



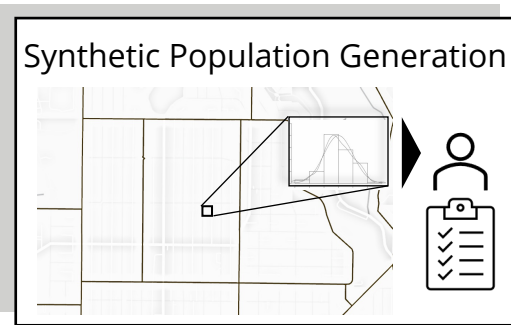
Using agent-based simulation to explore human mobility

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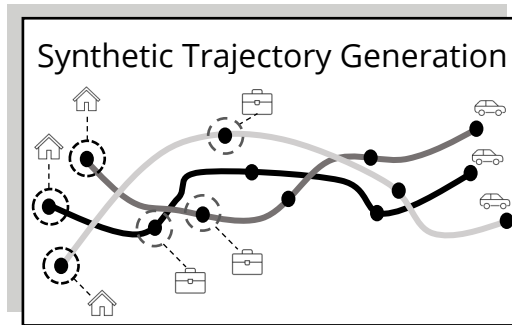


Agent-based simulation for high-fidelity mobility analysis



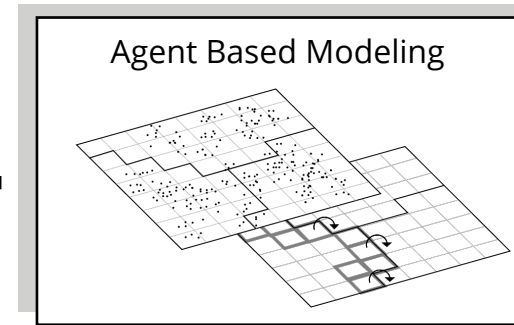
Deep learning approach for generating a validated synthetic population from Census data inputs

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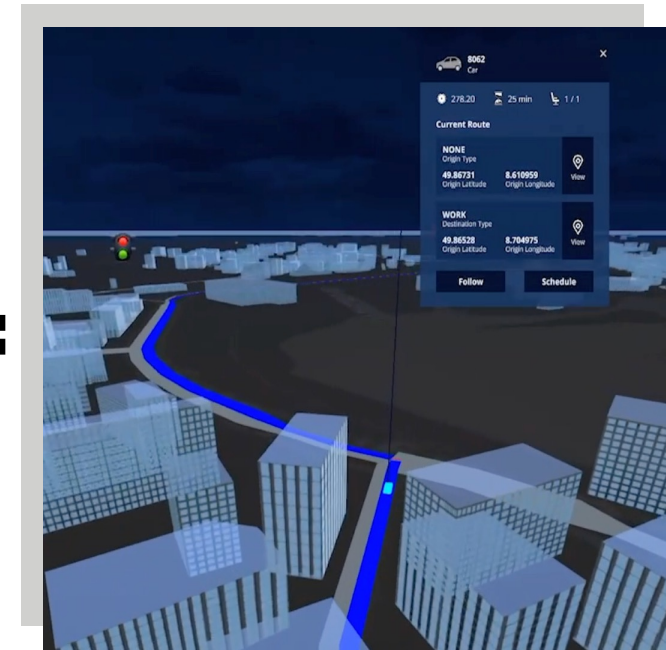
Custom pipeline for transforming raw mobility data into targeted trajectory models

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Agent-based model using a patented distributed compute architecture to create fine-grained simulations over large geographic areas

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Massive-scale, agent-based simulation for exploring human mobility



Synthesizing realistic populations via deep generative modeling

GOAL

Generate a synthetic population with realistic demographic and socioeconomic attributes that influence an agent's decision-making with respect to travel and activity patterns.

APPROACH

- Our agent-based simulation relies on a highly realistic synthetic population that incorporates a broad set of demographic, socioeconomic, and behavioral features.
- Census data is an excellent data source for population information, but we want to avoid the pitfalls of probabilistic sampling and IPF techniques.
- Leveraging a deep learning architecture allows us to sample specific population characteristics and groups once the model is trained, and the feature-rich synthetic population allows for capturing emergent mobility behavior in the simulation.



Harnessing mobility data to create synthetic activity schedules

GOAL

Leverage real mobility traces from cellular devices to construct realistic models of human movement that can be paired with a fully synthetic population.

APPROACH

- Raw mobility data from cellular devices offers a rich dataset for understanding human mobility patterns.
- We can contextualize this data through spatial binning and broad activity-type identification, as well as estimating some user demographic characteristics.
- We use these inputs in concert to train a series of spatiotemporal trajectory models, each fit to population subgroups identified in the data.
- These models are sufficiently abstracted from the input data to protect privacy.



Using a scalable framework for agent-based modeling

GOAL

Model synthetic population and trajectories with an agent-based approach in a way that does not compromise the model's scale or the fidelity of the data.

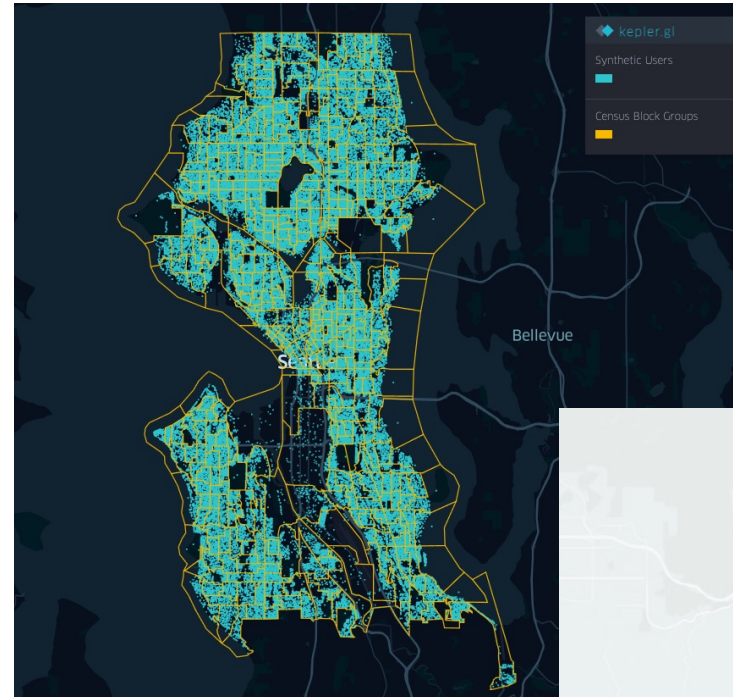
APPROACH

- We have developed a patented approach to automatically assign simulation processes to available compute hardware and pass information between them to form a single simulated world.
- This cloud-based horizontal and vertical scaling is key to running rapid, simultaneous scenarios at scale.
- We rigorously test our models to confirm that they replicate datasets at baseline conditions and demonstrate appropriate sensitivity to parameter changes.

Modeling human mobility with agent-based simulation

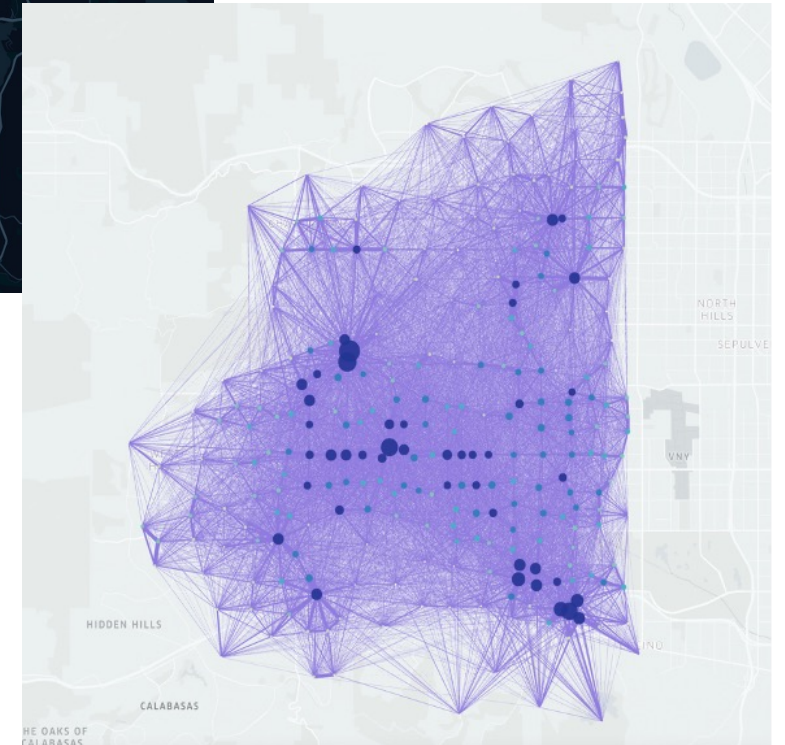
We combine synthetic population generation with trained trajectory models in a principled way to create realistic inputs for fine-grained, high-fidelity, long-duration simulations for any specified geographic area.

We can modify simulation parameters to explore the impact of environmental, demographic, and behavioral changes on agent mobility patterns in a way that is repeatable and allows for in-depth analysis.



◀ We seed simulations with synthetic population data. Each agent has an activity schedule generated from models trained on real mobility data. Agent movement is affected by real-time conditions in the simulation.

▶ Data outputs from simulations have high spatial and temporal resolution. We can analyze how agents move and create scenarios to explore how those mobility patterns change given different initial conditions.



Thank you

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