City Disaster Planner

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Problem 3: Introduction

Tower of The Four Winds:

- 50 BC ~ 1 BC
- Oldest existing weather station
- A Disaster Predictor

Problem 3: Optimize First Responder Routes

- ★ Use Google maps to chart best travel routes based on observed Traffic for any city
- ★ Use Social Media to identify road closures
- ★ Simulate emergency evacuation locations, randomize police, and destroyed roads
- ★ Optimize dispatch for police and rescue for any city

Problem 3: Workflow

Google and Osmnx

- Use Python Package Osmnx and Networkx to build model of Medford.
- Based on four times of day, have google route crosstown traffic.

Social Media

- Use Mass511, Twitter, and Navbug to identify roads to remove from from network

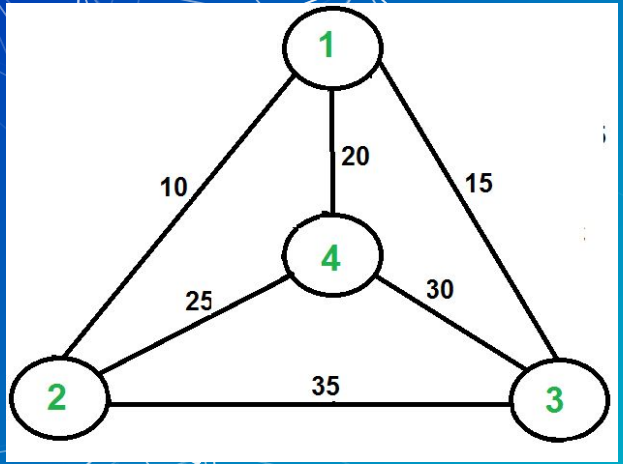
Simulate Disaster

- Destroy a radius of roads based on a random disaster location
- If google route destroyed, calculate alternate route
- Dispatch Police

Problem 3: Analysis / Traveling Salesman

Google and Osmnx

- Social Media and Disaster destroys edges (roads)
- Nodes are the points of all emergencies
- Google and Networkx label edges based on travel speed



www.geeksforgeeks.org/travelling-salesman-problem-set-1/

Problem 3: Analysis / Most Stable Marriage

Networkx

- Given a set of disaster locations and random police locations, find the best match to reduce travel time for the entire ensemble

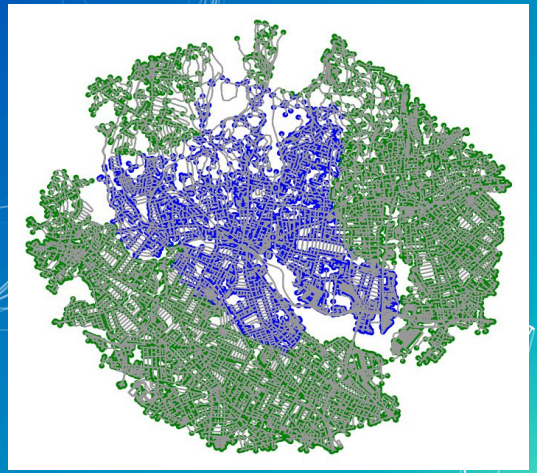
Fiddler on the Roof

Problem 3: Graph Analysis

Google and Osmnx

Osmnx

Google and Networkx



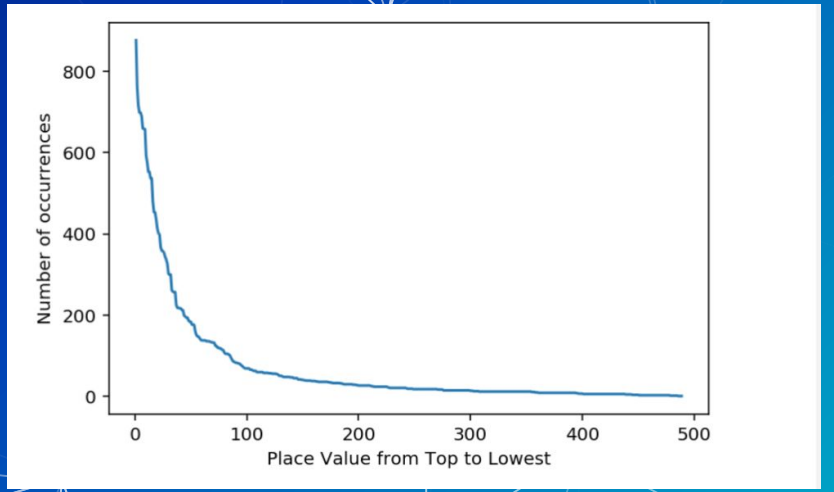
Google maps

-- Travel distance -- Time -- Alternative routes

x_start	y_start	x_end	y_end	Time_adj	distance	duration_in_traffic	coordinates	directions
-71.090072	42.436659	-71.092265	42.411050	May 31 2019 8:30AM	2.8 mi	9 mins	{0: {'lat': 42.4373659, 'lng': -71.08992169999...	{0: 'Head north on Palmer St toward Park Ave',...
-71.090072	42.436659	-71.092265	42.411050	May 31 2019 3:30PM	2.8 mi	9 mins	{0: {'lat': 42.4373659, 'lng': -71.08992169999...	{0: 'Head north on Palmer St toward Park Ave',...
-71.090072	42.436659	-71.092265	42.411050	May 31 2019 5:30PM	2.8 mi	10 mins	{0: {'lat': 42.4373659, 'lng': -71.08992169999...	{0: 'Head north on Palmer St toward Park Ave',...

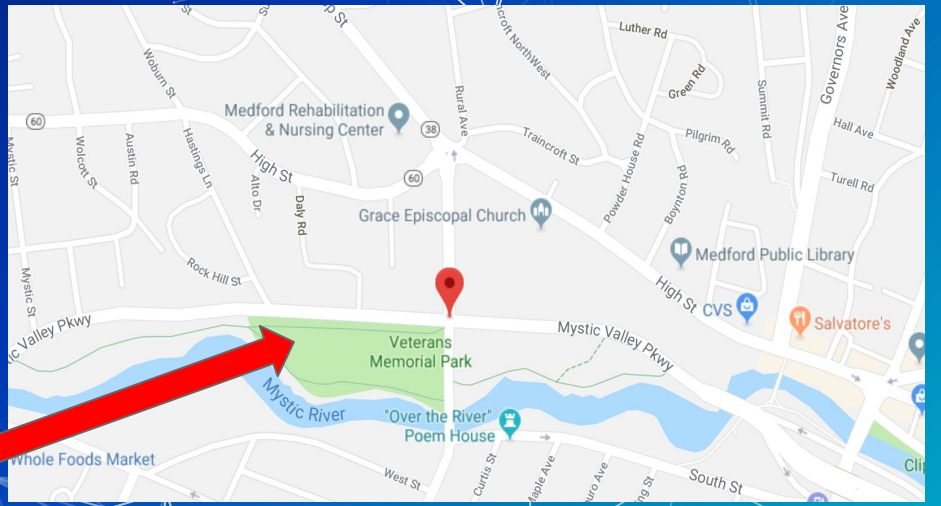
Google maps

- **Google identified the most important nodes by frequency of use**



	highway	osmid	ref	x	y	geometry	major	color	major_inter	medford	traffic_importance
66455370	traffic_signals	66455370	MA 16/MA 38	-71.117942	42.419096	POINT (-71.117942 42.419096)	MA 16 MA 38 MA 16;MA 38	black	6	1	877
66458425	traffic_signals	66458425	NaN	-71.110596	42.416629	POINT (-71.1105965 42.4166294)	MA 38	goldenrod	1	1	699
66459547	traffic_signals	66459547	NaN	-71.121782	42.411549	POINT (-71.121782 42.411549)	minor	whitesmoke	0	1	690
66462764	NaN	66462764	NaN	-71.097592	42.405835	POINT (-71.09759200000001 42.405835)	MA 16	cadetblue	1	1	593

Google maps



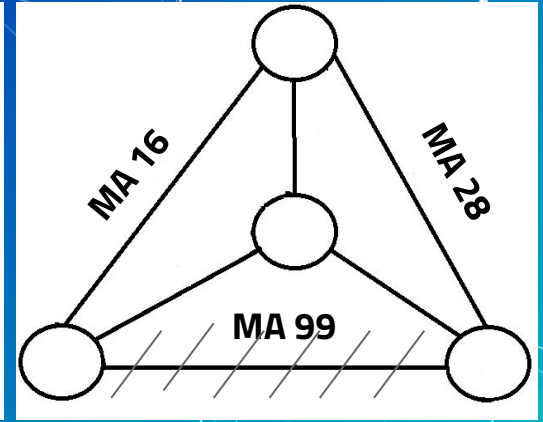
- Evaluate the magnitude of the impact, urgency of the situation, and need for resources

Twitter

- Realtime
- Roads conditions (closures, jams, etc.)

Twitter

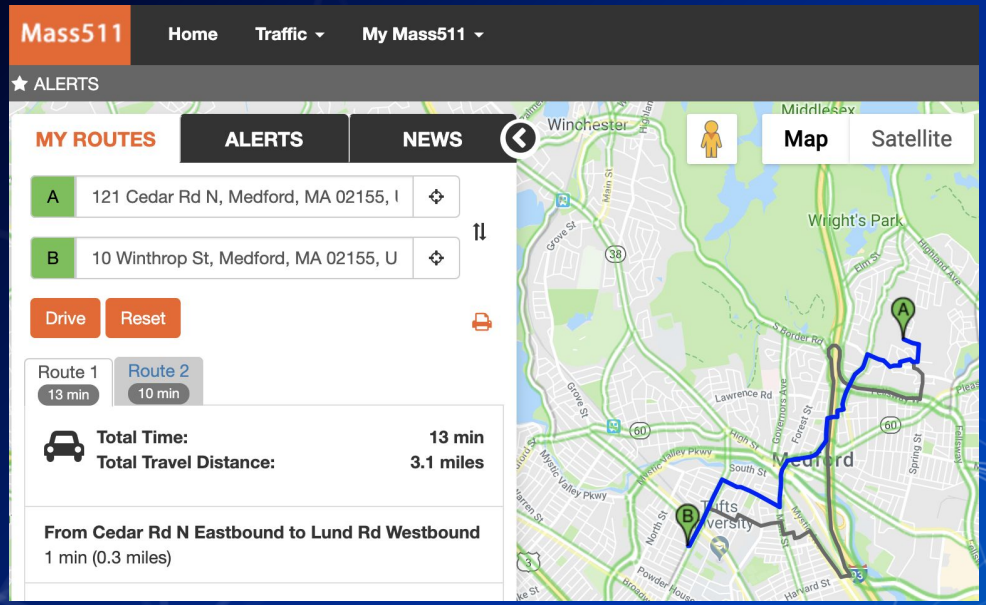
Start	End	Road closed	tweets
MA 16	MA 28	MA 99	Road closed intermittently in #Medford on Rt-1...
I 93	MA 16	MA 28	Road construction, left lane closed in #Medfor...
I 93	MA 60	MA 28	#Woburn road construction. two lanes closed on...



Aim of the Data Scrape

- The tools you use could be any live traffic application or social media in order to see the shortest time to place
- If you want to use these tools effectively you should integrate these tools to your model.
- The more sources the more reliable

Mass511



- Mass511:
  - Alternative app for google.maps
  - Live traffic
  - It gives min 1, max 2 Route options for given two points
  - Have check boxes for map features

https://mass511.com/

Coding for Mass511

- Which Way?
  - Api Key
  - Selenium Webdriver <---
- Coding?
  - Make EDA with the given data by Michael
  - X, and Y coordinates are entered to origin and destination points
  - Scrape the all given data (total time, total distance, breakdown of the time and distance for each leg)
  - 3,000 origin & destination scraped

https://mass511.com/

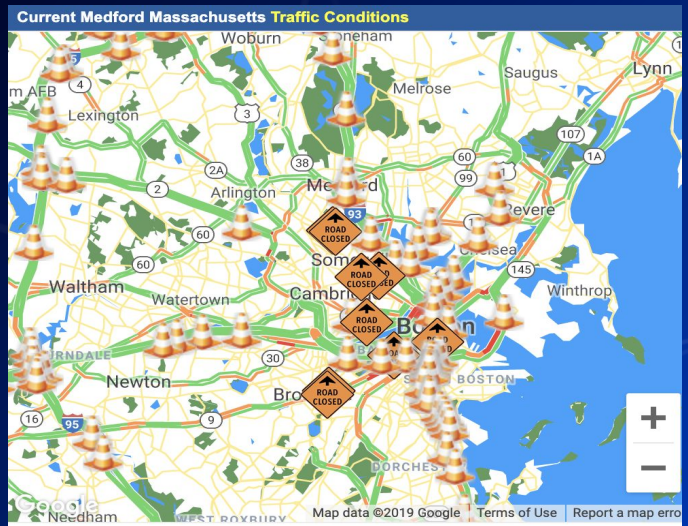
Coding for Mass511

- Selenium

from to where	direction	route	x_start	y_start	x_end	y_end	origin	destination	start_zone	end_zone	time	distance
From 616 Fellsway, Medford, MA 02155, USA to 9...	{0: 'From Fellsway Southbound to Mystic Valley...	Route 1	42.405726	-71.082345	42.427037	-71.093567	42.4057258, -71.08234470000001	42.4270375, -71.0935666	2.0	1.0	5 min	2.2 miles
From 616 Fellsway, Medford, MA 02155, USA to 9...	{0: 'From Fellsway Southbound to Fellsway W We...	Route 2	42.405726	-71.082345	42.427037	-71.093567	42.4057258, -71.08234470000001	42.4270375, -71.0935666	2.0	1.0	5 min	2.2 miles
From Interfaith Center, 58 Winthrop St, Medfor...	{0: 'From Emery St Westbound to Hillsdale Rd N...	Route 1	42.411153	-71.122030	42.432024	-71.088900	42.411153000000006, -71.12203000000001	42.4320236, -71.0889002	0.0	1.0	12 min	4.6 miles
From Interfaith Center, 58 Winthrop St, Medfor...	{0: 'From Emery St Westbound to Hillsdale Rd N...	Route 2	42.411153	-71.122030	42.432024	-71.088900	42.411153000000006, -71.12203000000001	42.4320236, -71.0889002	0.0	1.0	12 min	4.0 miles

https://mass511.com/

navbug.com



Latest Accident and Construction Reports Around Medford MA

At Mystic Valley Pky/Exit 31 - Queuing traffic. Approach with care. (...)
TYPE: CONGESTION | MODERATE

At RT-60/Exit 32 - Queuing tr
TYPE: CONGESTION | MODERATE

Closed at Broadway/Dexter S
TYPE: CONSTRUCTION | SERIOUS

city	road	news_feed
MEDFORD	I-93	Boston News, Weather, Sports | WHDH 7NewsBILL...
MEDFORD	I-93	CBS BostonA Massachusetts State Police troope...
MEDFORD	I-93	CBS Boston / WBZA 17-year-old has been charge...
MEDFORD	I-93	MEDFORD, MA - I-93 South traffic is backed up ...
MEDFORD	I-93	MEDFORD, MASS. (WHDH) - A car caught fire on I...

- Navbug:
  - Alternative site for Mass511
  - Shows live traffic map
  - No choice for origin & destination
  - Live news about the traffic
  - Don't give route options but keywords are helpful
- Coding:
  - Scrape the news titles , subtitles and stories
  - Scrape related roads
  - Scrape the key words e.g., 'Road Close' , 'Construction' in order to destroy the mentioned road in the Model
  - 263 rows scraped

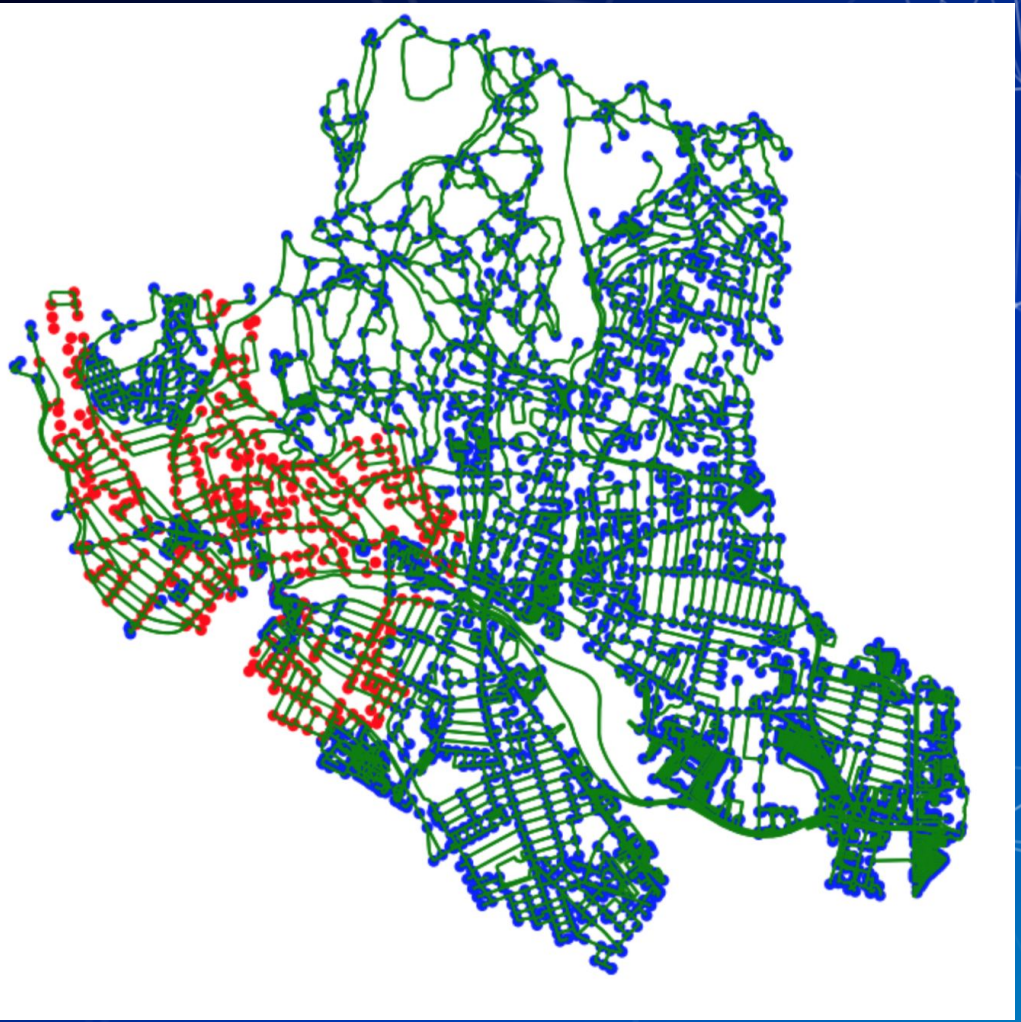
https://www.navbug.com/massachusetts/medford_traffic.htm

Problem 3: Disaster Simulation

```
#returns a graphs object of a disater
disaster = gf.disaster_generator(nodes_med, radius = 2500)
```

Disaster Simulation

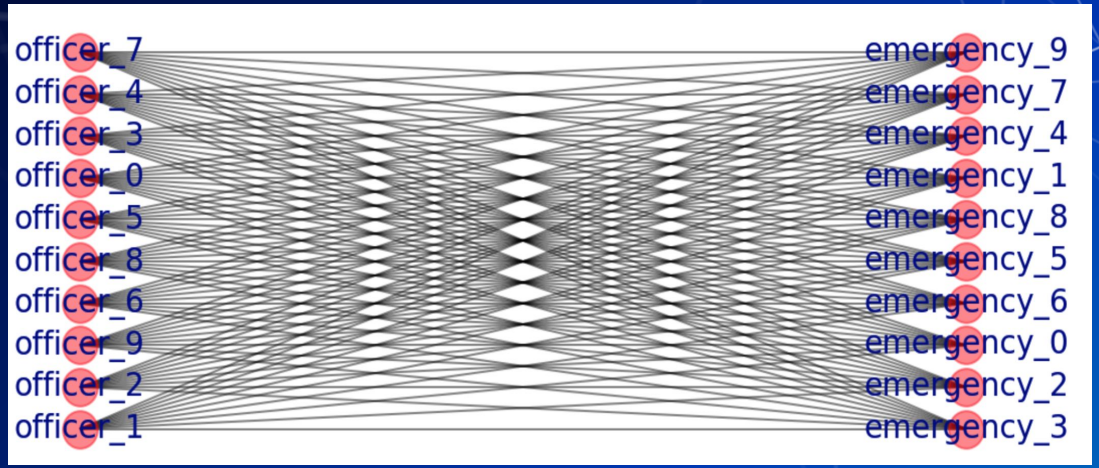
- Destroys a percentage of roads in the radius of a random disaster location
- Destroys roads based on social media input

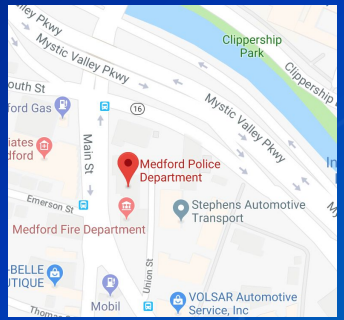


Disaster Simulation

- 10 Disaster Nodes are selected as emergency locations
- Unreachable Locations are given a distance of 10 km

Problem 3: Disaster Simulation Rules

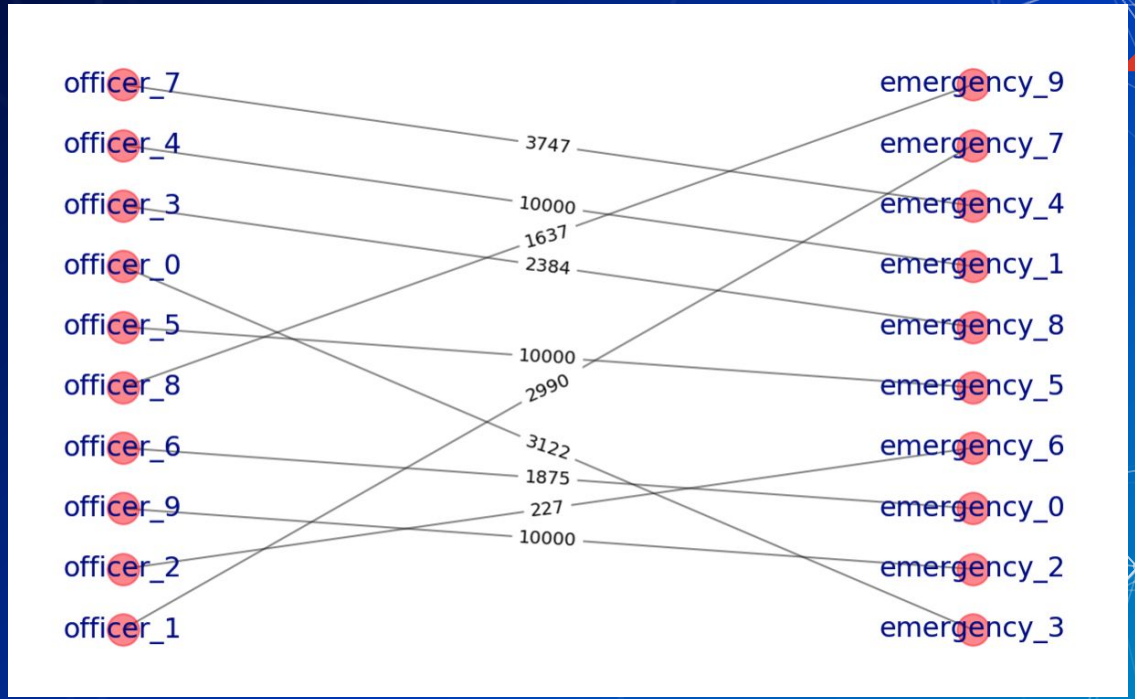




Disaster Simulation

- 5 patrol officers anywhere in Medford
- 5 officers dispatched from station
- I-93 Taken out by disaster

Problem 3: Disaster Simulation Results



Disaster Simulation

- Routes successfully charted
- Distance Calculated
- Optimal pairing found!

Takeaways

- More simulations for different cities
- Implement live updating of map on web
- Plot escape routes for emergency nodes

Questions?