TECHNISCHE UNIVERSITÄT DARMSTADT

Deep learning models and machine learning methods for predicting times of presence at delivery addresses.

Pro-/ Project Seminar, Bachelor-/ Master Thesis

Fachbereich 18
Elektrotechnik und Informationstechnik
Selbstorganisierende Systeme

Department 18
Electrical Engineering and Information Technology
Self-Organizing Systems

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Motivation and Background

Parcel services oftentimes face the problem of failing delivery attempts due to absent costumers at the delivery address. One option to solve this problem is to predict save delivery time frames for delivery services to ensure a successful delivery.

For this methods from machine learning [1] and deep learning [2] for automatic and data protective determination of times of presence at the delivery address to optimize delivery have to be developed. The thesis is in collaboration with the startup Green Convenience (GC).[1]

Approaches and Goals

The thesis can go into multiple directions. Possible topics and approaches for this thesis are:

- The development of new prediction algorithms:
  - Time-series prediction using deep-learning models [2], e.g., long-short-term-memory (LSTM) neural networks [3], Transformer neural networks [4], neural ordinary differential equations (ODEs) [5], neural stochastic differential equations (SDEs) [6], etc.
  - Probabilistic (non)-linear state space models, e.g., SDE models [7], Gaussian process models [8], etc.
- Data collection and pre-processing
  - Finding data-sets, e.g., [9], and extracting information which meaningfully represent the user behavior, e.g., finding important feature representations in the data using classical methods such as K-means [1] but also deep generative methods such as variational autonencoders [2].
- Developing a model for motion behavior to use for synthetic data-generation
  - Methods based on motion models, such as *Bonnmotion* [10] but also Markov chain models could be an interesting direction.
  - Deep generative models based on generative adversarial networks (GANs) [2].

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[1] Introduction video: https://youtu.be/9XXBQQxgWs0

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