Data-Driven Urban Dynamics: Modeling, Simulation, Visualization

ARCH 6306, MUD 6050: Tuesdays/Thursdays 1:00pm-2:15pm, Room: Storrs 155

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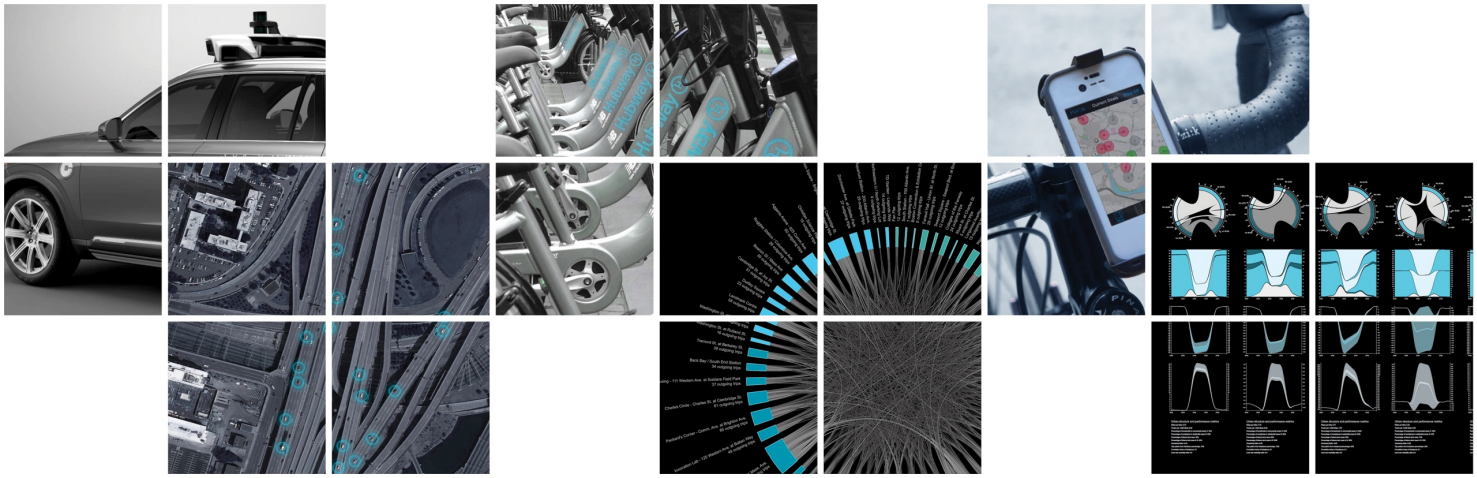

PREMISE

This seminar introduces data-driven modeling, simulation, and visualization of urban mobility systems for computational scenario analysis. Urban simulation models are used to understand behavior of complex urban systems and to address what-if questions for decision-making such as: how would traffic, parking availability or carbon emissions in a city change if a portion of private conventional vehicles were replaced by shared autonomous ones? The course focuses on mobility-on-demand (MoD) systems such as car sharing, bike/scooter sharing, or future autonomous cab systems. While City of Charlotte will be the main context, urban mobility systems in other cities will also be considered.

OBJECTIVES

Provides foundational skills in data visualization and in modeling and simulation of complex systems using System Dynamics (SD) and Agent-Based (AB) methodologies. Students will learn: how to find, collect, process, visualize big urban data; how to use data to model and simulate urban systems; how to formulate meaningful research/policy questions for resiliency and sustainability and how to use simulations to explore scenarios for addressing them; how to develop interactive web-based simulation/visualization applications using state-of-the-art tools.

TOPICS

Urban Resiliency, Ecology, Systems Thinking, System Dynamics, Agent Based Systems, Data Visualization, Modeling and Simulation. Teaches basic programming skills in JavaScript, D3.JS, LeafLet/Mapbox, NetLogo, Vensim, and Java (Processing).

METHOD

The seminar combines lectures, lab tutorials, readings, and student presentations, and is organized into team assignments, a final project and a paper. For final projects, students will select a dataset and an urban system of their interest, they will identify a policy problem, they will develop a model, and they will use their model for policy assessment. Alternatively, students may develop an interactive web-based visualization platform for exploring data (real-time or archived) for their selected system. Possible datasets include: trip data from bike sharing systems; taxi trip datasets; e-scooter GPS datasets; subway, bus or light rail trip datasets.

PARTICIPATION

Open to students in Architecture, Software and Information Systems (SIS), and Computer Science (CS).

PREREQUISITES

Programming skills in any programming language are highly desirable but not required.

TENTATIVE SCHEDULE (MILESTONES)

Weeks 01-04: Introduction, Urban Data, Collection, and Visualization
Weeks 05-08: Agent-Based Modeling and Simulation
Weeks 09-12: System Dynamics Modeling and Simulation
Weeks 13-16: Scenario Analysis & Decision Making

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