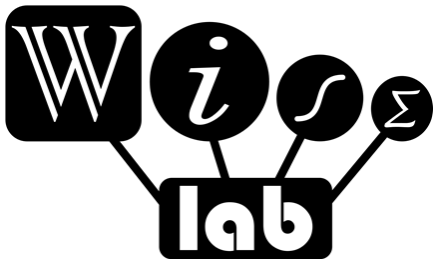


GeoScenario: A Lightweight, WISIWIG Scenario-Based Test Definition Language for Automated Driving

by Michał Antkiewicz, MSc., PhD. And Rodrigo Queiroz, MSc.
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2019.10.24



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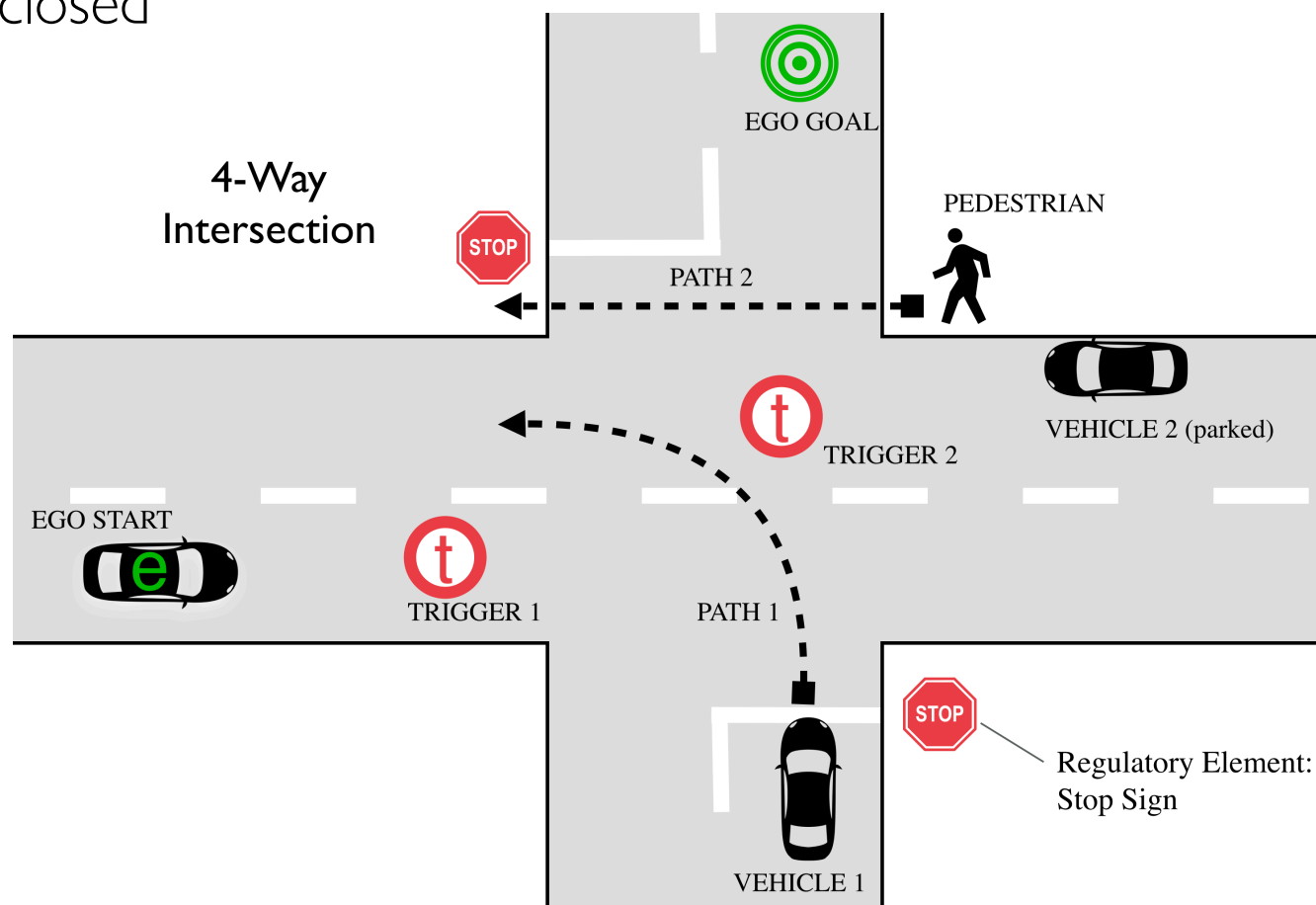
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GeoScenario

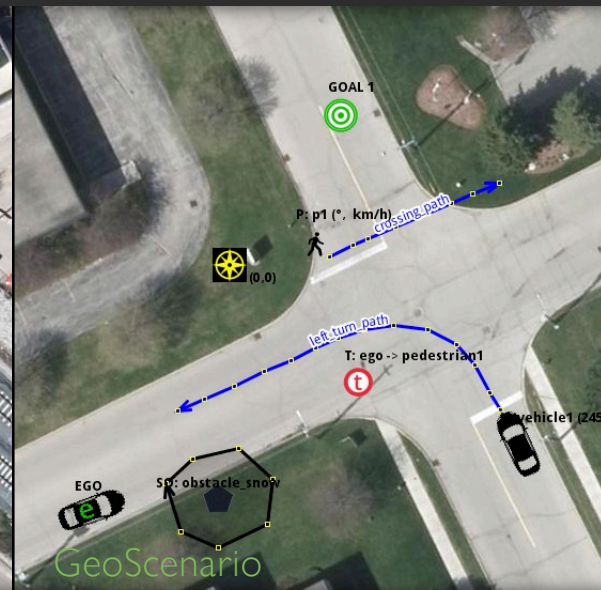
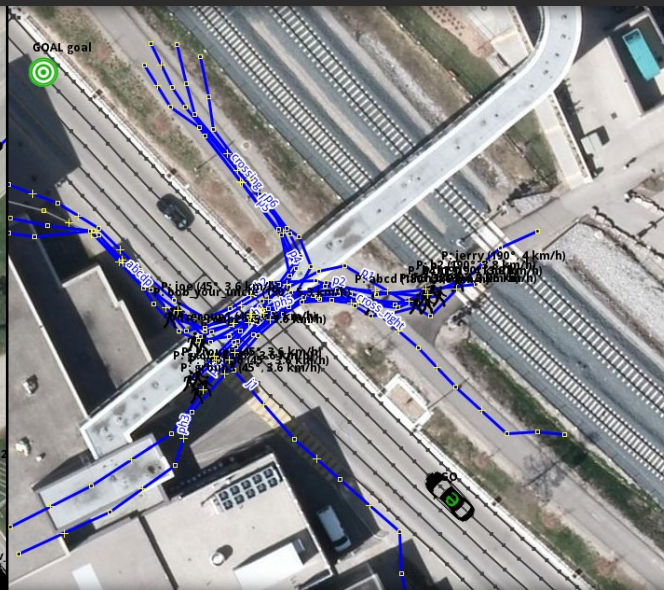
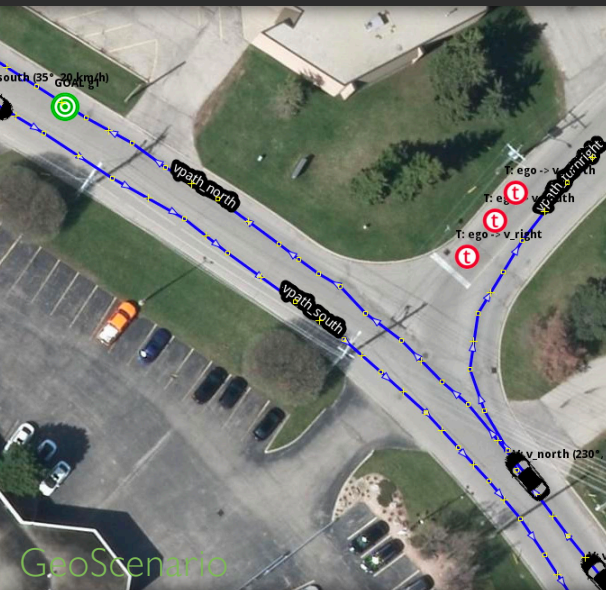
A Domain-Specific Language (DSL) for scenario-based test representation for simulation, closed course, and mixed reality testing.

- Open language for expressing **concrete, executable** scenarios
- Lightweight
- Simple
- Modular
- Built on top of Open Street Map (OSM) standard



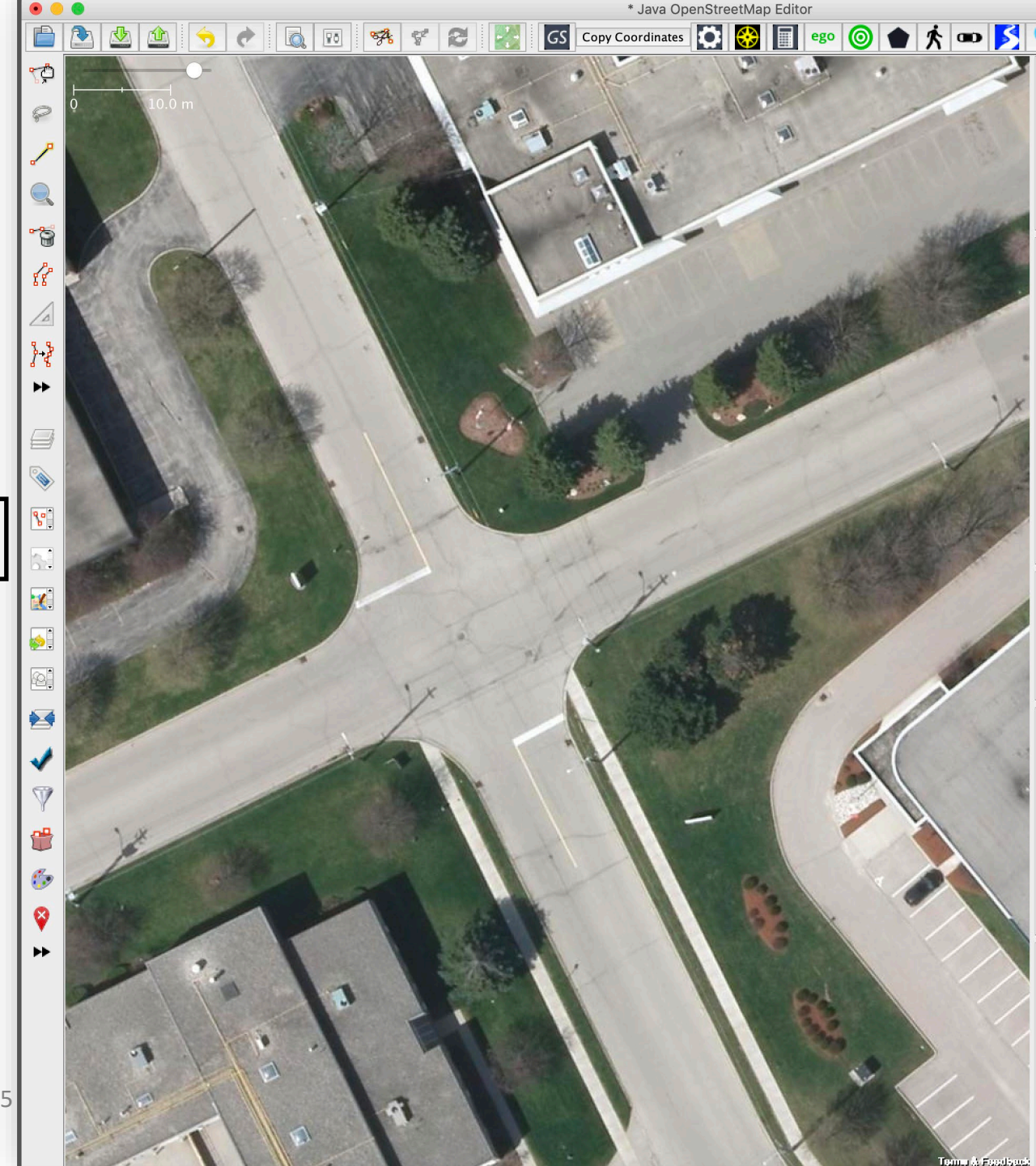
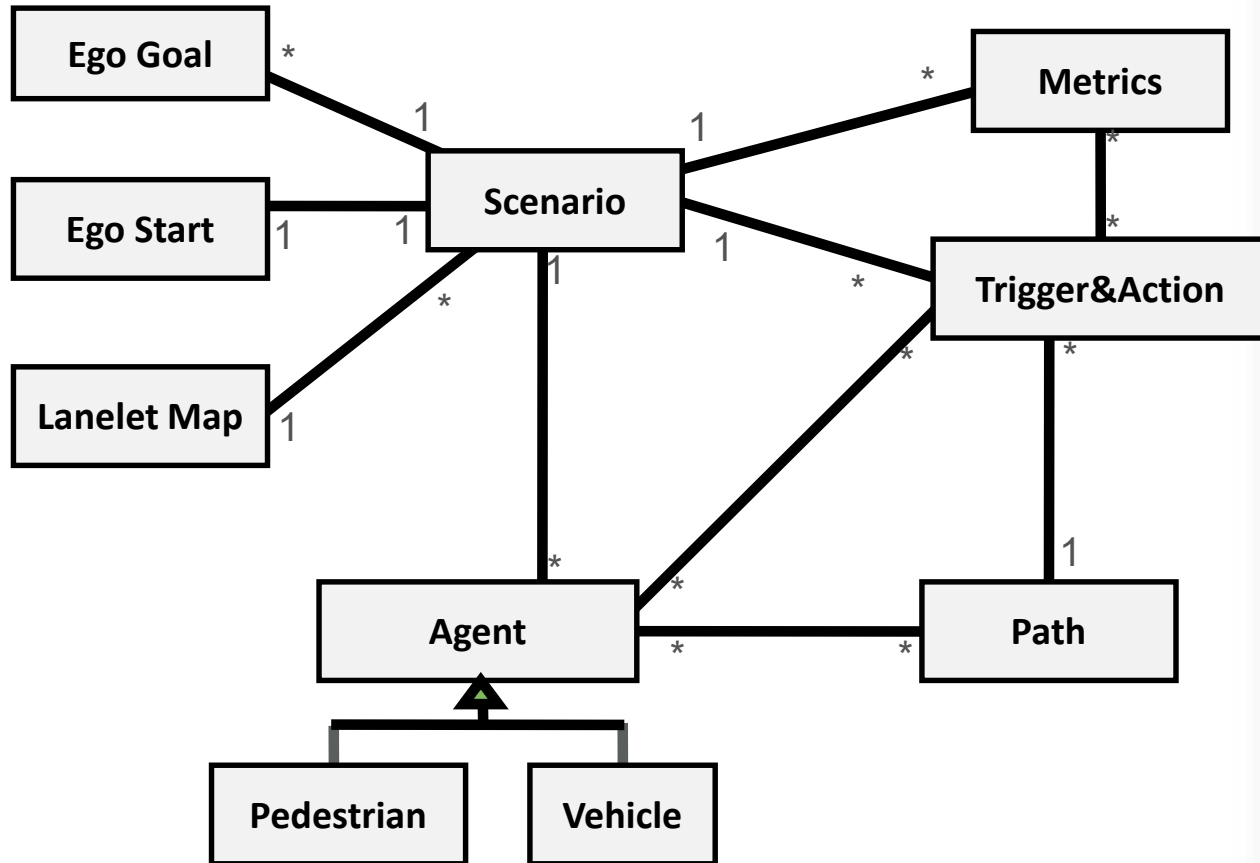
Application - Autonomoose Project

- University of Waterloo's Self-Driving Research Platform
- GeoScenario as the official format for all scenario-based tests in simulation, closed course, and mixed reality
- 130+ scenario-based tests designed with GeoScenario
- To be released:
 - WiseBench: Benchmark with focus on behaviour planning
 - Critical Scenarios Database



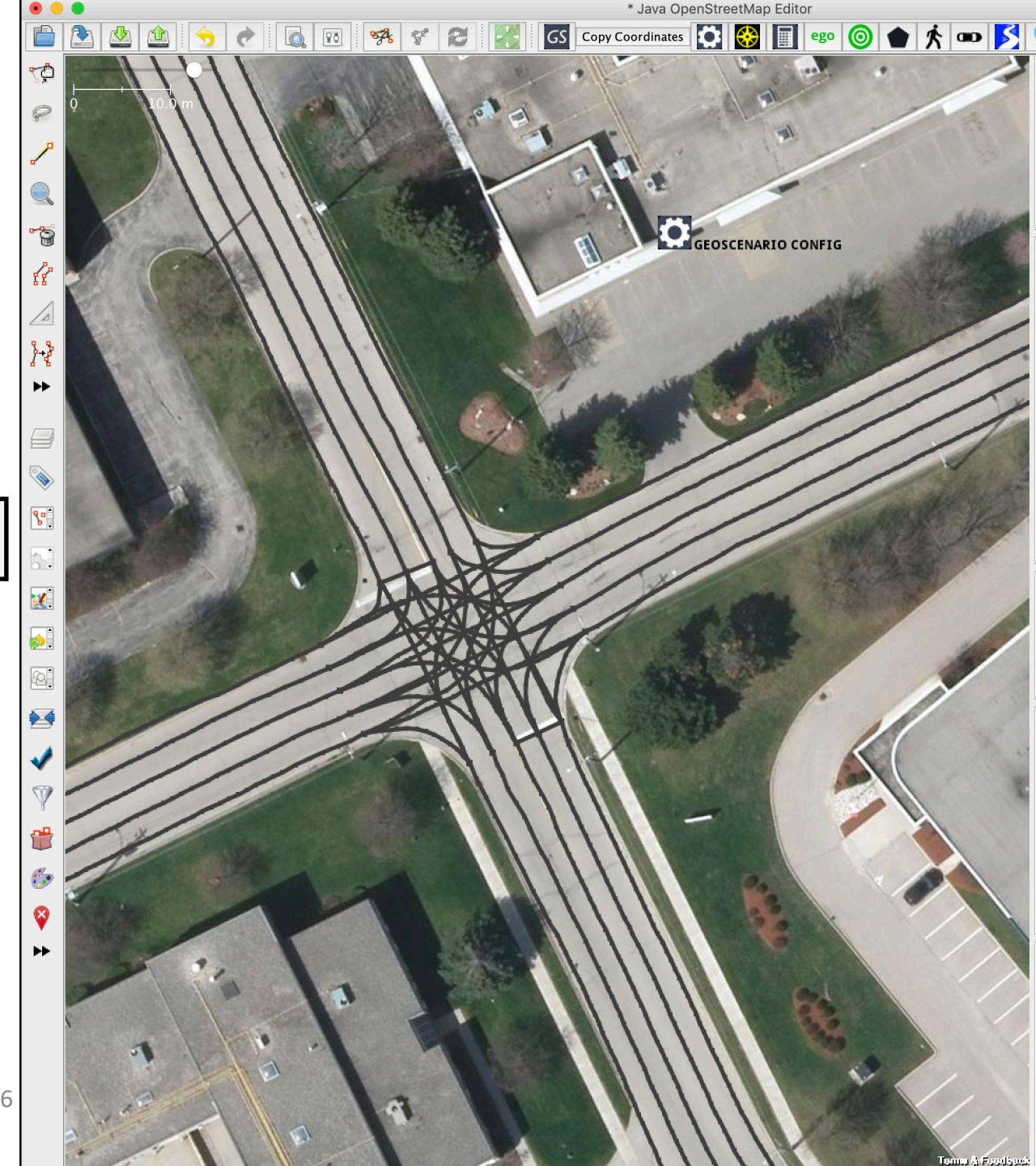
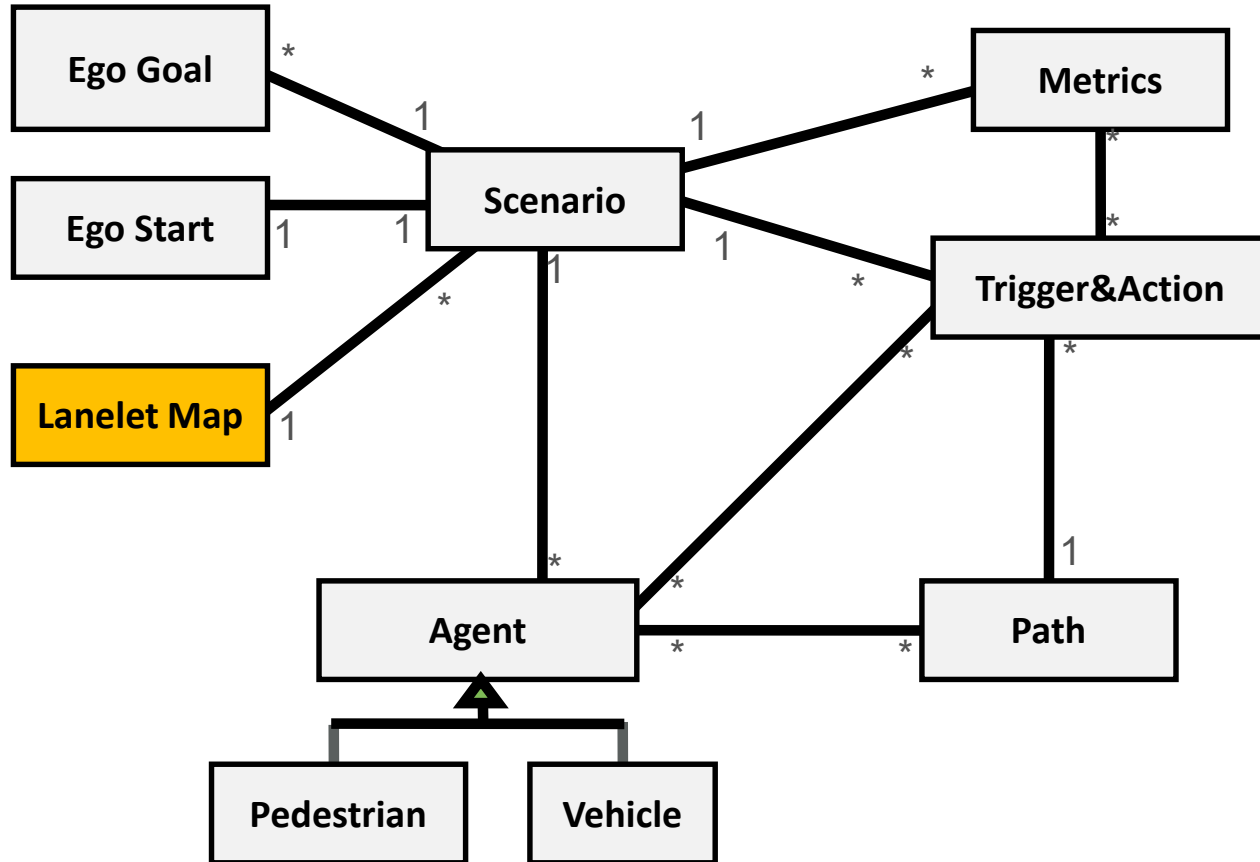
GeoScenario design

Covers a variety of elements that compose typical traffic situations need to be formally declared and executed on self-driving vehicle testing.



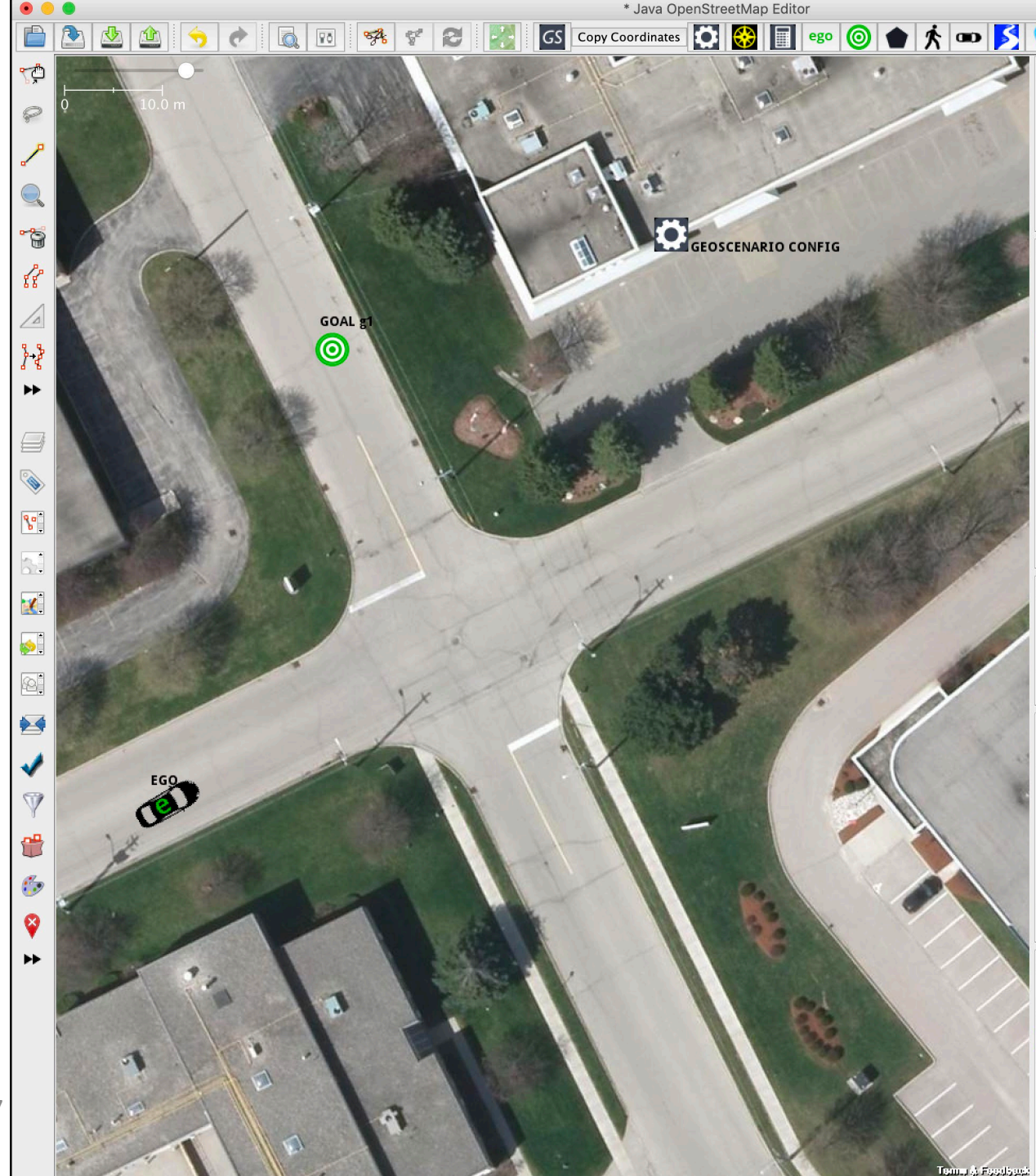
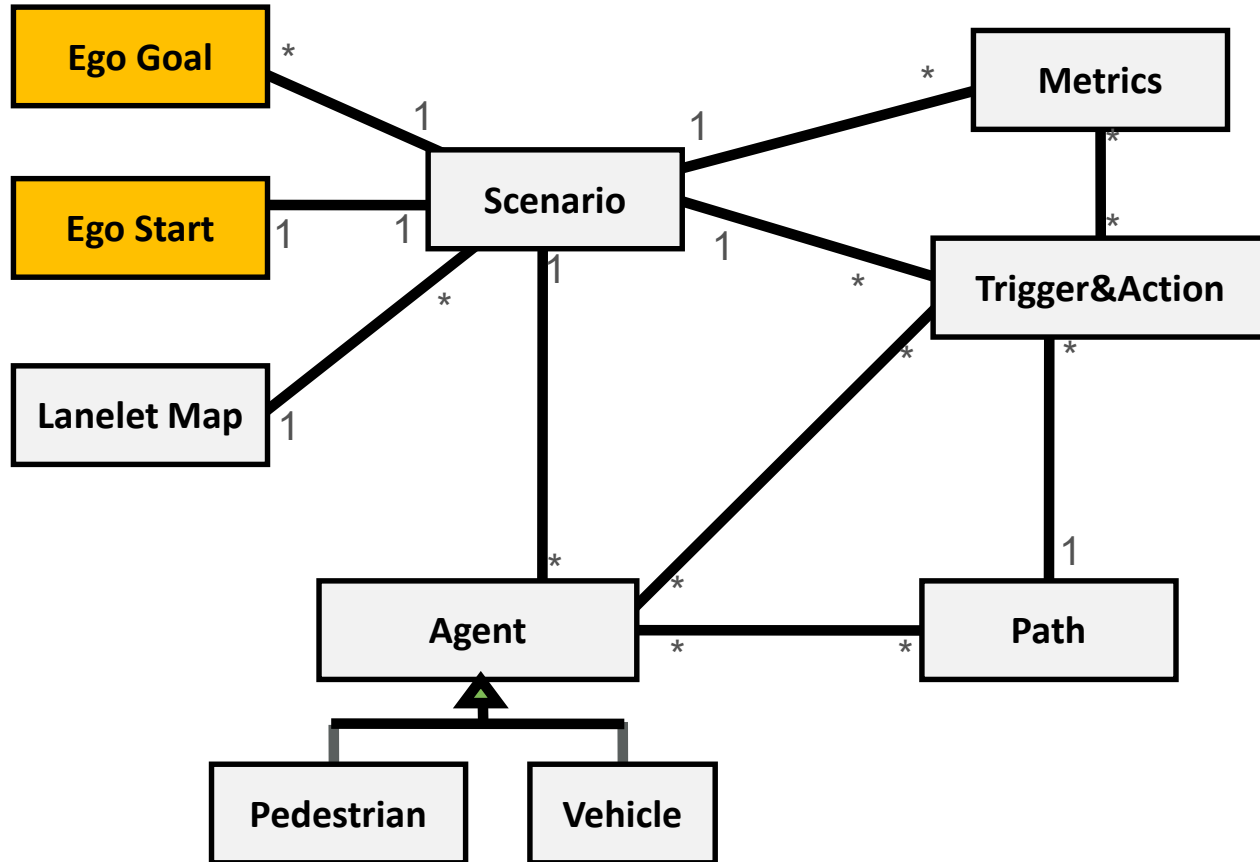
GeoScenario design

The Road Network



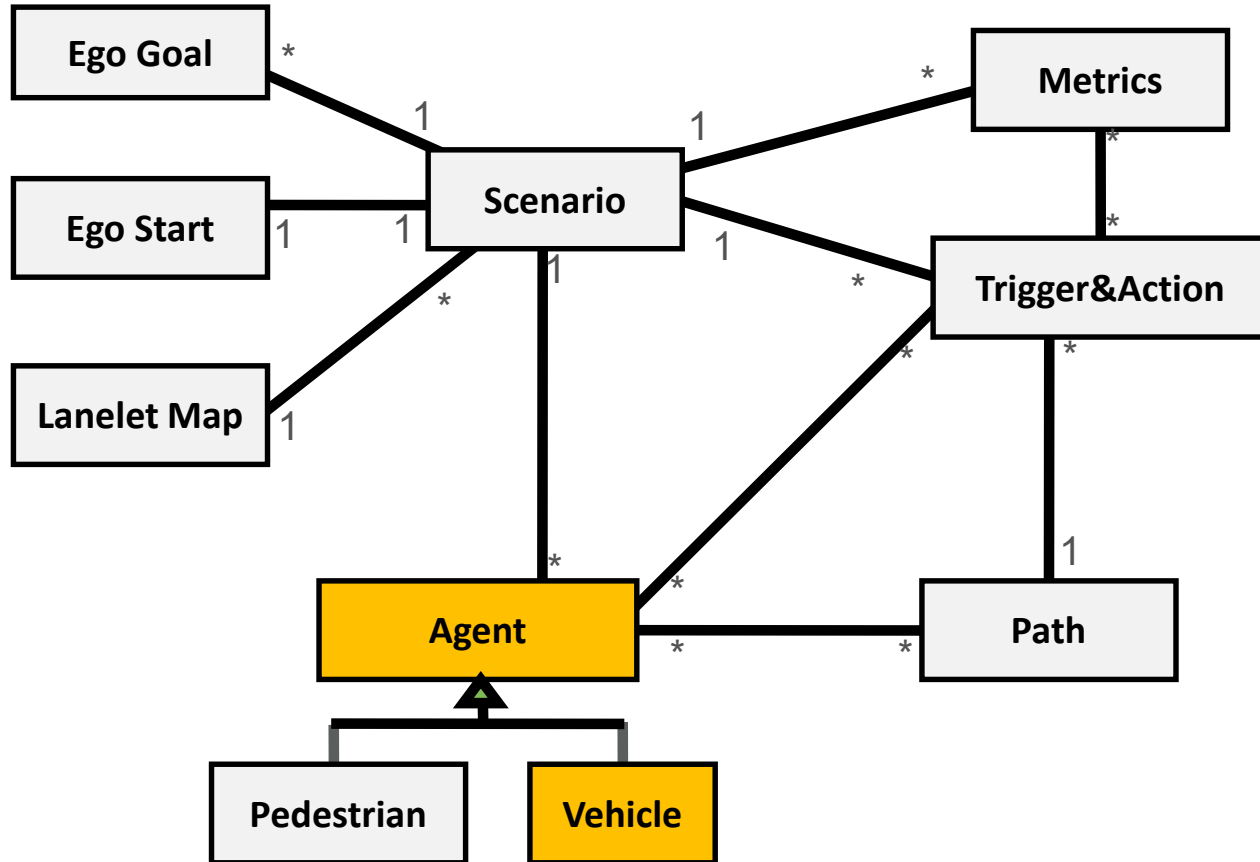
GeoScenario design

Driving Mission



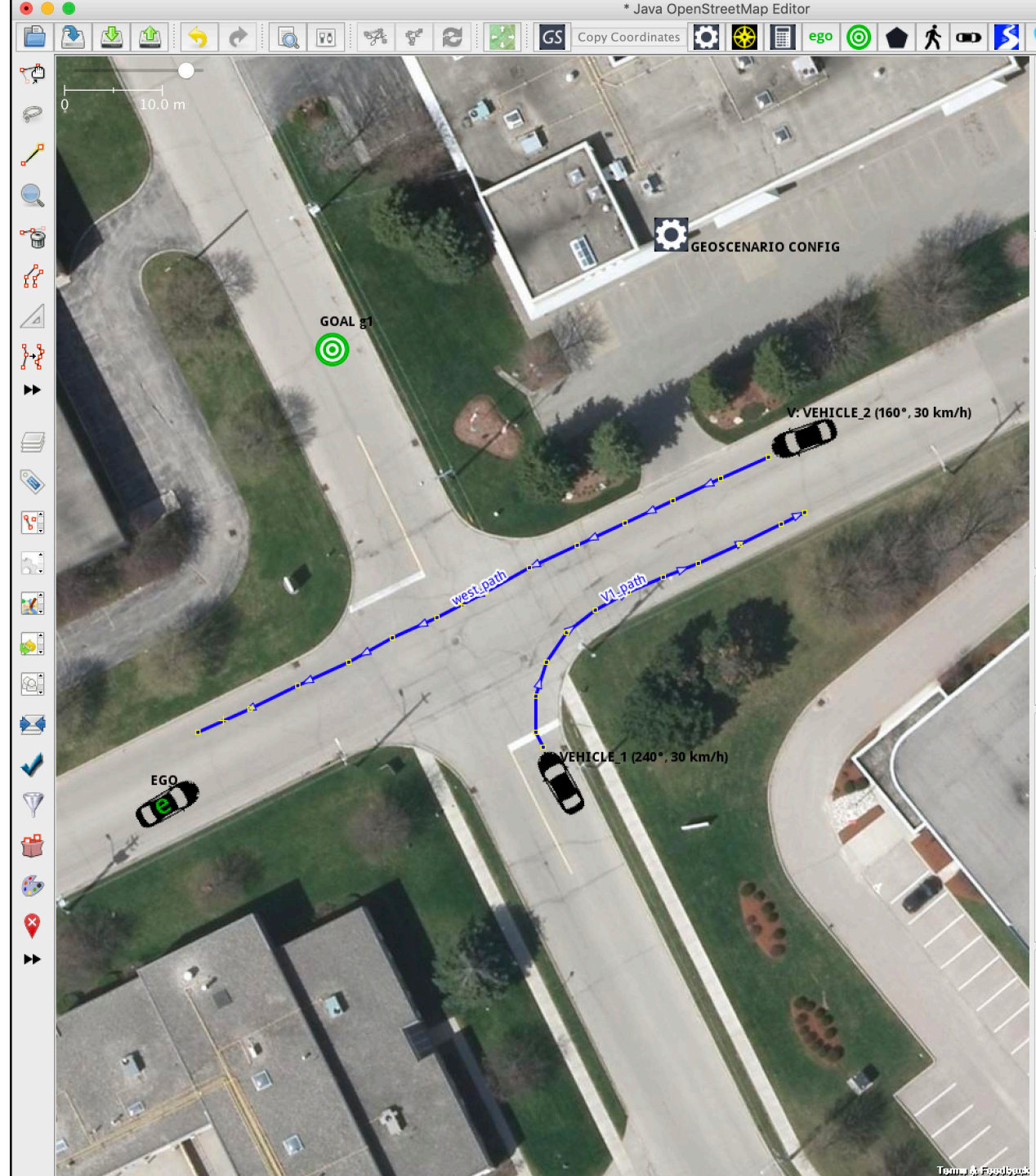
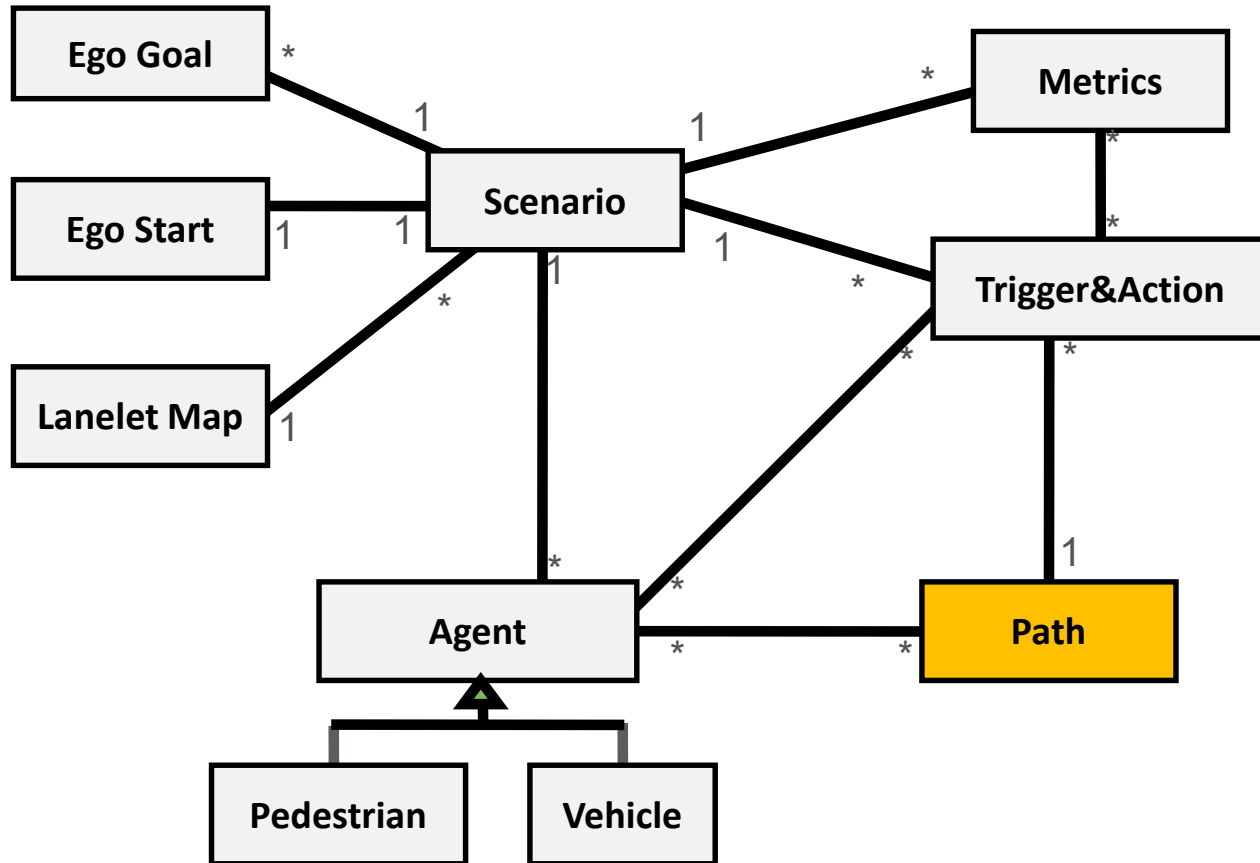
GeoScenario design

Traffic Agents: Vehicles



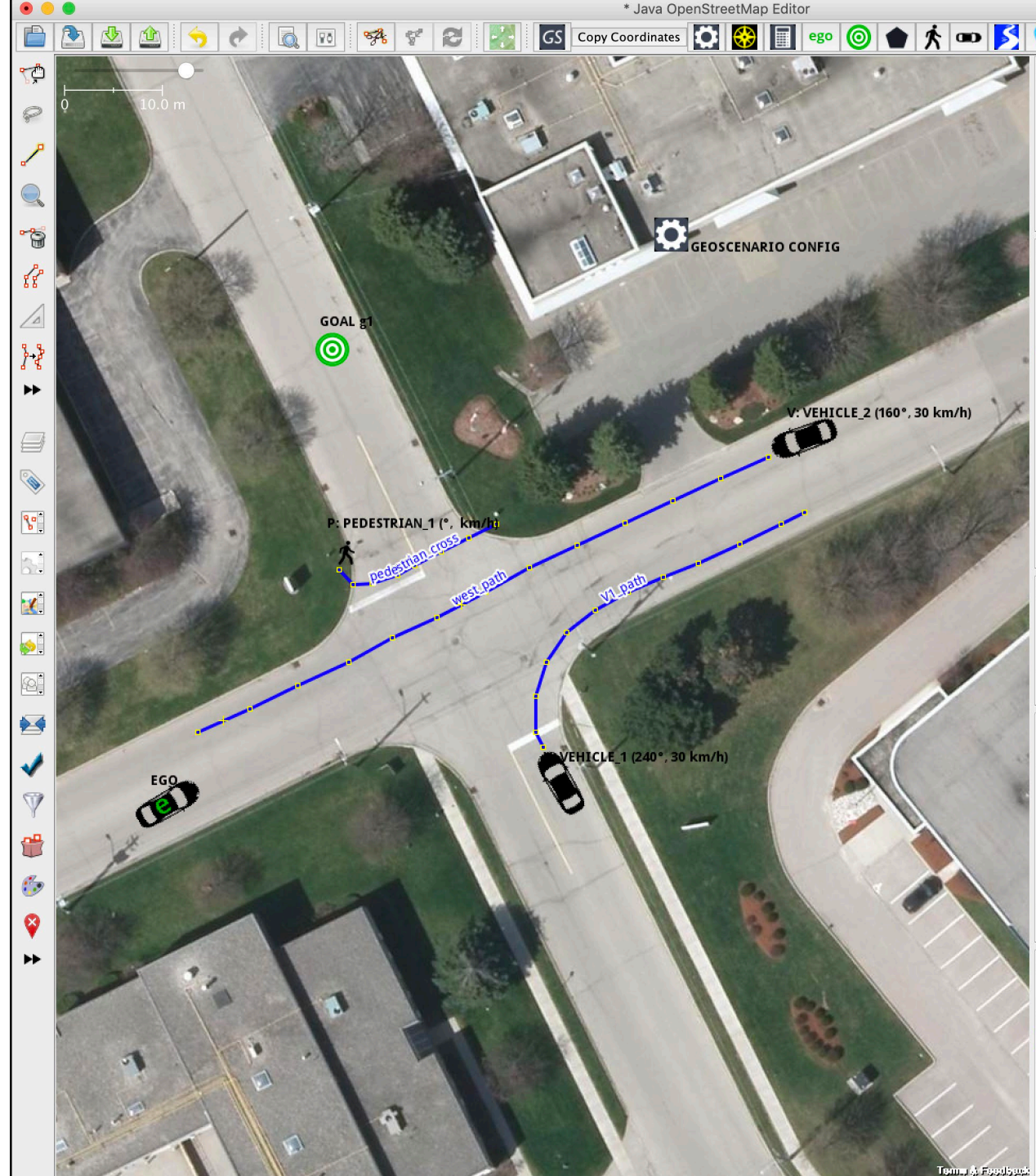
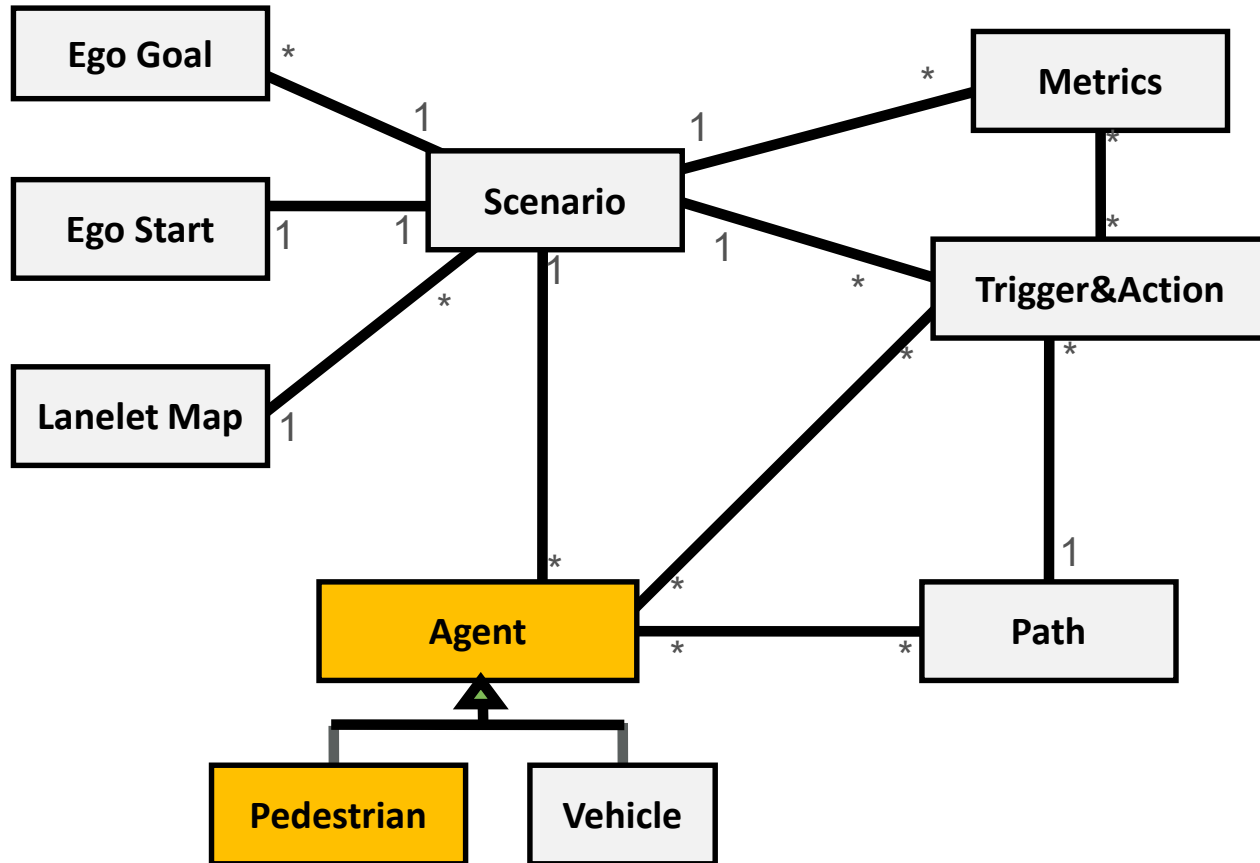
GeoScenario design

Paths including velocity and acceleration profiles



GeoScenario design

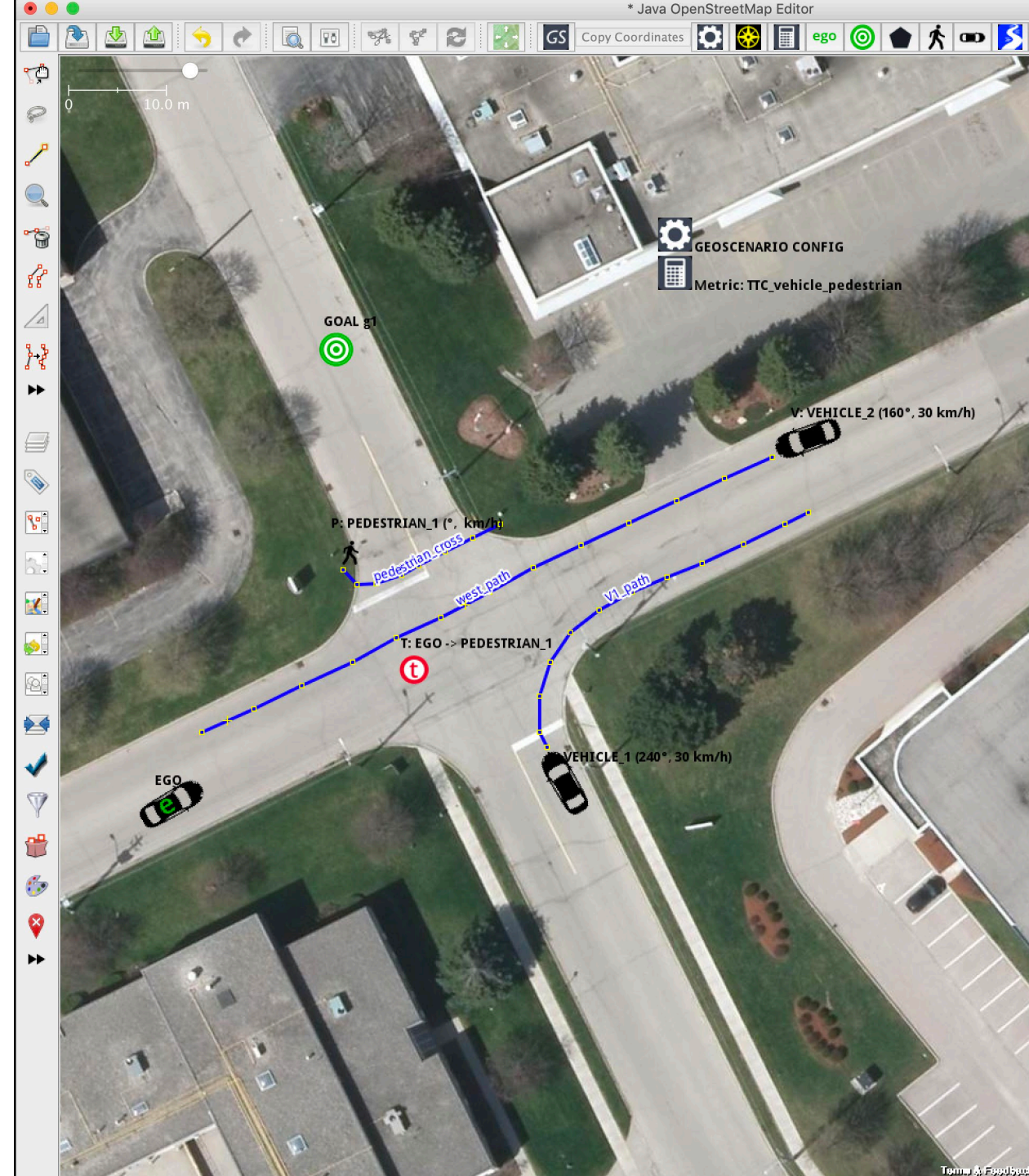
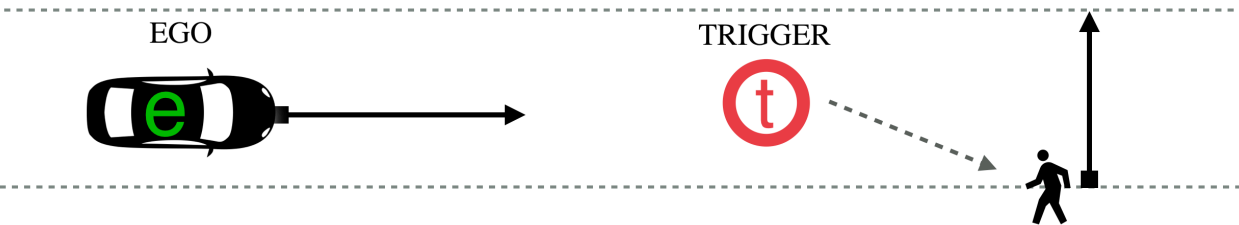
Traffic Agents: Pedestrians



GeoScenario design - orchestration

Triggers & Actions.

Basic concept: to add *trigger nodes* over strategic places of the road network, and activate different actions over dynamic agents.



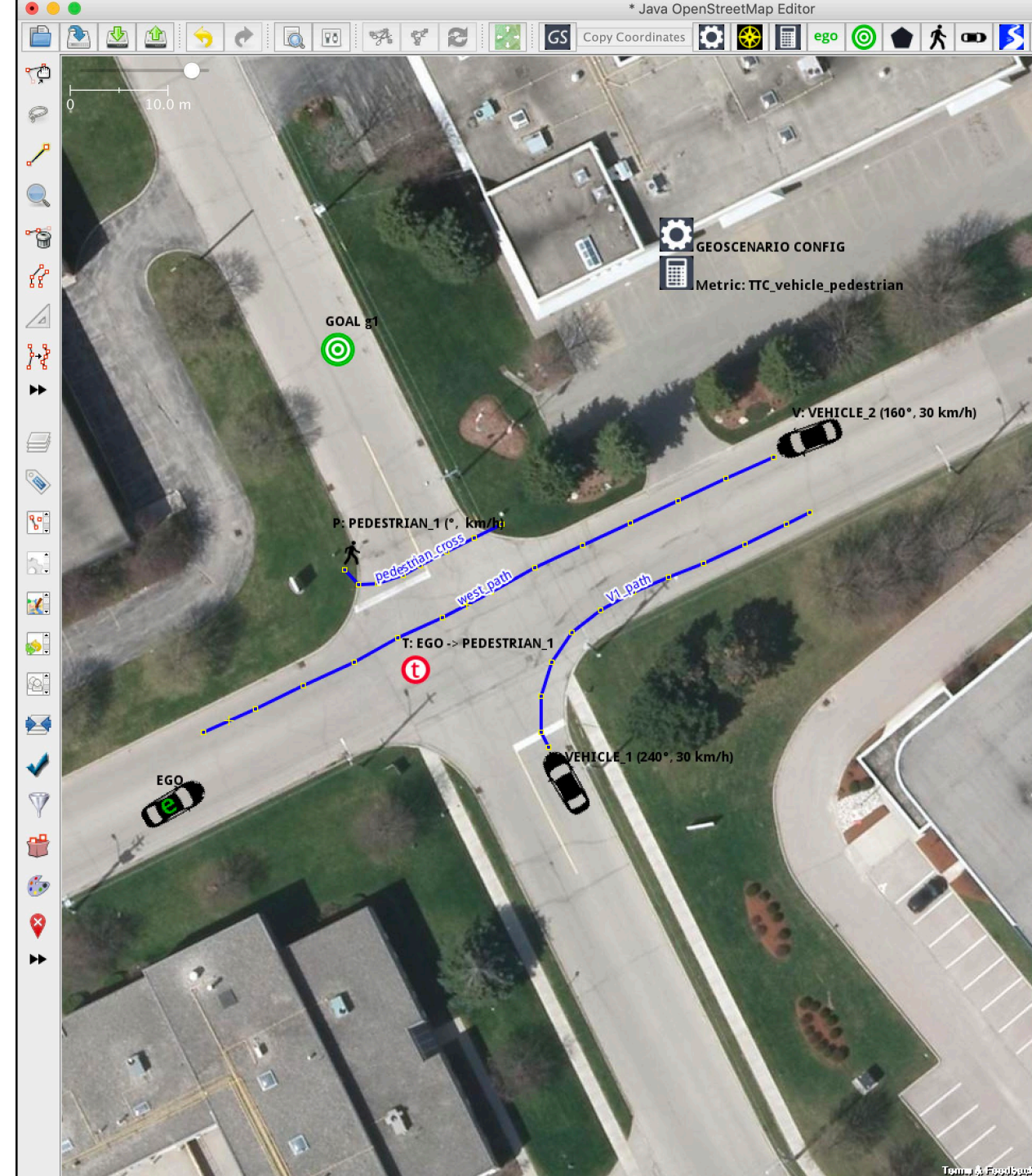
GeoScenario design - composition

Parallel composition: merge scenario layers

- Layer 1: vehicle 1 and its path
- Layer 2: vehicle 2 and its path
- Layer 3: pedestrian and its path

Sequential composition: actors from one layer can control actors from another layer via triggers. E.g.,

- ego can activate vehicle 1,
- vehicle 1 can activate vehicle 2, and
- vehicle 2 can activate the pedestrian

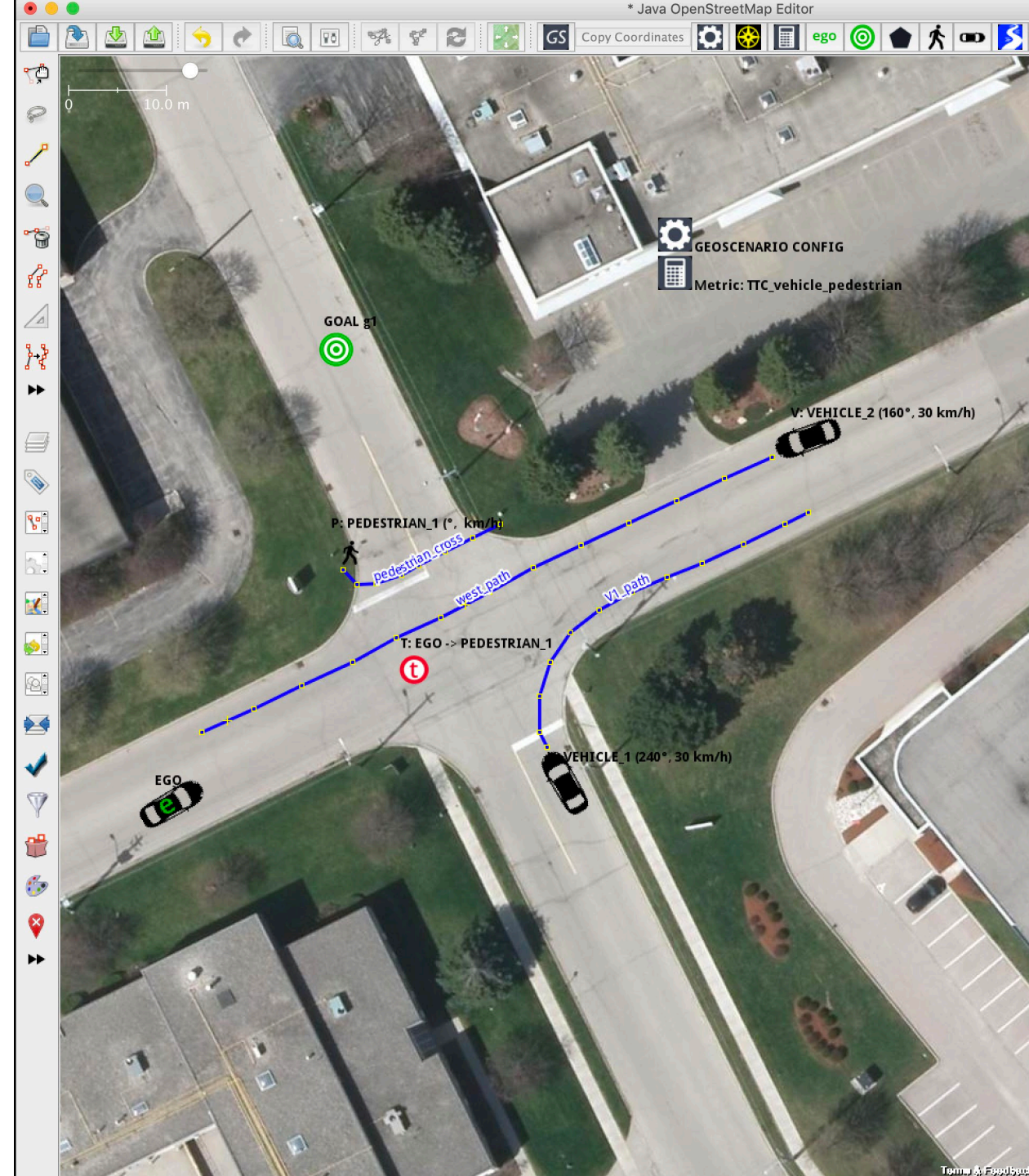


GeoScenario design - fuzzying

Possible to vary

- Agent start location
- Velocity range or profile
- Timing on triggers

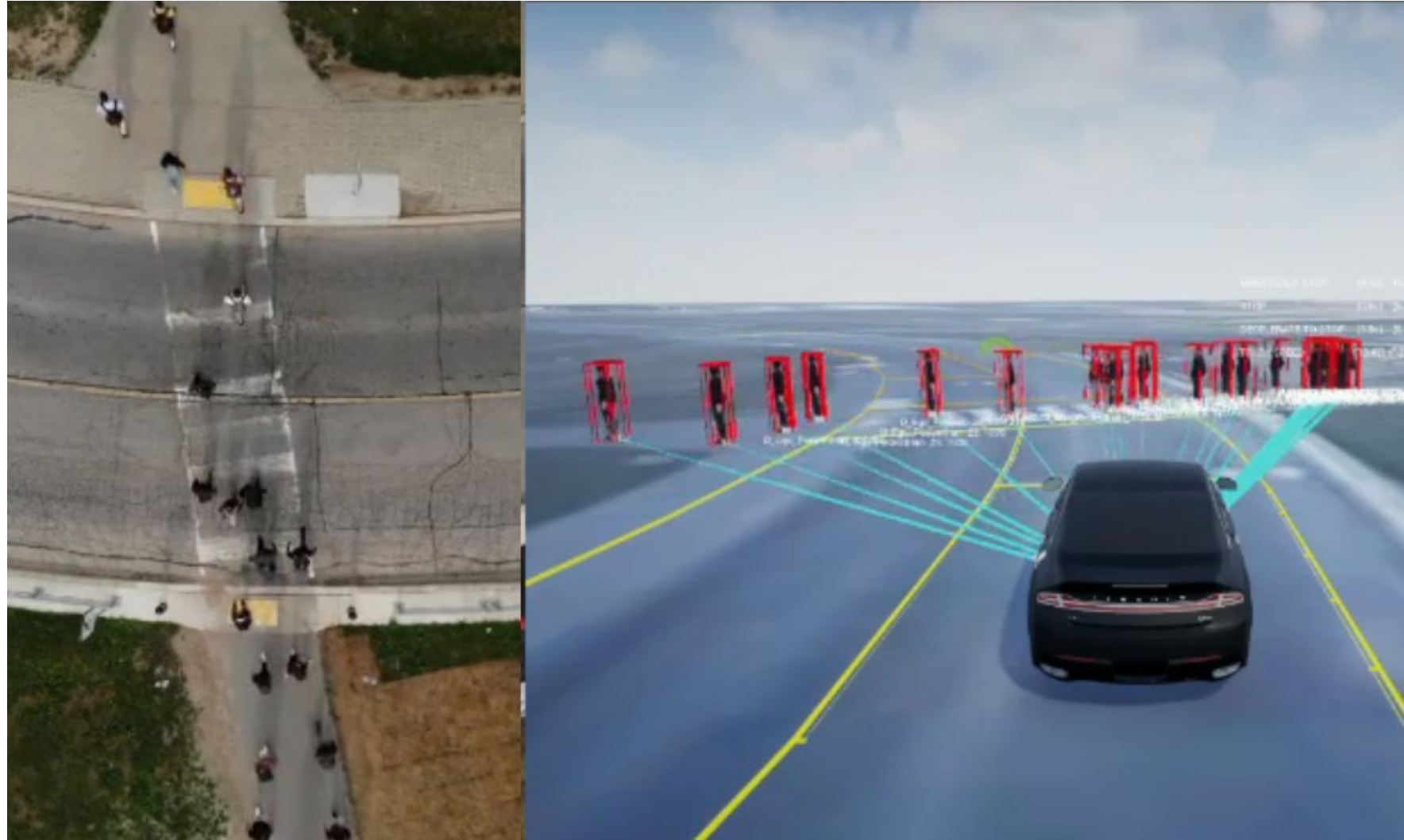
Sample most difficult variant of the test



Application: re-create real-world situations

Example:

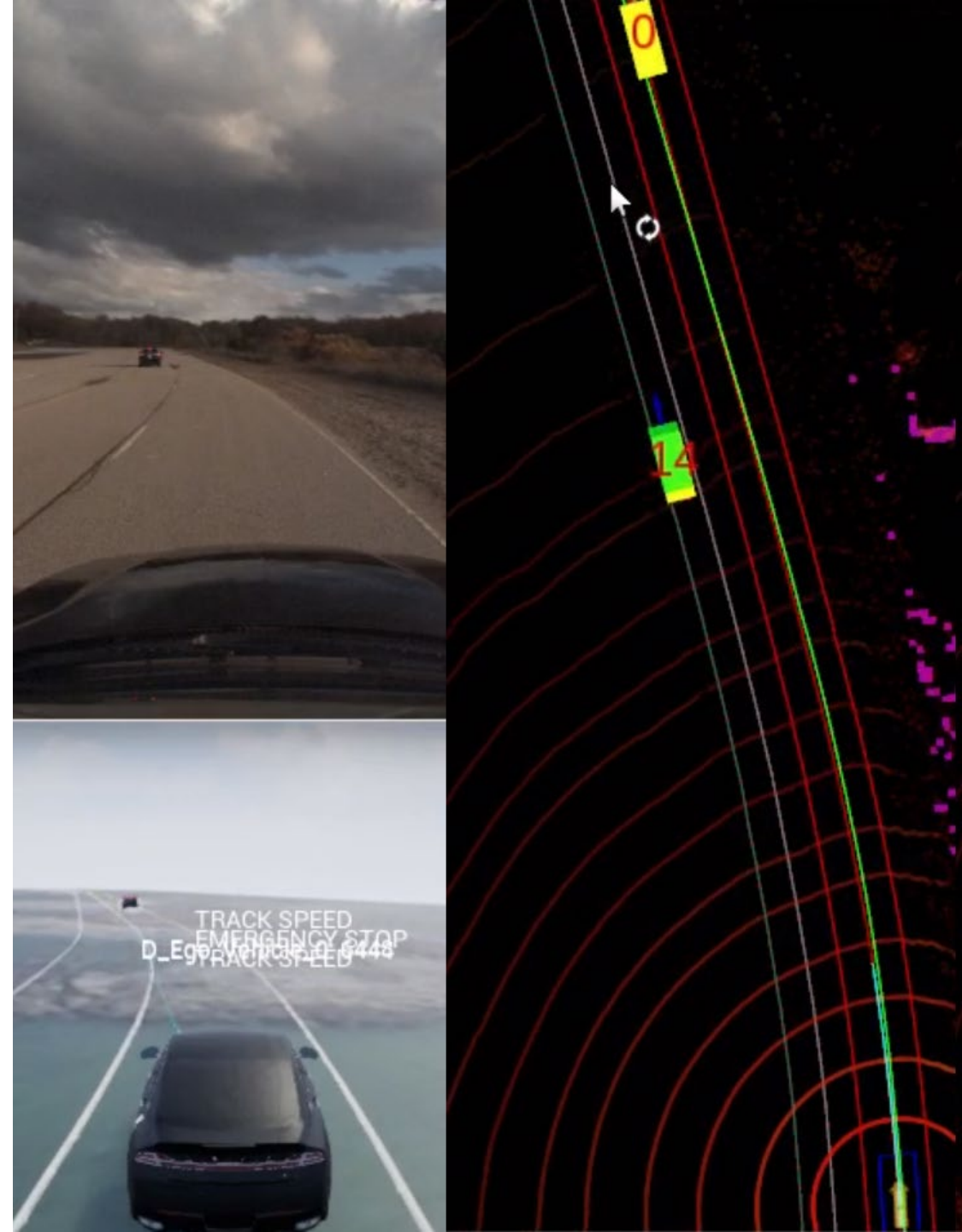
- Obtain pedestrian trajectories from drone video recordings
- Create scenario-based test



Application: mixed-reality testing

Example: bounding box mixing

- Run the simulator on the car
- Ego perceives both real-world and simulated agents



GeoScenario and OpenScenario/MSDL

Language	Textual	WYSIWYG	Abstract to concrete	Concrete to abstract	Good for
GeoScenario	XML	JOSM	-	+	Test engineers
MSDL	Python-like syntax	-	+	-	Requirements engineers

Lessons learned with GeoScenario

- Very easy to learn and use
 - Intuitive – immediately useful to many undergraduate and graduate students @ WISE Lab
 - Fast – create scenario-based tests in minutes
- Used to formalize and execute informal choreography
 - Collaboration with AAA North California, Nevada, and Utah
 - Executed 6 scenarios at the closed course, in simulation, and in mixed reality
- Behavioral planning benchmark
 - Set of scenario-based tests at increasing levels of difficulty
 - Score behavioral planners

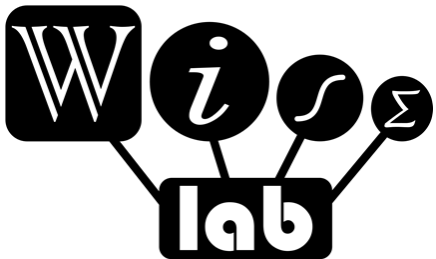
Conclusion

- GeoScenario is complimentary to OpenScenario/MSDL
- Brings an additional concrete-to-abstract perspective
- Some ideas can be contributed to the standard

Thank You!

<https://geoscenario.readthedocs.io/>

<https://git.uwaterloo.ca/wise-lab/geoscenario>



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