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Context Aware Data Reduction:

Selectively Lossless Data Reduction through Partially Synthetic Representations for Highly Automated Driving

Gefördert durch:

Bundesministerium für Wirtschaft und Energie

aufgrund eines Beschlusses des Deutschen Bundestages

Agenda

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1. Information for Highly Automated Driving
2. Data reduction
3. Components of Context Aware Data Reduction
4. Prototype
5. Outlook
6. Discussion

Information for Highly Automated Driving

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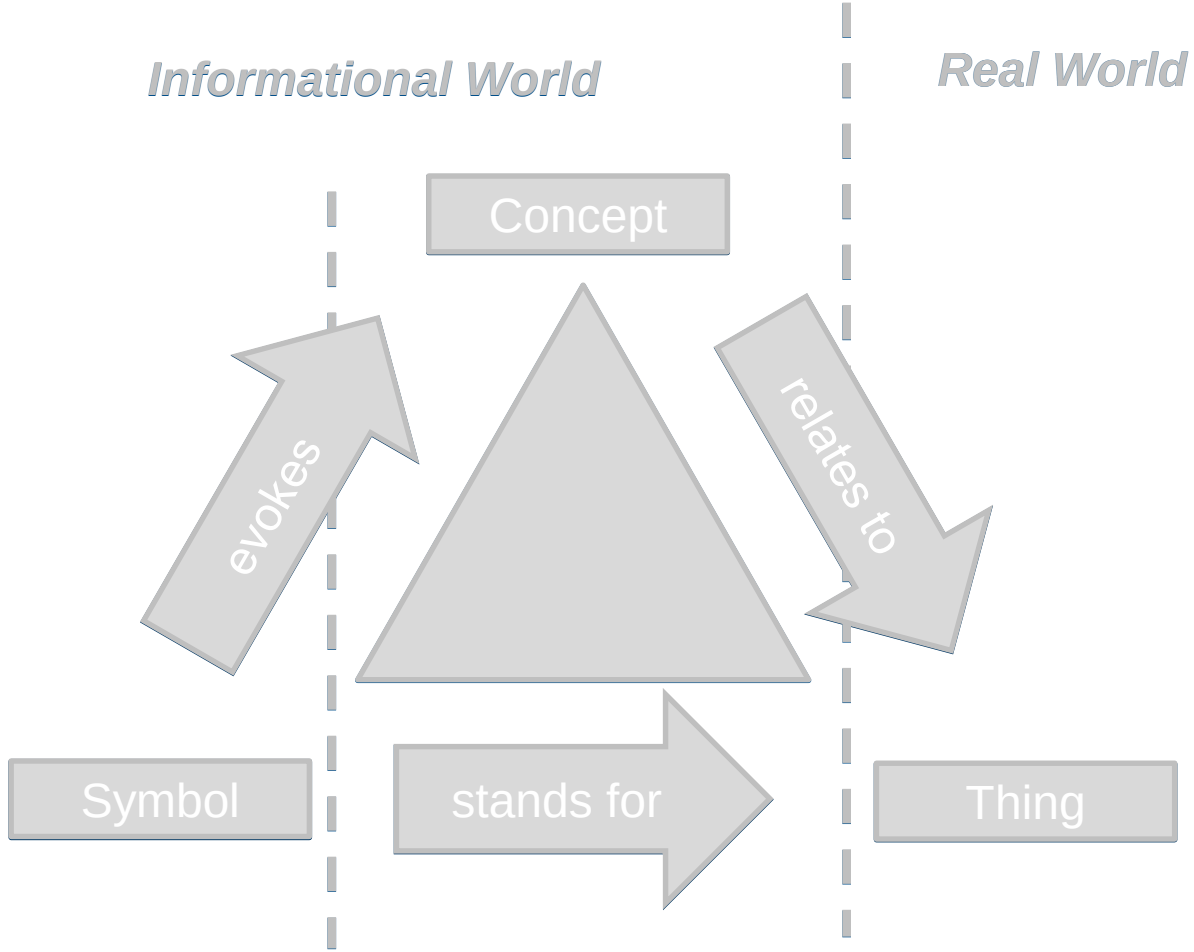
What is Information?

- Describes the real world
- Can be distinguished into [1]
  - Data ≔ stored / transferred symbols
  - Messages ≔ stored / transferred concepts



[1] Werner, Martin: Information und Codierung, Vieweg Verlag (2002)

Ilustration based on: Thomas, Oliver; Fellmann Michael, Semantische Integration von Ontologien und Ereignisgesteuerten Prozessketten

Information for Highly Automated Driving

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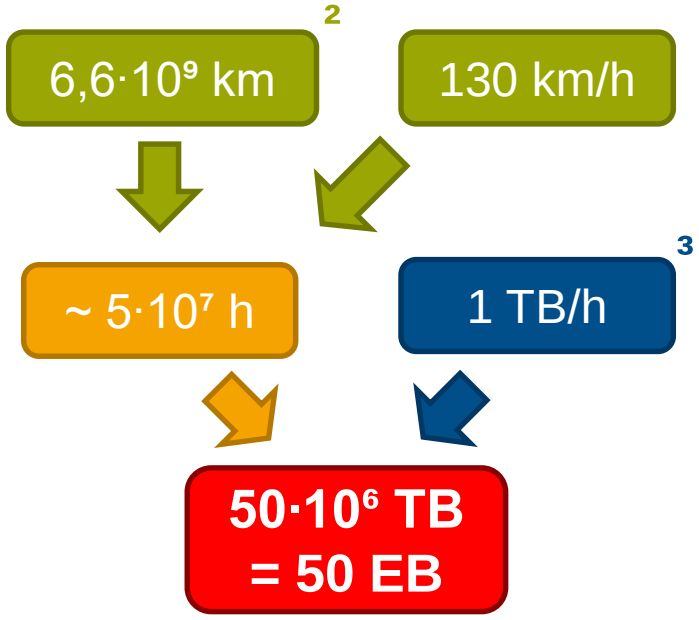
What does Data mean for HAD?

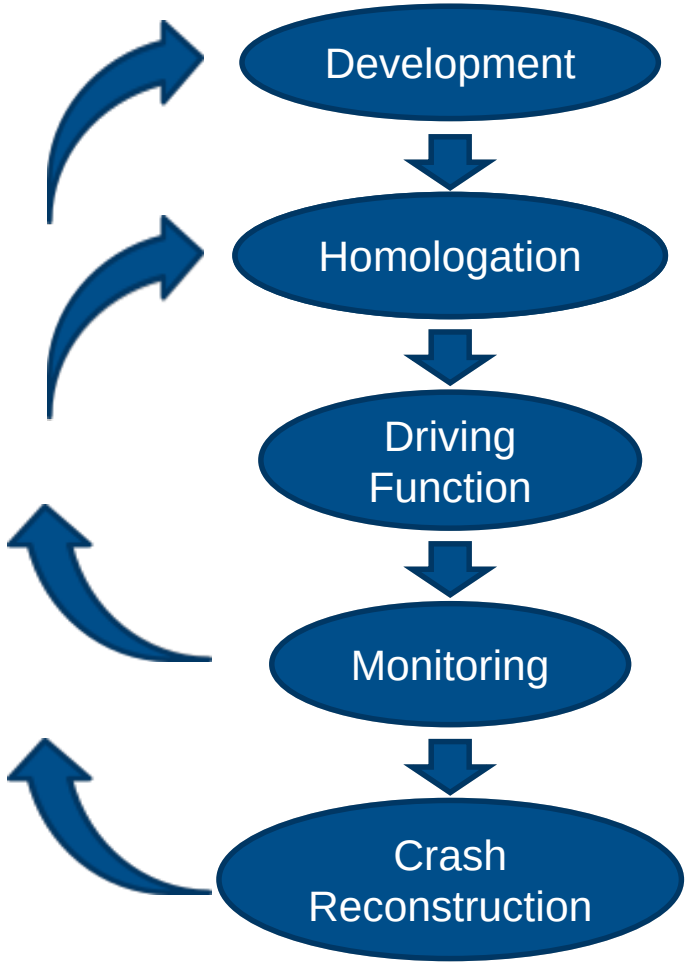
- **Present throughout the lifecycle**

Why Data Reduction?

- **Need for large amounts of Data**
- **Growing Data rates**

- **<u>Scalable approaches are necessary</u>**





[2] Winner, H. et al.: Autonomous Driving: Technical, Legal and Social Aspects (2016), p. 458.

[3] Patzer, Andreas: Data Recording for ADAS Development (2017), p. 1.

Data Reduction

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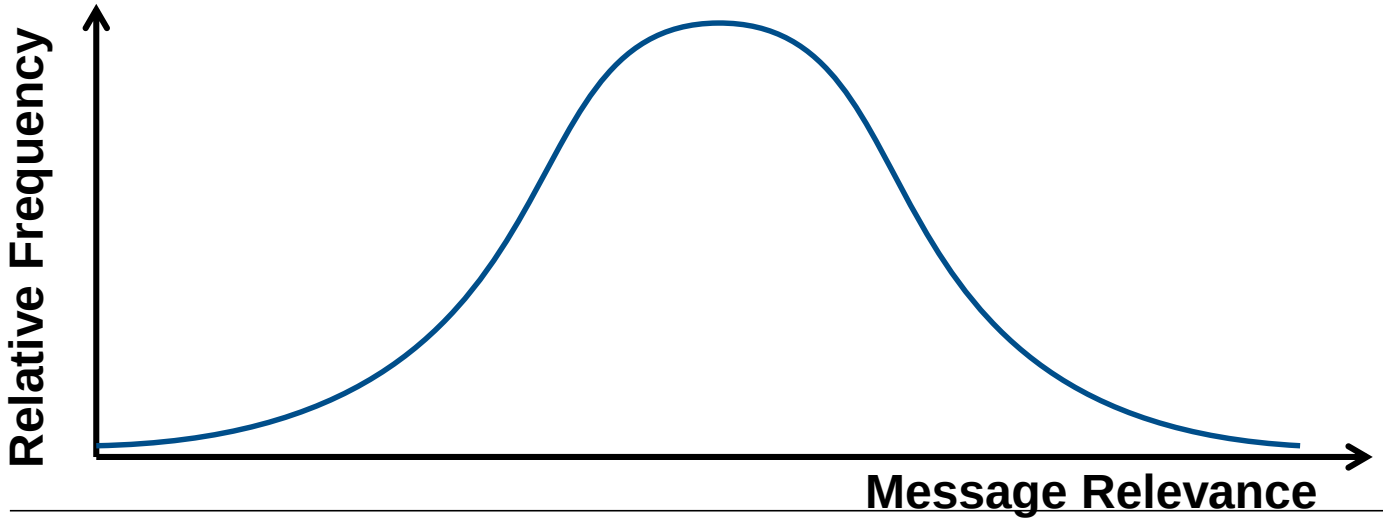

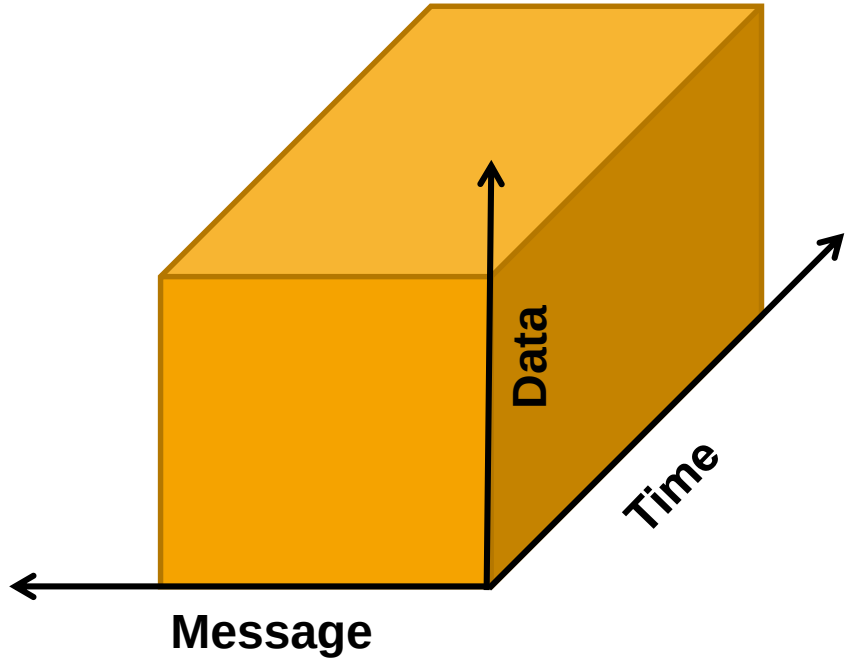

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Data Reduction

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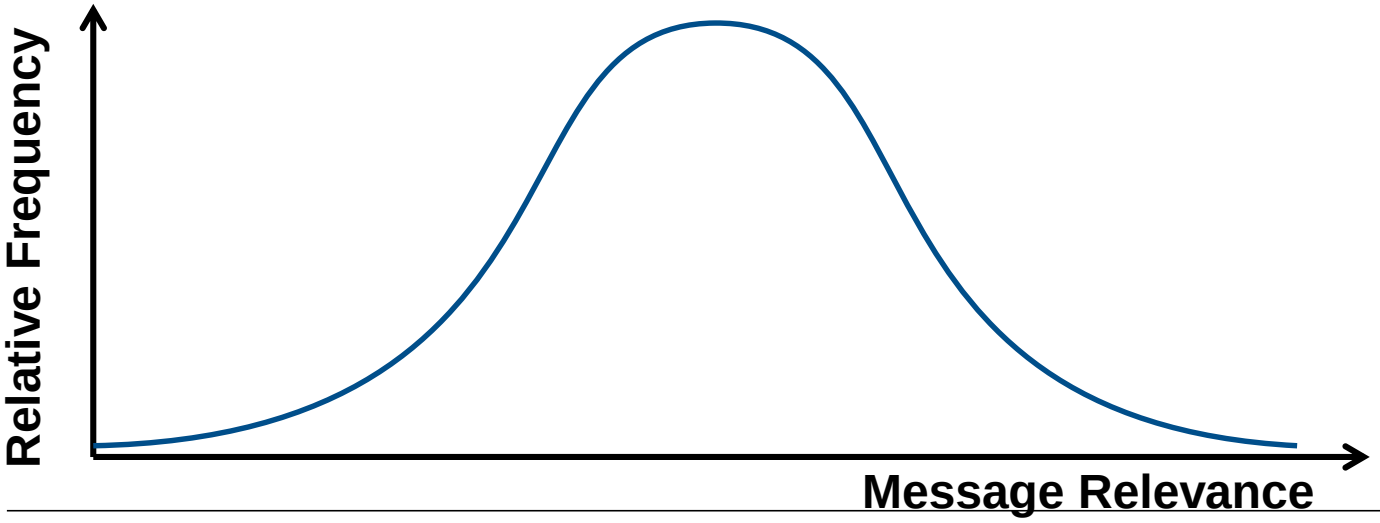
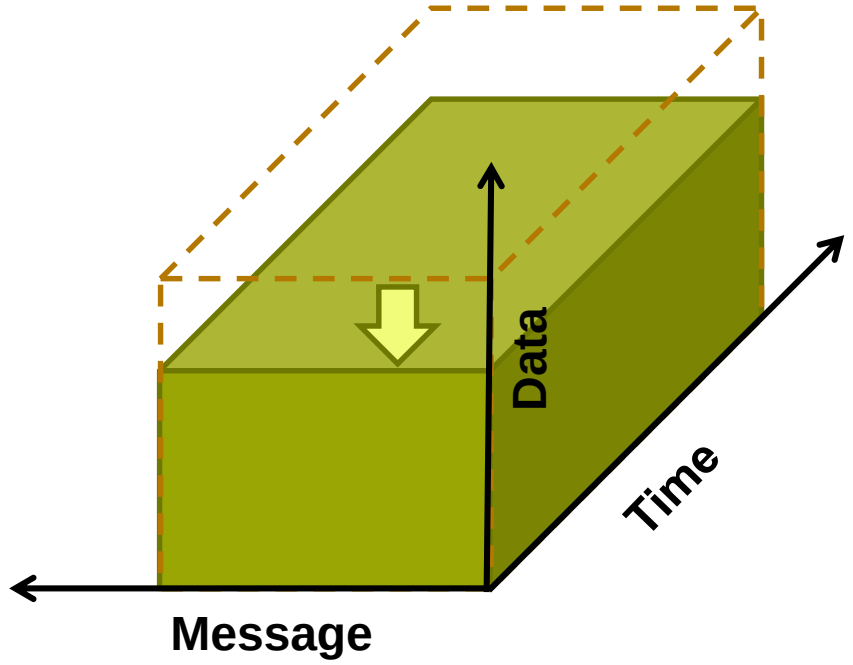
State of the Art

- (En-)Coding





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Data Reduction

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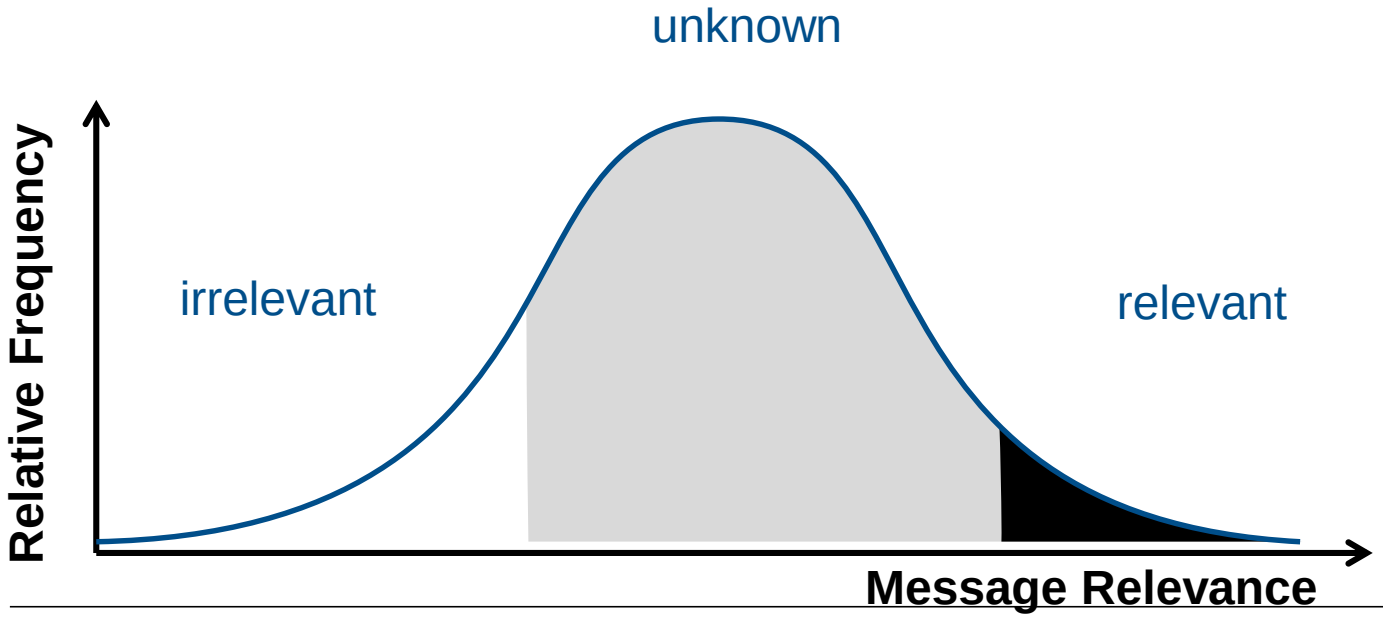
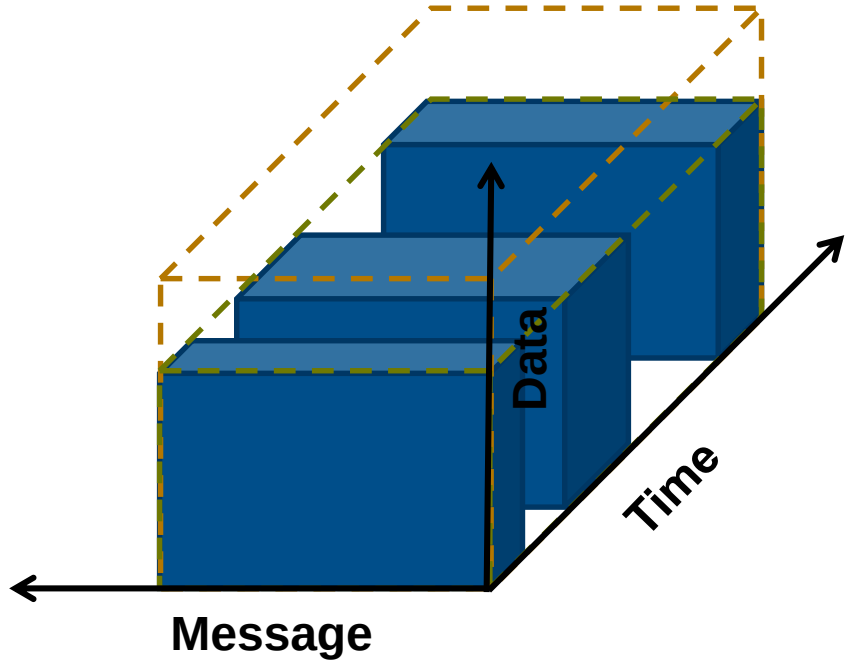
State of the Art

- (En-)Coding
- Selection





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Data Reduction

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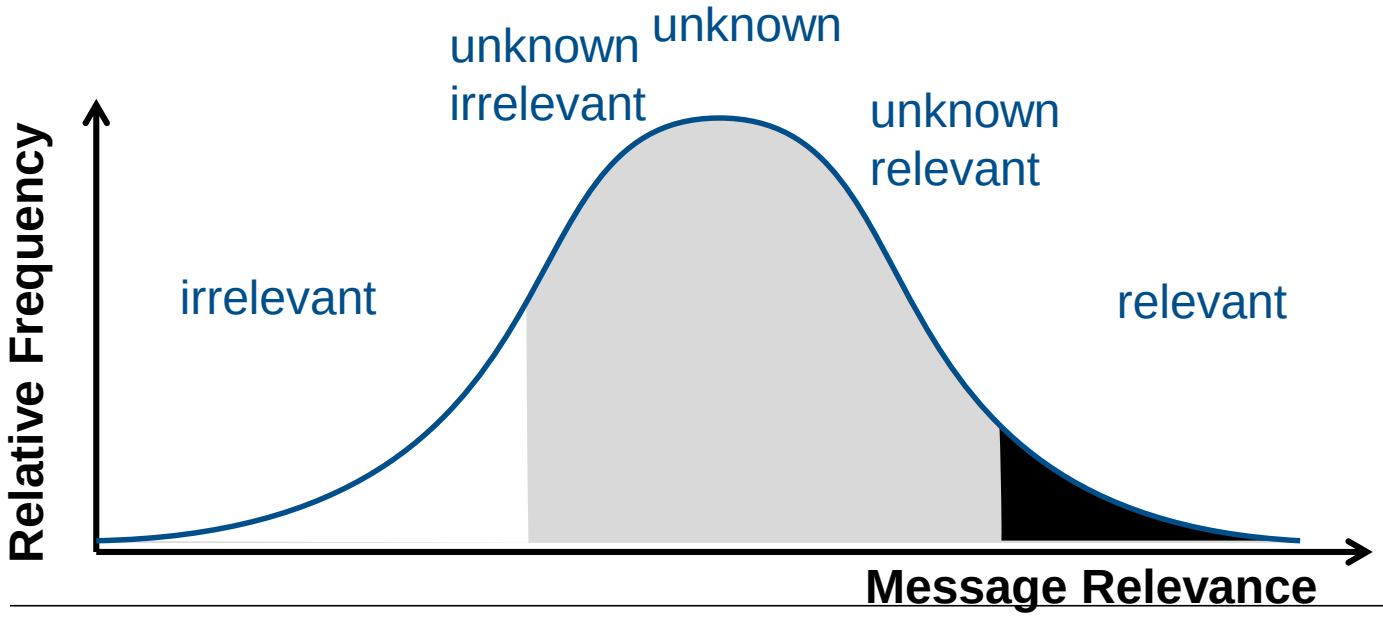
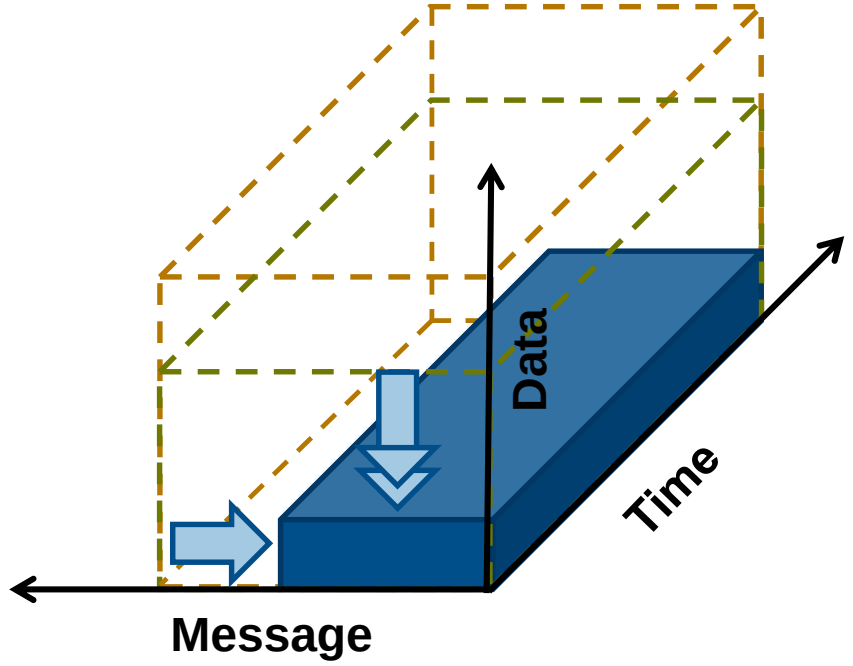
State of the Art

- (En-)Coding
- Selection
- Compression





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Data Reduction

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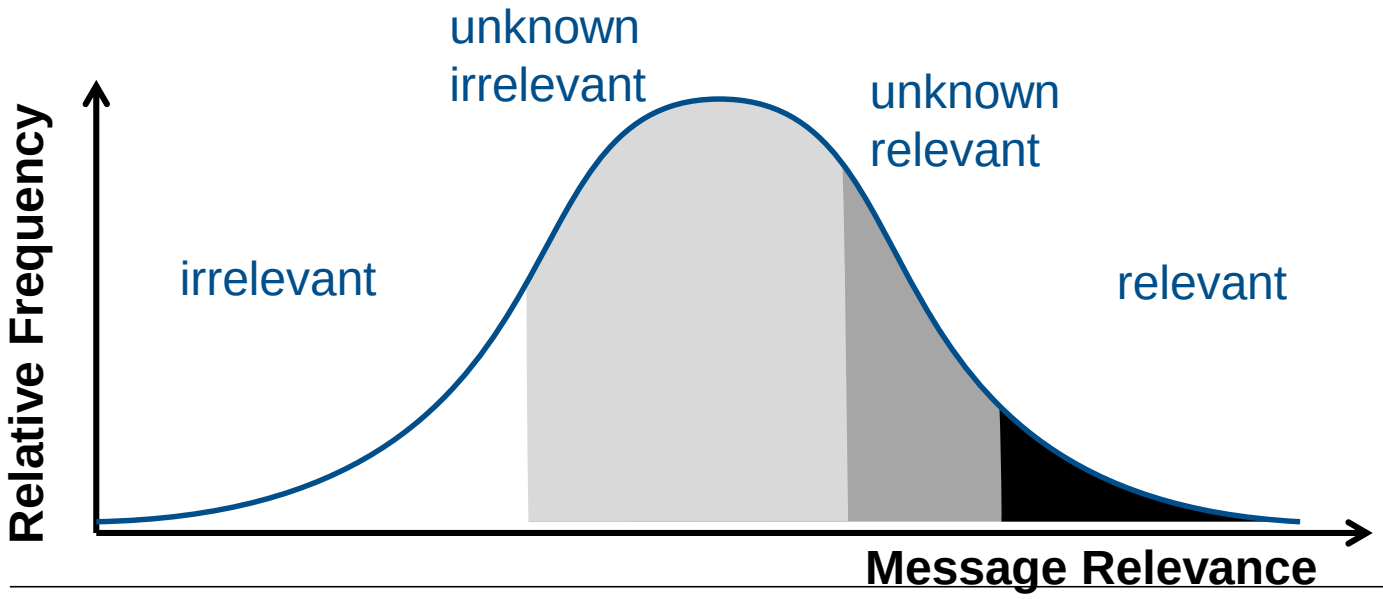
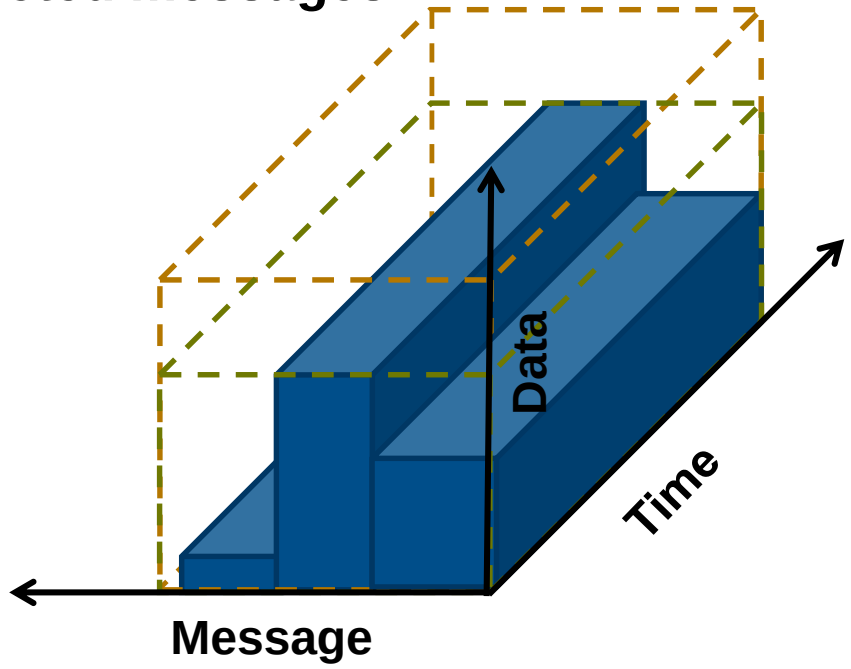


Context Aware Data Reduction

- Compression on selected messages



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Components of Context Aware Data Reduction

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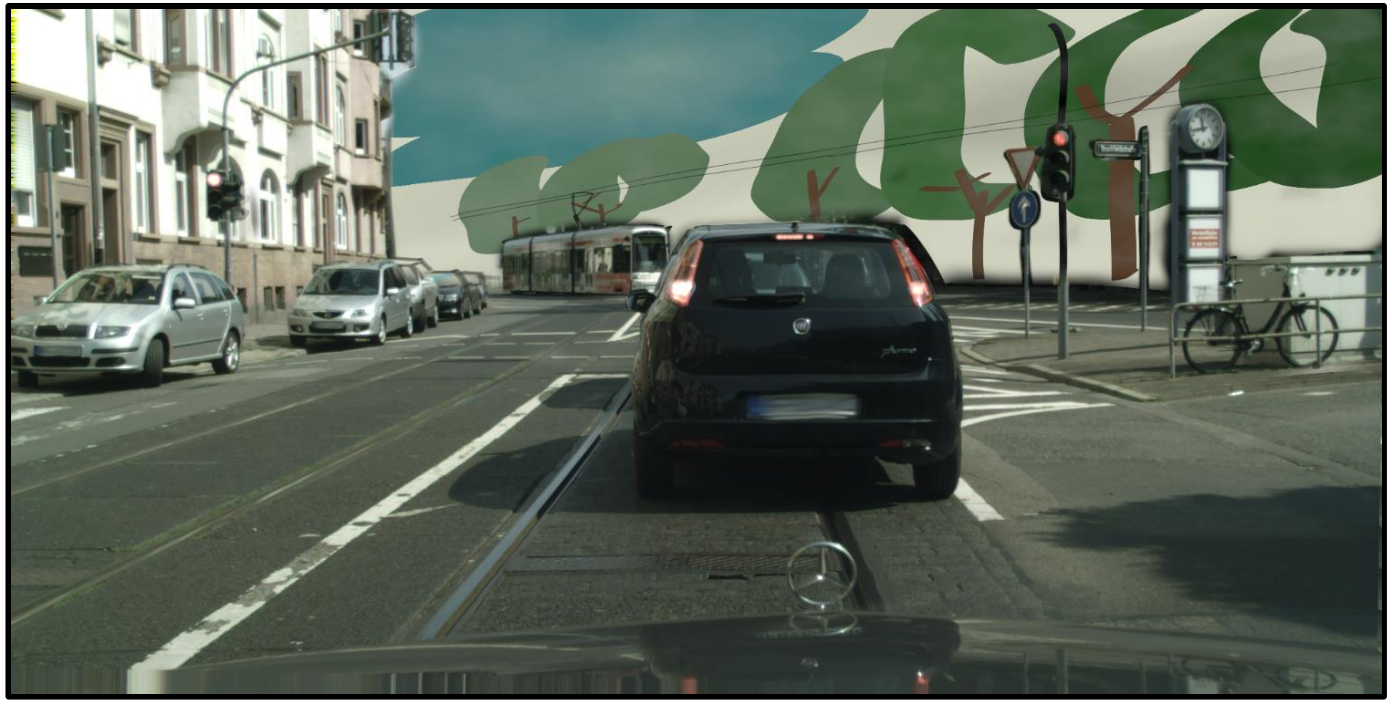
Basic Concept

- Messages summarizes data
- Use Cases rely on messages

- Messages and data use different representations

- Relevant data:
  presented ***as is***
- Less relevant data:
  presented as ***plausible lie***


[4]

[4] Background Image from: M. Cordts et. al, The Cityscapes Dataset for Semantic Urban Scene Understanding, in Proc. of the IEEE Conference on Computer Vision and Pattern Recognition (CVPR), 2016

Components of Context Aware Data Reduction

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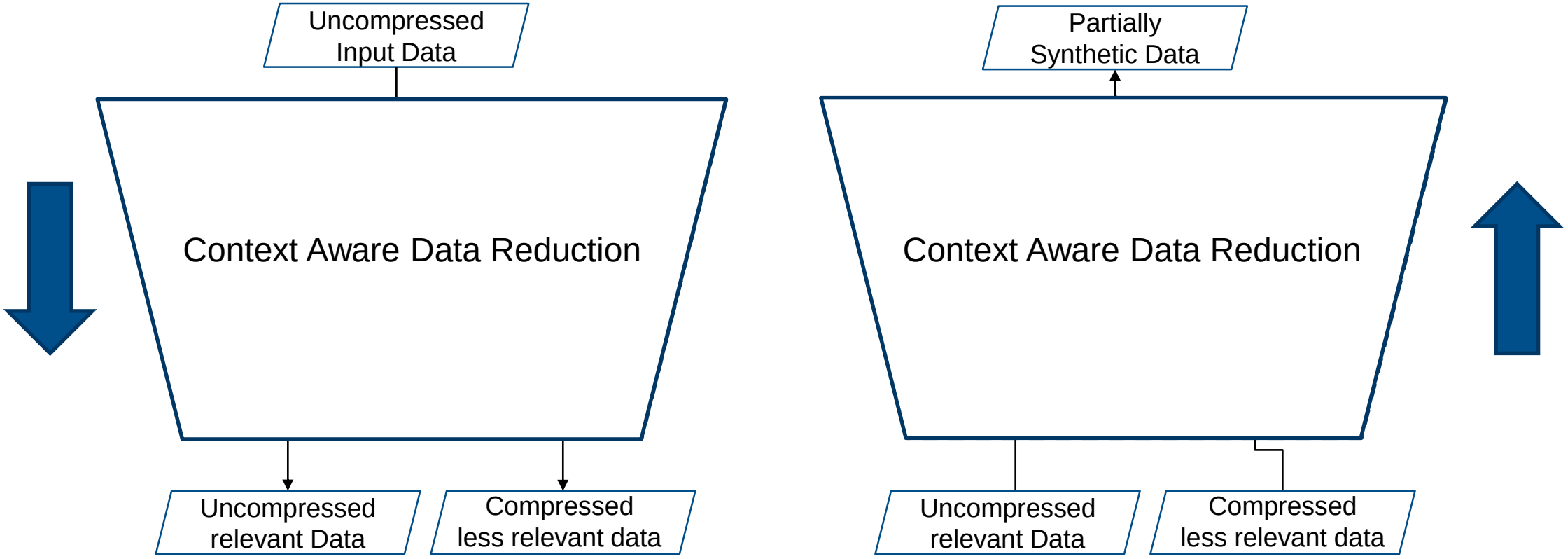

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Prototype

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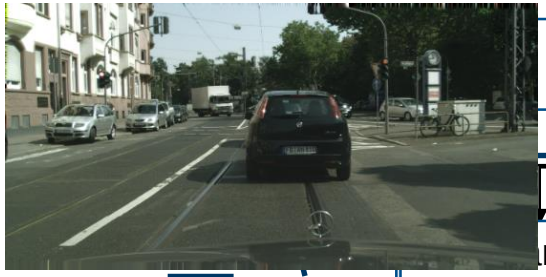

Uncompressed input data

nce Metric

Message Compression

ROI Selection

Uncompressed relevant data

Compressed less relevant data

Partially synthetic data

Merge

Synthetic irrelevant Data

GAN

Uncompressed relevant data

Compressed less relevant data

[5] Scenario data based on: M. Cordts et. al, The Cityscapes Dataset for Semantic Urban Scene Understanding, in Proc. of the IEEE Conference on Computer Vision and Pattern Recognition (CVPR), 2016

Prototype

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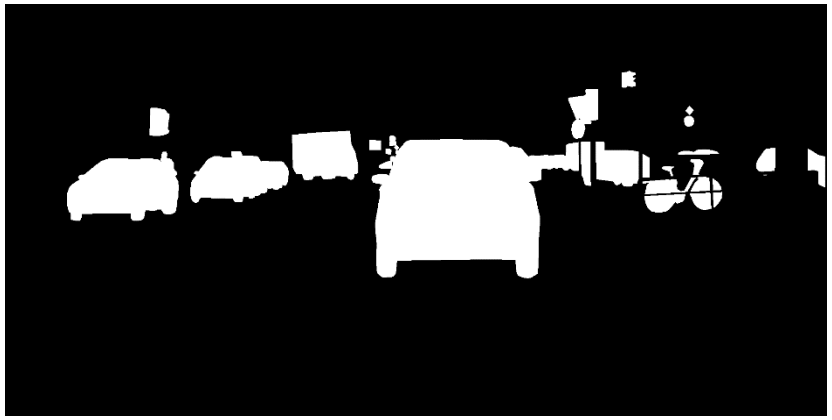
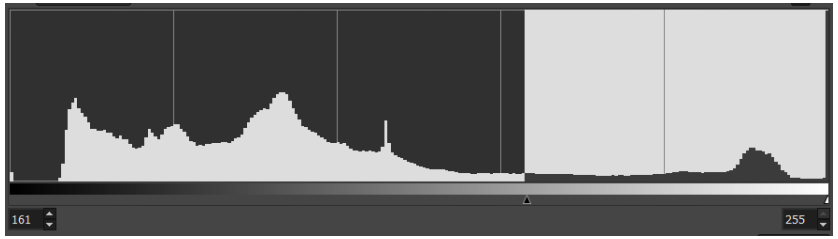
Class based Selection

- Semantic segmentation as baseline
- Lane marking detection as additional selection



Relevant	Irrelevant
Car, Truck, Bus	Ground, Road
Caravan, Train, Trailer	Sidewalk, Parking, Rail track
Person, Rider, Motorcycle, Bicycle	Building, Wall, Fence, Guard Rail
Traffic Light, Traffic Sign	Bridge, Tunnel, Pole, PoleGroup
	Vegetation, Terrain, Sky



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Prototype | Results

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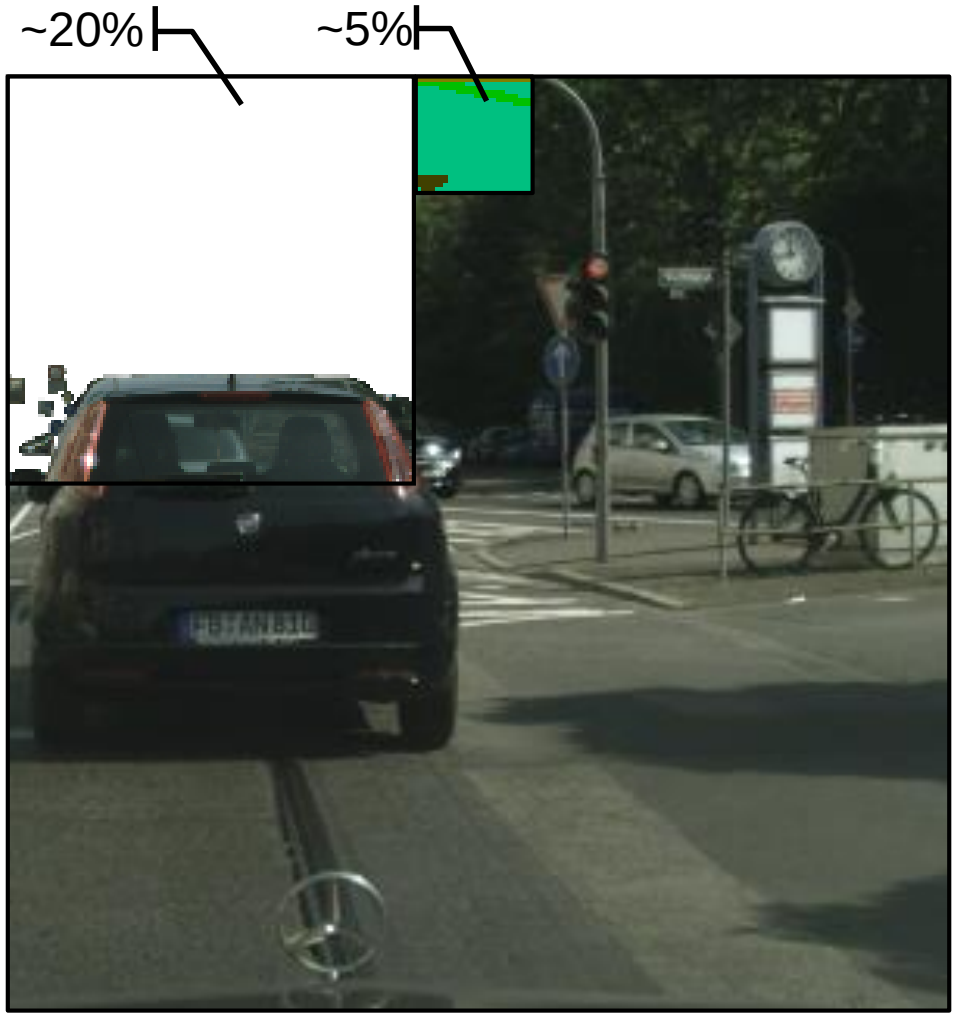
Benefits of Context Aware Date Reduction

- ~ 25% storage space needed
- Lossless storage of relevant regions
- Relies on already present algorithms in HAD

Challenges of Context Aware Date Reduction

- Exact knowledge of use case necessary
- Relevance harder to define than irrelevance



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Outlook

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What are the missing Pieces?

- **Substantiated selection criteria**

  What defines relevance?

- **Verfication method**

  How can we assure that nothing import will be lost?

- **Application process**

  How can the method be established in an operational environment?

What are the next steps?

- **Extend Prototype to:**
  - **Different selection criteria**
  - **Video data**
  - **Heterogenic sensor setups**

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FZD COMPREHENSION DRIVING INNOVATION

Original Representation

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Original Representation

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Partially Synthetic Representation

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