

# SBFT/ICST TOOL COMPETITION: SELF-DRIVING CAR TESTING



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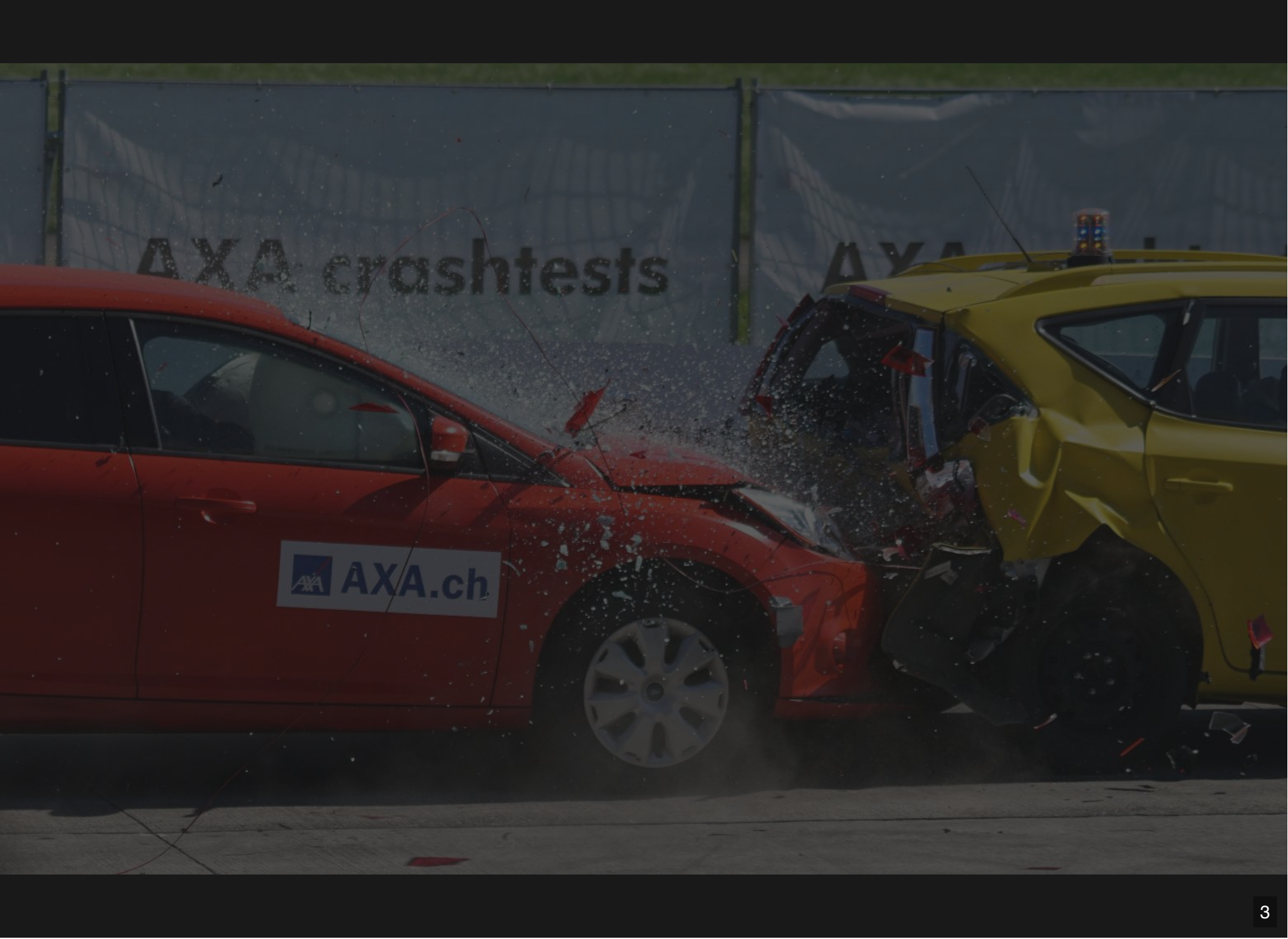
**Sebastiano Panichella**

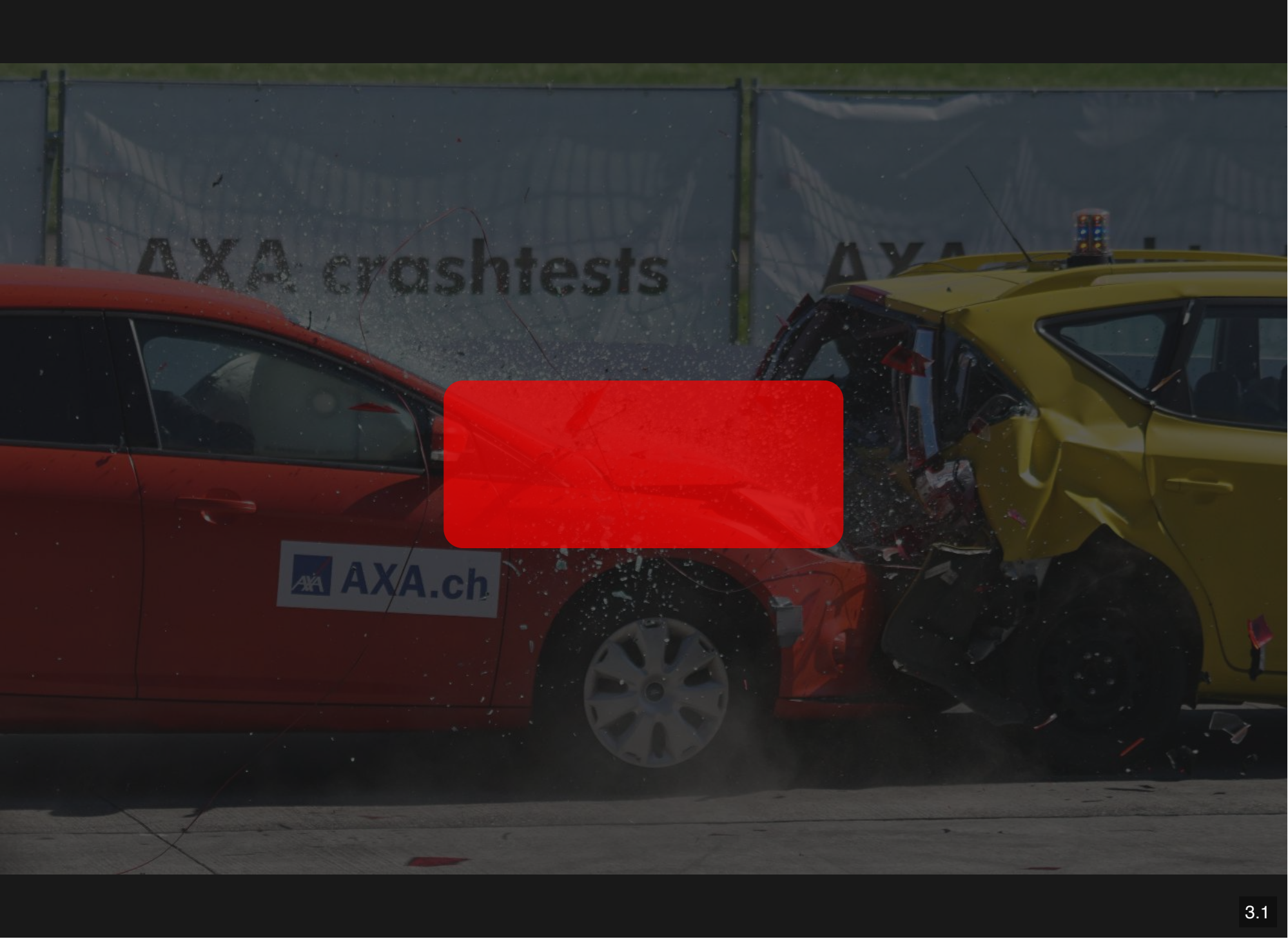
*University of Bern*  
Switzerland  
*AI4I - The Italian Institute of Artificial Intelligence for Industry*  
Italy

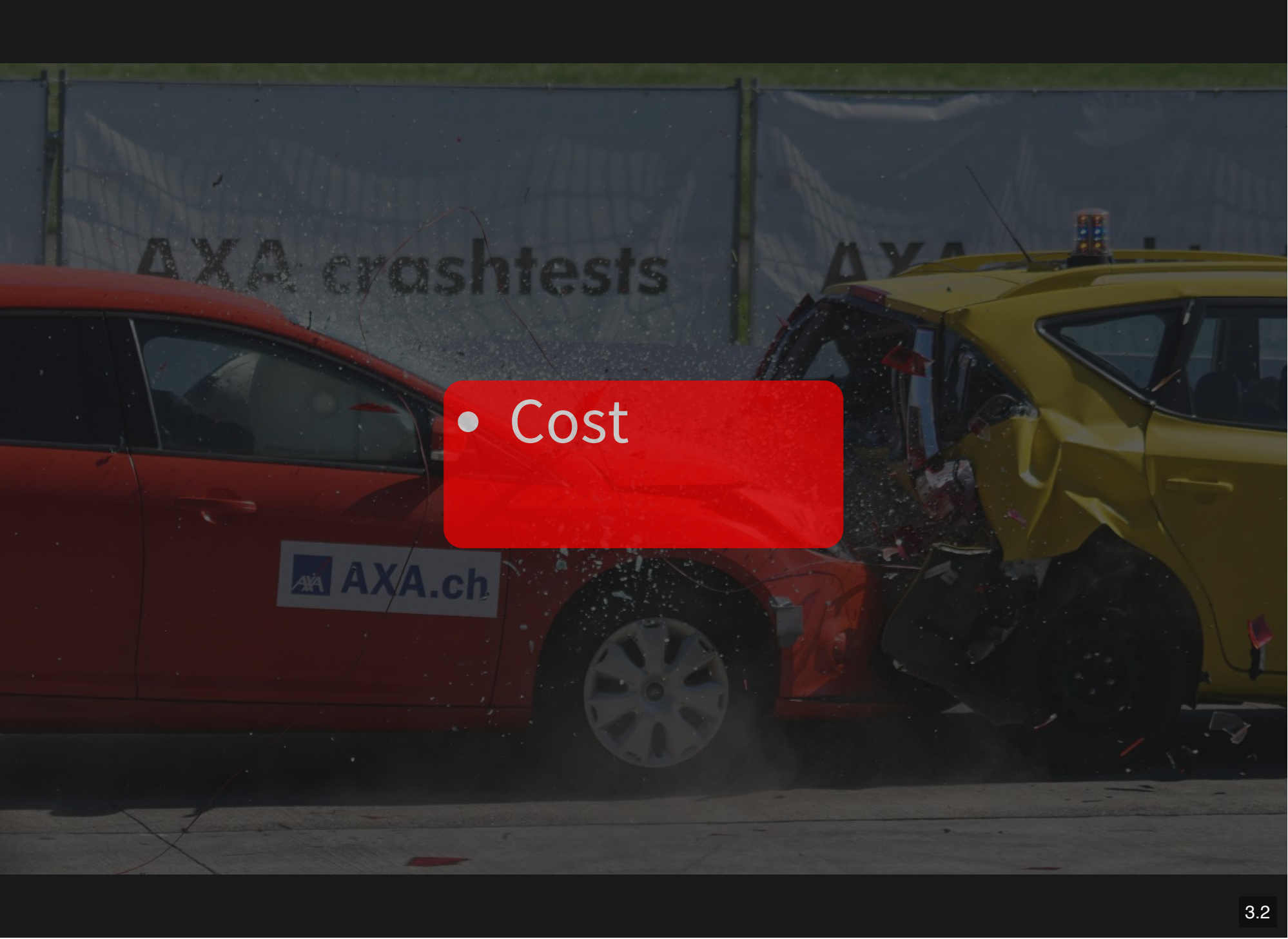
# SELF-DRIVING CAR COMPETITION

**SELF-DRIVING CAR COMPETITION**

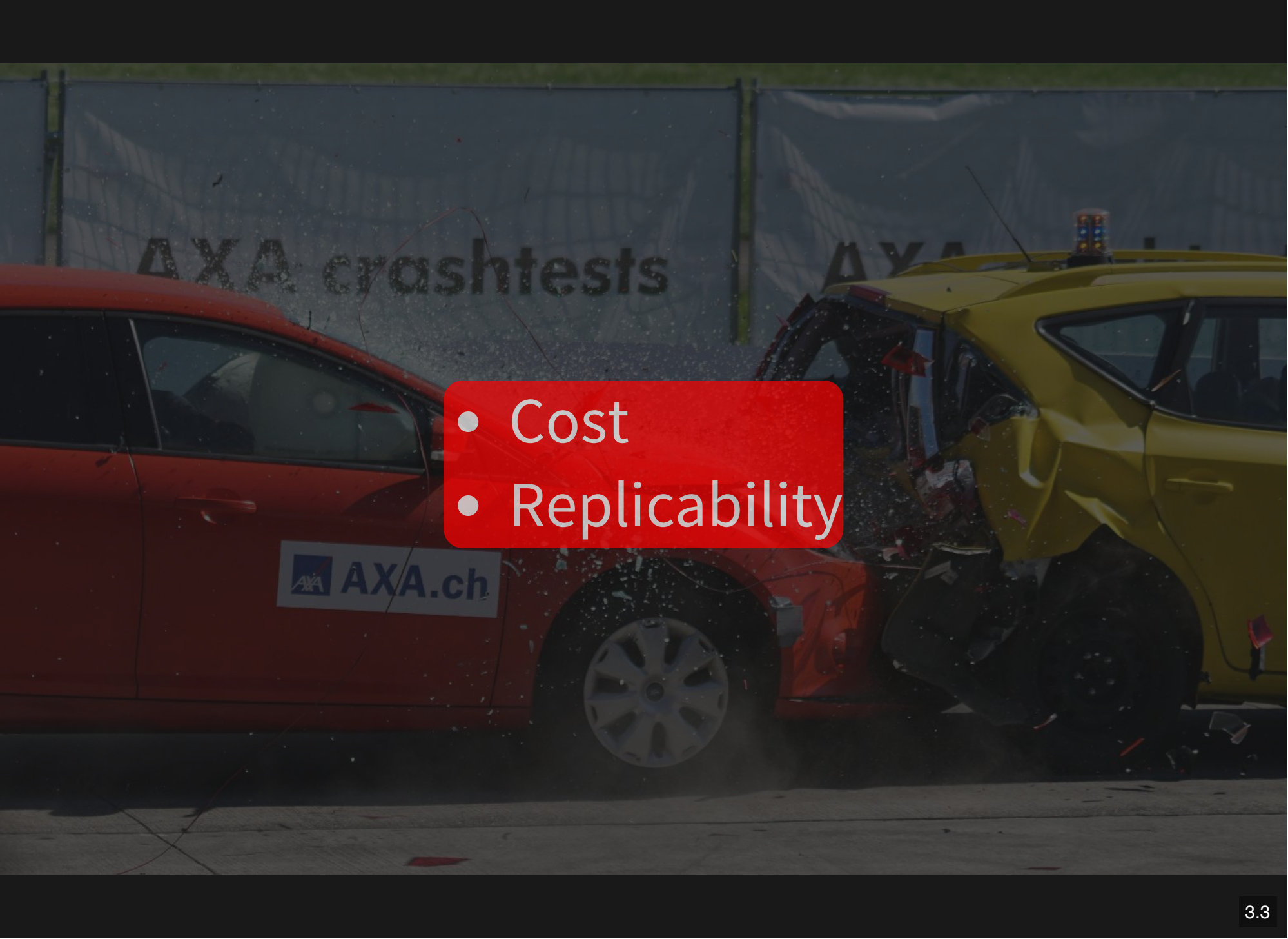
# **CONTEXT**



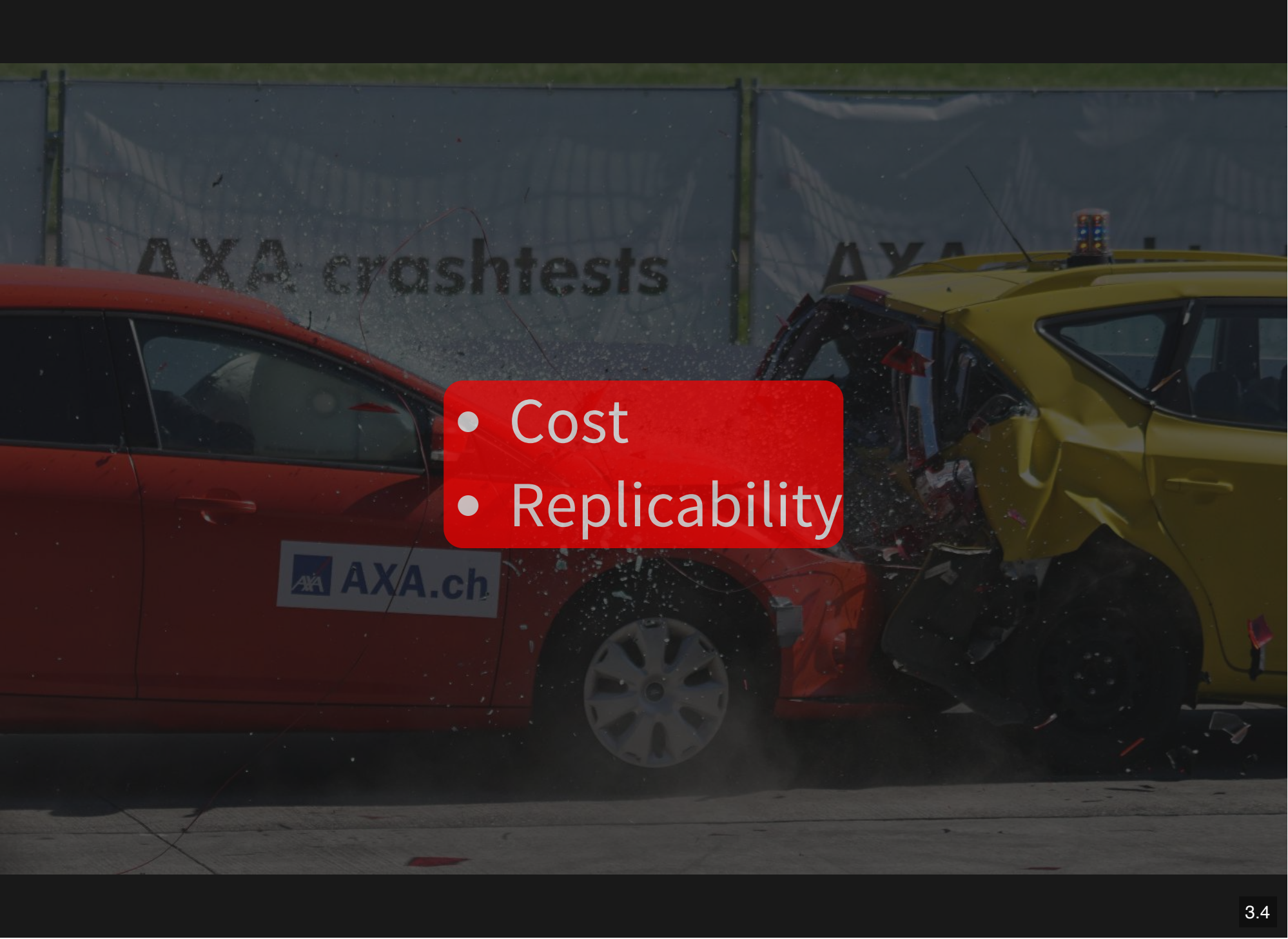




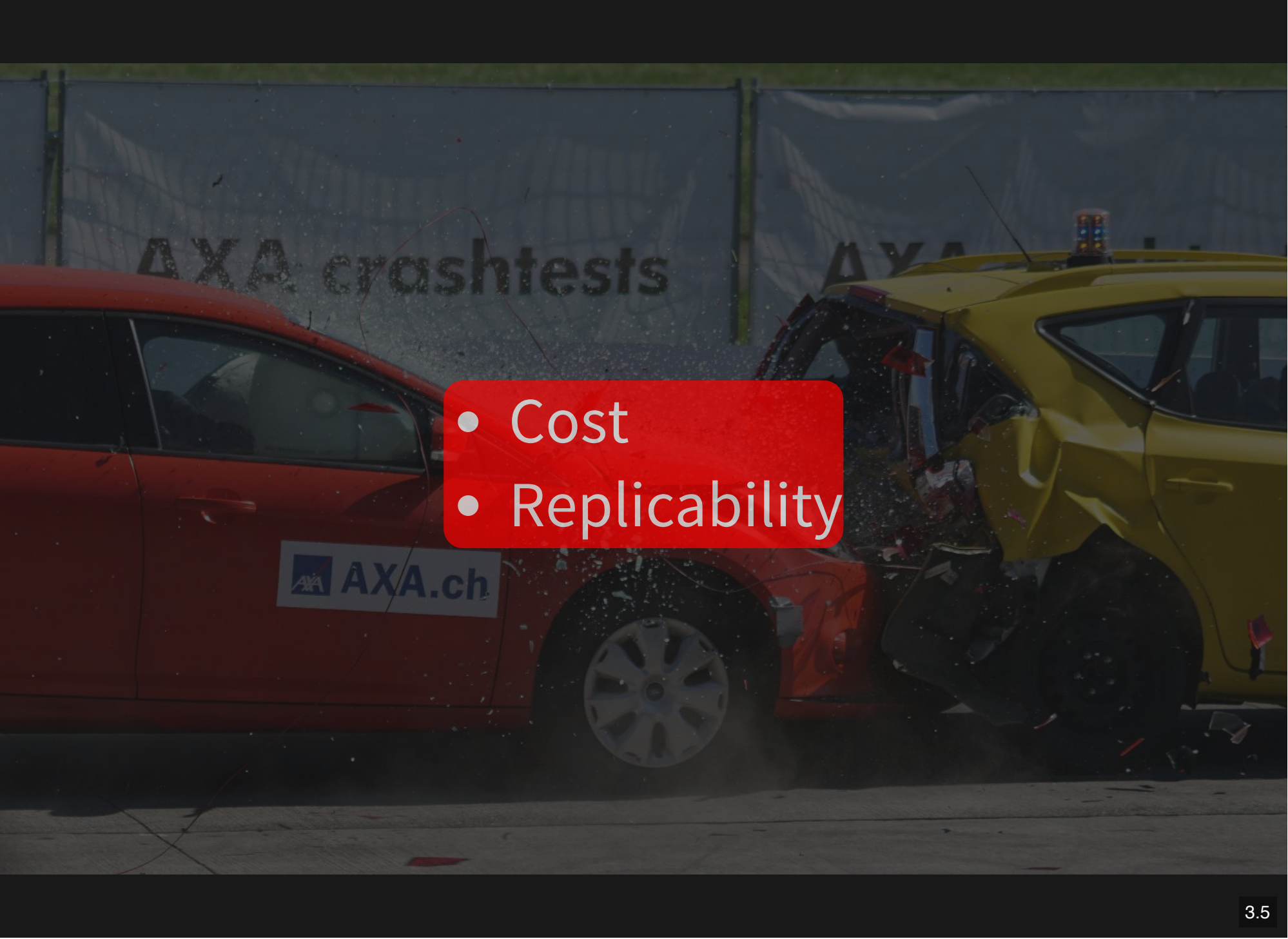
- Cost



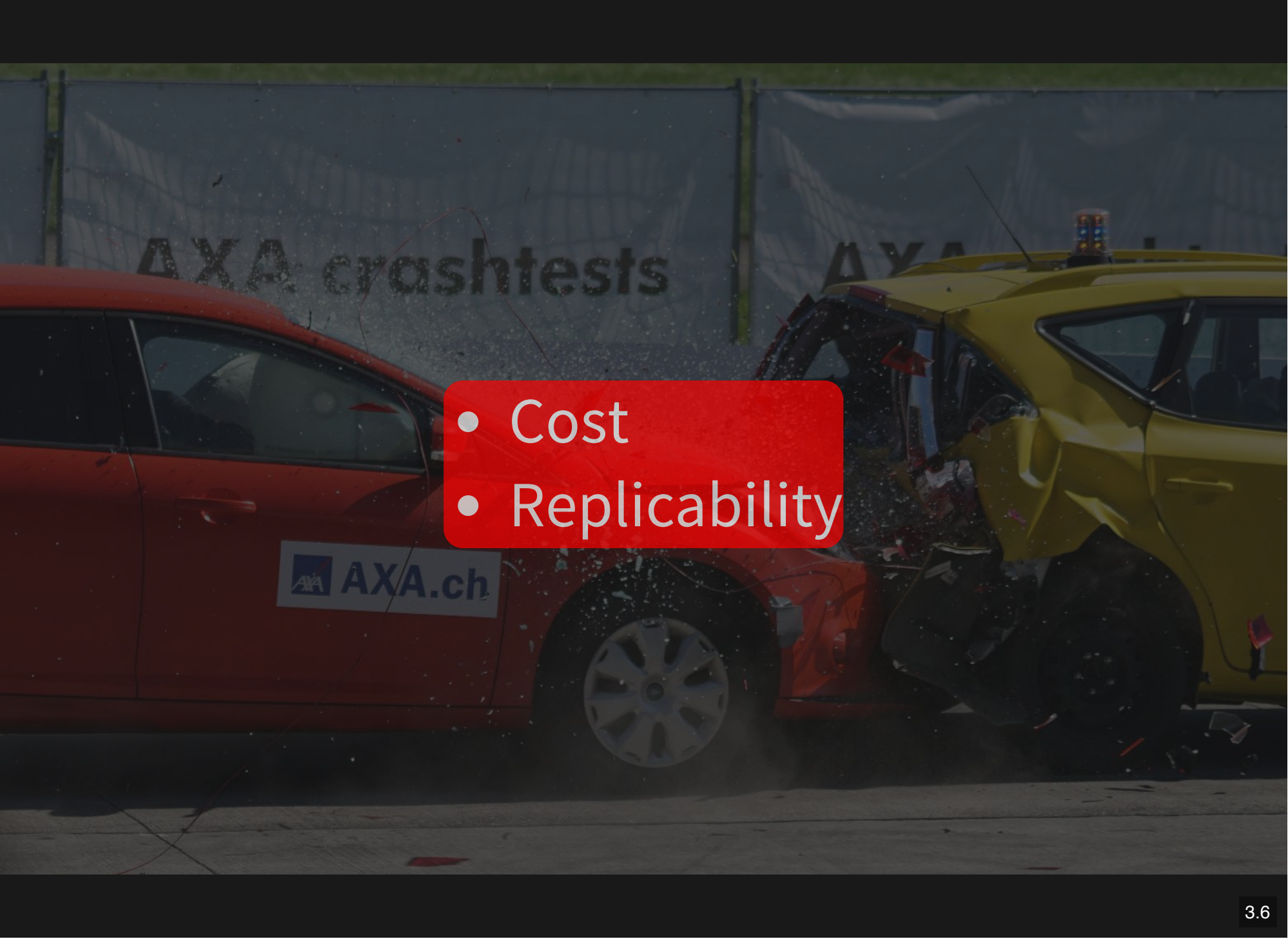
- Cost
- Replicability



- Cost
- Replicability



- Cost
- Replicability



- Cost
- Replicability

Time  
00:02:250

- Cost
- Replicability



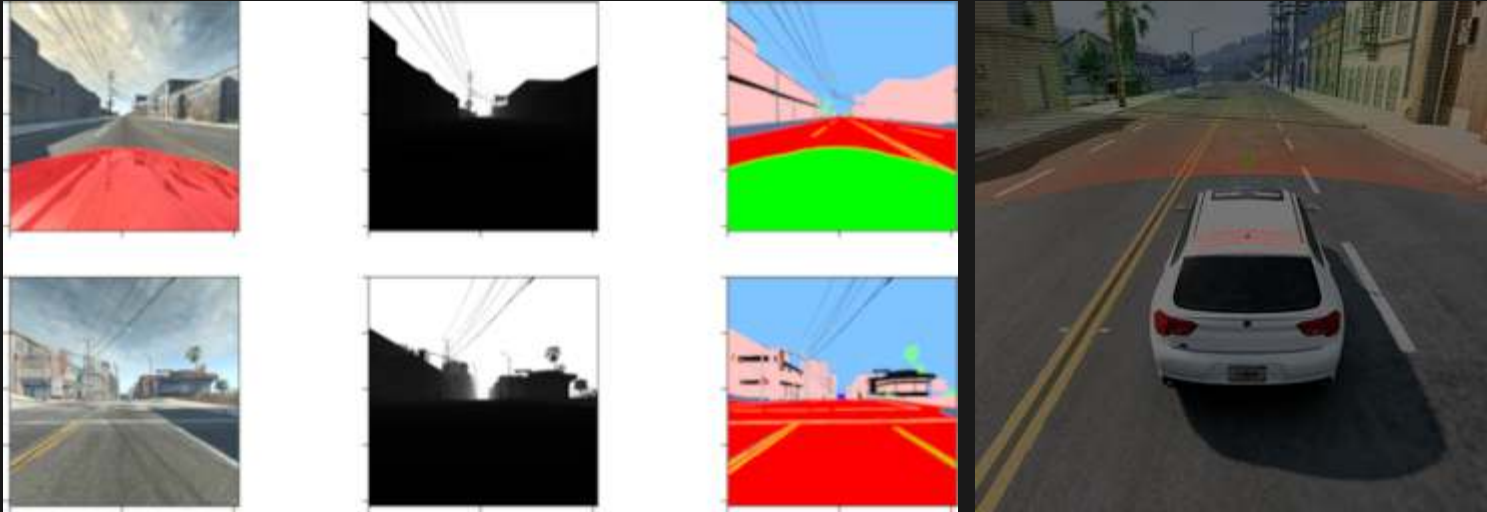
Time  
00:02:250

- Cost
- Replicability



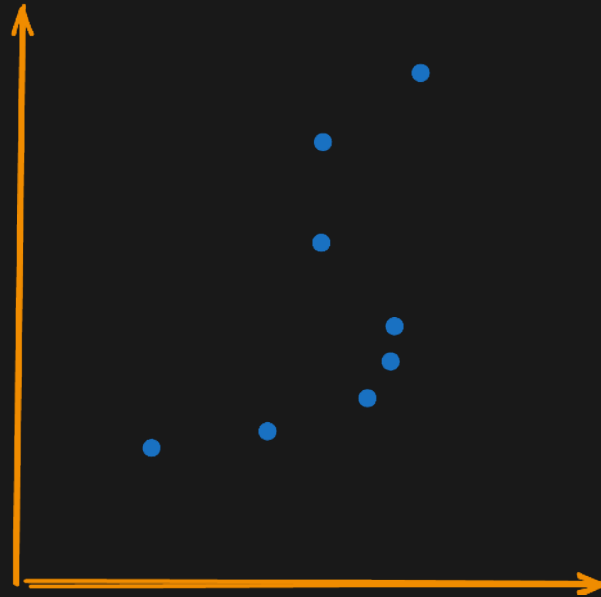
# BeamNG.tech Simulator



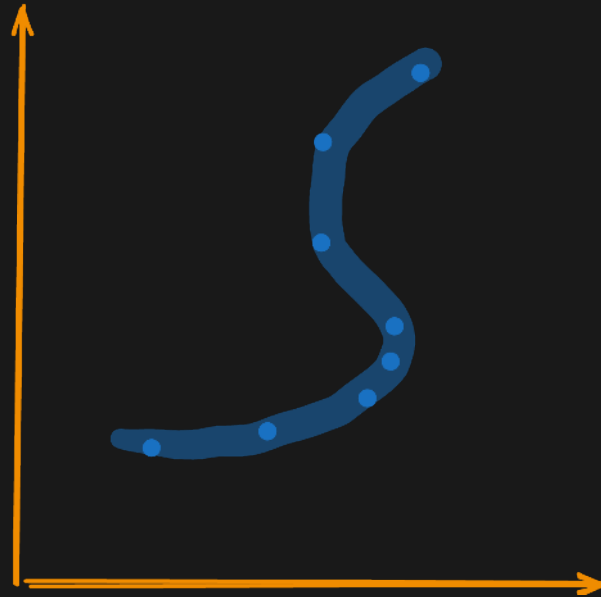


# HOW IS A TEST DEFINED?

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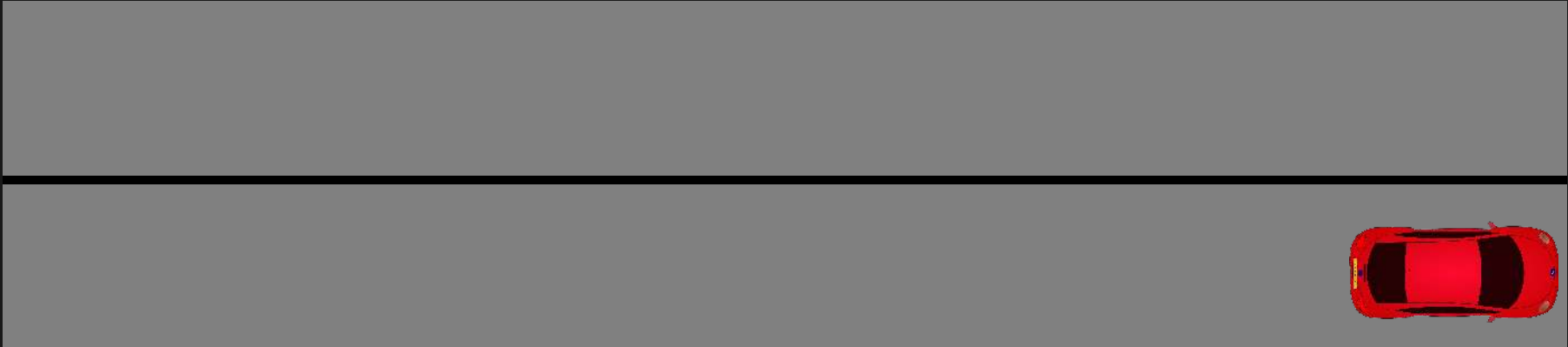


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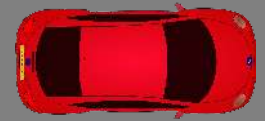


WHEN IS A TEST FAILING OR PASSING?

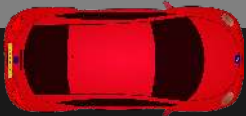




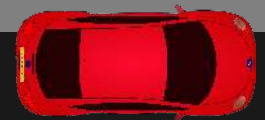
# PASSED

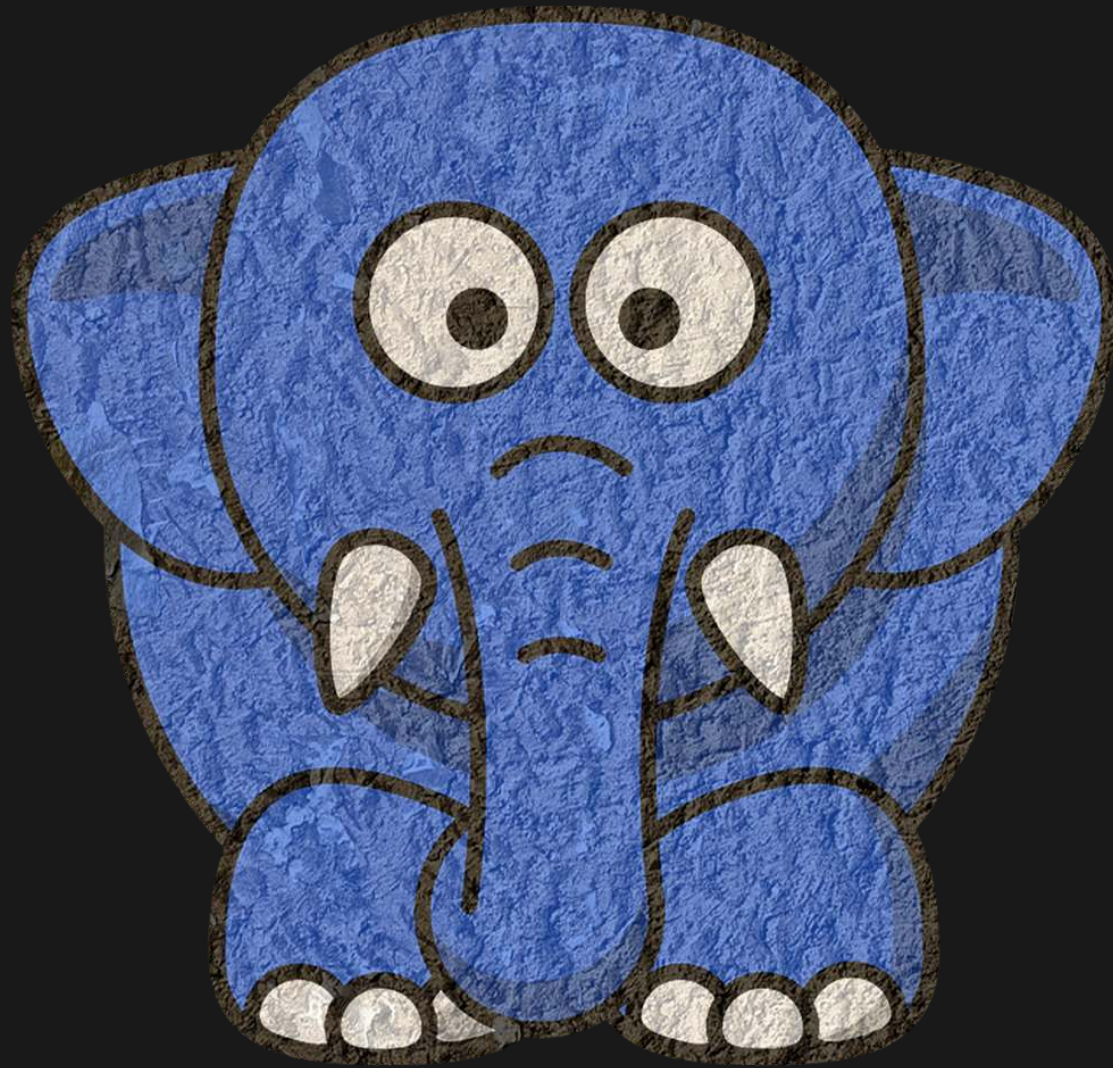




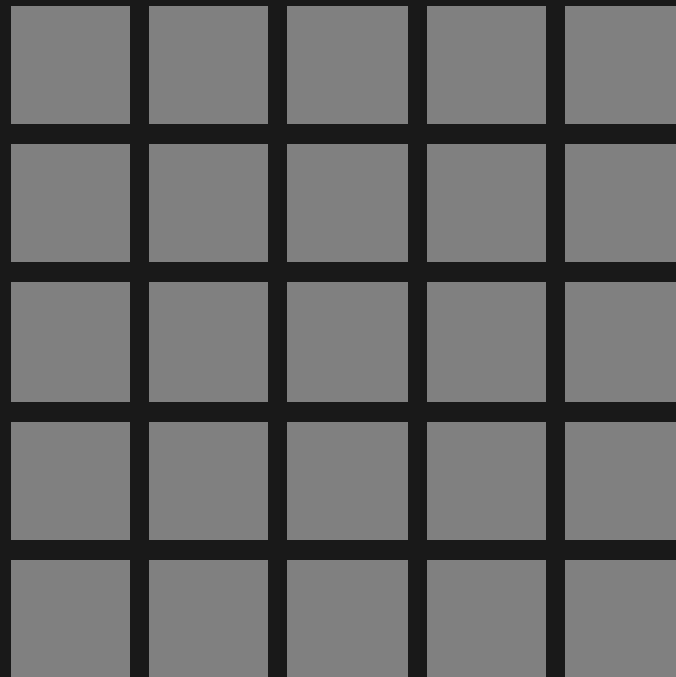


# FAILED

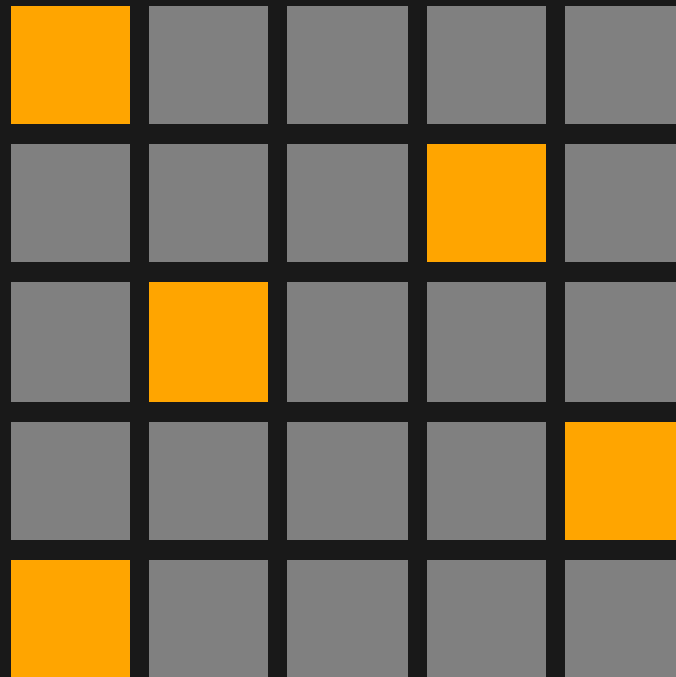




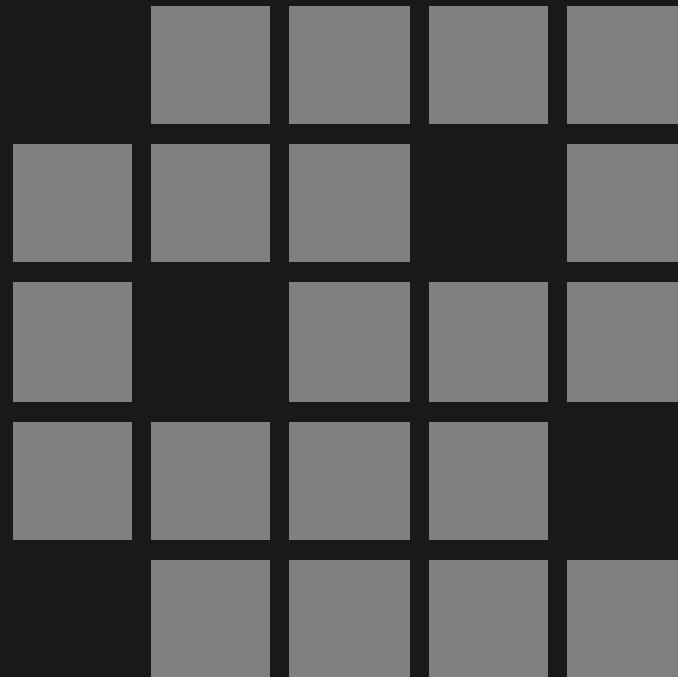
# REGRESSION TESTING



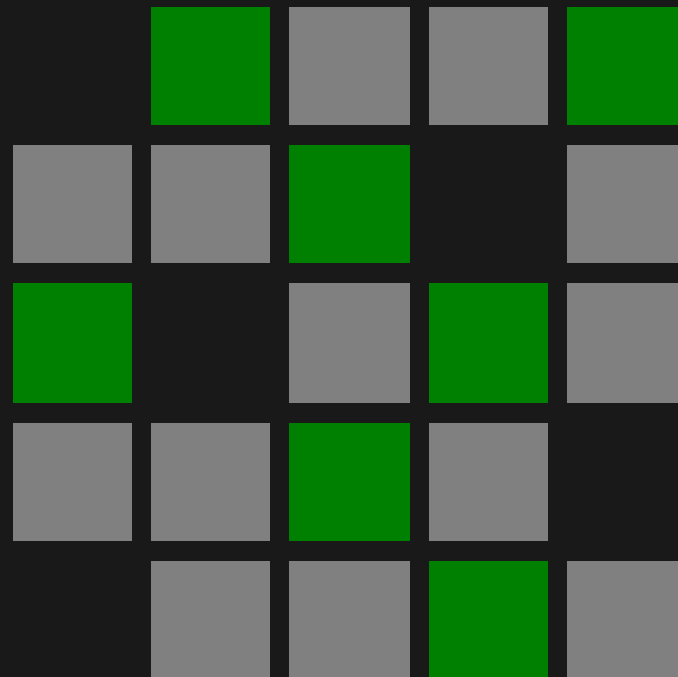
# REGRESSION TESTING



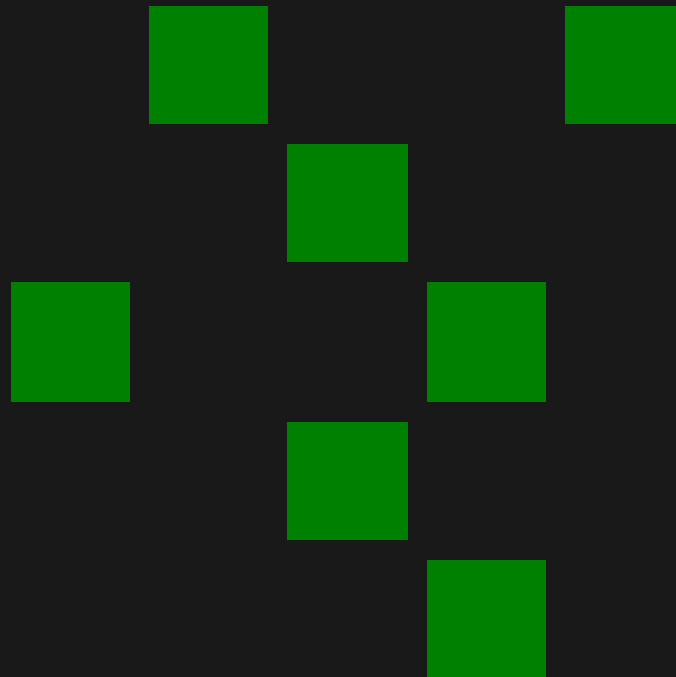
# REGRESSION TESTING



# REGRESSION TESTING



# REGRESSION TESTING





# Last year's competition:

Last year's competition:  
What tests should be selected?

Last year's competition:

What tests should be selected?

How should tests be selected?



This year:

# This year:

How should tests be prioritized?

sdc-testing-competition Public

Edit Pins Unwatch 4 Fork 8 Starred 7

main 1 Branch 12 Tags

Go to file Add file Code

	ChristianBirchler fix typo	56c51a1 · last month	205 Commits
📁	evaluator	rename to csv	2 months ago
📁	tools	fix typo	last month
📄	.gitattributes	Adding drvn_tool to the repo	4 months ago
📄	.gitignore	ignore result text file	2 months ago
📄	CHANGELOG.md	mention results in changelog	last month
📄	COMPETITION.md	mention beamng parameters	4 months ago
📄	LICENSE	Create LICENSE	7 months ago
📄	README.md	extend SBFT tool submission deadline	3 months ago
📄	competition.proto	adapt api	7 months ago
📄	example.png	change image format	7 months ago

README GPL-3.0 license

# SDC Testing Competition

Python 3.11 discussions 15 total issues 5 open

About

🚗 Tool Competition: Test Selection for Self-driving Cars in Simulation

[conf.researchr.org/home/icst-2025](https://conf.researchr.org/home/icst-2025)

competition tools conference software-engineering regression-testing test-selection

- 📖 Readme
- 📄 GPL-3.0 license
- 📈 Activity
- 📁 Custom properties
- ☆ 7 stars
- 👁 4 watching
- 🍴 8 forks
- Report repository

Releases 11

v1.2.0 Latest on Feb 12

+ 10 releases

Packages 10

ml\_selector

# • Competition code on GitHub

The screenshot displays the GitHub interface for the repository 'sdc-testing-competition' by 'christianbirchler-org'. The repository is public and has 7 stars, 8 forks, and 4 watchers. The main content area shows a list of files and folders with their commit history:

File/Folder	Commit Message	Time Ago
evaluator	rename to csv	2 months ago
...	...	...
.gitattributes	Adding drvn_tool to the repo	4 months ago
.gitignore	ignore result text file	2 months ago
CHANGELOG.md	mention results in changelog	last month
COMPETITION.md	mention beamng parameters	4 months ago
LICENSE	Create LICENSE	7 months ago
README.md	extend SBFT tool submission deadline	3 months ago
competition.proto	adapt api	7 months ago
example.png	change image format	7 months ago

The README section is visible, titled 'SDC Testing Competition', and includes tags for 'Python 3.11', 'discussions 15 total', and 'issues 5 open'. The repository is licensed under GPL-3.0. The right sidebar shows repository statistics: 7 stars, 4 watching, 8 forks, and 11 releases, with the latest release being v1.2.0 on Feb 12.

- Competition code on GitHub
- Troubleshooting with Issues and Discussion Forum

ChristianBirchler	fix typo	56c51a1 · last month	205 Commits
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conf.researchr.org/home/icst-2025

competition tools conference

software-engineering regression-testing

test-selection

Activity

Custom properties

7 stars

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Report repository

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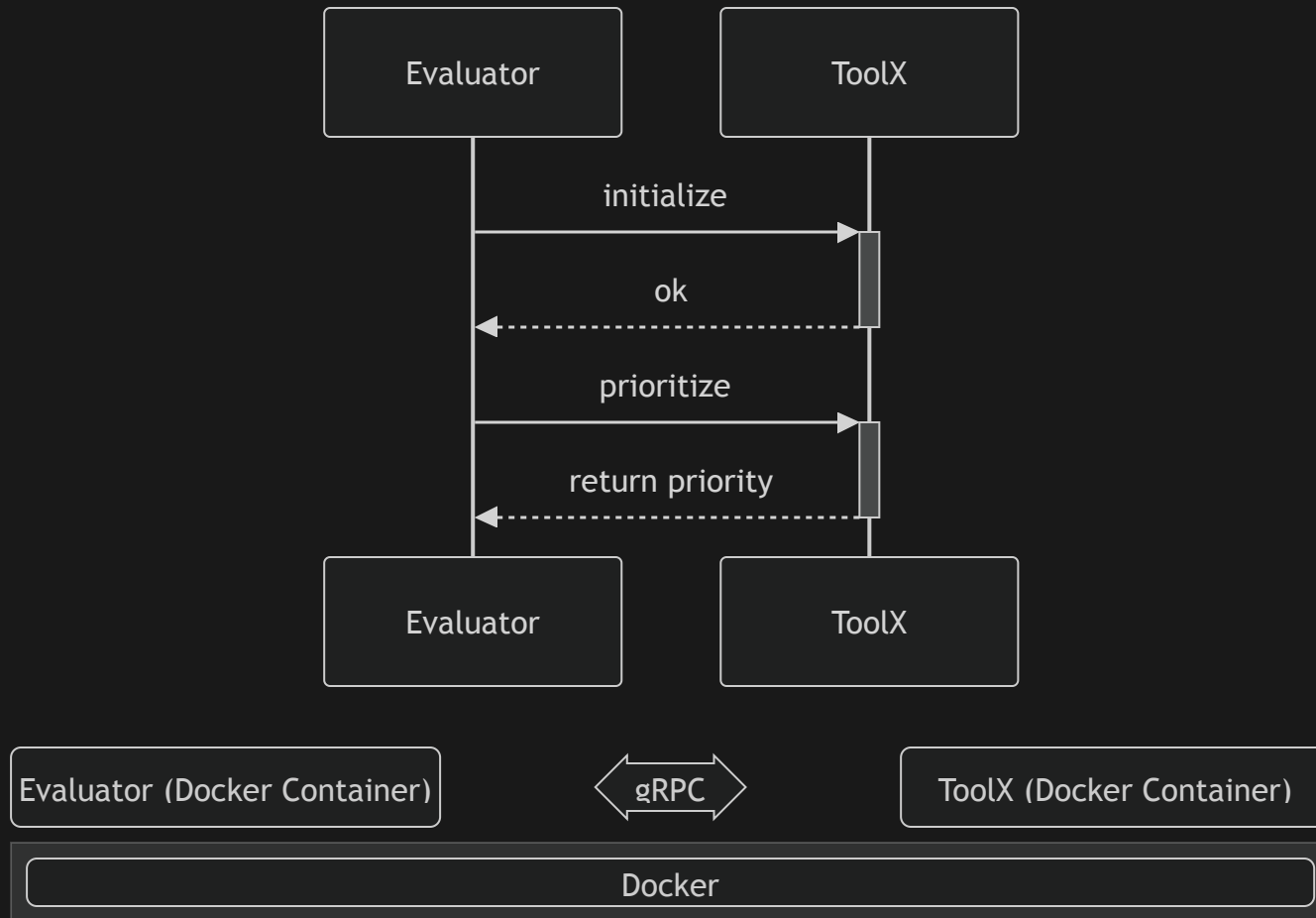
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ml\_selector

- Competition code on GitHub
- Troubleshooting with Issues and Discussion Forum
- Docker Images of all Tools!

# INFRASTRUCTURE



# PROTOCOL BUFFERS

```
syntax = "proto3";

service CompetitionTool {
  rpc Name(Empty) returns (NameReply) {}

  rpc Initialize (stream Oracle) returns (InitializationReply) {}

  // bidirectional streaming for high flexibility
  rpc Prioritize (stream SDCTestCase) returns (stream PrioritizationReply) {}
}

message Empty {}

message NameReply {
  string name = 1;
}

message Oracle {
  SDCTestCase testCase = 1;
  bool hasFailed = 2;
}

message SDCTestCase {
  string testId = 1;
  repeated RoadPoint roadPoints = 2;
}

message RoadPoint {
  int64 sequenceNumber = 1;
  float x = 2;
  float y = 3;
}
```

```
syntax = "proto3";
```

```
service CompetitionTool {
```

```
  rpc Name(Empty) returns (NameReply) {}
```

```
  rpc Initialize (stream Oracle) returns (InitializationReply) {}
```

```
  rpc Prioritize (stream SDCTestCase) returns (stream PrioritizationRep
```

```
}
```

```
...
```

# What are the evaluation metrics?

```
@dataclass
class EvaluationReport:
    """ This class holds evaluation metrics of a tool. """

    test_suite_cnt: int
    benchmark: str
    time_to_initialize: float
    time_to_prioritize_tests: float
    tool_name: str
    time_to_first_fault: float | None
    time_to_last_fault: float | None
    apfd: float
    apfdc: float
```

# BENCHMARK

## SensoDat: Simulation-based Sensor Dataset of Self-driving Cars

### SensoDat: Simulation-based Sensor Dataset of Self-driving Cars

Latest Release on Zenodo: DOI [10.5281/zenodo.12600225](https://doi.org/10.5281/zenodo.12600225)

Original Paper Artifact: DOI [10.5281/zenodo.10307479](https://doi.org/10.5281/zenodo.10307479)

SensoDat is a dataset of self-driving car simulation data (30K executed simulations). Concretely, it contains:

- Simulation description data in [ASAM OpenDRIVE](#) format
- Sensor data as time series of 81 sensors/properties

- 32,580 Test Cases
- Generated by three test generators

# EXPERIMENTS

The experiments are conducted on a virtual machine (VM) with **16GB of RAM**, eight virtual CPUs.

# RESULTS OF ICST COMPETITION

Tool	Statistic	Metrics				
		apfd	apfdc	t_prioritize_tests	t_first_fault	t_last_fault
RoadFury	max	0.84	0.90	0.43	85.44	5,005.27
	mean	<b>0.80</b>	<b>0.83</b>	0.42	<b>52.21</b>	<b>3,273.49</b>
	std	0.03	0.04	0.01	27.03	1,067.11
	min	0.75	0.78	0.41	11.45	1,946.21
EagleSemble	max	0.81	0.88	1.02	60.40	2,246.57
	mean	<b>0.78</b>	<b>0.83</b>	0.97	45.99	2,053.17
	std	0.04	0.06	0.09	21.80	316.75
	min	0.75	0.79	0.92	30.90	1,872.13
RTE4SDC	max	0.82	0.88	0.47	82.83	5,067.84
	mean	<b>0.77</b>	<b>0.82</b>	0.40	47.73	3,803.70
	std	0.03	0.04	0.04	27.55	761.18
	min	0.73	0.75	0.33	8.93	2,751.26
KSERESNET	max	0.69	0.73	0.09	193.62	6,188.57
	mean	0.62	0.65	<b>0.08</b>	77.83	5,593.73
	std	0.04	0.05	0.00	59.71	414.17
	min	0.56	0.57	0.08	13.29	4,909.35
ITEP4SDC	max	0.84	0.92	0.80	87.90	3,706.99
	mean	<b>0.79</b>	<b>0.83</b>	0.78	<b>54.77</b>	<b>3,016.25</b>
	std	0.03	0.05	0.02	28.31	553.80
	min	0.74	0.76	0.76	22.69	2,451.42
Random Baseline	max	0.62	0.67	0.52	668.30	6,613.83
	mean	0.50	0.52	0.46	145.75	5,781.33
	std	0.05	0.06	0.03	132.02	349.89
	min	0.38	0.39	0.37	6.65	4,898.84





# ROADFURY

Chi-Nguyen Tran, Dao Sy Duy Minh, Huynh Trung Kiet,  
Phu-Hoa Pham, Nguyen Lam Phu Quy,  
University of Science, VNU-HCM, Ho Chi Minh City,  
Vietnam

**THANK YOU ALL!**

# THANK YOU ALL!

Any feedback and/or ideas are welcome for future editions.



[github.com/christianbirchler-org/sdc-testing-competition](https://github.com/christianbirchler-org/sdc-testing-competition)