Machine Learning for Road Conditioning

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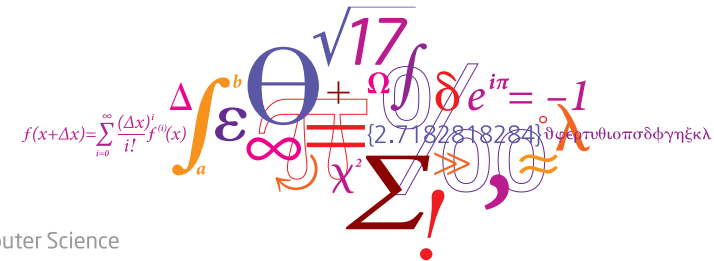
Cognitive Systems section

DTU Compute

Innovation Fund Denmark



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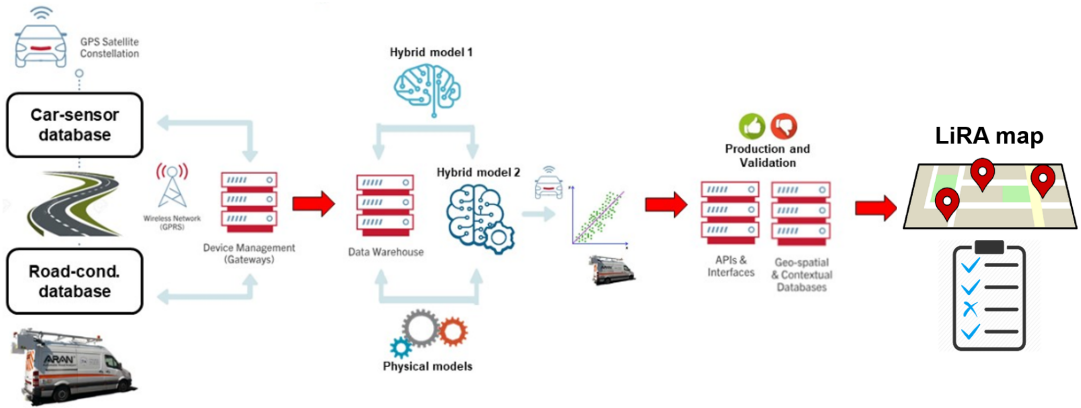
Where do we fit in?



People on the machine learning efforts

- Milena Bajic, Post doc.
- Tommy Sonne Alstrøm, Associate Professor.
- Two master thesis projects fall 2020:
  - "Map-matching GPS data to roads in Denmark by using car sensor information".
  - "Road condition assessment using deep learning".
- Physical modeling
  - Asmus Skar, Assistant Professor.
  - Eyal Levenberg, Associate Professor.

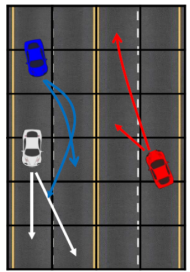
Overarching research goal for the machine learning efforts

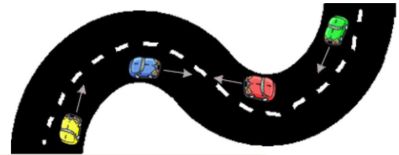
Working towards hybrid modeling, where we can leverage on physical models but still harness on the power of data-driven machine learning.

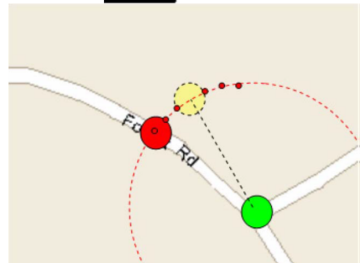
Machine learning challenges faced

- Acquistion of validated data is very time-consuming and requires numerous infrastructure components.
- We do not yet have enough data to fully leverage on deep learning.
  - For that reason we use random forests right now.
- Data cleaning and data alignment required (and requires) substantial effort
  - Many road conditions are rather localized, and needs rather precise car location information.
  - Better estimation of the true car location ongoing research.
  - Car data is regularly sampled, but due to speed changes we have irregular number of samples per road segments.

Vehicle trajectory estimation and correction





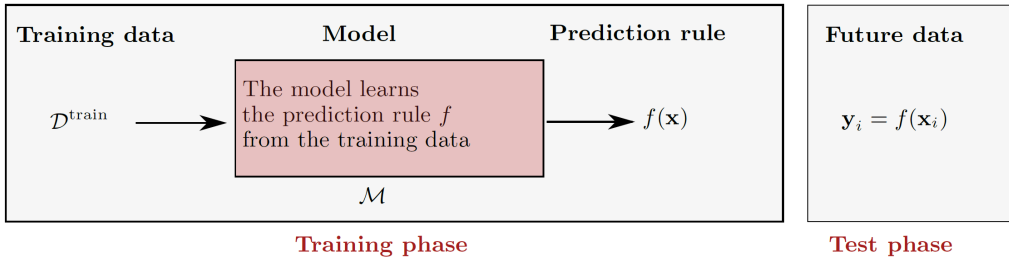


S. H. Park, B. Kim, C. M. Kang, C. C. Chung and J. W. Choi, "Sequence-to-Sequence Prediction of Vehicle Trajectory via LSTM Encoder-Decoder Architecture," 2018 IEEE Intelligent Vehicles Symposium (IV)

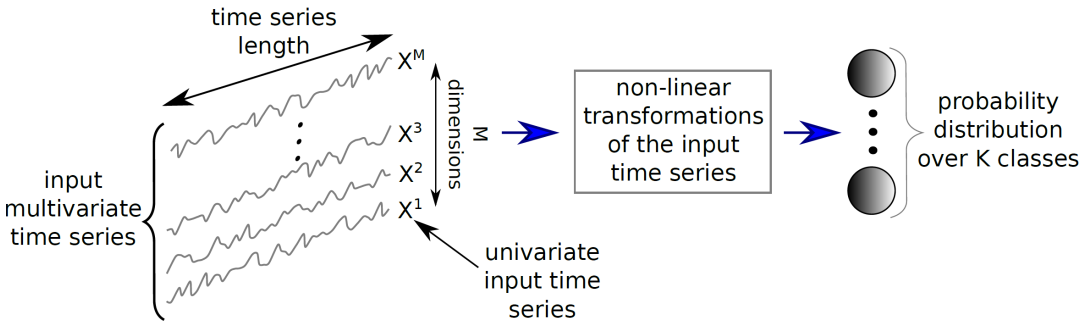
Barrios, Cesar, Motai, Yuichi, Improving estimation of vehicle's trajectory using the latest global positioning system with Kalman filtering IN IEEE Transactions on Instrumentation and Measurement, 2011

What is machine learning (only listing what we currently use)

- Unsupervised learning (exploratory analysis)
- Supervised learning
  - End-to-end (representation learning, deep learning)
  - Feature-based models (we use e.g. random forest)

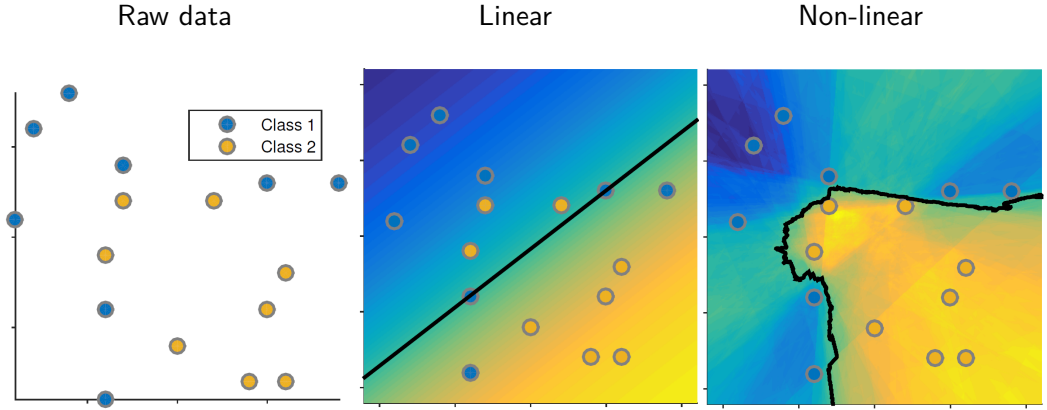


Example of representation learning (deep learning)



Ismail Fawaz, H., Forestier, G., Weber, J. et al. Deep learning for time series classification: a review. Data Min Knowl Disc 33, 917–963 (2019).

Example of supervised learning



On to machine learning efforts by Milena Bajic