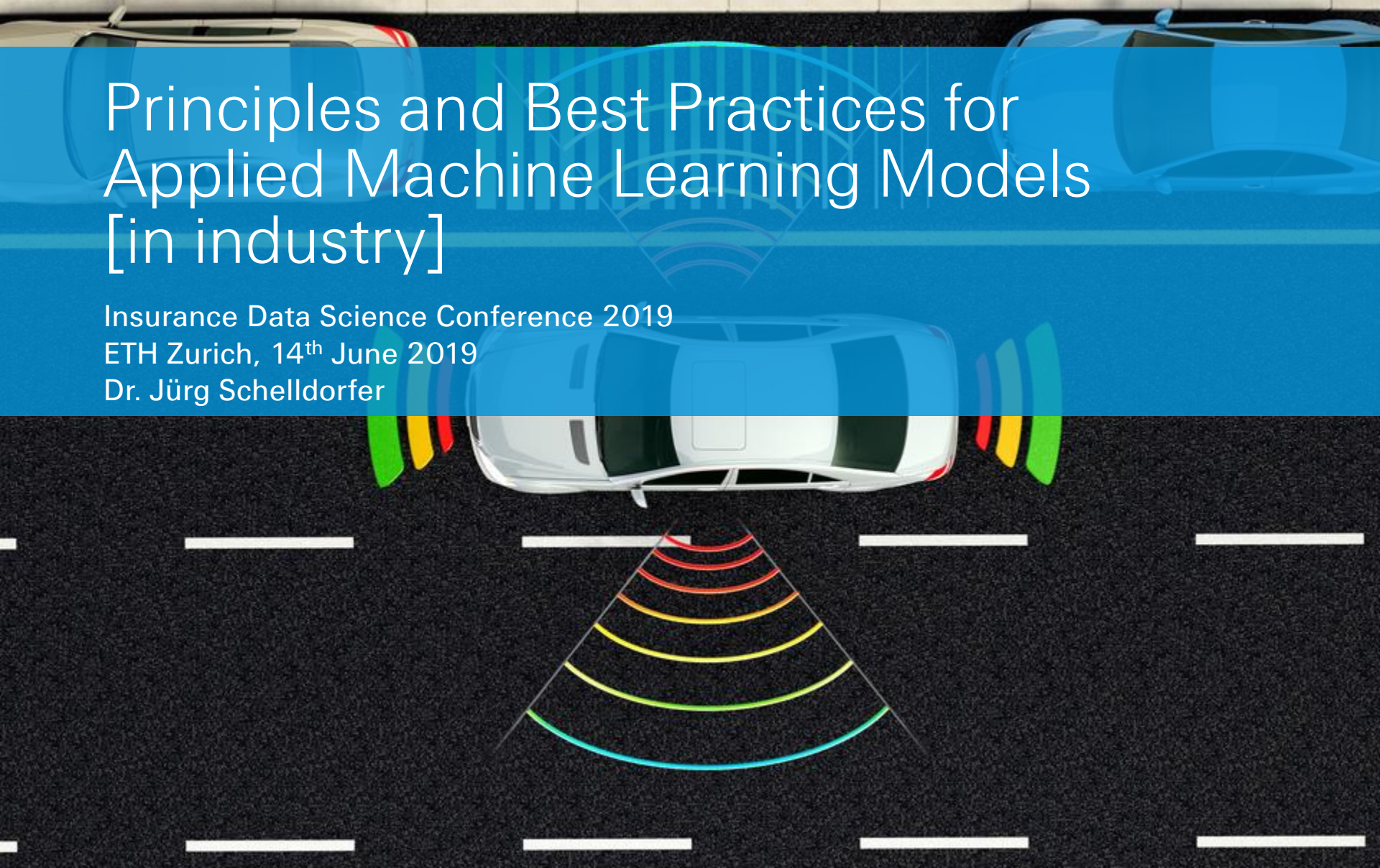


Principles and Best Practices for Applied Machine Learning Models [in industry]

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Motivation (1/2)

Financial crisis 2007/08:

Some replies by researchers:

- (L.C.G. Rogers) The problem is not that mathematics was used by the banking industry, the problem was that it was abused by the banking industry. Quants were instructed to build models which fitted the market prices. Now if the market prices were way out of line, the calibrated models would just faithfully reproduce those wacky values, and the bad prices get reinforced by an overlay of scientific respectability! Students will have to use the tools and techniques of QM wisely in a world where the rules of the game will have been changed.
- Always be scientifically critical, as well as socially honest, adhere to the highest ethical principles, especially in the face of temptation ... which will come!

From: Prof. Paul Embrechts, [«Did a Mathematical Formula Really Blow up Wall Street?»](#), ASTIN Colloquium, 2009

Models were not used properly!

Today, we should be aware that...

Machine learning models can be very powerful, but there are also limitations and fallacies....

...so we need to be very careful how and where they are used.

...we do not want to read «The Neural Network that».

Why do we need a set of data science principles?

“So our work has the right quality for decision-making and is ultimately deployed in and trusted by the business.”



Modern data-driven techniques (ML) increase expressivity but also complexity compared to well-established methods.



Extra focus on understanding prediction uncertainty, not only classification/regression.



Insurance is an industry which knows a lot about models:

- Oversight and correctness of models is culturally prioritized.
- Industry is very tightly externally regulated.
- Wrong predictions can lead to severe implications (e.g. customer churn prevention vs. probability of mortality).



Principles instead of checklists and processes.

Peer-Review Board examines application of principles to projects.

We aim for mitigating model risks by...



Proper use

Ensure machine learning models are used appropriately with awareness of limitations.



Development Best Practice

Establish and build best practice among the data scientist community.

Overseen by...



Internal peer review and governance framework.

Our Principles

„Data-Related“ Principles:

- ✓ Choice of appropriate data features
- ✓ Data Quality & Governance
- ✓ Feature Engineering



„Model Development“ Principles:

- ✓ Performance Metrics
- ✓ Model Validation
- ✓ Model Calibration
- ✓ Model Uncertainty
- ✓ Robustness



„Usage“ Principles:

- ✓ Fit for purpose
- ✓ Explainability
- ✓ Recalibration
- ✓ Change Management



„Governance“ Principles:

- ✓ Reproducibility & Auditability



Examples of Principle Definitions

Performance Metrics

- Are the proposed performance metrics appropriate for the given business challenge?
- Does the proposed evaluation methodology accurately capture the chosen performance metric?
- Has a meaningful benchmark been set up?
- Example: Accuracy, distance measure, distribution divergence measure, expert user evaluation.

Explainability

- Can the results of the model be fully described and inspected for individual records?
- Are decisions traceable? Can it be explained why a decision was reached?
- Are simple explanation methods for a complex model available?

Such an approach has also been used by the The High-level Expert Group on Artificial Intelligence in their publication «Ethics Guidelines For Trustworthy AI», 2019 ([Link](#)).

Questions





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