data.berkeley.edu. We have recently released an arXiv report on it. And there is still time to participate in our CVPR 2018 challenges!

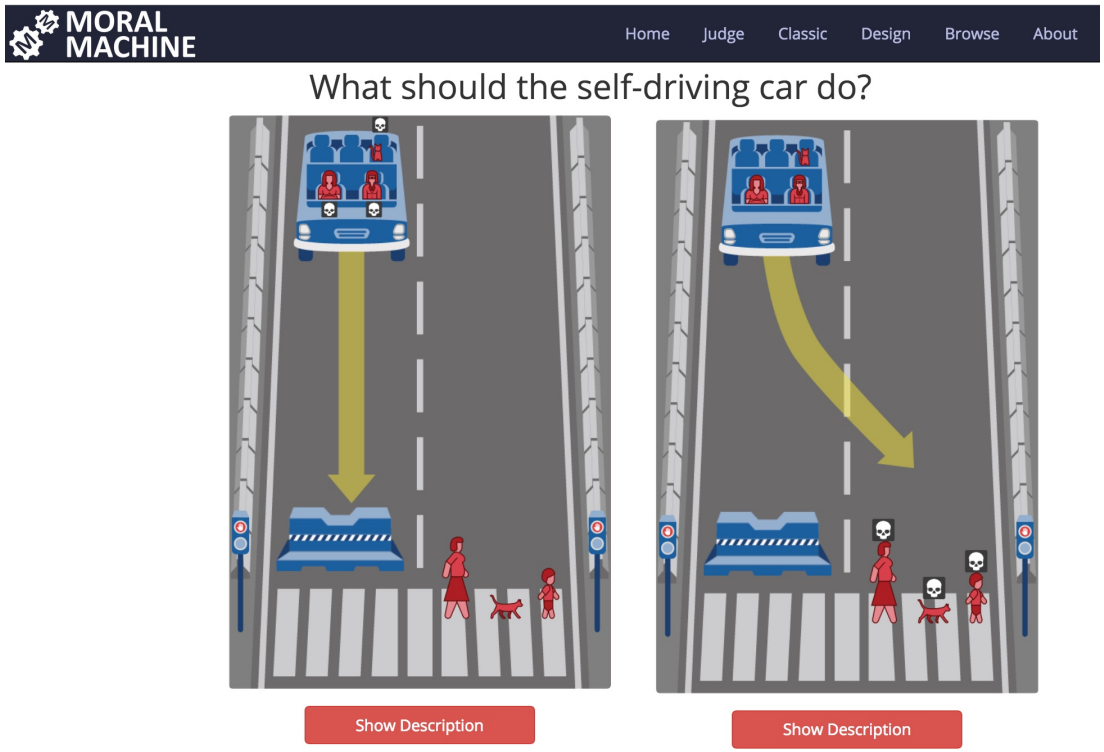




## Baidu Apollo Releases Massive Self-driving Dataset; Teams Up With Berkeley DeepDrive

Baidu this Thursday announced the release of ApolloScape, billed as the world's largest open-source dataset for autonomous driving technology.

and simulators (Carla, google & microsoft)

# Pour quoi faire ?




## Accepter les voitures autonomes

- Une histoire de confiance
- Nous voulons comprendre les enjeux
- conduite du changement

http://moralmachine.mit.edu/

# Towards scaling self driving

When will we have more than 10,000 Full Autonomous cars?

- Tesla's strategy of the little steps (improving the ADAS)
- Wyamo strategy including more areas (less specific)

- not yet: status quo
  - driving assistance (automation)
    - ★ increase safety
    - ★ reduces environmental impact
  - specific applications
  - communication and equipment

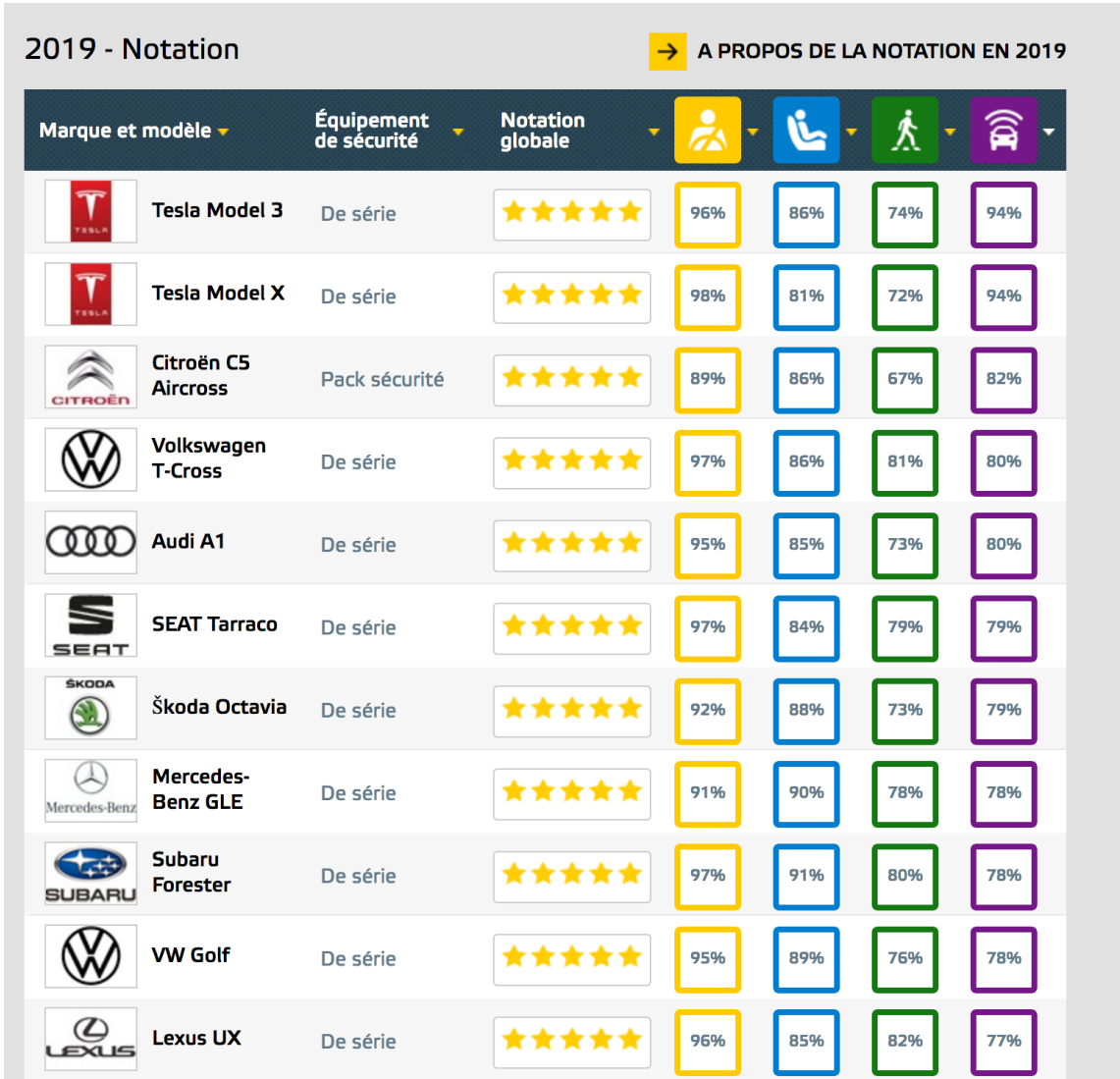
- No full autonomy unless... safety is proven
  - new solution (cf Google)

# Accidents: 14 lethal since 2015 (+1 processing)


https://en.wikipedia.org/wiki/List_of_self-driving_car_fatalities

# Safety Ratings

Safety Assist evaluating driver-assistance and crash-avoidance technologies.



2019 - Notation

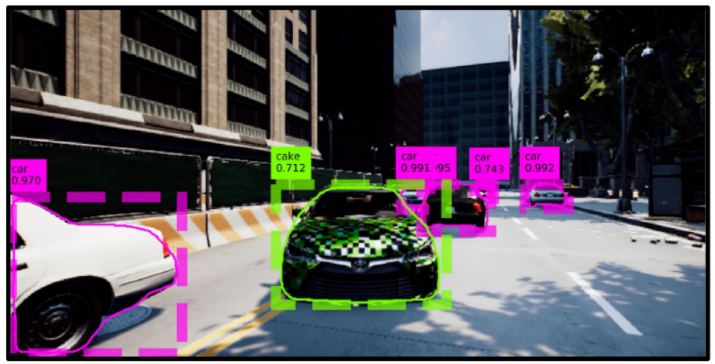
A PROPOS DE LA NOTATION EN 2019

| Marque et modèle | Équipement de sécurité | Notation globale | | | | |
|---|---|---|---|---|---|---|
| Tesla Model 3 | De série | ★★★★★ | 96% | 86% | 74% | 94% |
| Tesla Model X | De série | ★★★★★ | 98% | 81% | 72% | 94% |
| Citroën C5 Aircross | Pack sécurité | ★★★★★ | 89% | 86% | 67% | 82% |
| Volkswagen T-Cross | De série | ★★★★★ | 97% | 86% | 81% | 80% |
| Audi A1 | De série | ★★★★★ | 95% | 85% | 73% | 80% |
| SEAT Tarraco | De série | ★★★★★ | 97% | 84% | 79% | 79% |
| Škoda Octavia | De série | ★★★★★ | 92% | 88% | 73% | 79% |
| Mercedes-Benz GLE | De série | ★★★★★ | 91% | 90% | 78% | 78% |
| Subaru Forester | De série | ★★★★★ | 97% | 91% | 80% | 78% |
| VW Golf | De série | ★★★★★ | 95% | 89% | 76% | 78% |
| Lexus UX | De série | ★★★★★ | 96% | 85% | 82% | 77% |

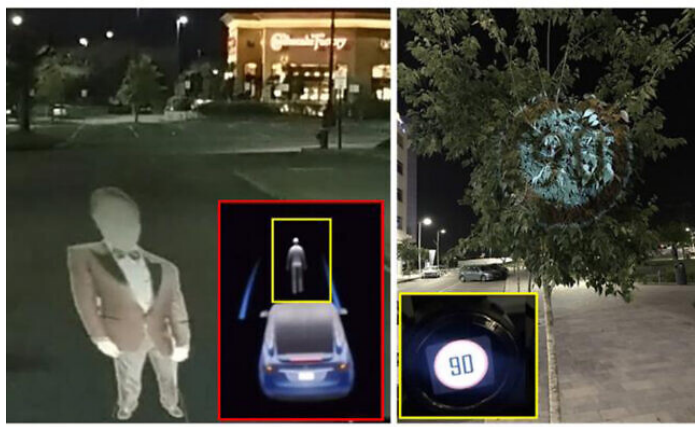
https://www.euroncap.com/en/ratings-rewards/latest-safety-ratings/

# Attacks against autonomous vehicles


Eykholt et al, Robust Physical-World Attacks on Deep Learning Visual Classification, CVPR 2018




Zhang et al., CAMOU: Learning Physical Vehicle Camouflages to Adversarially Attack Detectors in the Wild, ICLR 2019

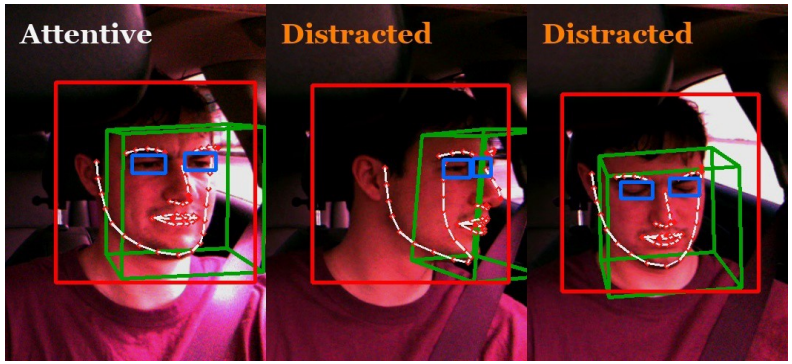




https://www.mcafee.com/blogs/other-blogs/mcafee-labs/model-hacking-adas-to-pave-safer-roads-for-autonomous-vehicles/

Nassi et al., Phantom of the ADAS: Securing Advanced Driver-AssistanceSystems from Split-Second Phantom Attacks, 2020

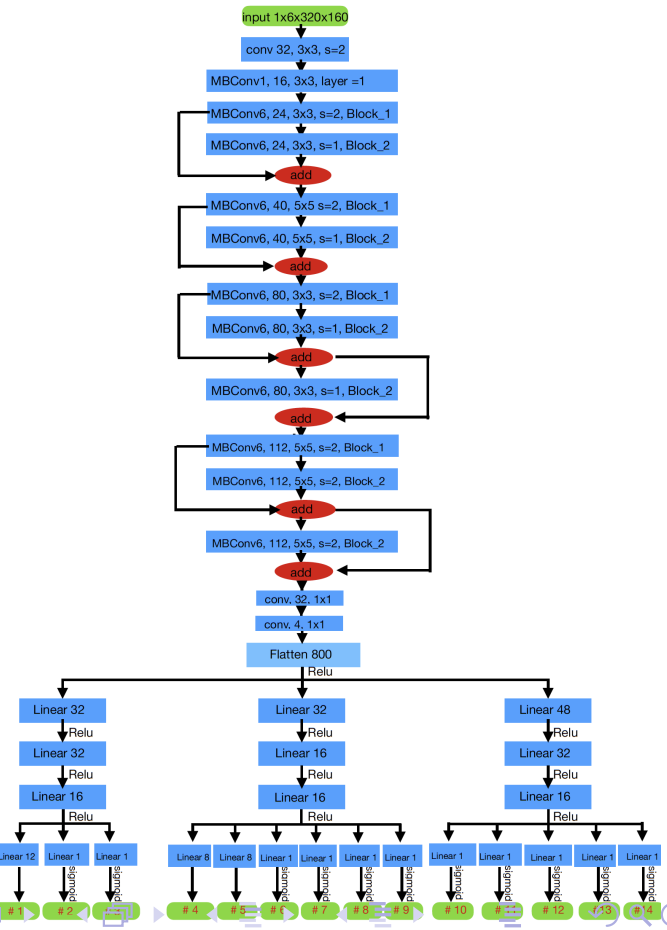
Qayyum, et al., Securing Connected & Autonomous Vehicles: Challenges Posed by Adversarial ML, IEEE Communications, 2019

# Attacking Openpilot 's DMS

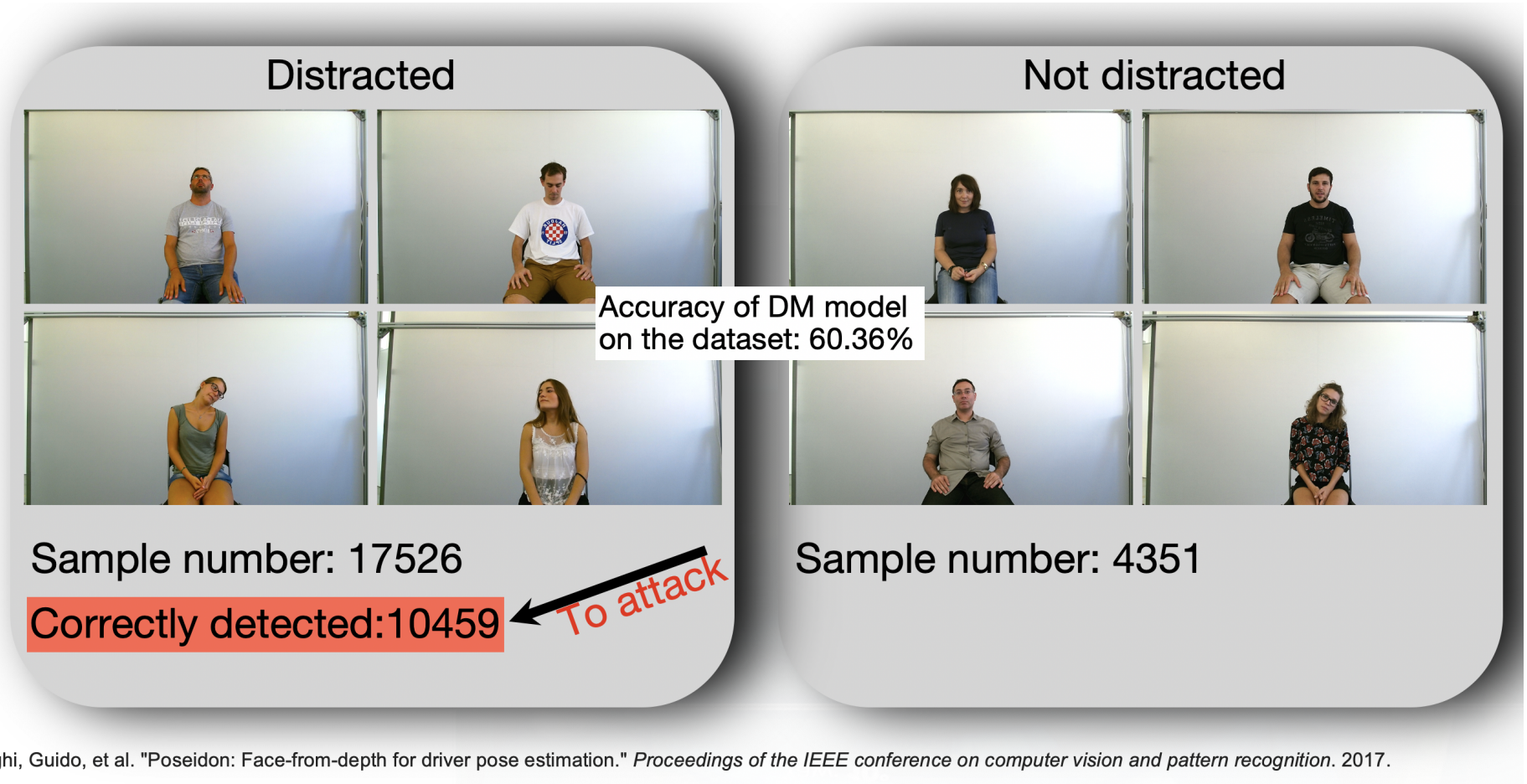



Three components

- Face localization
  - openCV -> cropping
- Feature generation
  - EfficentNet b0 architecture
  - Fine tuning
- Decision module
  - Treshold based decision



# Datasets: Pandora (head pose)

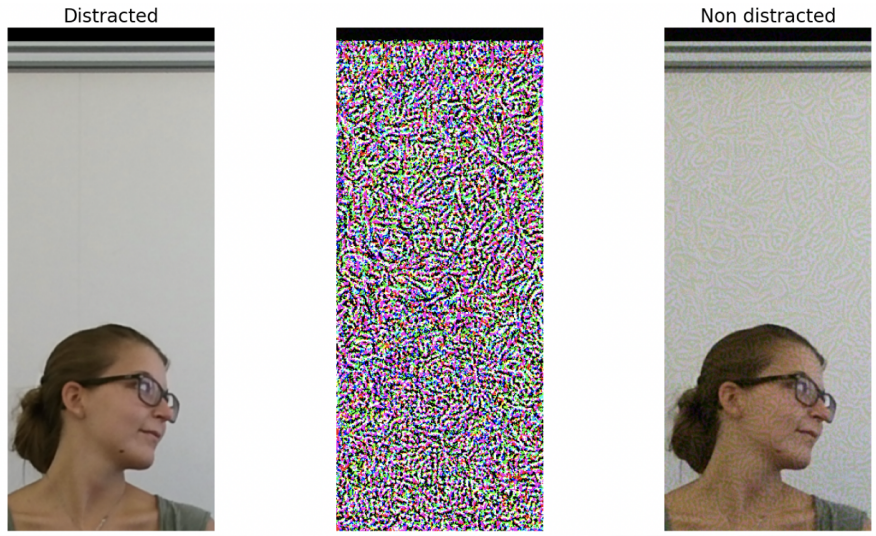



1. Borghi, Guido, et al. "Poseidon: Face-from-depth for driver pose estimation." *Proceedings of the IEEE conference on computer vision and pattern recognition*. 2017.

# Attack performance

- Accuracy on original data: 100%
- Attack settings:
  - torchattacks
  - c=1000 for CW
  - *steps =50 for CW and Deepfool*
  - $L_\infty$ *10/255 = for all the others*
- Accuracy on adversarial data:

| Attack models | FGSM | CW | PGD | APGD | AutoAttack | Deepfool |
|---|---|---|---|---|---|---|
| Accuracy(%) | 81.85 | 21.90 | 13.17 | 0.057 | **0.0** | 6.39 |




**100 % Distracted**

**100 % Attentive**

# Road map (done)

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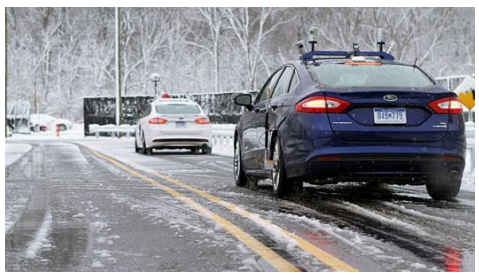
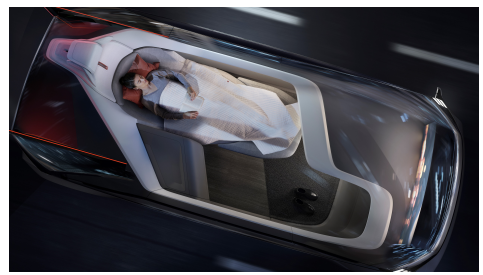
# Future of AI in Automotive Industry

- The value of your data (IA fuel) — big data
- Robustness (degraded conditions) — deep learning theory
- Level 4 Autonomous driving — common sense (cf Y. LeCun) unsupervised learning
- Predictive Maintenance — data + prior knowledge
- Acceptability (safety) — Ethic Interpretable AI





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# Les murs de l'IA

# Les murs de l'IA

# Les murs de l'IA

Après que l'IA s'est fracassée sur le mur,
le mur est encore là mais il n'y a plus d'IA

# Les murs de l'IA

- Recherche : aujourd'hui c'est l'IA spécifique
- Confiance : Données, Validation et Sureté
- Biais - usage - éthique
- Durabilité : les questions énergétiques

## Acceptabilité sociale de l'IA

# Questions?

http://asi.insa-rouen.fr/enseignants/~scanu/