Car to car communication of autonomous driving vehicles in dangerous situations

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Content

1. Introduction to autonomous driving vehicles
2. How car to car communication of autonomous driving vehicles works
3. Decision making in dangerous situations
4. Ethics

1. Introduction to autonomous driving vehicles

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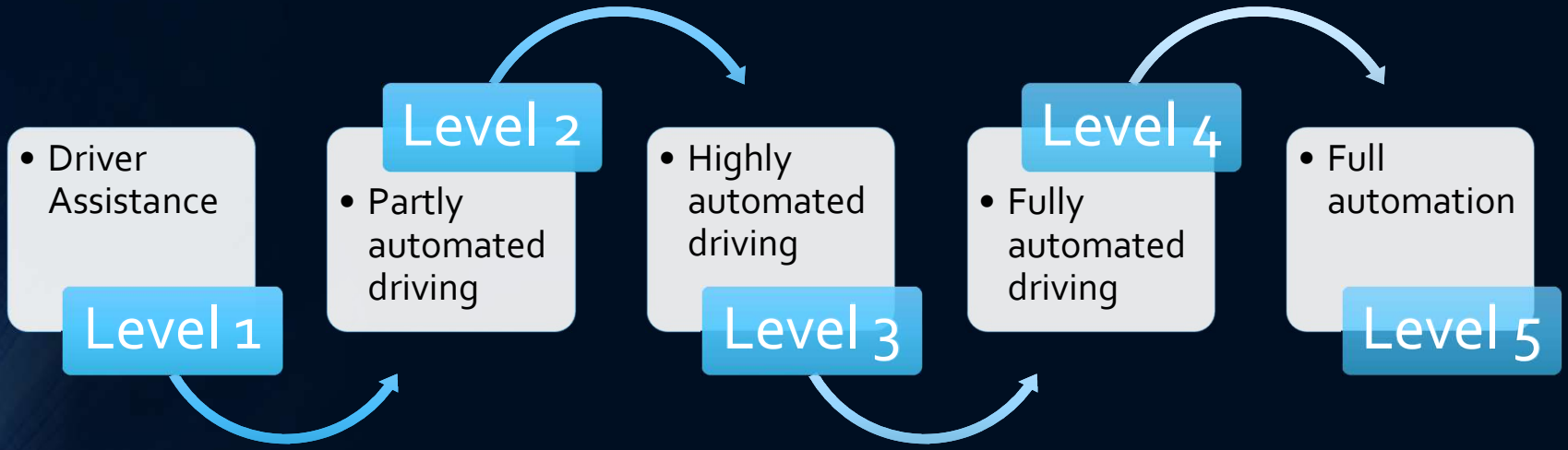
Source: https://www.youtube.com/watch?v=eU5jezjdXxA&list=LL6l3dDxfAkUqal1kytuRgzQ&index=5&t=0s

1.1 Necessary definitions

- Autonomous Driving
  - Self driving of a vehicle to a specific target in real traffic without the intervention of a human driver. (Daimler)
- Artificial Intelligence
  - Simulation of human intelligence processes by machines, especially computer systems.
- Intelligent Behavior
  - A person's aggregate capacity to act purposefully, think rationally, and deal effectively with the environment

1.2 Basic functionality: The 5 Levels of autonomous driving



1.3 History of autonomous vehicles

- Norman Bel Geddes created first self driving car concept in 1939
- 1958: Concept made reality by GM
- 1977: Japanese improved that idea
- 1987: Germans gave another improvement

For the picture source please refer to the "Picture Sources" Slide

1.4 Upcoming Future

- How far is the technology?
- When does it start in public?
- Where will that technology lead?

2. How car to car communication of autonomous driving vehicles works

2. How car to car communication of autonomous driving vehicles works

Outline

1. Detection of other objects

2. Communication technologies

2.1 Detection of other objects

- Object detection nature:
  - Object Classification

For the picture source please refer to the "Picture Sources" Slide

  - Object Localization
    - Done by defining a bounding box

For the picture source please refer to the "Picture Sources" Slide

- Object detection
  - More bounding boxes with same variables

2.2 Communication technologies

- Radar/Ultrasound
- Information feed for the (artificial) driver
- Wireless network connection

2.2.1 Radars/Ultrasound

- Very short range
- Easily disturbed by poor weather
- Detection stops at first obstacle
- Cameras insights are very limited as well

For the picture source please refer to the "Picture Sources" Slide

2.2.2 Information feed for the (artificial) driver

- Vehicles broadcast data within a few hundred meters like:
  - Position
  - Speed
  - Steering wheel position
  - Brake status
- Other vehicles use that information to picture their environment

2.2.3 Wireless network connection

- Creating a car to car network is a complex challenge
  - 5G is a crucial must have here (transfer of 2 petabits per week)
  - Possible due to combination of bandwidth of 5G frequencies and new digital radio architectures
- Broadcasted data is processed 10 times per second
- Transmitters use 802.11p (new wireless standard) to authenticate each message

3. Decision making in dangerous situations

3. Decision making in dangerous situations

Outline

1. Artificial Intelligence Challenges

2. Case examples

3.1 Artificial Intelligence Challenges

- Safe, secure and highly responsive solutions, made in split seconds required
- Extensive amount of training for AI network necessary
- One autonomous vehicle is projected to have more code than any other software ever created

For the picture source please refer to the "Picture Sources" Slide

3.2. Case examples

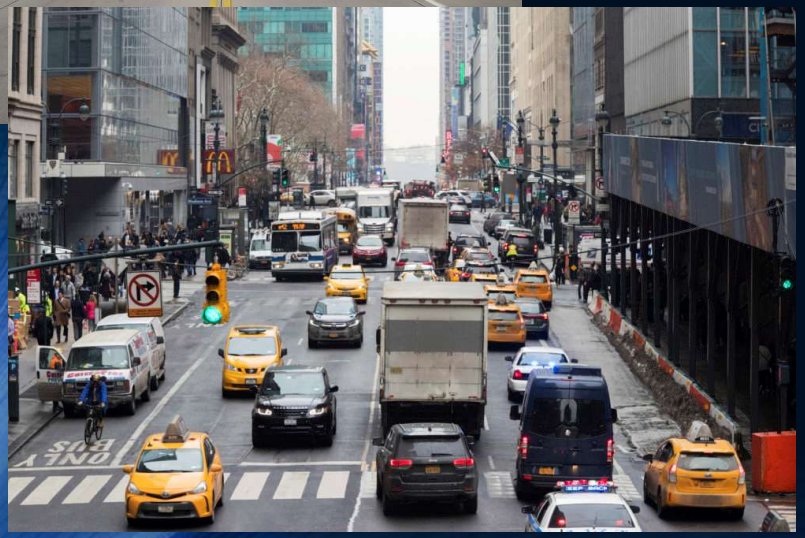
1. City traffic

2. Overtaking

3. Obstacles on the pathway

4. Not preventable accidents

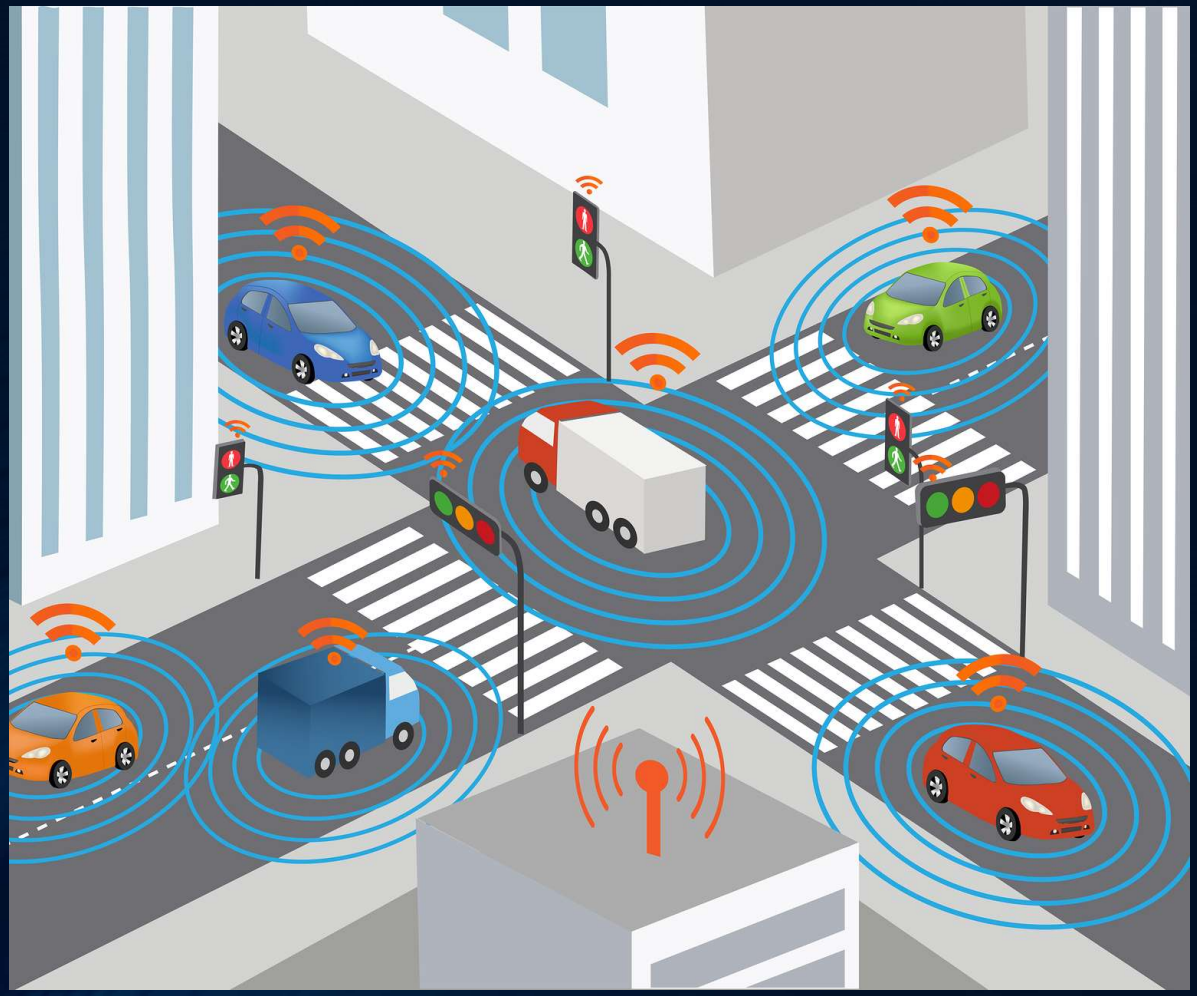
3.2.1 Case example: City traffic



For the picture source please refer to the "Picture Sources" Slide

3.2.1 Case example: City traffic

- Vehicle to Infrastructure – Communication (V2I)
- Vehicle to pedestrian – Communication (V2P)



For the picture source please refer to the "Picture Sources" Slide

3.2.2 Case example: Overtaking

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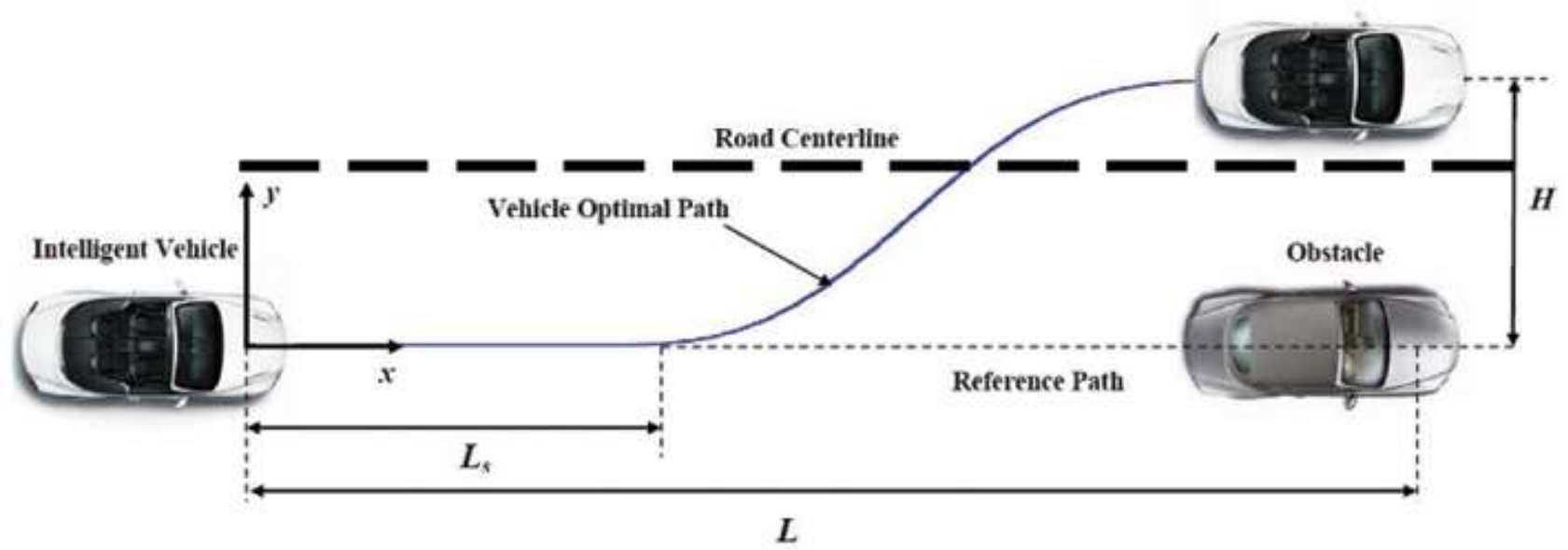

Figure 1: Schematic diagram of the lane-change maneuver.

For the picture source please refer to the "Picture Sources" Slide

3.2.3 Case example: Obstacles on the pathway

- Traffic Jam
  - Communication with other vehicles alerts in time
- Damaged Street/Accident
  - Information Broadcast online
- Fallen Tree?
  - Bugs?

For the picture source please refer to the "Picture Sources" Slide

3.2.4 Case example: Not preventable accidents

- Very tough decision making
- Priority is always to not damage environment (including own car)
- What would you damage if you have no other choice?

4. Ethics

4.1 Data protection

- Which data is shared?
  - Car position, speed, traffic status etc.
  - Pick up?
  - Destination?

- Creation of a movement profile

- Problem still not solved entirely

4.2 The trolley problem

What would you do?

For the picture source please refer to the "Picture Sources" Slide

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Picture/Video Sources

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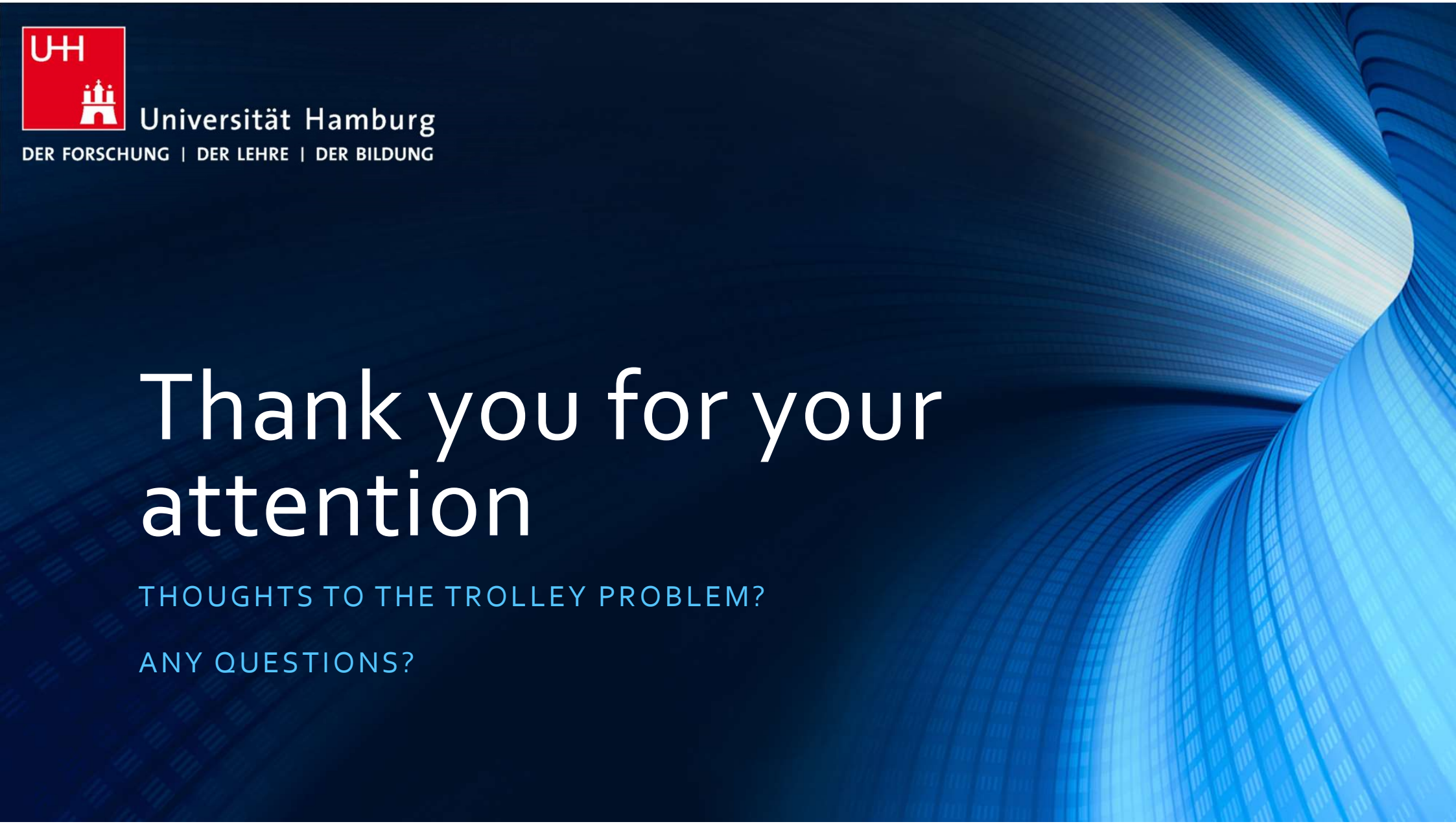
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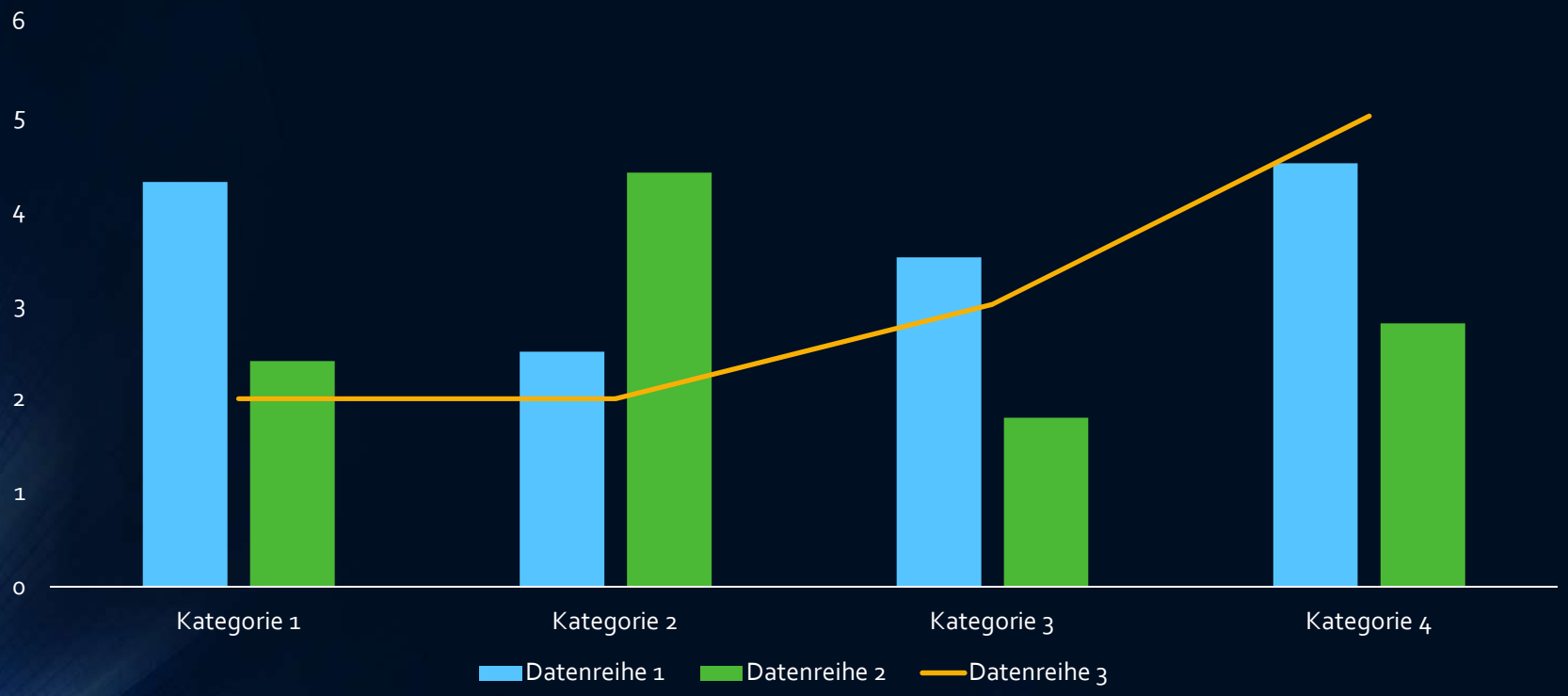
Thank you for your attention
THOUGHTS TO THE TROLLEY PROBLEM?
ANY QUESTIONS?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Datenreihe 2
Datenreihe 3

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Klasse 2	76	88
Klasse 3	84	90