

Identification of Critical Scenarios in Real World Drives

Lars Klitzke, Hochschule Emden/Leer

Symposium „Testen - Automatisiertes und Vernetztes Fahren“, DLR Braunschweig

Motivation

- During RWTD *several hundreds* of TB data collected [1]
- Prove driving function based on **scenarios** [2]
- scenarios identified in the real world can be used for *simulation-based validation*

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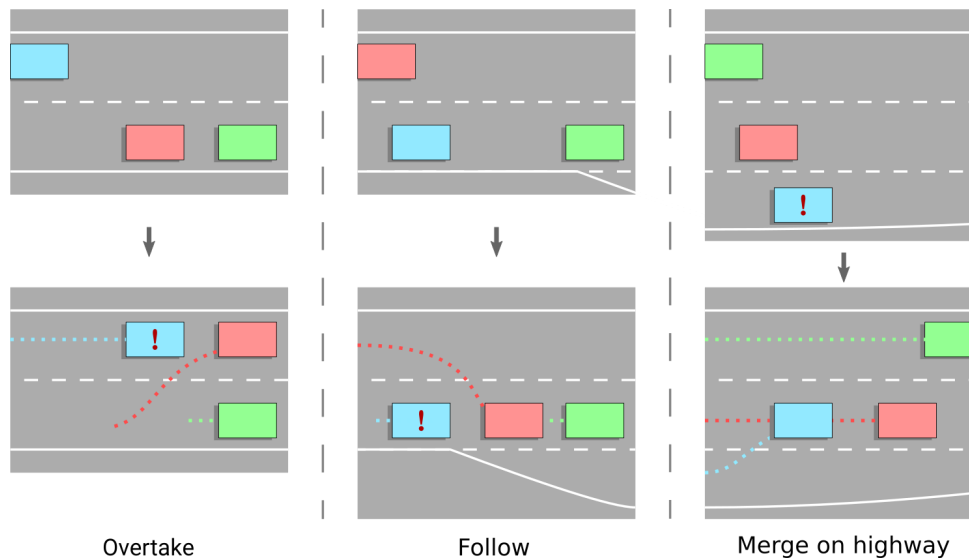
Which scenarios exist and
how can we identify them?

But what is a scenario?

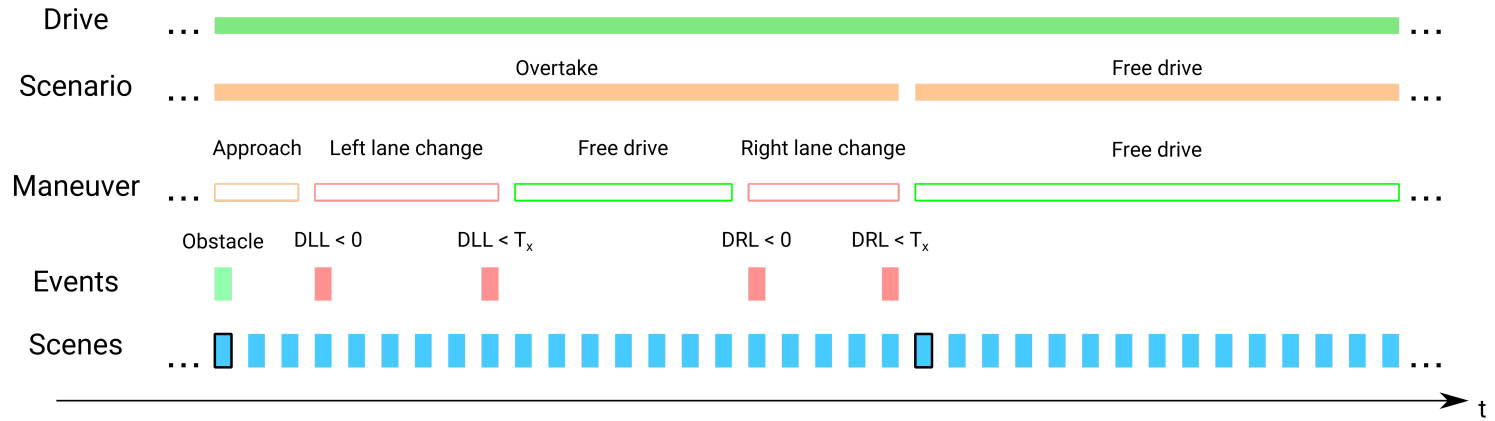
Definition and examples

"A scenario describes the temporal development between several scenes in a sequence of scenes. Every scenario starts with an initial scene. Actions & events as well as goals & values may be specified to characterize this temporal development in a scenario. Other than a scene, a scenario spans a certain amount of time."

(Ulbrich et. al., 2015)



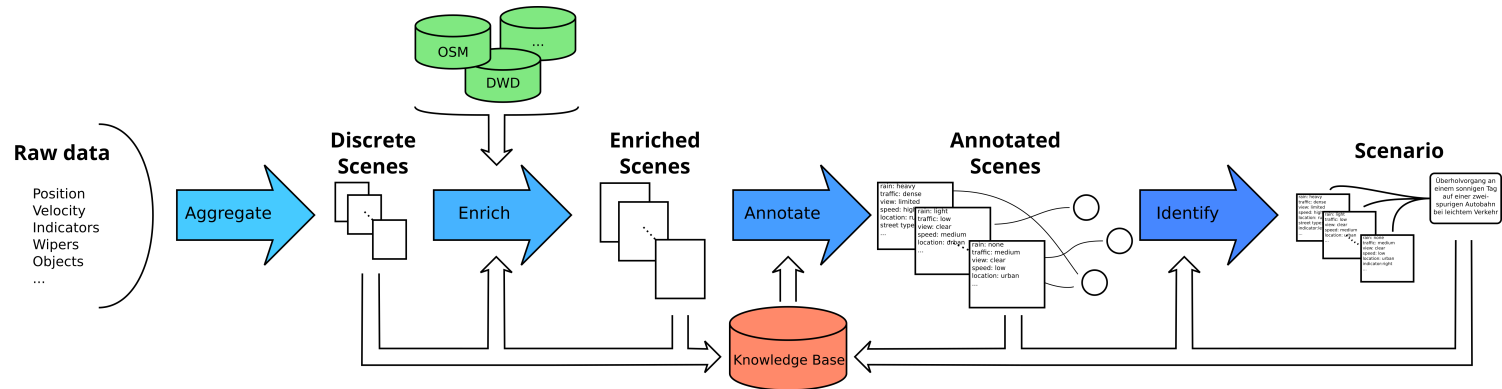
Definition and examples



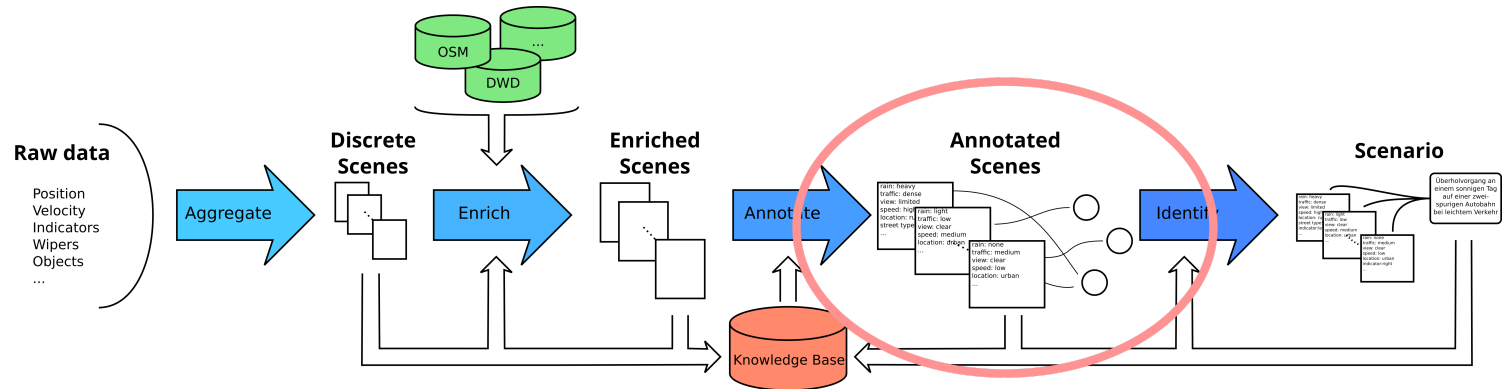
A drive is a gap-free **sequence of scenarios**.

How to find those scenarios in real world data?

Data processing chain



Data processing chain



Annotate scenes with domain knowledge

- The most natural scenario description type is the *functional scenario* [4]

An overtake scenario at day on a highway with two lanes and heavy rain.

- Describe domain knowledge using the Web Ontology Language (OWL), e.g. in Protégé

Examples

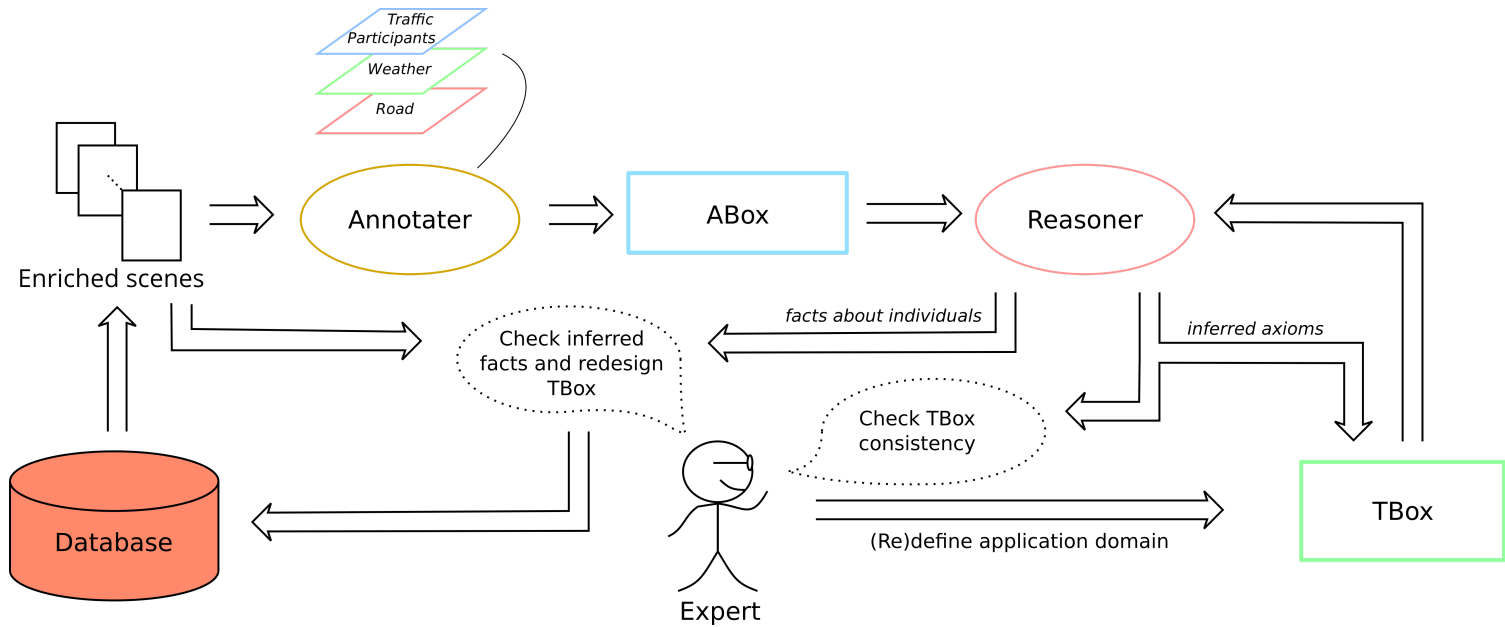
```
HighwayScene EquivalentTo Scene and (isOn some Highway)
Highway EquivalentTo road and (hasRoadType value osm:highway or
                                hasRoadType value osm:trunk)
```

```
HighwayLinkScene EquivalentTo LinkScene and (isOn some HighwayLink)
HighwayMergeOnFinishedScene EquivalentTo HighwayScene and (metBy some HighwayLinkScene)
```

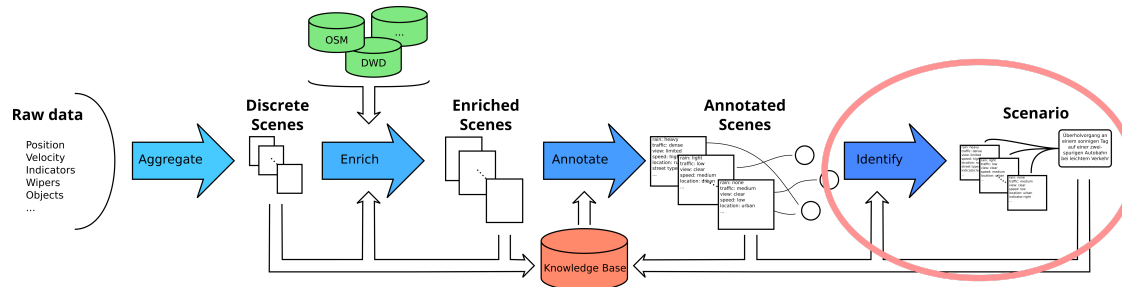
```
HighwayScene and (metBy HighwayMergeOnFinishedScene) EquivalentTo
                                (isPart value HighwayDrive)
```

```
HighwayScene and (metBy (HighwayScene that isPart HighwayDrive)) SubClassOf
                                (isPart value HighwayDrive)
```

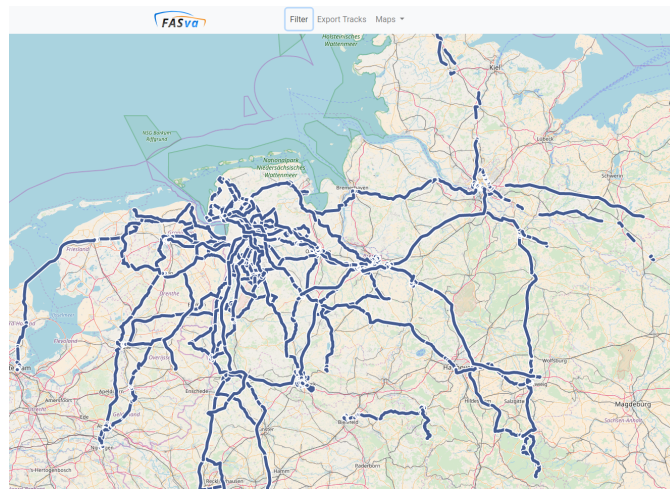
Domain knowledge definition process



Outlook and further work



Evaluate approach using test drive database of Hochschule Emden/Leer.



Questions?

Thanks for your attention!

Literature

- [1] C. Kessler, A. Etemad, G. Alessandretti, K. Heinig, R. Brouwer, A. Cserpinszky, W. Hagleitner, and M. Benmimoun. *European large-scale field operational tests on in-vehicle systems. Final Report (EuroFOT Deliverable D11.3)*. Dec 2012.
- [2] F. Schuldt. *Effiziente systematische Testgenerierung für Fahrerassistenzsysteme in virtuellen Umgebungen*. In AAET – Automatisierungssysteme, Assistenzsysteme und eingebettete Systeme für Transportmittel, pages 114 - 134. 2013.
- [3] S. Ulbrich, T. Menzel, A. Reschka, F. Schuldt, and M. Maurer. *Defining and substantiating the terms scene, situation, and scenario for automated driving*. In 2015 IEEE 18th International Conference on Intelligent Transportation Systems, pages 982–988, Sept 2015.
- [4] G. Bagschik, T. Menzel, A. Reschka und M. Maurer. *Szenarien für die Entwicklung, Absicherung und Test von automatisierten Fahrzeugen*. In Workshop Fahrerassistenzsysteme und automatisiertes Fahren, volume 11. March 2017.

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