The course taught students to work with “Big Data” to answer and expose urban issues.

Big Data Visualization & Society - Riyadh

Detail

Class Photos?

COURSE CONTEXT

The course taught students to work with “Big Data” to answer or expose urban issues. Students learned the technical skills involved in working with “Big Data”. Following the overall project’s objectives, the class focused on transportation networks, and more specifically the public policy and social implications of the creation of the future metro system in the city of Riyadh. With the introduction of the metro system, students reflected about their implications in the social dynamics of the city, considering the existing gender and racial inequality, the overall design of the transportation network and their local issues, the implications of new technologies and transportation modes in the city, and civic engagement in transportation planning, among others. Through the projects, students aimed to develop projects capable of trough design, facilitating the conversations regarding transportation policy between citizens, policy-makers and stakeholders.

Technical Sessions

- Open-source development – Github
- Python
- Data wrangling: Pandas
- Web-scrapping
- Network Analysis
- Web-development: HTML, CSS
- JavaScript
- Data-structures
- D3
- Data-driven Maps
- User interaction

Datasets Used

- 30+ Gigabytes of data collected over 3 months
- Taxi trips from taxi operators (e.g., Uber and Easy Taxi)
- Taxi trips from crowd sourced mobile phone applications
- Riyadh bus routes (ADA)
- Existing bus demand
- Tweets:
  8 gbs of geo-located tweets
  2+ months of data collection
- Foursquare Check-ins:
  1 gb of trending venues check-ins
  2+ months of data collection
- Instagram:
  1 gb of geo-located instragram posts
  2+ months of data collection
- Google Points of Interest:
  6,000 + POIs
- OD Flows:
  Aggregated Flows Among Towers
  24 hr Range
- Road Network Congestion:

Project Images?

PROJECT CONTEXT

The project is part of a multi-year collaboration between MIT and KACST in Riyadh, bringing together multi-disciplinary teams, combining designers, planners, engineers, physicists, and computer scientists. On its Phase III, the current iteration of the project focuses on the development research for the construction of an “Integrated Transportation System” for Riyadh. The project is overseen at MIT by Sarah Williams (DUSP), and Marta Gonzalez (CEE), and at KACST by Dr. Mansour Alsaleh and Dr. Areej Alwabil.

The overall project is an attempt to theorize about the implications of the dramatic changes Riyadh’s transit infrastructure will experience after the introduction of the upcoming metro and bus system.

Motivated by the rapidly growing population demand (e.g. Riyadh’s population has doubled in the last 15 years), the upcoming transportation system introduces the largest public transit system implemented from scratch in a city with no form of public transportation. The transportation system is the largest urban public transportation project in the world, with the rapid integration of 6 metro lines (87 stations), 24 bus routes (nearly 4,000 bus stops), and 20 parking stations. In a city dominated by cars, with no pedestrian infrastructure and where women cannot drive, the introduction of the public transportation system will transform the urban and social dynamics of Riyadh.

Current Research

• How would commuters use the transit system in the city?	Through modeling the transit system as a multiplex network, different layers of the transportation network can be interconnected to each other, speculating about their interactions. A coupled network connects the public transit system to an extensive road network, evaluates the transit system using travel times for existing demands, and examines the effects of various coupling strategies
• How will public transit be adopted by Riyadh’s population?	Exploration of the role of demographics in metro usage to speculate which parts of the population will use the metro, and what parts of the city are they going to. A comprehensive transportation model for the city of Riyadh that models the upcoming public transit system which can help us to understand the effects on the existing road network, perform detailed simulations that examine the interactions between existing traffic and public transit, and estimate how the public transit system could fulfill existing demand based on the current movement patterns.
• How will public transit affect traffic and congestion?	Modeling of urban dynamics through the use of alternative data sources, CDR and GIS data to identify the potential future demand for public transit.

Interfaces & Visualizations

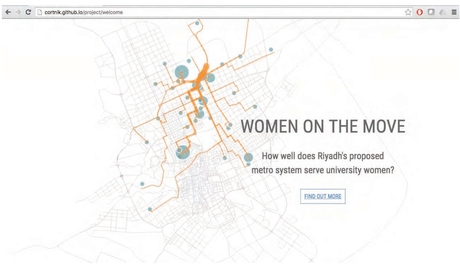
As part of the overall project, the development of interfaces for open and accessible data visualization aims to serve as a pedagogical tool for urban issues, diminishing the barriers between citizens and stakeholders. The web-based interactive platform combines several layers of different datasets to help transportation planners understand existing metro project (e.g., adoption, and effects on the existing road network), analyze the relationship between these layers, and integrate and examine different scenarios (e.g., calculate travel times by performing coupling mechanisms for road and transit trips).

STUDENT PROJECTS

Riyadh: Pedestrian vs. Car

Team: Dennis Harvey, MCP'17, Brandon Peterson, MCP'17

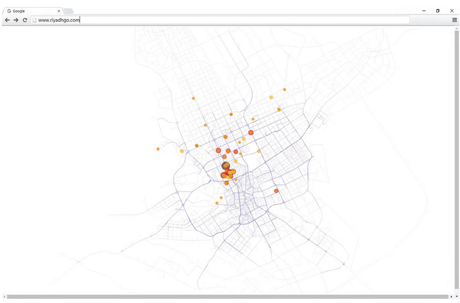
Riyadh is a city with both enormous amounts of traffic congestion and vast possibilities for pedestrian-focused urban design. Its ongoing public transportation development sug-gests a city invested in improving its walkability, while its current pedestrian zones are showcasing their successes with high amounts of social activity. Where can traffic calm-ing measures and street pedestrianization have the highest impacts in Riyadh, and how can data visualization help find these opportunities? Using Twitter data as a proxy for potential pedestrian activity, mapped against car con-gestion data for Riyahd's many highways and city streets, Pedestrian vs. Car visualizes densities of tweets versus densities of traffic in order to find zones of separation and overlap.



Riyadh: Women on the Move

Team: Sin Bin Tan, MCP'17, Elaine Kim, MCP'17, Cortni Kerr, MCP'17

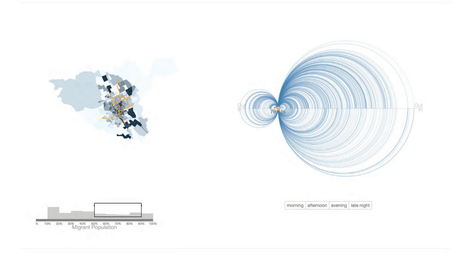
In Saudi Arabia, women are not allowed to drive. Instead they rely on personal drivers to get around the city. A public transport system could have a tremendous impact on the mobility of women. Riyadh, the Saudi Arabia's capital city, is currently building an ex-tensive metro system, scheduled to be completed in 2018. The Women on the Move pro-ject seeks to understand the movements of women in Riyadh, and analyze how the pro-posed rail system will serve the places they travel.
The project created a sample population utilizing call detail records with origins and des-tinations at an all-women's university. This analysis identifies where women travel before or after going to campus, potential paths, and the hotspots not served by the pro-posed rail system.



Riyadh GO

Team: Waishan Qiu, MCP'17, Xu Zhang, M.Arch'17

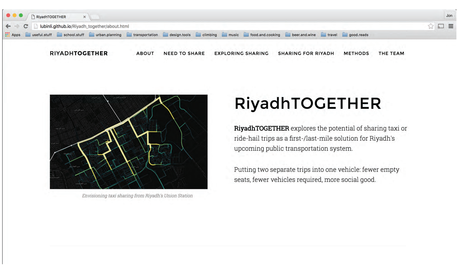
Riyadh GO is a comprehensive visualization of your real-world travelling cost in terms of Money and Time from Riyadh hotspots. You can explore how far can you travel by Uber given a time and monetary constrain.
The collected Foursquare check-in data of Riyadh is visualized with their node size and color-code based on the relative importance according to social activity, defining urban hotspots. The transportation OD analysis data and congestion simulation data obtained from MIT's HuMNet LAB is used to visualize the time-travel cost. The Uber cost estima-tion algorithm is implemented to assess the trip monetary cost -a combination of time and distance.



Migrant Population and Transportation

Team: Sergio Galaz Garcia, M.Arch'17, Weiqian Liu, M.Arch'16

Current estimates suggest that a third of Riyadh's inhabitants are migrants. This commu-nity is inserted unevenly in Riyadh's daily life: residentially, it tends to concentrate in the central aras, and labor wise, it tends to be largely concentrated in private enterprises --in fact, it represents 90% of the total workforce of this sector. Due to these characteristics, visualizing the way Riyadh's migrant population relates to the city's overall transporta-tion workflows is significant, first, as it allows to understand transportation patterns of a significant size of the Saudi's capital population; second, as a first way of understanding changes in transportation patterns that may ensue due to the forecasted entry of more Saudi people into the private economy, and third, as a way of understanding how inte-grated or fragmented gated Riyadh is as a urban unit composed of Migrant and Saudi people.
Two visual outputs were produced to visualize transportations from a migratory status perspective: one entailed the production of a choropleth map allowing for a rapid visua-li-zation of the different proportion of migrant population that Riyadh's Transportation Ar-ea Zones feature, and another was related to the generation of an arc map that would show the mobility relationships between a particular target TAZ and all the others. The project allowed the user to select this target TAZ by clicking on a particular zone in the choropleth map.



Riyadh Together: Shared Mobility

Team: Jon Cambell, MCP'16, Corinna Li, MCP'16

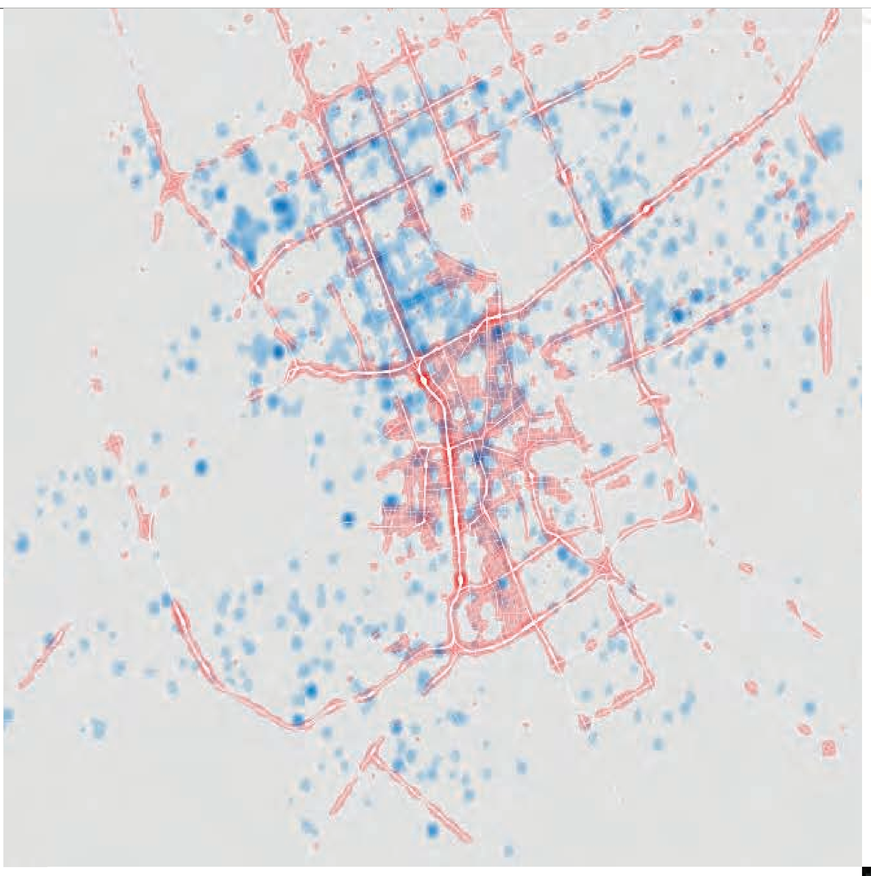
RiyadhTOGETHER explores the potential of sharing taxi or ride-hail trips as a first-/last-mile solution for Riyadh's upcoming public transportation system. While the planned subway and bus routes cover major corridors, it can still take up to 25 minutes to walk to the nearest stop/station. Accessibility to public transport stops and stations is especially crucial for Riyadh, given the hot climate, insufficient infrastructure for walking and bik-ing, and the cultural preference towards driving.
As Riyadh's public transport system is still in construction, we conduct the exercise based on a city with existing public transport network, stations, and publically-available taxi trip data. We use New York City as a jumping board, with aims to develop tools and methods that can be applied to Riyadh. We used a week of taxi trips data from the NYC Taxi & Limo Commission for trips be-ginning or ending at Flushing-Main St Station on the 7 Train. Each record contains loca-tion and time of that trip's pick-up and drop-off. We developed an algorithm to match potentially sharable trips using the Google Maps Directions API to determine trip rout-ing. Trips are considered sharable if delay due to sharing is less than ten minutes for each passenger. After determining all possible shared trips, we apply a maximum matching algorithm to determine the sharing scenario with the most possible shared trips.

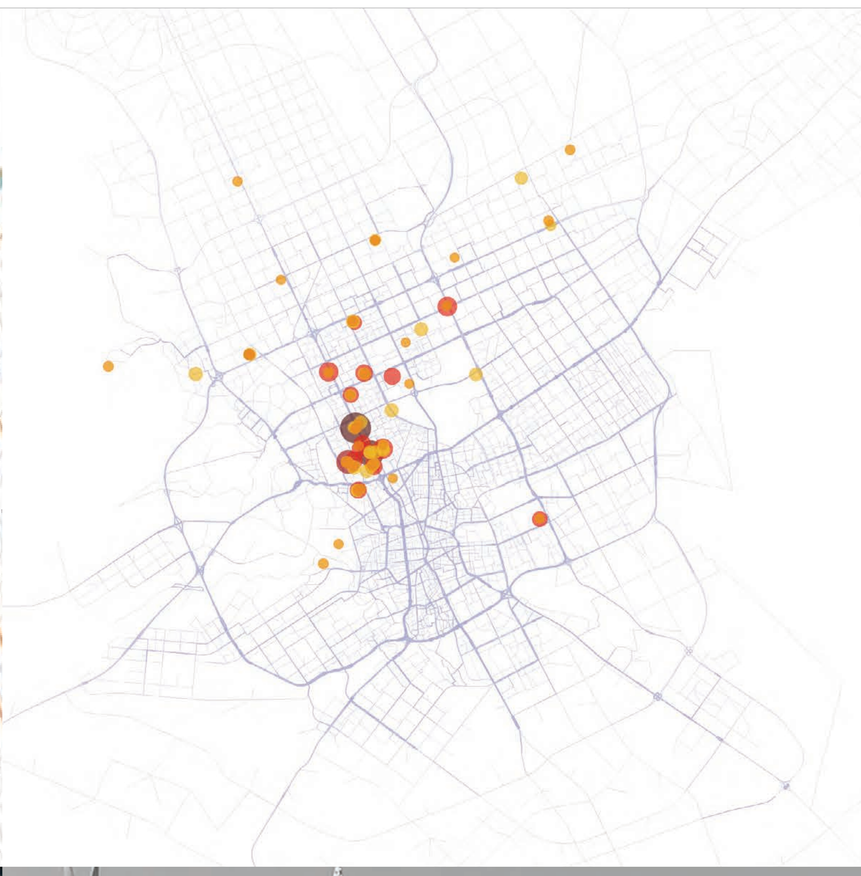
Voices of Riyadh

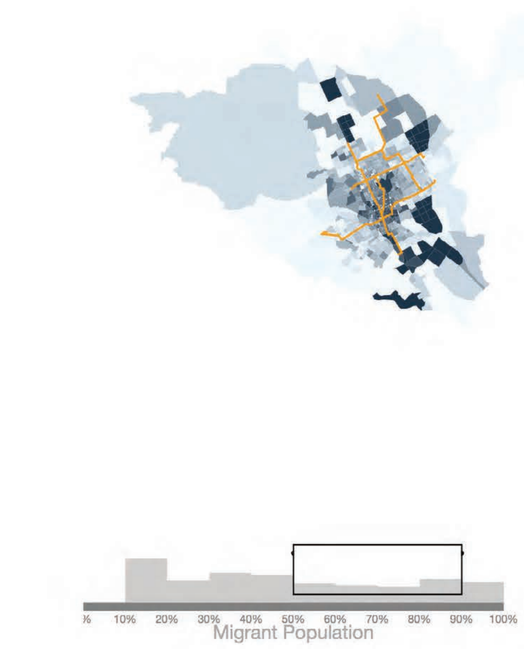
Team: Team: Scott Margeson, MCP'17, Luke Mich, MCP'17

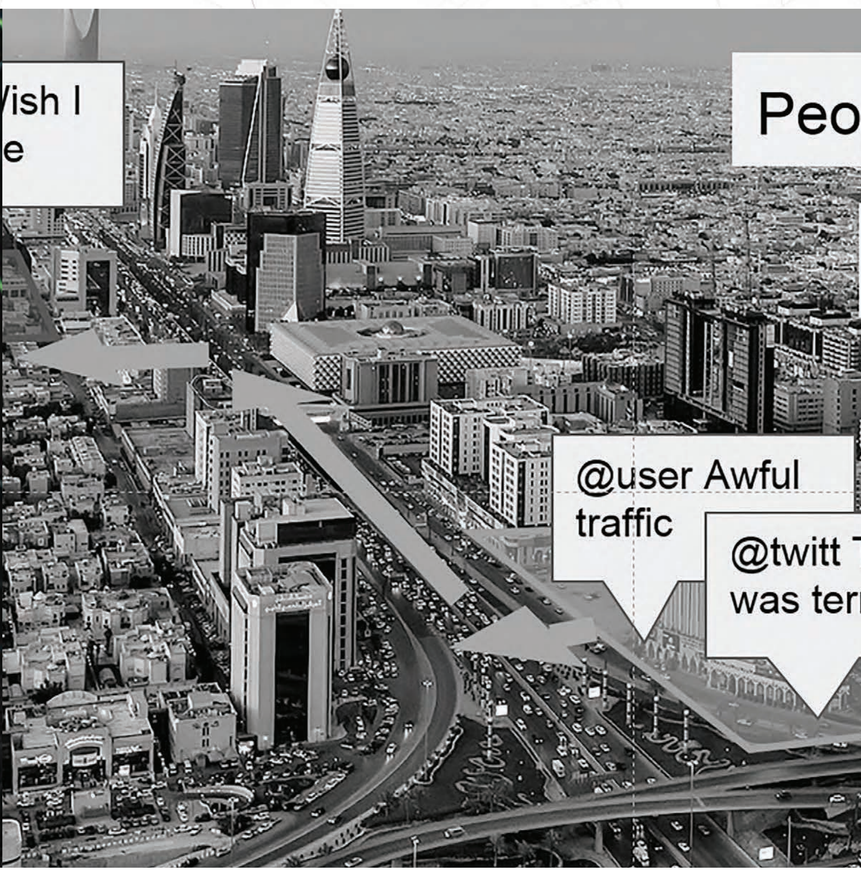
Planning a new transit system requires an understanding of current travel behaviors and needs, but surveys and field observations don't always uncover the whole story. Is there a way we can mine the data that people are constantly sharing? Can social media tell us anything about how people are moving around the city? Our web tool, entitled "Voices of Riyadh," aims to distill travel trends by parsing Twitter for both content and user infor-mation and mapping that data both spatially and temporally.
We began by categorizing tweets by content and user type. We then mapped this data over space and time, allowing users to view trends throughout the week and locate those trends within the city.

STUDENT PROJECTS

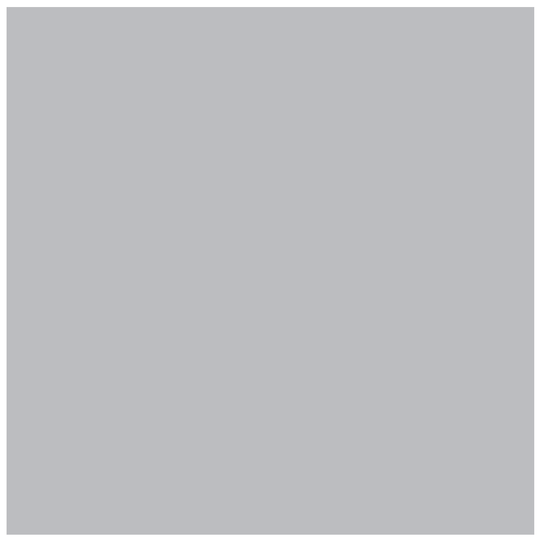








TEAM



Sarah Williams

Director
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Sarah Williams is currently an Assistant Professor of Urban Planning and the Director of the Civic Data Design Lab at the Massachusetts Institute of Technology's School of Architecture and Planning. The Civic Data Design Lab employs data visualization and mapping techniques to expose and communicate urban patterns and policy issues to broader audiences. Before coming to MIT, Williams was Co-Director of the Spatial Information Design Lab at Columbia University. Sarah has won numerous awards, including being named top 25 planners in technology and 2012 Game Changer by Metropolis Magazine. Her work is currently on view in the Museum of Modern Art (MoMA), New York.

Carlos Sandoval Olascoaga

PhD Student, Computation Group
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Carlos is an architect that specializes in computational design. Before joining the Design and Computation Group at MIT, he was a research scientist at UC Berkeley, investigating the convergence of design, data science, and social sciences. In the past four years, Carlos has been a Lecturer at UC Berkeley and a Visiting Professor at UNAM, and has taught computational design seminars and workshops in the United States, Italy, China and Mexico. His work has been supported by numerous fellowships, more recently by the IDEA Studio Fellowship at Autodesk, the National Council of Science and Technology, and the Jumex Foundation for Contemporary Arts. He is interested in urban data visualization, histories of computing in urban design tools, and technological platforms for design collaboration.

Michael Foster

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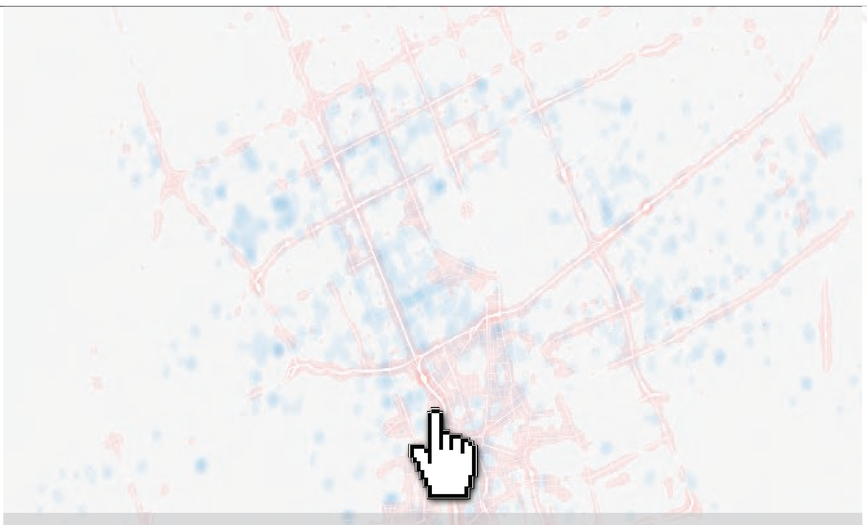
Mike is a GIS/Data Visualization Specialist with DUSP, focusing on high level data visualization, spatial analysis, and cartographic techniques. Mike holds a B.S. in Geography (Cartography and GIS) from the University of Wisconsin-Madison and a Master☒s in GIS and Computer Science from the University of Minnesota. His thesis work involved interoperability, database design, and volunteered geographic information. Before coming to MIT, Mike conducted data analysis and visualization for a large engineering/consulting firm, with a focus on transportation planning and environmental permitting.

STUDENT PROJECTS



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