

# Visual analysis with Artificial Intelligence

## In real-life applications



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# What is Artificial Intelligence?

Human brains are mimicked

- Machine learning, deep learning
- Technology to learn an output from set of input data
- Understand voice, interpret images, reason, ...

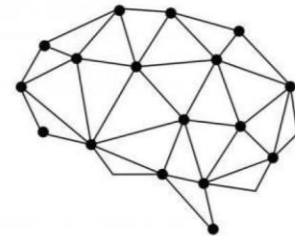
 amazon alexa

“Alexa, who was President when Barack Obama was nine?”

“Alexa, how’s my commute?”

“Alexa, what’s the weather?”

“Alexa, did the 49ers win?”



Cambridge  
Analytica

# Out market is traffic observation

Pedestrians, crowds, bicycles, trucks, cars, vessels, .....



2007

2011

2014

2015

2017

ViNotion  
Established



People  
counting



Traffic &  
Mobility



Maritime



New corporate  
identity

# Problem statement

Why do we need traffic analysis?

- Growing number of traffic participants
- Maintain safety
- Measure traffic: can we do this automatically?



# Automatic Traffic Analysis

State-of-the-Art Technologies

- Existing techniques
  - Tubes, loops in road, radar, Bluetooth/WiFi
  - Subset of road users, expensive maintenance, limited classification
- Smart cameras
  - Generic for all objects
  - Easy maintenance (next to road)
  - AI can learn (improve or new features)



# Naïve object recognition

State-of-the-Art in current security cameras

- Objects are different from background



# Naïve object recognition

State-of-the-Art in current security cameras

- Computer does not know what it sees...



# Visual Challenges

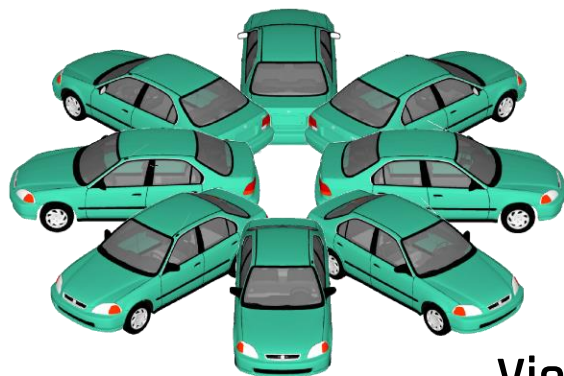
Why is visual recognition difficult?



Light



Occlusion



Viewpoint

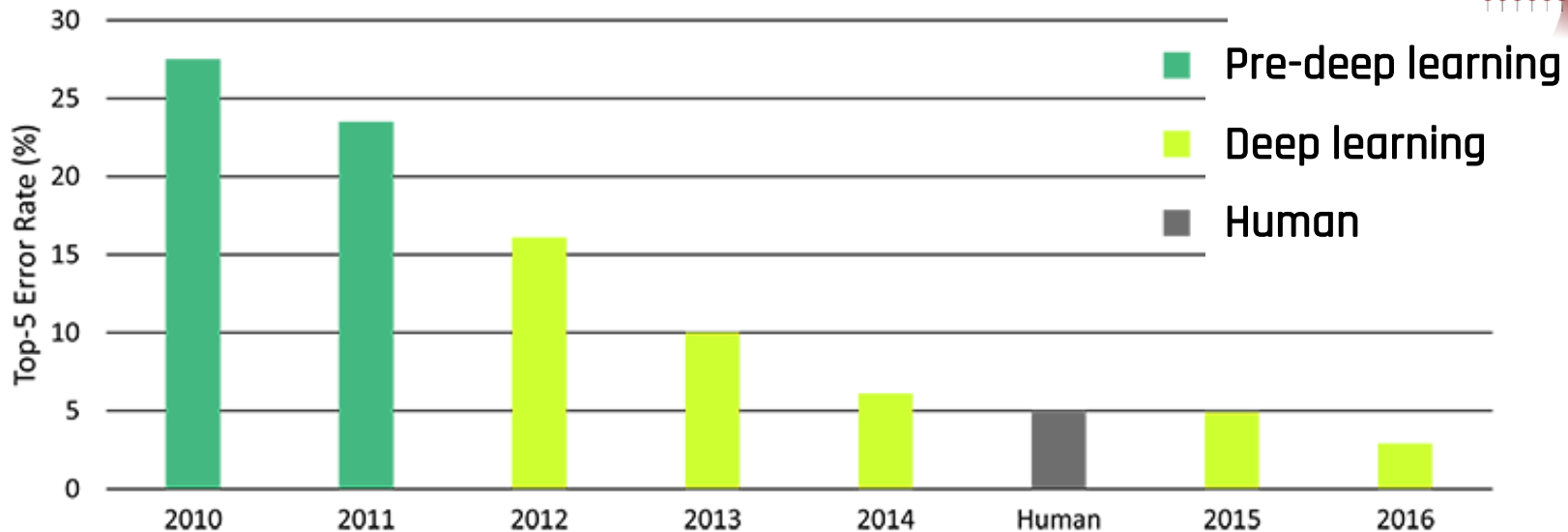
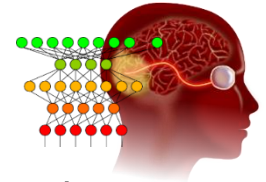


Intra-class

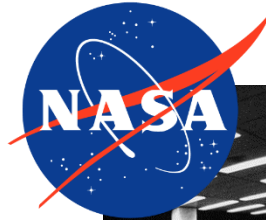
# Object Recognition: Deep Learning

Deep learning works!

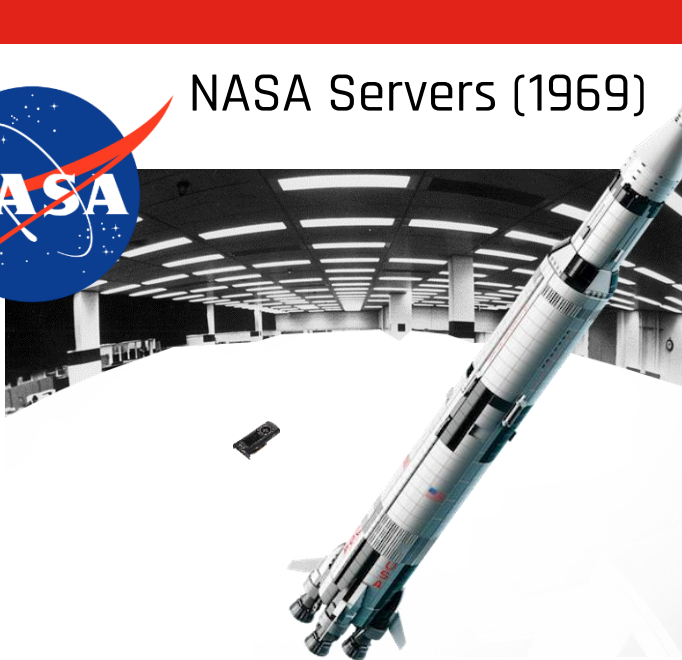
- Convolutional Neural Networks (CNNs)



# Computing power back then...



NASA Servers (1969)



Nvidia Titan X (2015)



~1,000,000x more powerful



# Computing power now...

Nvidia Titan X  
High performance  
250 Watt



Nvidia TX1  
Compact  
10 Watt



# ViSense: deep learning productized

Industrial application of deep learning

- Deep learning in a box
- Embedded solutions
- Real-time object recognition
- Visual validation
  
- Privacy by design
  - No storage of images
  - Anonymized statistics
  - Never to relate to individual persons

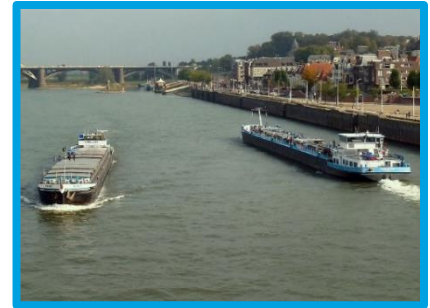


ViNotion

# ViSense Products

Deep learning productized

- Standard products
- Principles: Modelling, Training & Validation



# ViSense Products

Deep learning productized

- Public safety
- Events
- Retail

- Spatial planning
- Traffic control system calibration

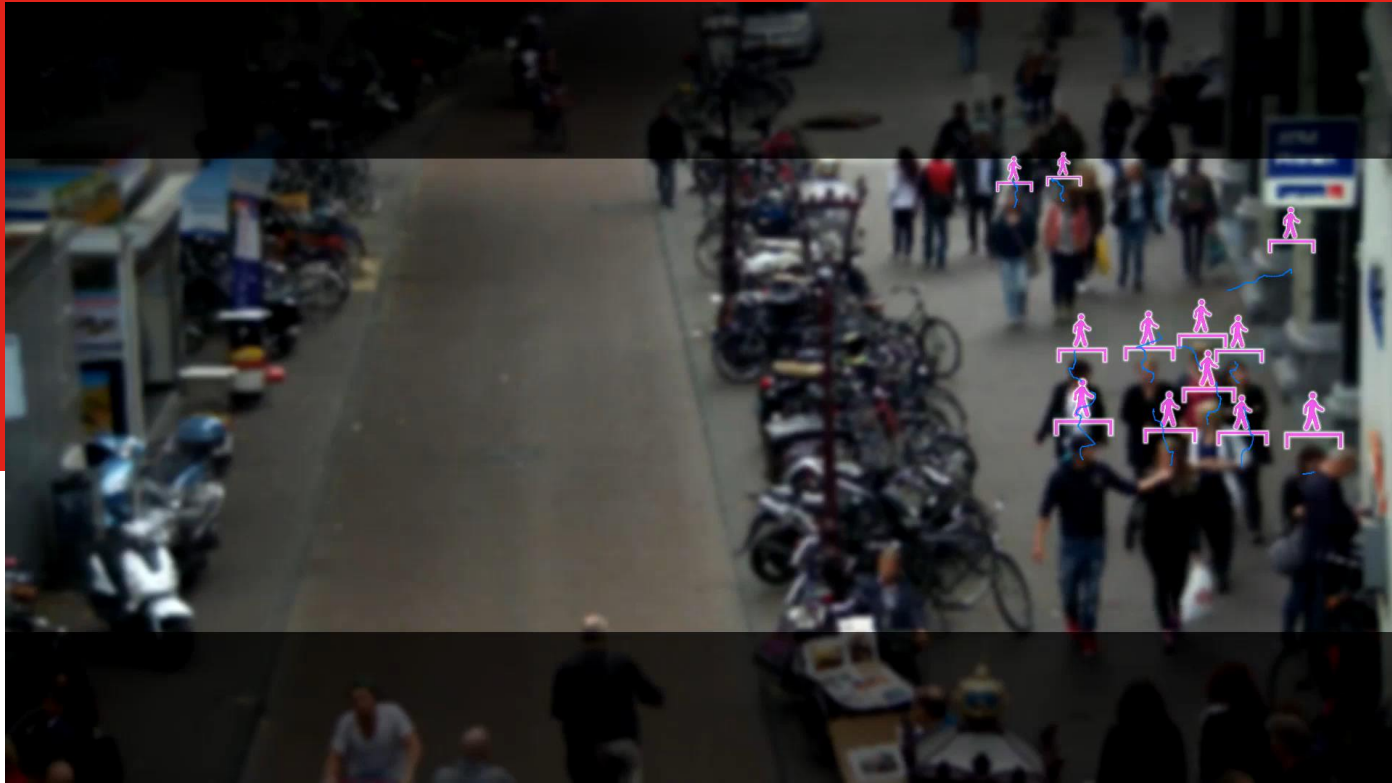
- Tolling
- Traffic control Integration

- Bridge & lock monitoring
- Harbor safety



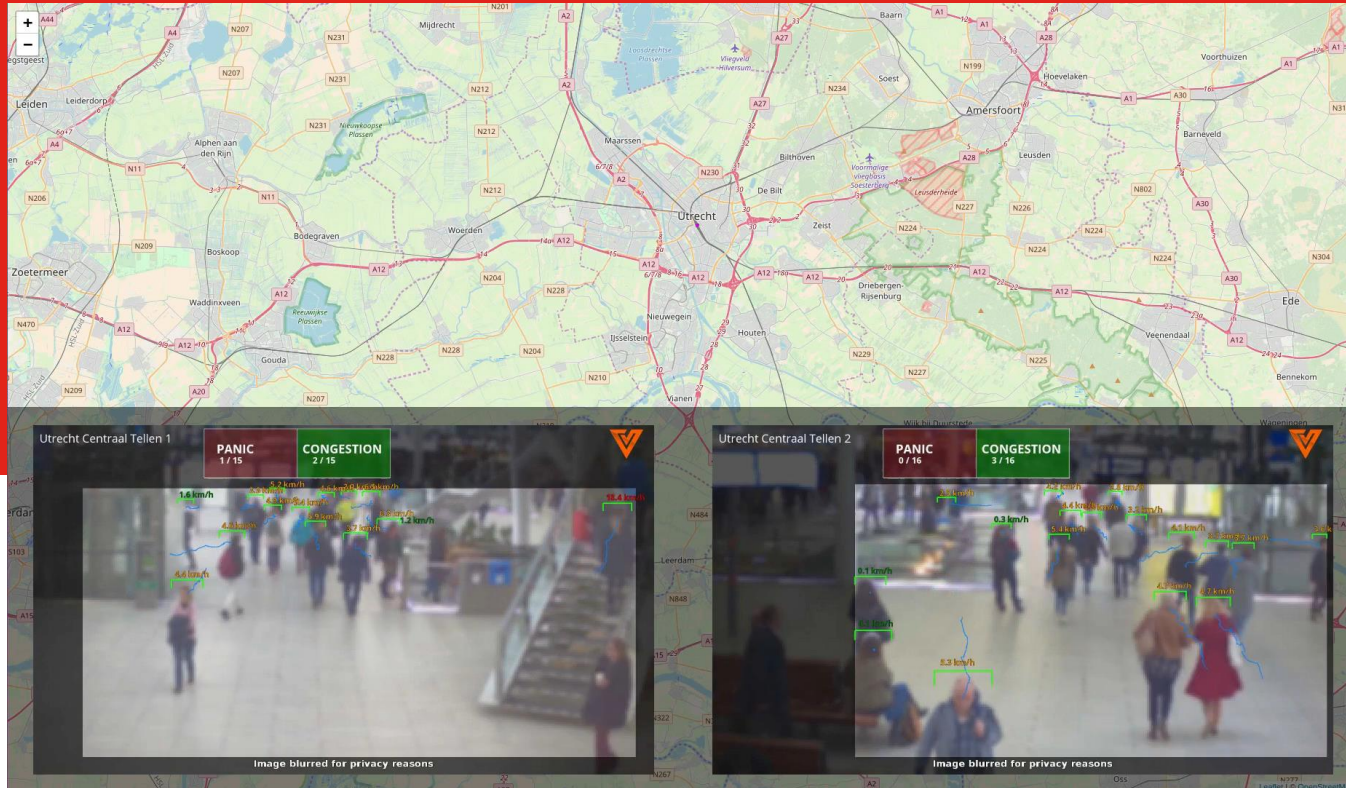
# CrowdDynamics

Pedestrians and bicycles for business information or crowd control



# CrowdDynamics

People observation for safety and security



# UrbanDynamics

Analyse traffic on a cross section for mobility improvement



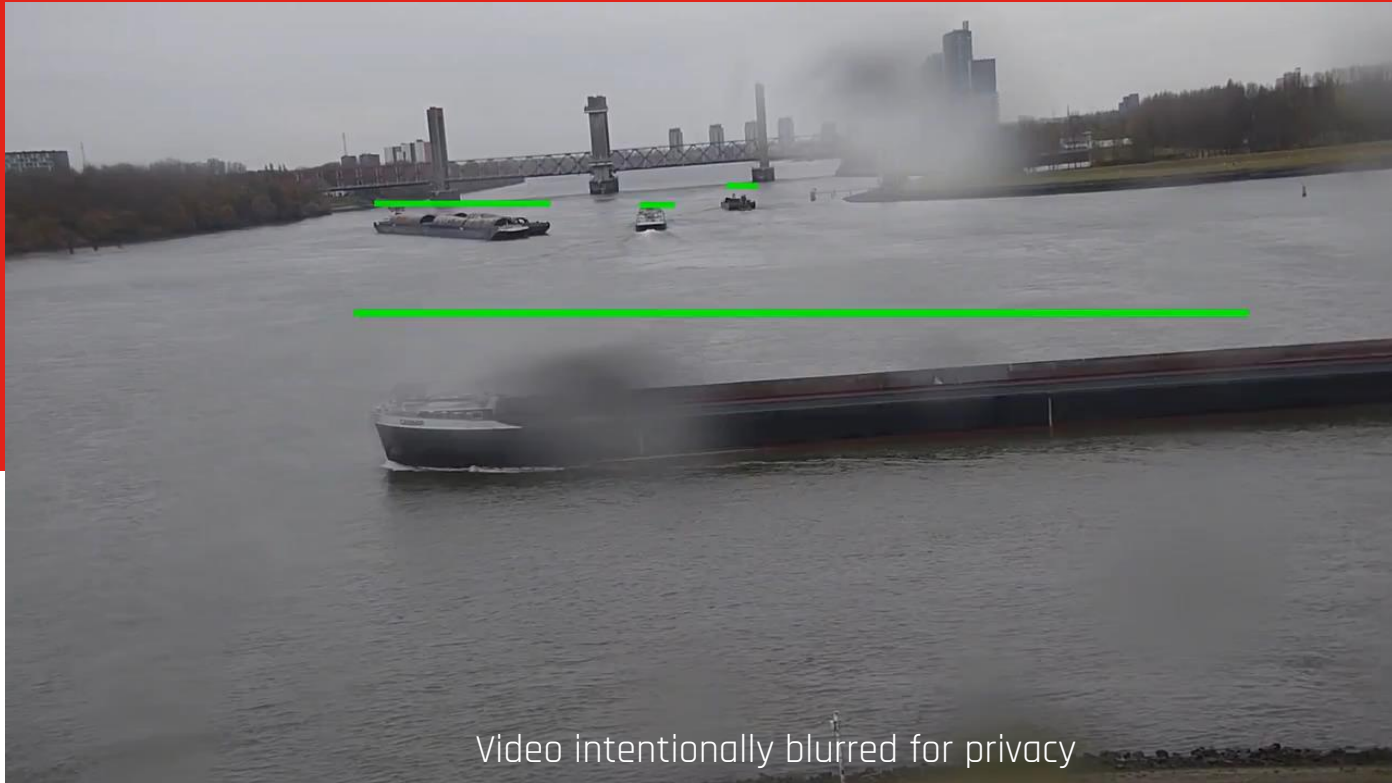
# TrafficDynamics

Highways monitoring for emergency lanes, tunnels, tolling, etc.



# MaritimeDynamics

Vessel analysis for bridge and waterlock control



# Make and Model Recognition (MMR)

Vehicle Recognition required for safety

- Crime involving vehicles
  - Stolen, runaway, fraud (wrong license plate)
- How to identify without/false plates?
- Goal: classify vehicle model with camera

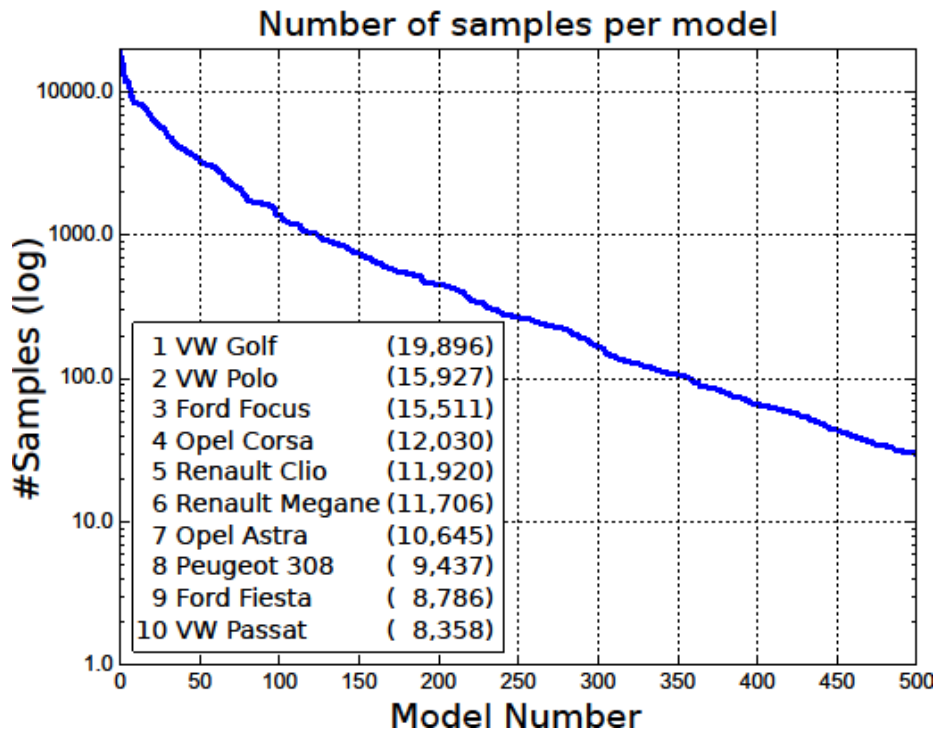


➔ VW Golf



# Make and Model Dataset

Non-uniform vehicle model distribution



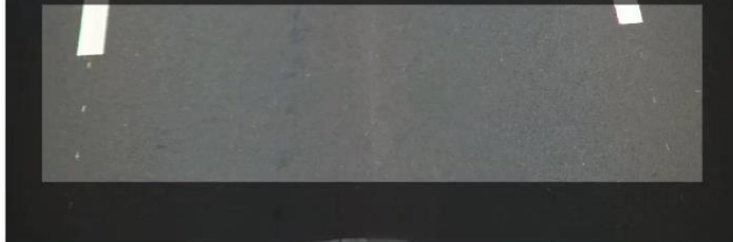
## Dataset Statistics

- 587,371 Samples
- 1,504 Models
- Highly Non-uniform

# Demo

NL Highway

A12 Harmelen



VOLKSWAGEN.EOS



MERCEDES-BENZ.



FORD.FOCUS



VOLKSWAGEN.TRA



KIA.PICANTO



MERCEDES-BENZ.



CITROEN.C4 CAC



RENAULT.MEGANE



VOLKSWAGEN.PAS



RENAULT.ESPACE



FIAT.500



# Conclusions

- Automated Traffic Analysis
  - Deep learning in a box
  - Embedded & low-power
  - Privacy by design
- Artificial Intelligence
  - Very suitable for simple tasks
  - Outperforming human capabilities
  - The future is unprecedented (for good and for worse)

