Hochschule Konstanz
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INSTITUT FÜR OPTISCHE SYSTEME

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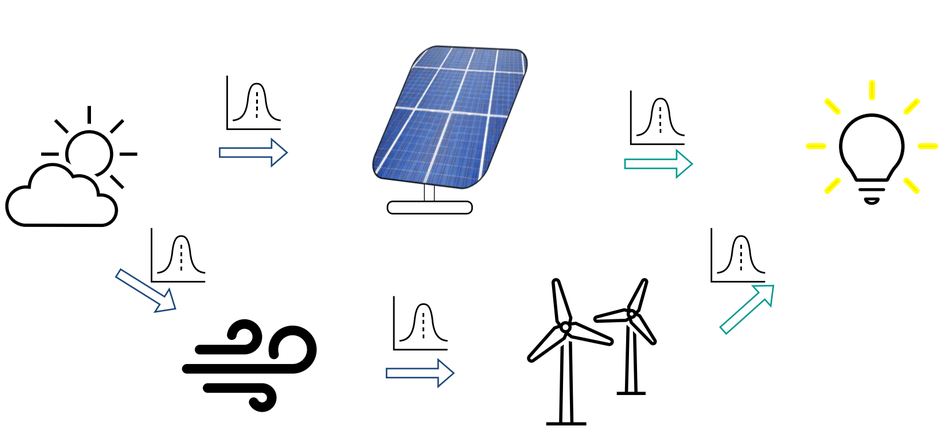
GEFÖRDERT VOM
Bundesministerium für Bildung und Forschung

Carl Zeiss Stiftung

Deep probabilistic modelling for energy forecasting

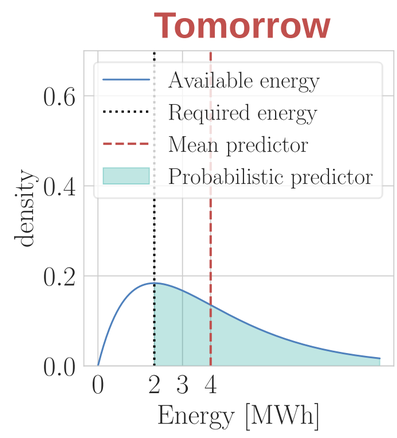
Why

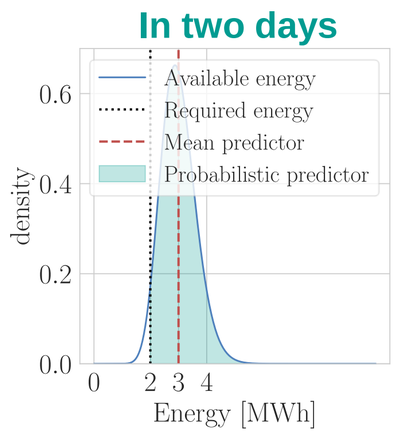


High uncertainties in renewable energy production (also in demand)

Boss: When do we have the greatest opportunity to produce our product (2MWh) with 100% renewable energy?

Mr. Meanpredictor: "**Tomorrow** we expect to have **4MWh** compared to 3MWh in two days."



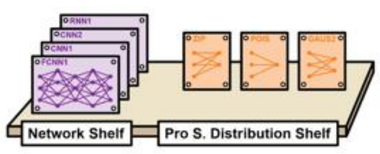


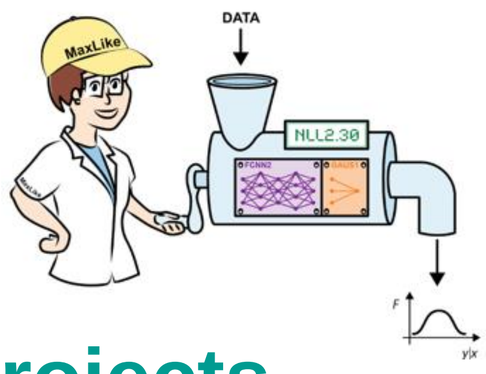
Mr. Probability: "Wait, but **in two days** there is a **96% chance** that the energy will be sufficient, compared to the **73% chance** we get tomorrow. We should prefer to produce in two days"

Probability to rescue.

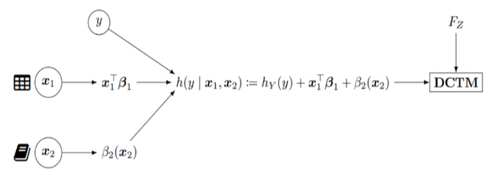
How

We combine Neural Networks with traditional statistic [1-5]

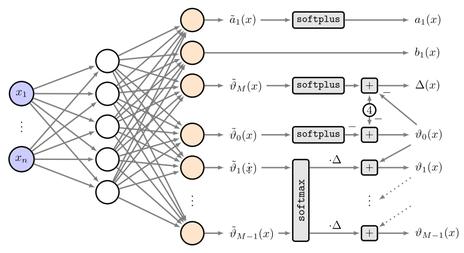




NN to model interpretable distributions [3]



NN to model complex prob. distributions [2, 5]



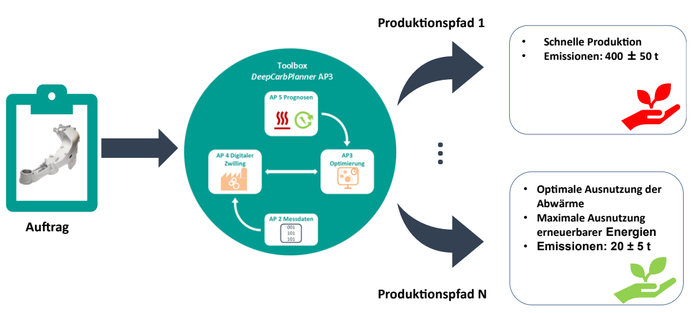
Current projects

DeepDoubt

Development of uncertainty measures to increase transparency and traceability in Deep Learning. (BmBF 640k€ Euro 2020 - 2023)

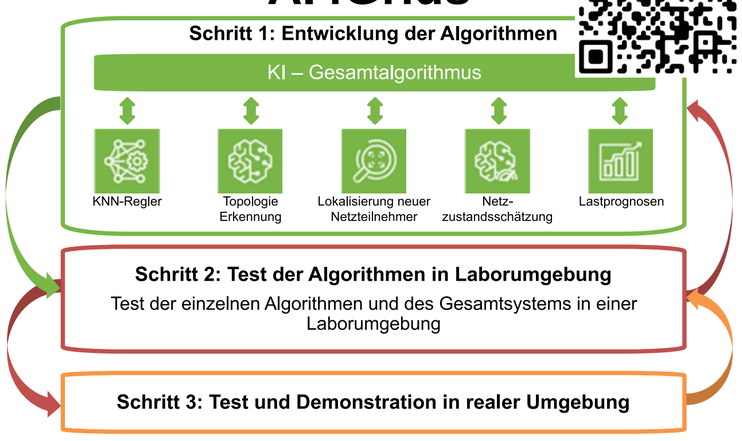
DeepCarbPlanner

Workflow



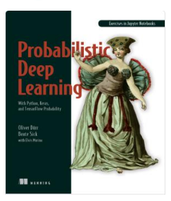
Decarbonization of energy-intensive industry through smart sector coupling with AI-based probabilistic forecasting and operations management. (Carl Zeiss Stiftung 1M€ 2023-2026)

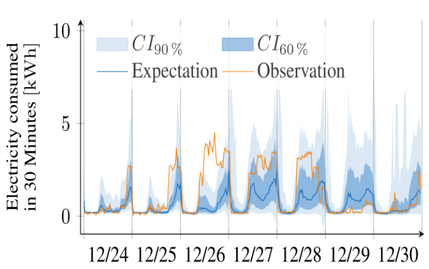
AI4Grids



AI-based planning and operational management of distribution grids and microgrids for optimal integration of renewable generators and fluctuating loads in the context of the energy transition.

Our recent work on probabilistic deep learning





[1] Dürr, Oliver, Beate Sick, and Elivis Murina. Probabilistic Deep Learning: With Python, Keras and TensorFlow Probability. *Manning Publications*, 2020.

[2] Sick, Beate, Torsten Hothorn, and Oliver Dürr. "Deep transformation models: Tackling complex regression problems with neural network based transformation models." *2020 25th International Conference on Pattern Recognition (ICPR). IEEE*, 2021.

[3] Kook, Lucas, Lisa Herzog, Torsten Hothorn, Oliver Dürr, and Beate Sick "Deep and interpretable regression models for ordinal outcomes." *Pattern Recognition 122* (2022): 108263.

[4] Dürr, Oliver, Stephan Hörling, Daniel Dold, Ivonne Kovylov, and Beate Sick "Bernstein flows for flexible posteriors in variational bayes." *arXiv preprint arXiv:2202.05650* (2022).

[5] Arpogaus, Marcel, Marcus Voß, Beate Sick, Mark Nigge-Uricher, and Oliver Dürr "Short-term density forecasting of low-voltage load using Bernstein-polynomial normalizing flows." *IEEE Transactions on Smart Grid* (2023).