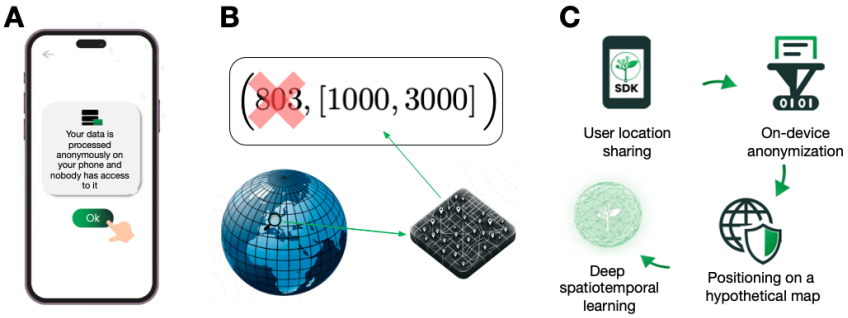
TECHNISCHE UNIVERSITÄT DARMSTADT

Thesis (B.Sc. / M.Sc.)
Licensed to Deliver: Agent-Based Data Generation for Parcel Optimization

Background: In collaboration with Frankfurt-based Green Convenience GmbH, we are developing an innovative machine learning solution for optimizing parcel delivery services. To train robust deep learning models, we require large-scale, realistic datasets that capture diverse user behaviors and delivery scenarios. We are looking for one motivated student to develop an agent-based simulation framework that generates synthetic training data through deep learning agents navigating simulated environments with realistic user profiles.



Spatiotemporal prediction framework. (**A**) User interface explicitly obtains user consent for GPS tracking. (**B**) Location anonymization method: user location is decomposed into quadrant identifier (803, crossed out to indicate it's discarded) and relative position [1000,3000] within that quadrant, which is retained. This prevents geographic re-identification while preserving movement patterns. (**C**) Complete data-processing pipeline: user consent, immediate on-device anonymization, mapping onto hypothetical coordinates, and spatiotemporal deep learning for availability prediction.

Objective: This thesis focuses on creating deep learning based agents that walk on a simulated map, exhibiting different realistic user profiles to generate high-quality training data. The student will work on developing and implementing a comprehensive agent-based simulation system. Key aspects of the project include:

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December 25, 2025

- **Deep Learning Agent Development:** Design and implement deep learning based agents capable of autonomous navigation and decision-making on simulated maps. Agents should exhibit diverse, realistic behaviors corresponding to different user profiles.
- **Realistic User Profile Modeling:** Create varied user profiles capturing different behaviors, preferences, schedules, and mobility patterns. Ensure the generated data reflects real-world complexity and variability.
- **Simulation Environment:** Develop or integrate a simulated map environment where agents can navigate, interact, and generate meaningful delivery-related data. This includes implementing realistic constraints and scenarios.
- **Data Generation and Validation:** Implement mechanisms to generate, collect, and validate synthetic data. Ensure the generated datasets are suitable for training downstream deep learning models and capture relevant features for parcel delivery optimization.

This thesis offers an excellent opportunity to gain hands-on experience in agent-based modeling, simulation, and synthetic data generation for machine learning applications. You will work closely with both academic supervisors and industry partners, gaining valuable insights into the practical challenges of creating realistic training data for real-world business applications.

Prerequisites:

- Strong background in machine learning and deep learning (e.g., students of electrical engineering, computer science, data science, mathematics, or related fields).
- Proficiency in Python and deep learning frameworks (e.g., TensorFlow, PyTorch).
- Interest in agent-based modeling and simulation.
- Motivation to work on real-world applications with industry partners.

For further information, please contact Philipp Froehlich.