PASSAGE

A Travel Safety Assistant

CSE 6242 Fall ‘15 Capstone Project

Team

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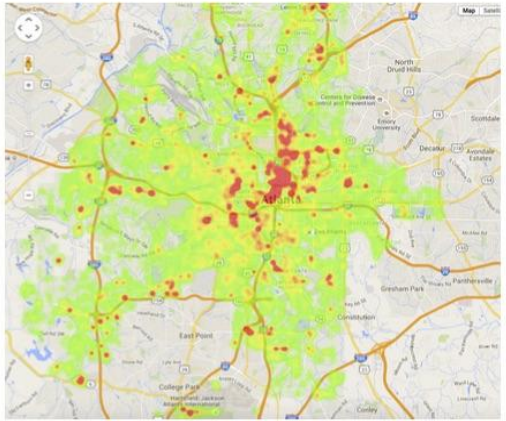
PROBLEM

- Atlanta is one of the most crime-ridden cities in U.S.A.

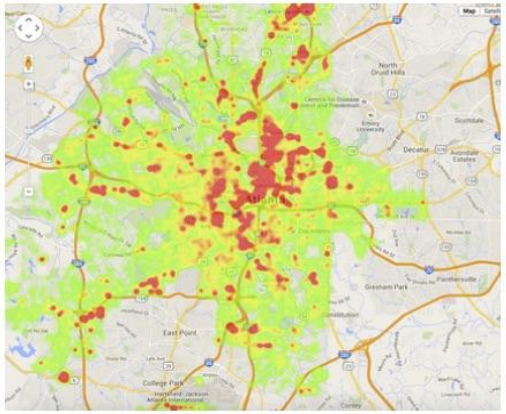
- Pedestrians are highly susceptible to crime, especially at night.

Hours 0-6

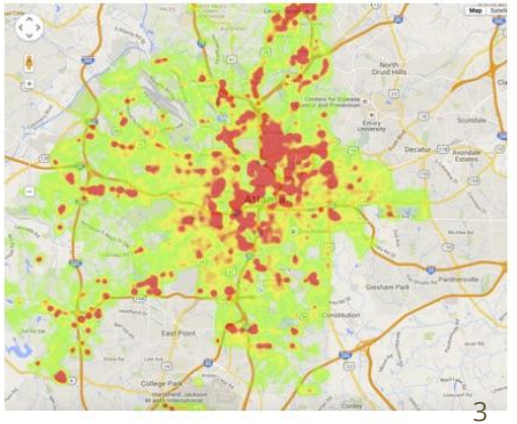


Hours 6-12

Hours 12-18



Hours 18-24



Clery Act Safety Alert
Armed Robbery

Incident Date/Time: December 30, 2014, at approximately 6:15 p.m.

Incident Location: Hemphill Avenue, NW near Center Street Apartments

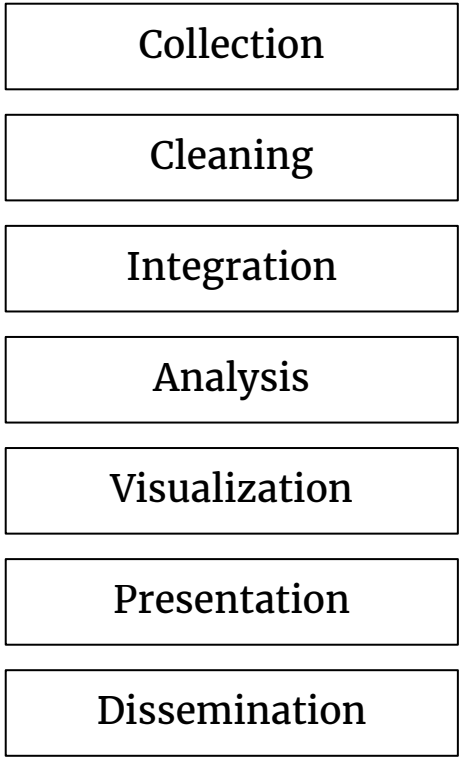
Incident Description: A student reported to the Atlanta Police Department that while walking north on Hemphill Avenue, just north of the Georgia Tech Police Department, he was approached by a black male who brandished a handgun and demanded the student's phone. When the student refused to give the suspect his phone, the suspect fired the weapon in the direction of the student. The student began to approach the male, who retreated to a black 4-door sedan that was parked a short distance away. As the student continued to approach the male, he fired a second shot in the direction of the student before climbing into the passenger seat. The vehicle was last seen heading northbound on Hemphill Avenue. The student believed the gun might have been loaded with blanks.

After the incident, the student continued walking north on Hemphill Avenue before deciding to contact the police approximately ten to fifteen minutes later. The student met with Atlanta Police and Georgia Tech Police at the McDonald's on Northside Drive, where officers began to canvas the surrounding area. Investigators are currently processing the crime scene.

OBJECTIVES

- Enhance walking safety by providing routes with less crime risk
- Provide risk-distance trade-off path choices to users
- Enable safety alert to friends when user is in distress

ANALYTICS BUILDING BLOCKS



Collection | Cleaning | Integration | Analysis | Visualization | Presentation

CRIME DATA

- Atlanta Police Department website
- 2009 → 2015
- ~ 250k crimes
- All crime data in CSV format

MI_PRINX	offense_id	rpt_date	occur_date	occur_time	poss_date	poss_time	beat	location	UC2 Literal	neighborhood	x	y
1160569	90360664	2/5/2009	2/3/2009	13:50:00	2/3/2009	15:00:00	305	55 MCDONOUGH BLVD SW	LARCENY-NON VEHICLE	South Atlanta	-84.3865	33.72024
1160570	90370891	2/6/2009	2/6/2009	8:50:00	2/6/2009	10:45:00	502	464 ANSLEY WALK TER NW	LARCENY-FROM VEHICLE	Ansley Park	-84.3728	33.79685
1160572	91681984	6/17/2009	6/17/2009	14:00:00	6/17/2009	15:00:00	604	375 AUBURN AVE	LARCENY-NON VEHICLE	Sweet Auburn	-84.3752	33.7554
1160573	72692336	2/24/2010	2/24/2010	23:29:00	2/24/2010	23:30:00	303	600 MARTIN ST	AGG ASSAULT	Pittsburgh	-84.3946	33.72212

CLASSES OF CRIMES

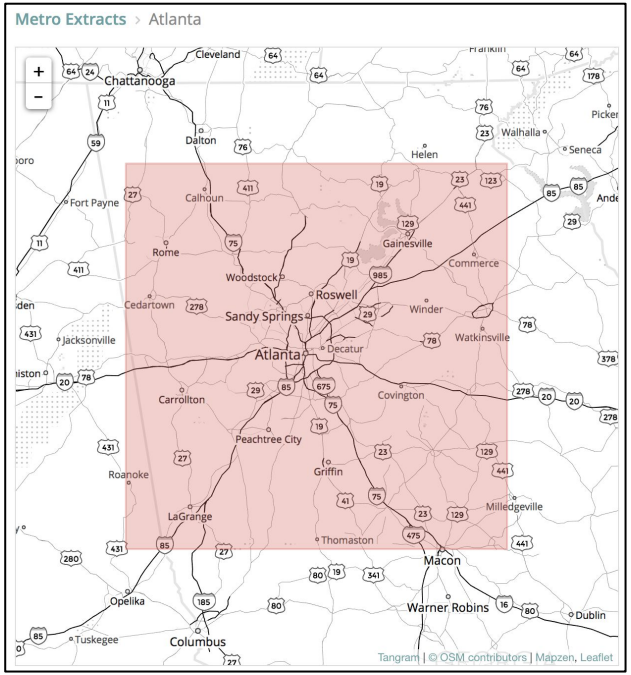
Legend

	> 20,000
	> 5,000 AND < 20,000
	< 5,000

Class	Count (2009 - 2015)
LARCENY-FROM VEHICLE	64345
LARCENY-NON VEHICLE	55902
BURGLARY-RESIDENCE	38277
AUTO THEFT	33256
AGG ASSAULT	16388
ROBBERY-PEDESTRIAN	12483
BURGLARY-NONRES	7243
ROBBERY-RESIDENCE	1632
ROBBERY-COMMERCIAL	1575
RAPE	789
HOMICIDE	592

MAP DATA

- OpenStreetMap of Atlanta
- Downloaded using Mapzen metro extracts



Collection | Cleaning | Integration | Analysis | Visualization | Presentation

Data is usually messy!

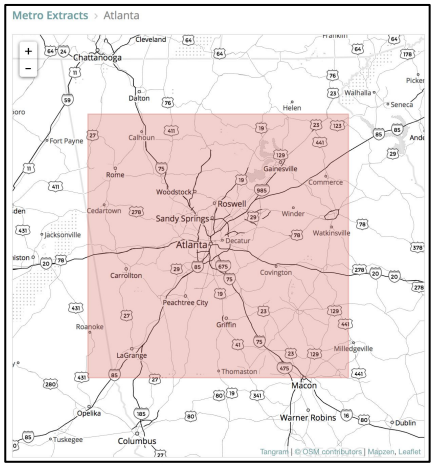
offense_id	occur_date	occur_time	location	Shift	UC2 Literal	x	y	
90360664	02/03/2009	13:50:00	55 MCDONOUGH BLVD SW	Day	LARCENY-NON	-84.38654	33.72024	
91681984	06/17/2009	14:00:00	375 AUBURN AVE	Day	LARCENY-NON	-84.37521	33.7554	
80081069	**01/08/2008**	**13:14:00**	**447 ARNOLD STREET**	**NE**	**Day**	**BURGLARY-RES**	**-84.36896**	**33.76658**
82040835	07/21/2008	18:00:00	1721 BROWNING ST	Eve	BURGLARY-RES	-84.44342	33.75265	
82922120	10/19/2008	18:30:00	3393 PEACHTREE ROAD	Eve	AUTO THEFT	-84.36212	33.84676	
83271617	11/22/2008	16:00:00	106 DOGWOOD DR NW	Eve	BURGLARY-RES	-84.49389	33.78241	

Collection | Cleaning | **Integration** | Analysis | Visualization | Presentation

Integration of 2 datasets

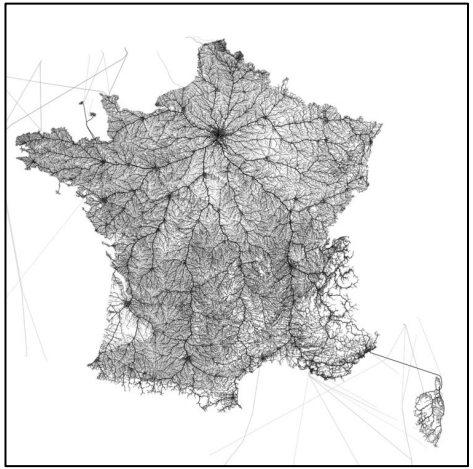
City Crime Data – available by **coordinates** and **time of day**

City Map Data – in **OpenStreetMap** format



MAP DATA

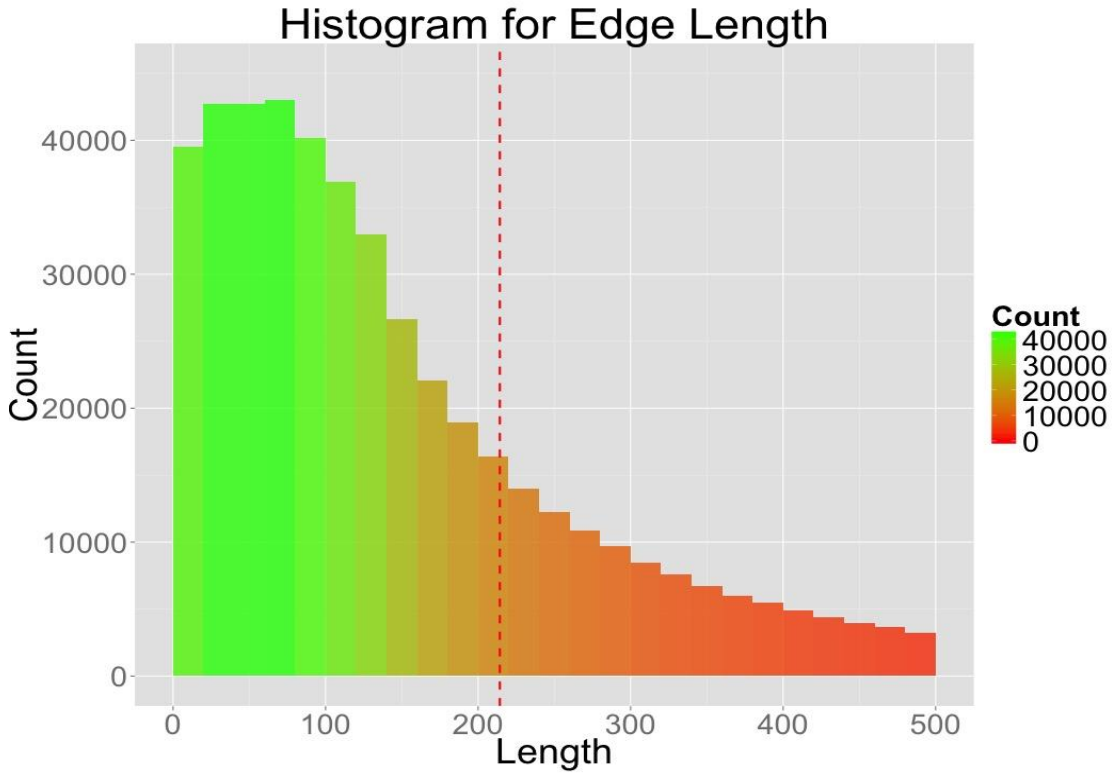
- Converted to a graph using osm4routing
- Graph consists of nodes on every road segment in the city
- Nodes on the same road segment are successively connected by edges
- **Nodes: 111,380**
- **Edges: 141,656**



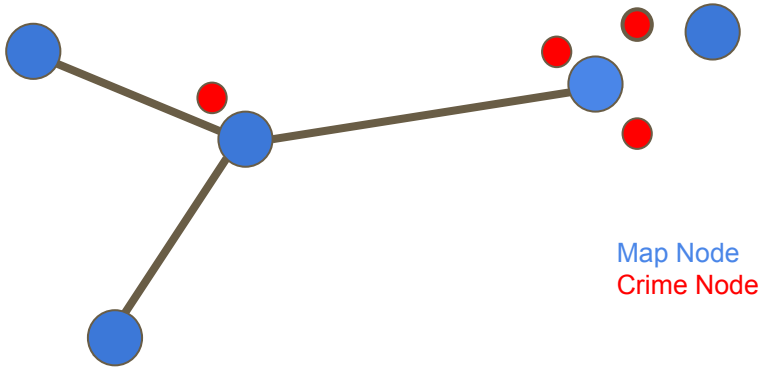
MAP DATA - EDGE LENGTH

Walkable Distance

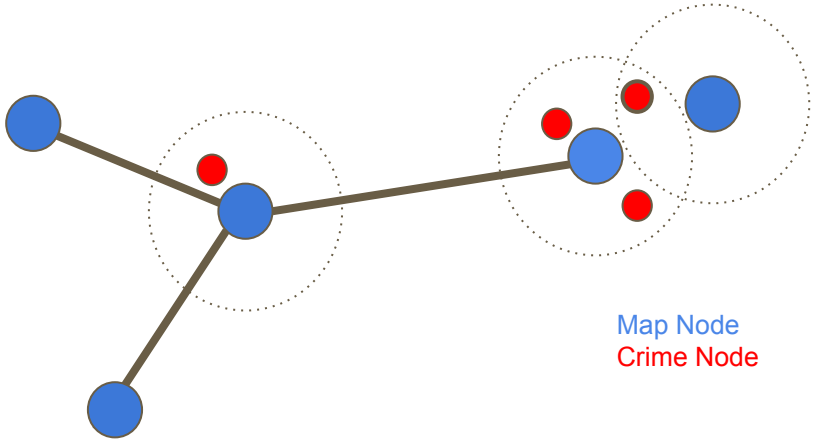
- Skewed left with a mean of ~215m
- Majority of edges being under 150m
- Maximum 400m-500m



RISK OF EDGES

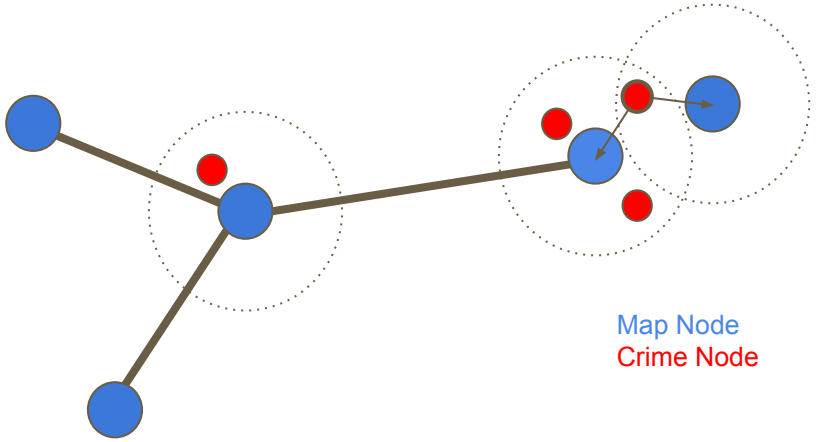


RISK OF EDGES



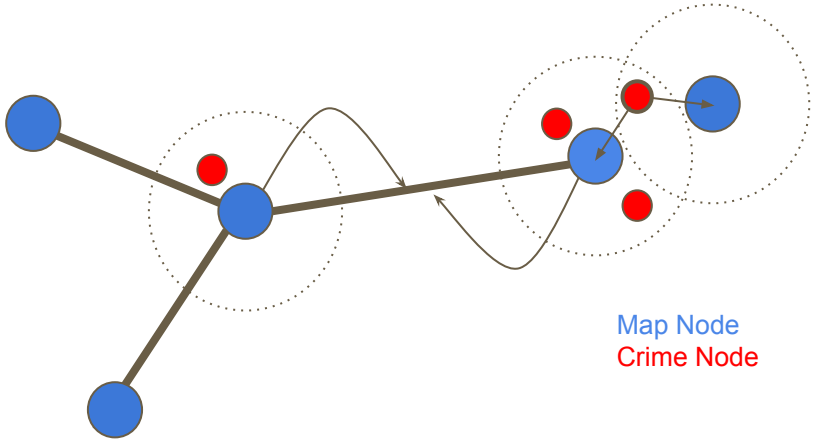
RISK OF EDGES

- Assign risk values to nodes based on crime density



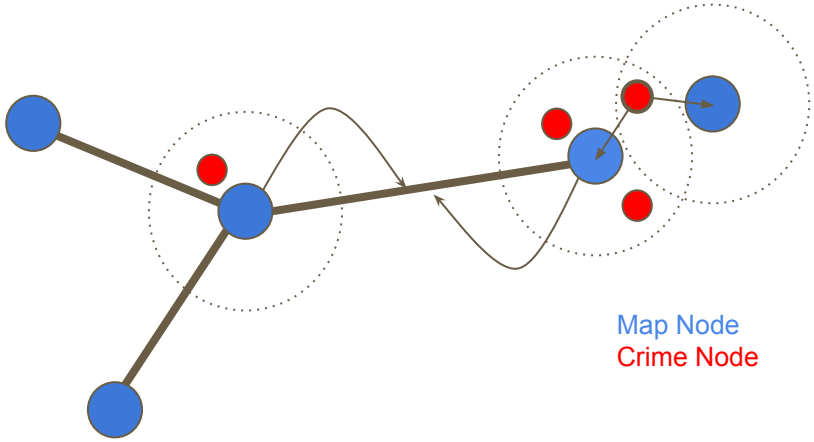
RISK OF EDGES

- Assign risk values to nodes based on crime density
- Assign risk values to edges based on node values



RISK OF EDGES

- Assign risk values to nodes based on crime density
- Assign risk values to edges based on node values
- Each edge has a both a distance and risk value

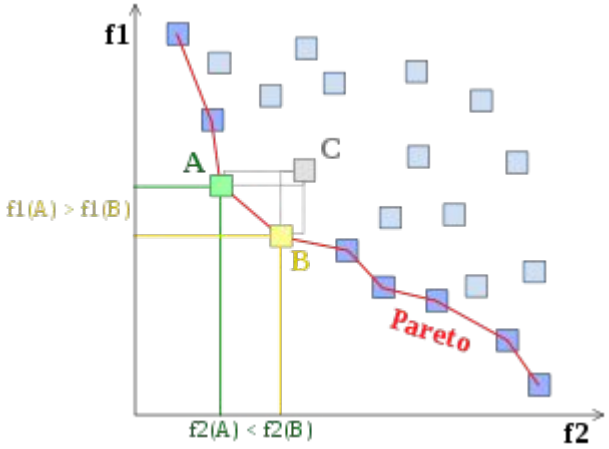


Collection | Cleaning | Integration | **Analysis** | Visualization | Presentation

OPTIMAL PATHS

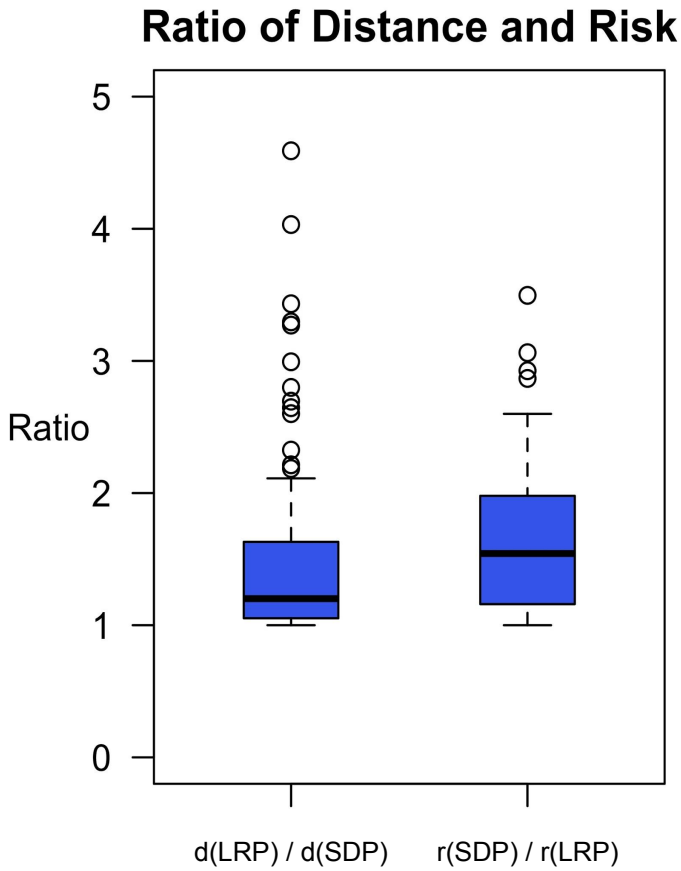
Pulse algorithm

- shortest distance, more risk → least risk, more distance
- pruning algorithm
- outputs all dominant paths



TRADEOFF ANALYSIS

- Left Plot:
  - Ratio of Least-Risk-Path's distance to the Shortest-Distance-Path's distance
  - mean: 1.13
- Right Plot:
  - Ratio of Shortest-Distance-Path's risk to the Least-Risk-Path's risk
  - mean: 1.58
- Takeaway
  - Going from SDP to LRP produces a larger proportional decrease in risk than the proportional increase in distance

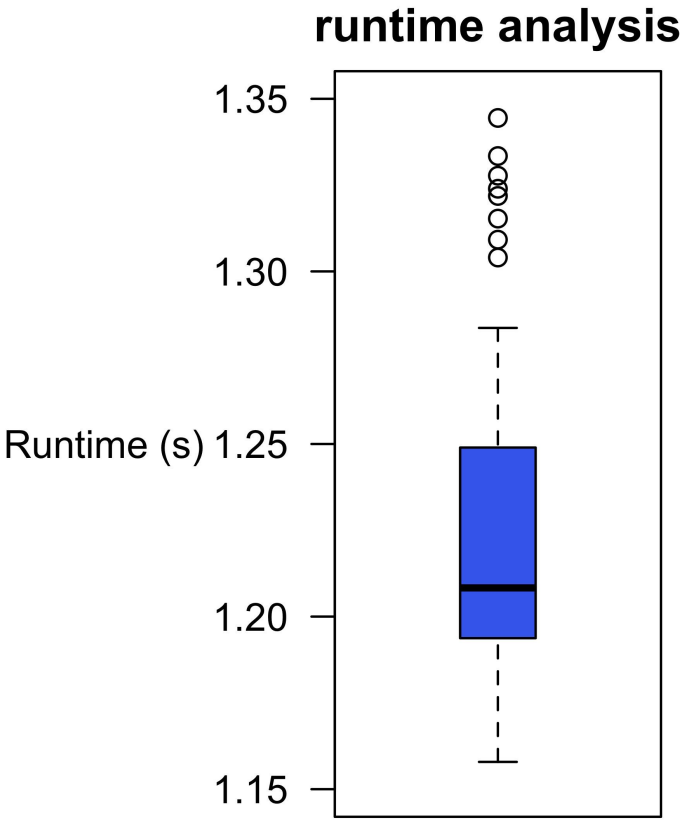


RUNTIME ANALYSIS

400 recorded runtime instances

Statistics (seconds)

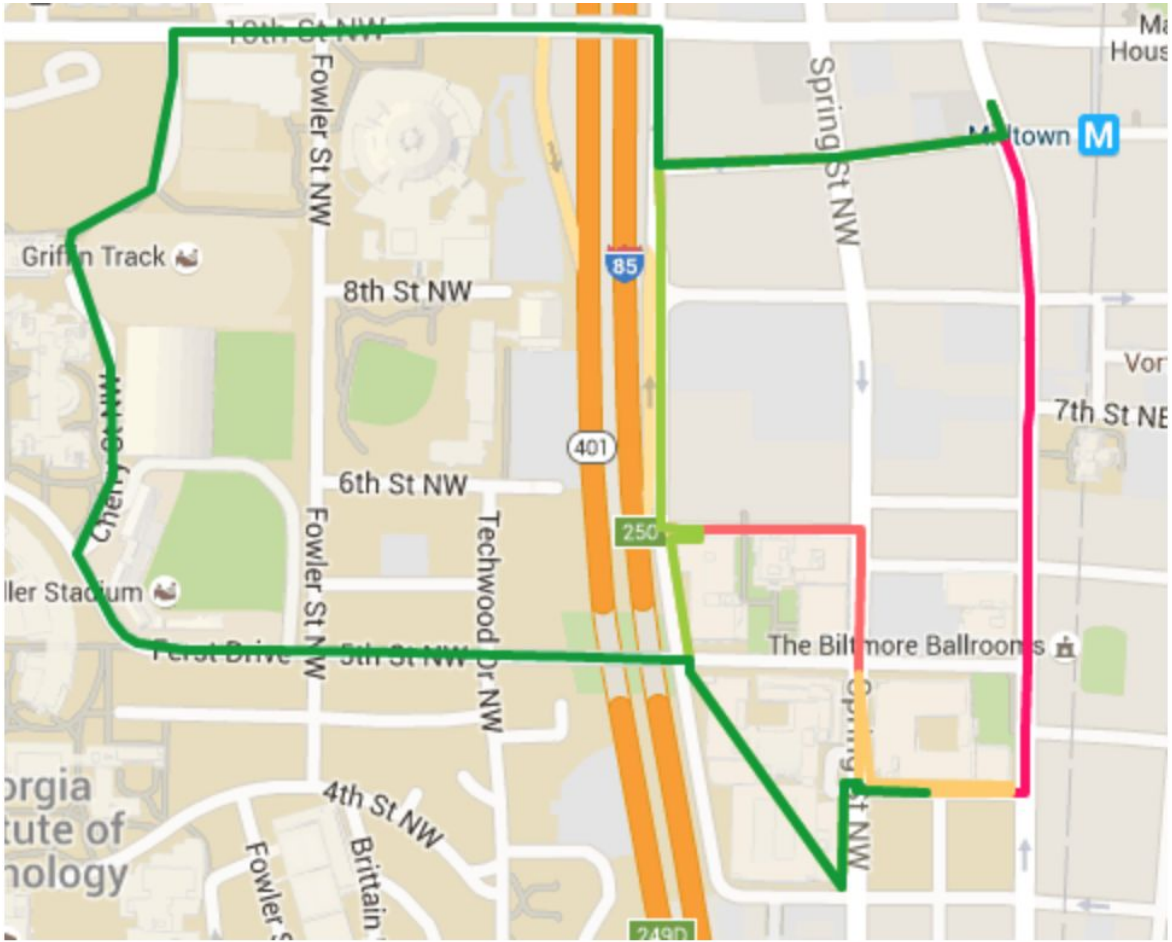
mean	1.22
SD	0.51
max	6.8 (not shown)
min	1.15



TECHNOLOGY

- MongoDB (Storing graph data, geospatial indexing)
- Apache Spark (Preprocessing)
- Python 2.7 (Preprocessing / Back-end)
- Node.js (Back-end)
- Phonegap - HTML/JS (Front-end)

Collection | Cleaning | Integration | Analysis | **Visualization** | Presentation


Fowler St NW
Spring St NW
8th St NW
85
401
6th St NW
Techwood Dr NW
250
Fowler St NW
4th St NW
Brittain
7th St NE
The Biltmore Ballrooms

Collection | Cleaning | Integration | Analysis | Visualization | **Presentation**

DEMO

Alice and Bob login

Alice requests Bob to track her

Bob receives a notification from Alice

Alice confirms her destination

The algorithm offers Alice multiple routes which range from shortest (pink) to safest (green)

Alice starts “safe mode” and places her thumb on the screen

Bob will be notified if Alice removes her thumb, signaling distress

PASSAGE: A Travel Safety Assistant With Safe Path Recommendations For Pedestrians

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Abstract

Atlanta has consistently ranked as one of the most dangerous cities in America with over 2.5 million crime events recorded within the past six years. People who commute by walking are highly susceptible to crime here. To address this proble… …up has developed a mobile application, PASSAG… …d crime data to find "safe pat… Atlanta. user int…

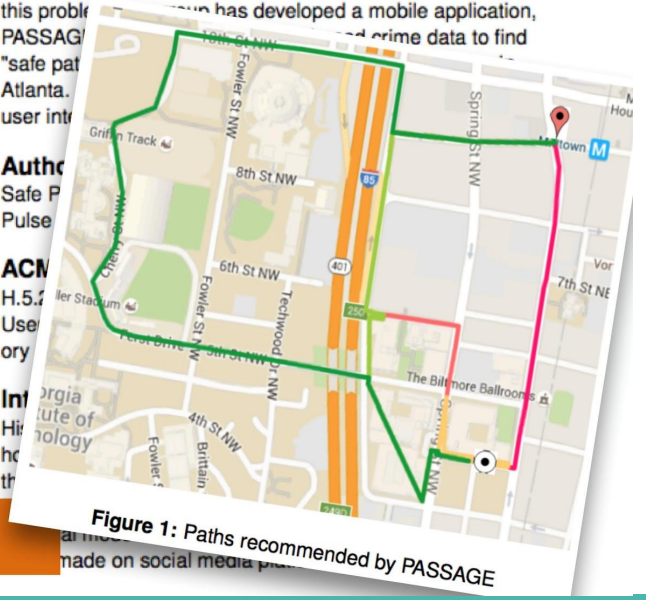
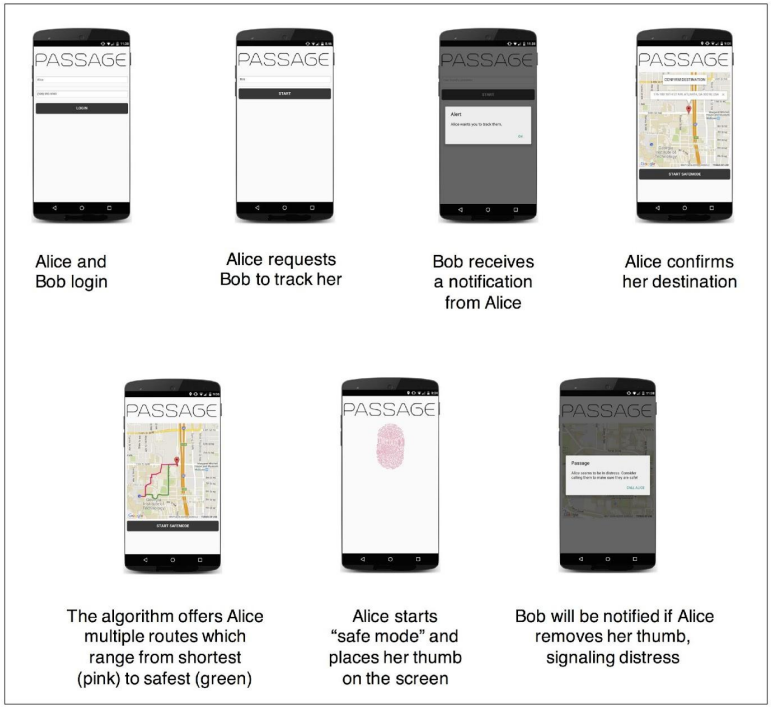


Figure 1: Paths recommended by PASSAGE

IUI'16 Poster paper



PASSAGE

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