UNCERTAINTY WRAPPERS FOR DATA-DRIVEN MODELS

INCREASE THE TRANSPARENCY OF AI/ML-BASED MODELS THROUGH ENRICHMENT WITH DEPENDABLE SITUATION-AWARE UNCERTAINTY ESTIMATES

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CrESt

Our Focus: Data-Driven Components

Intended Functionality

f(x) = x*1.19

Specification

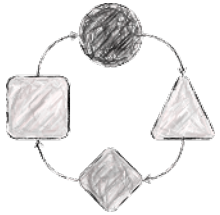
(Engineered) Component

Code

Intended Functionality

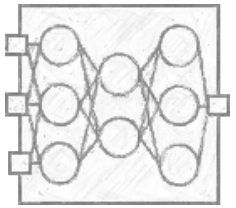
Recognize Stop Signs

Labeled Examples



Learning Approach

Data-Driven Component



Data-Driven Model

CNN

Does the component provide the intended outcome for each input ?

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Information

Outcome

No stop sign

Uncertainty

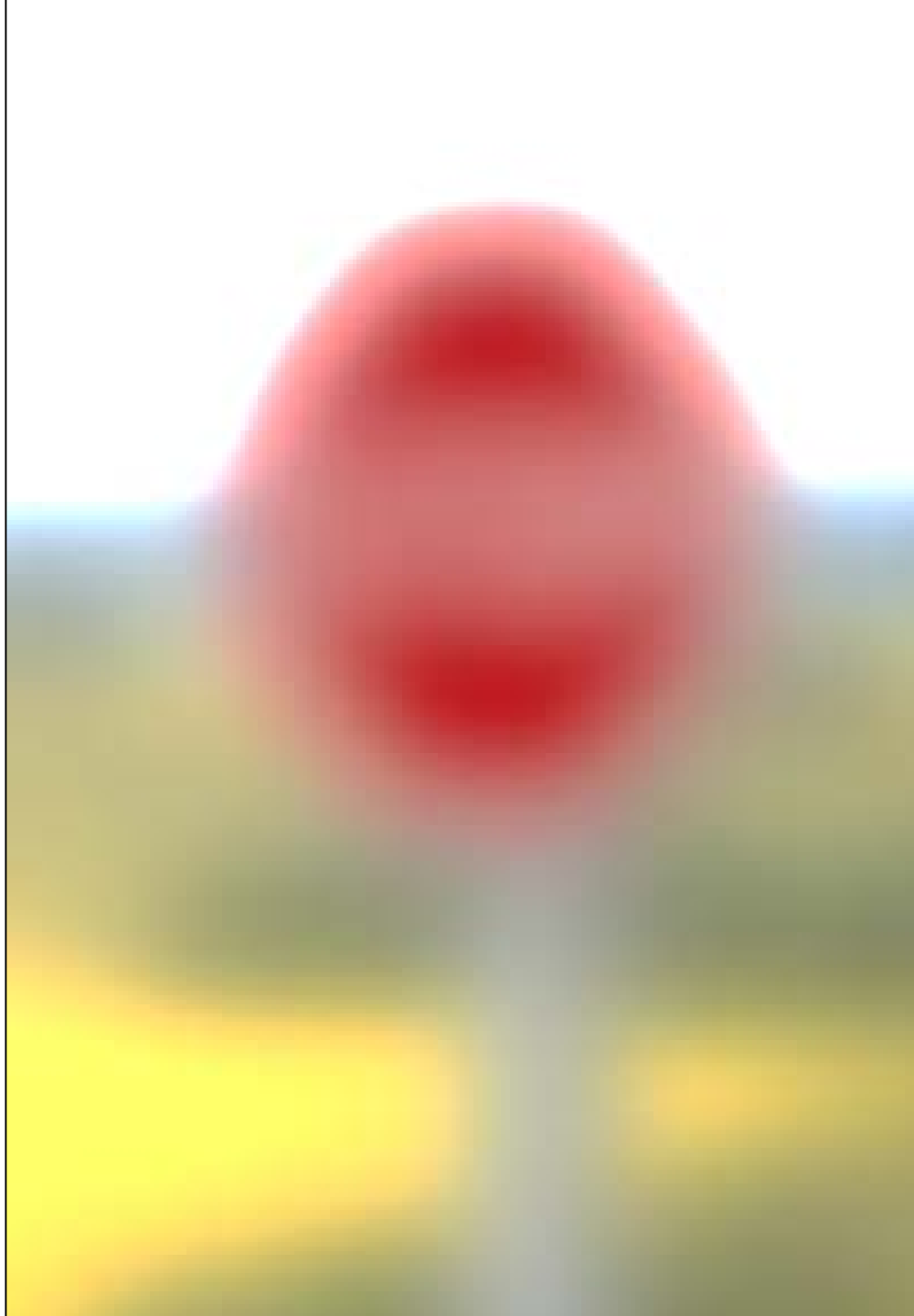
Error probability

0.5% | 40%

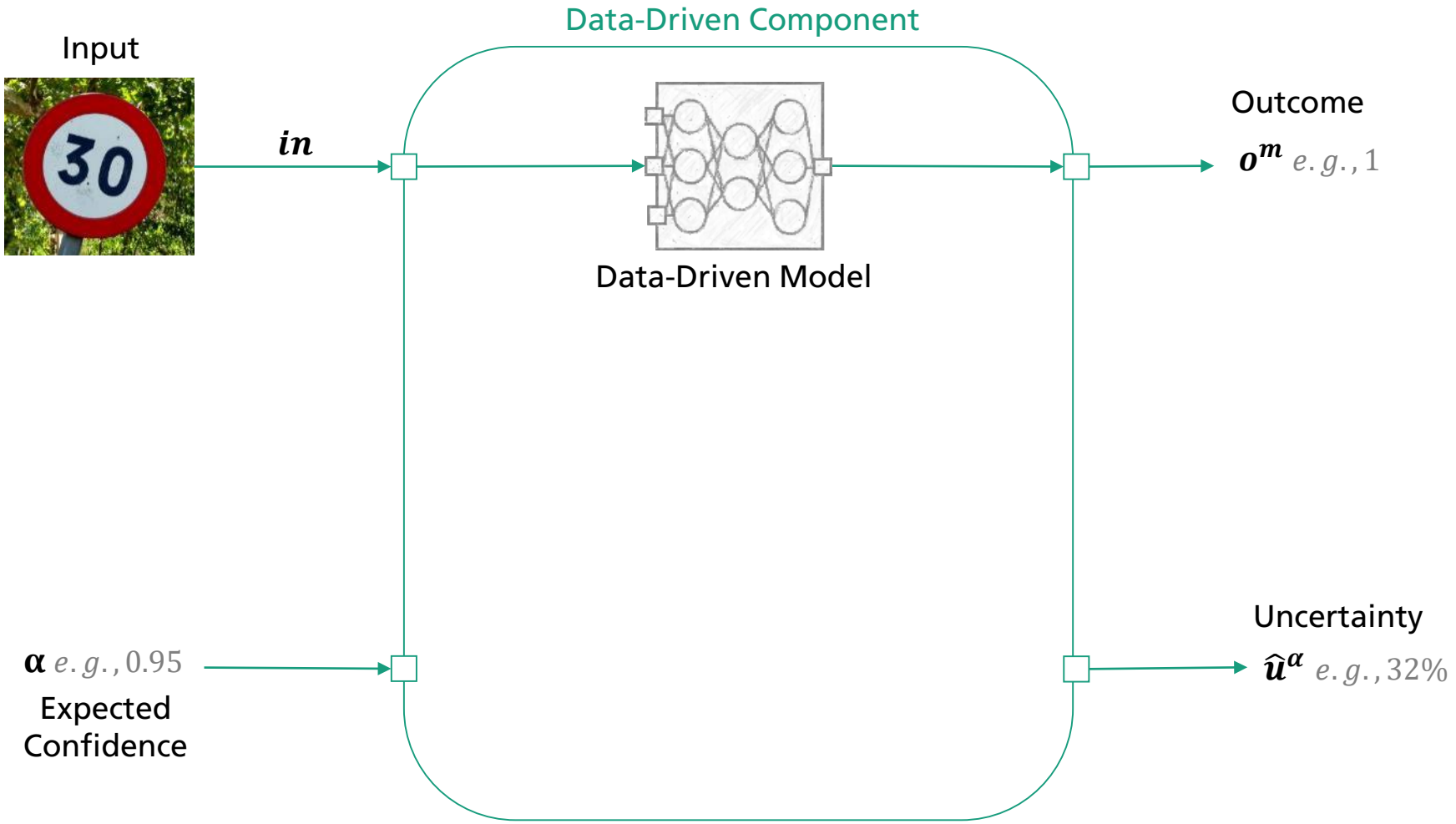
Dependability

Confidence level

95%



Uncertainty Wrapper: An Architectural Perspective



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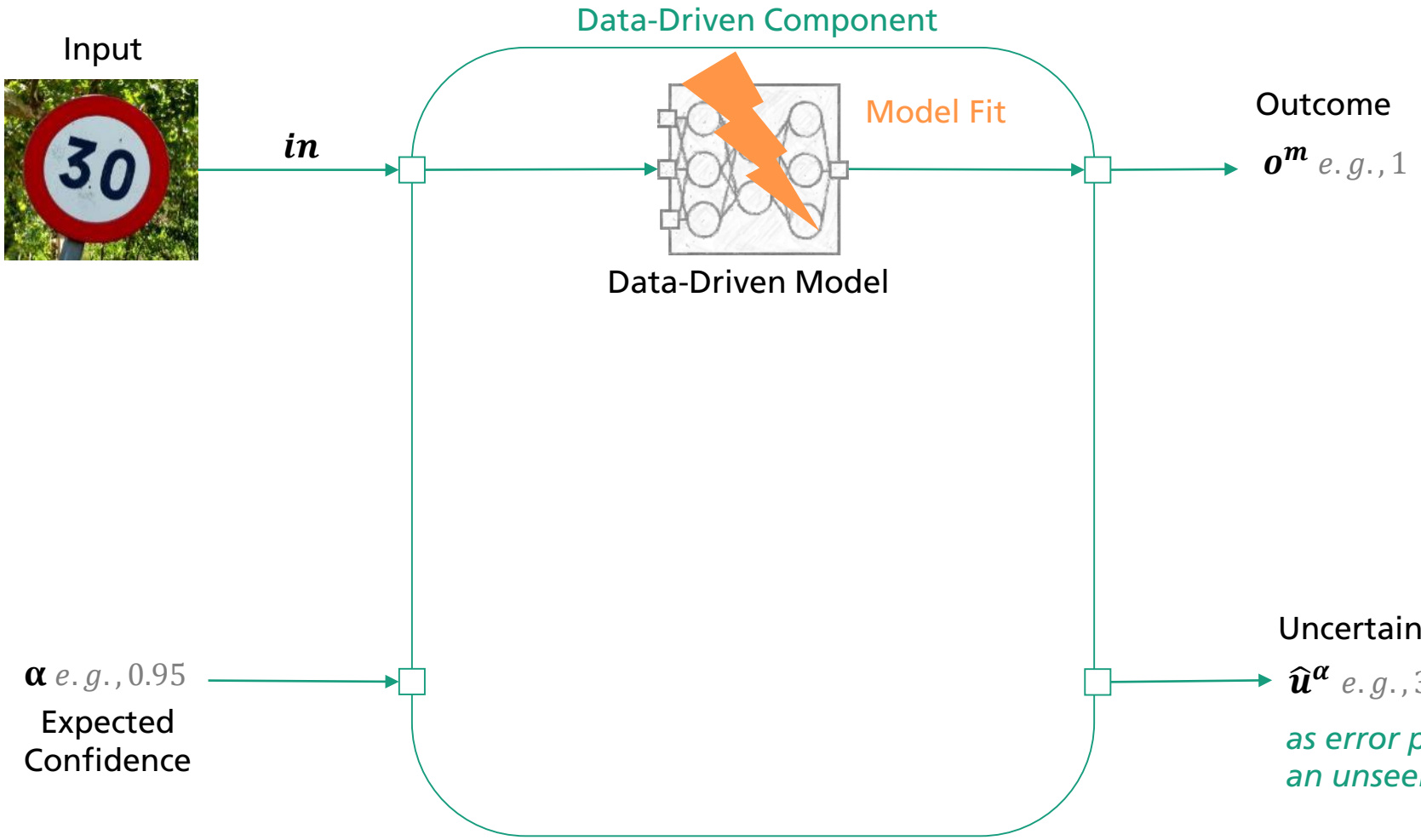
Key Sources of Uncertainty: Model Fit



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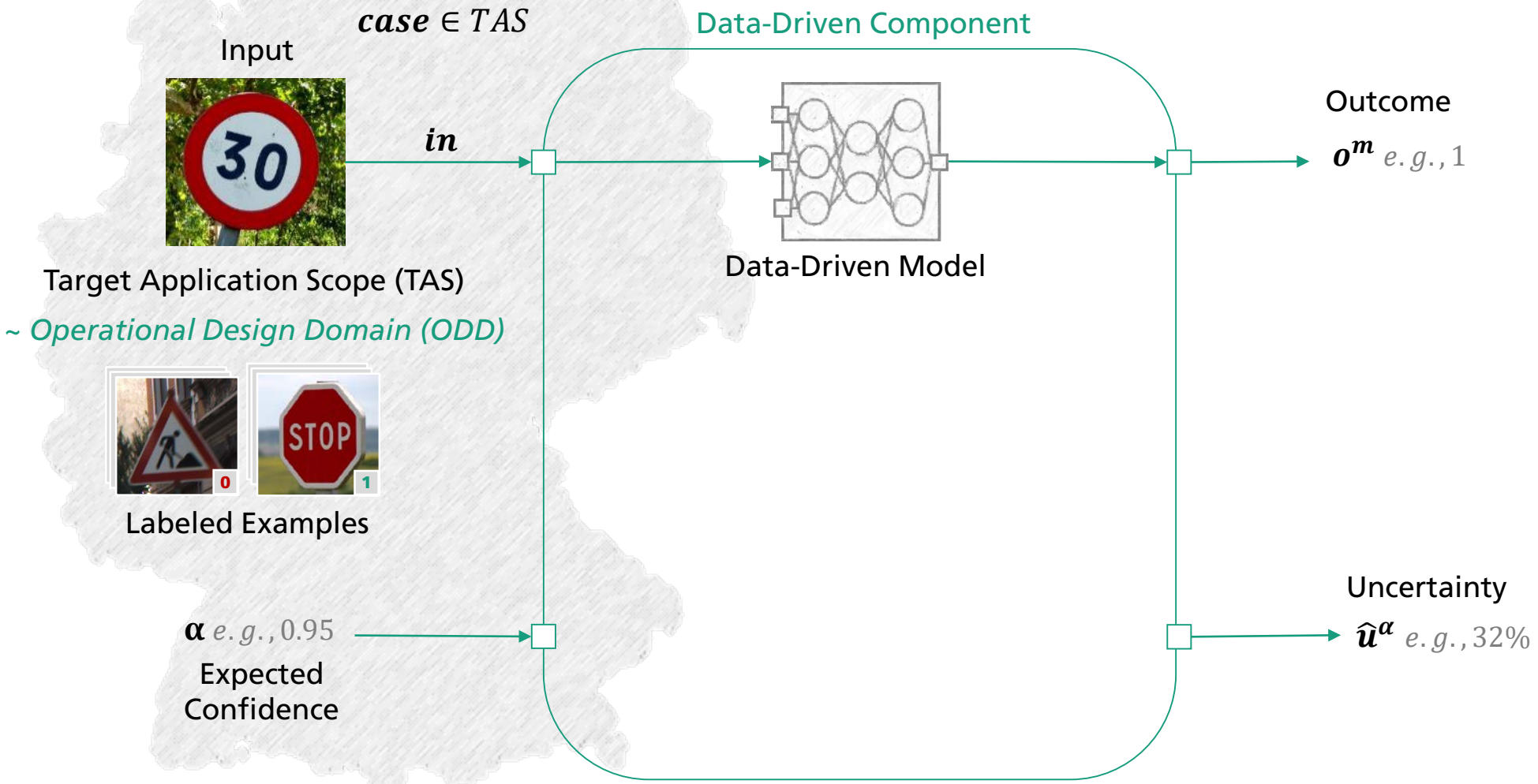
Key Sources of Uncertainty: Scope Compliance



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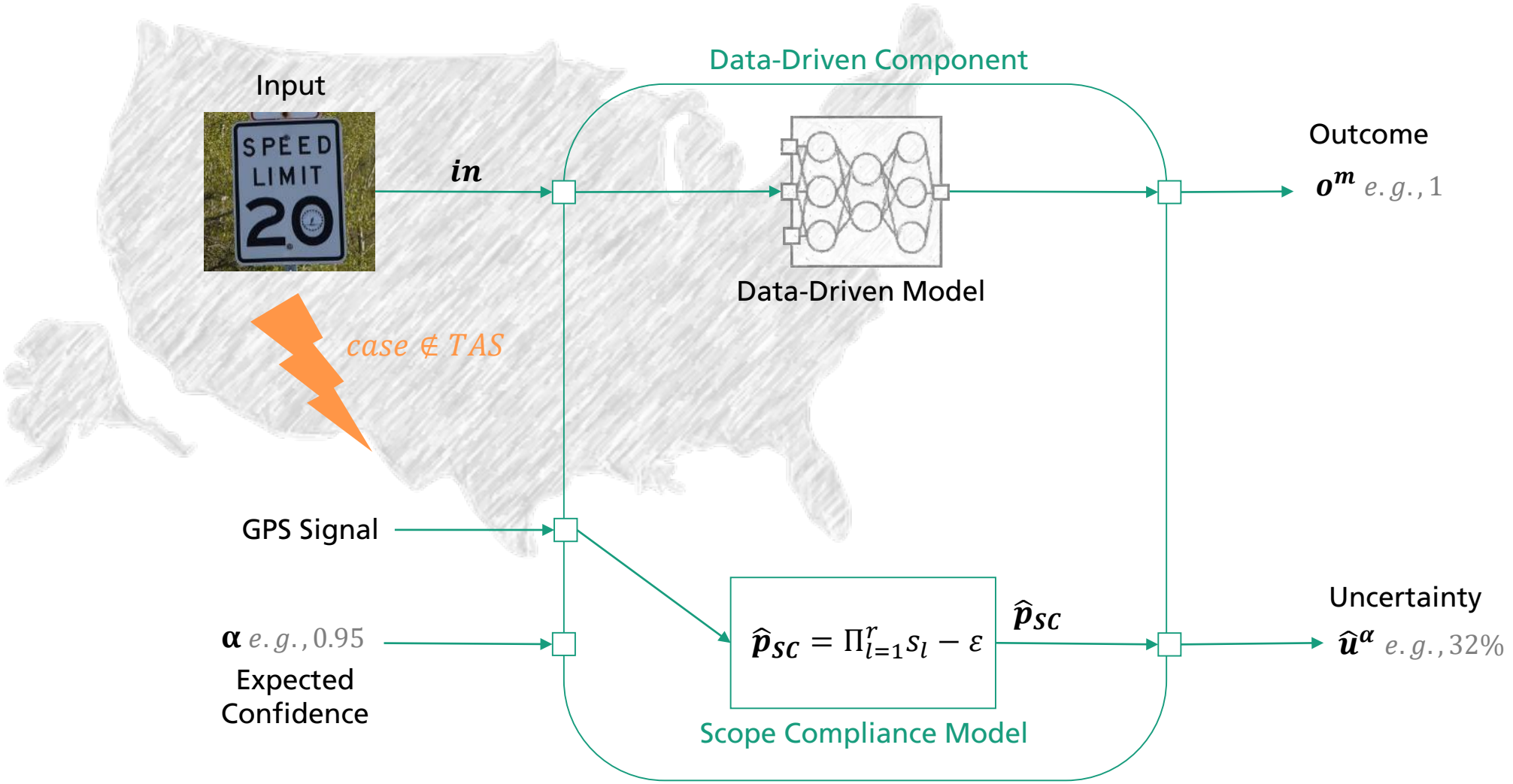
Key Sources of Uncertainty: Scope Compliance



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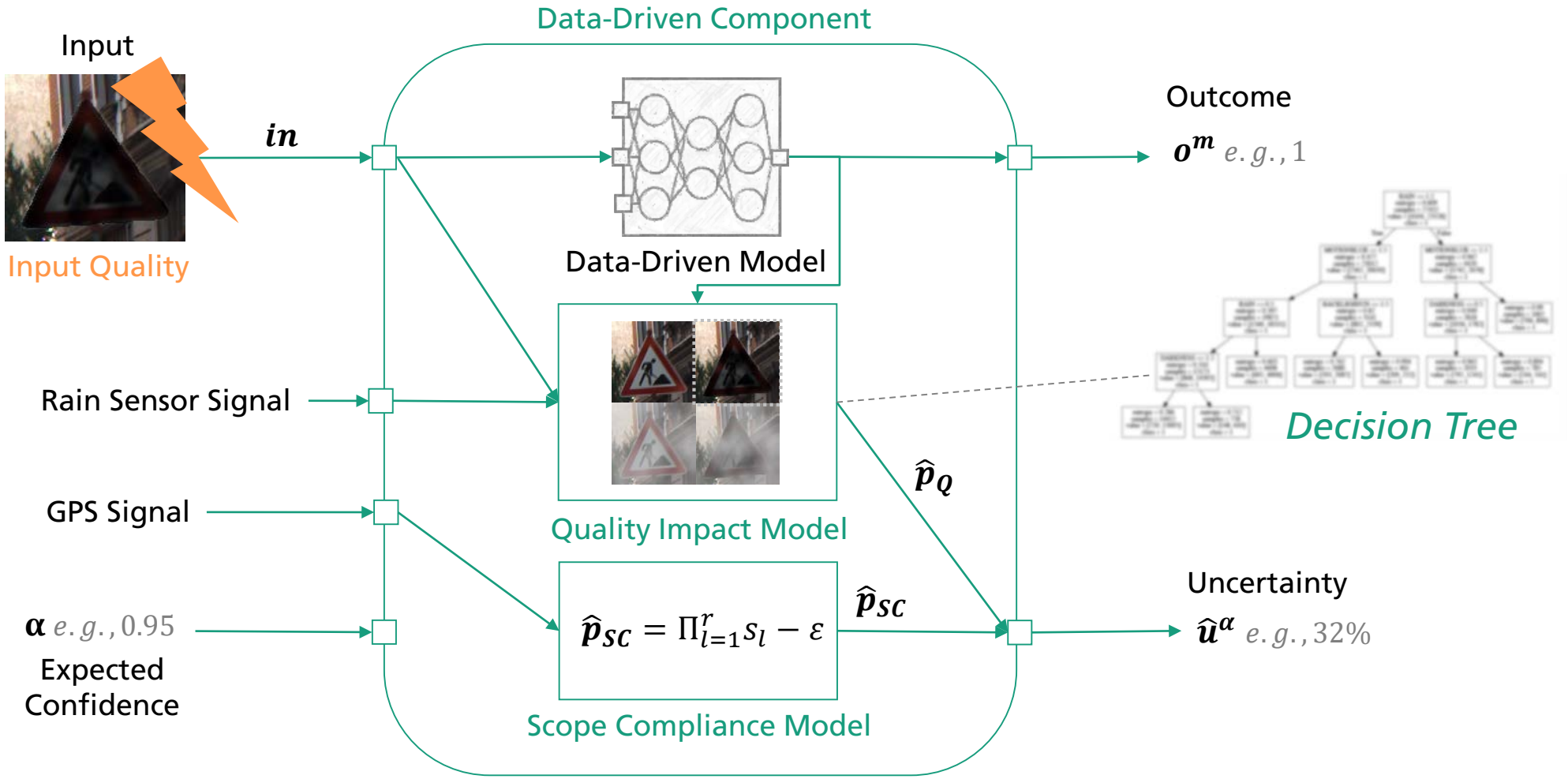
Key Sources of Uncertainty: Input Quality



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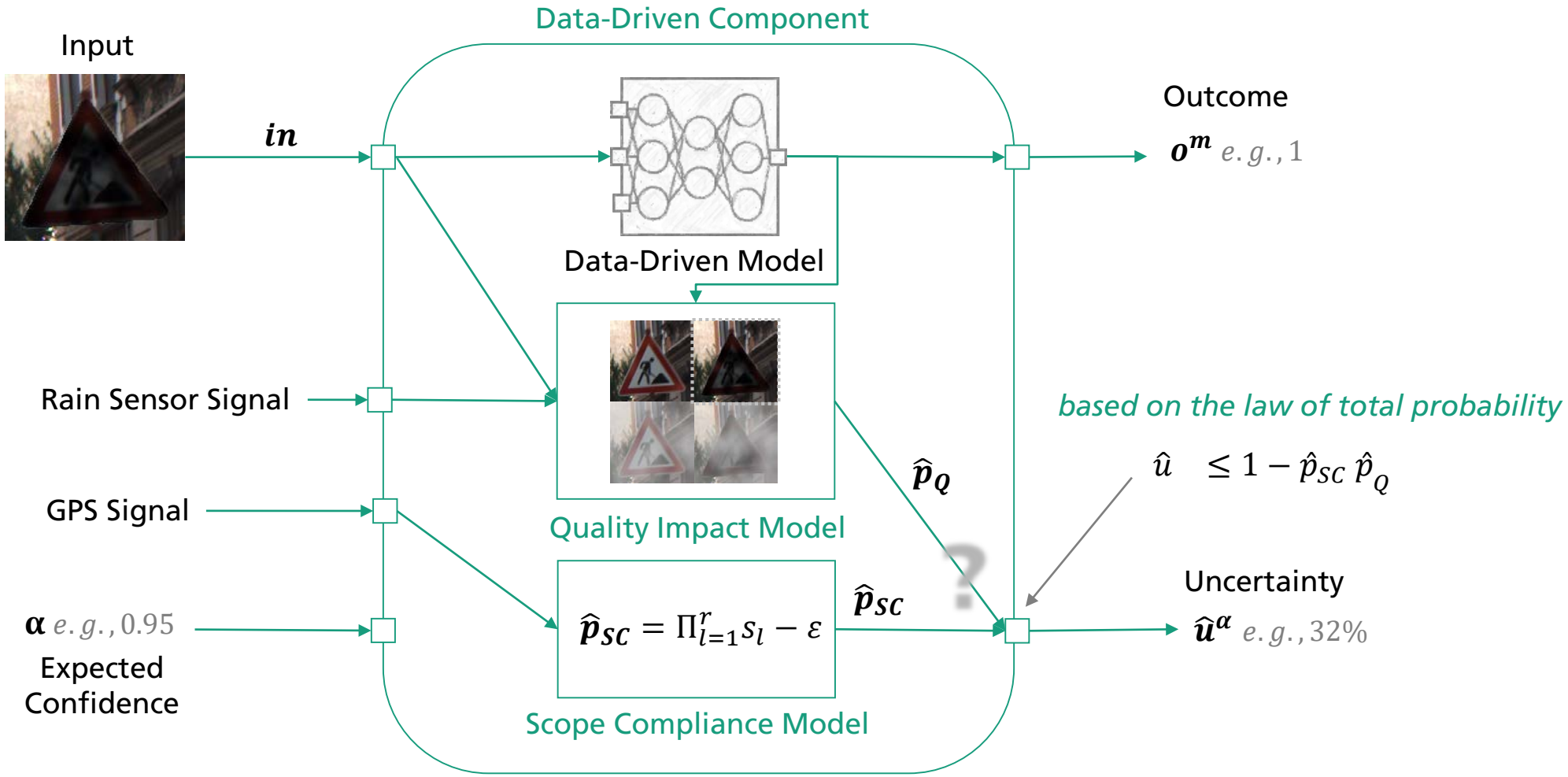
Combining Quality Impact and Scope Compliance



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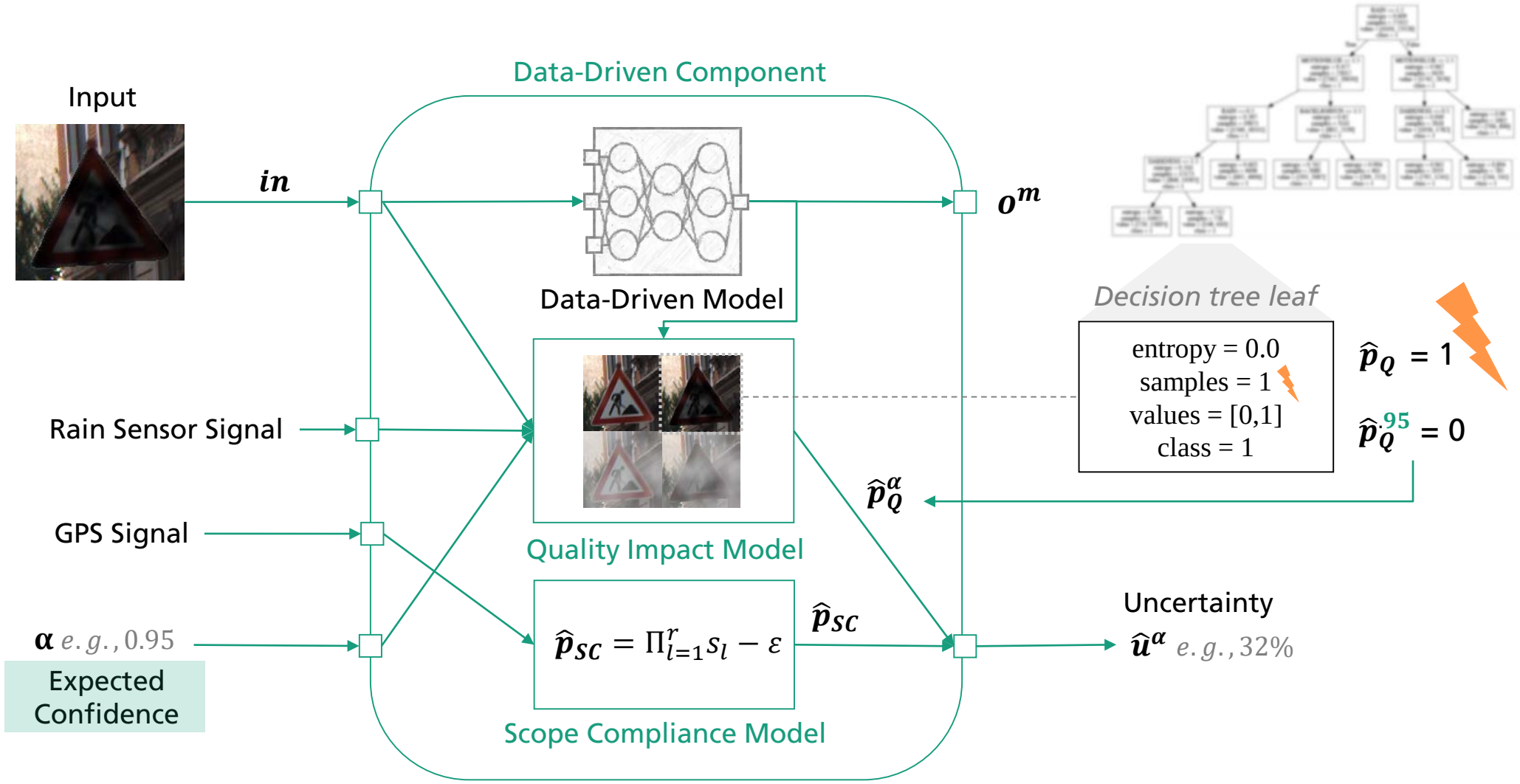
Considering Expected Confidence



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Summary: Key Advantages

Simple and justifiable interpretation based on decision tree structure

Holistic considering model fit, input quality, and scope compliance

Independently applicable from the encapsulated data-driven model

Related References

- Kläs, M., Sembach, L., "**Uncertainty Wrappers for Data-driven Models** - Increase the Transparency of AI/ML-based Models through Enrichment with Dependable Situation-aware Uncertainty Estimates," Second International Workshop on Artificial Intelligence Safety Engineering (WAISE 2019), Turku, Finland, 2019.
- Jöckel, L., Kläs, M., "**Increasing Trust in Data-Driven Model Validation** - A Framework for Probabilistic Augmentation of Images and Meta-Data Generation using Application Scope Characteristics," Proceedings of International Conference on Computer Safety, Reliability and Security (SAFECOMP 2019), Turku, Finland, 2019.
- Kläs, M., Vollmer, A. M., "**Uncertainty in Machine Learning Applications – A Practice-Driven Classification of Uncertainty**," First International Workshop on Artificial Intelligence Safety Engineering (WAISE 2018), Västerås, Sweden, 2018.
- Kläs, M., "**Towards Identifying and Managing Sources of Uncertainty in AI and Machine Learning Models - An Overview**," https://arxiv.org/abs/1811.11669, 2018.

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