



OPTIMIZING EVACUATION ROUTES DURING DISASTERS

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US-DSI-10

Hurricane Harvey August-September 2017



PROBLEM STATEMENT

Optimizing Evacuation Routes using Real-Time
Traffic Information

PROBLEM #1

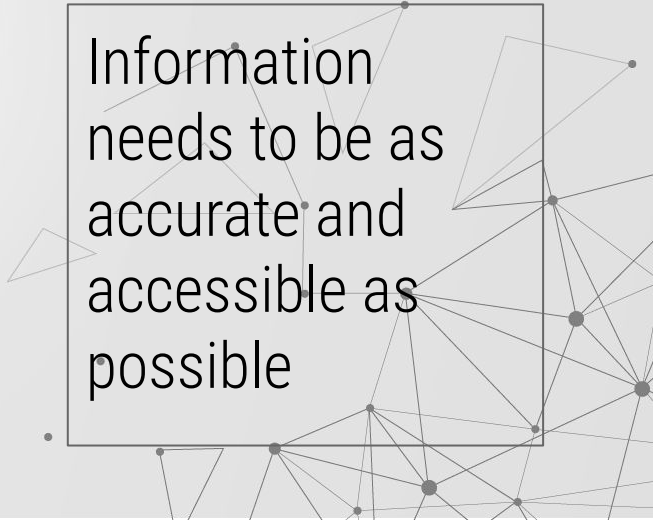
During disasters, people need real-time information quickly

PROBLEM #2

Current GPS and navigation systems are not prepared for disasters

PROBLEM #3

Information needs to be as accurate and accessible as possible

A decorative network diagram consisting of a series of interconnected nodes and lines, resembling a graph or a map, is positioned in the bottom right corner of the slide. The nodes are represented by small circles, and the lines are thin, light gray lines connecting the nodes in a complex, web-like pattern. The diagram extends from the right edge of the slide and partially overlaps the bottom of the 'PROBLEM #3' box.



DATA COLLECTION

Scraped 69 official Twitter accounts

01

EDA & CLEANING

Identified tweets with useful information

02

MODELS

Trained 4 models to predict useful tweets

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Extracted locations from useful tweets

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Mapped coordinates & possible developments

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Our method works





01

DATA COLLECTION

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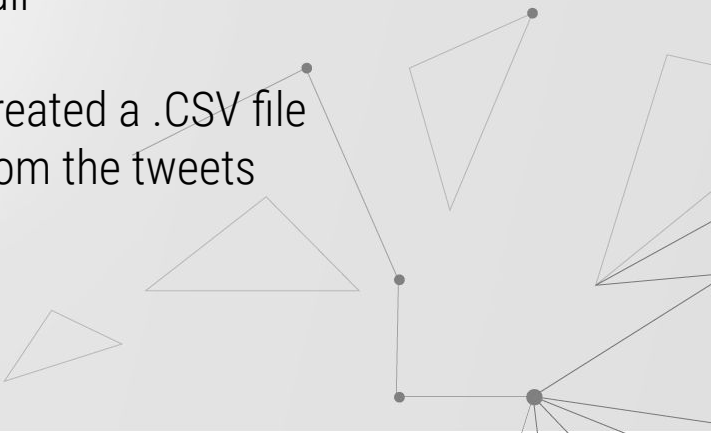
Sources

- All data came from **Twitter**
- About **174,000** tweets in total
- Tweets were collected from **January 2016 to February 2020**
- Feeds: **TX State Dept. of Transportation, 38 local DOTs, 30 police departments** of the most populous cities and towns

75545	ia Looks like Air was assisting with a call that came in around 5pm last night someone reported hearing shots fired near the block of Springdale Rd but no injuries were reported APD PIO
75546	PD was called out to that address regarding an Agg Assault incident around 5pm last night There is an open investigation right now Doesn't look like anyone has been arrested yet APD PIO
75547	Traffic is being diverted on to Parmer as crews continue to work this multivehicle crash Please avoid the area if possible
75548	Hi Monica we sent a media advisory out about our highway enforcement safety initiatives You can read it here
75549	Have you recently bought a vehicle Check the glove box for a valet key A message from your APD Auto Theft Unit SaferTogether AustinPD
75550	an please reach out to your district representative officers They would be your best resource to have directed patrol added to the area Looks like Woodward and St Elmo would be Region
75551	t we announce Keeper a beloved retired horse from APDs Mounted Patrol Unit passed away yesterday Retired APD Det Joanna Candoli cared for Keeper after his service with APD AustinPD
75552	APD News Release APD needs publics assistance identifying a person of interest
75553	Looking for a pet Visit Rocky at the Austin Animal Center today APDRescueMe
75554	d Never leave children pets or elderly who may need assistance exiting a vehicle in a hot car If you see something say something Always call for emergencies AustinPD SaferTogether ATX
75555	Media Corporal Jansky will be providing a media briefing on the traffic fatality train hitting a pedestrian Give her 15 minutes to head to your set up location PIO
75556	train and pedestrian Please stand by for more information Detectives are on the way to scene to investigate and gather more information Media No briefing scheduled at the moment PIO
75557	Missing 4 and 5 year old children have been found safe in NW Austin and are being reunited with family WC
75558	for CoffeeWithACop this Thursday at Rudys to meet your local law enforcement We hope to see you there and will be happy to discuss any safety concerns you may have AustinPD Safety
75559	iversity of New Mexico with a degree in Criminology and minor in Journalism Ofc Silva currently works in the Public Information Office but previously worked in PTU and patrolled NE Austin
75560	Never drink and drive Always have a plan to ArriveAlive
75561	Help keep our community safe Check out these safety practices to remember while driving Watch for pedestrians Dont text and drive Never drive after consuming alcohol ATX Safety
75562	reet please be safe Use a crosswalk when available If youre walking at night try to wear light colored clothing or reflective gear See more safety tips below AustinPD ATX PedestrianSafety
75563	Happy birthday UTAustin If you plan to attend the game and celebrate make sure you have a safe plan to get home Dont drink and drive HookEm ArriveAlive SaferTogether
75564	Do you know someone who would make a great police officer Is it your calling to be a public servant Start your journey with us today AustinPD SaferTogether
75565	Buying a used vehicle this weekend Check out these tips from our Auto Theft Unit AustinPD SaferTogether
75566	If youre driving this weekend stay off your cell phones Austin is a handsfree city Dont text and drive ItCanWait AustinPD SaferTogether
75567	its off Slaughter Ln We appreciate you helping this great cause For those whod like to come well be here for another hour hope to see you soon ATX CommunityPolicing at Dunkin Donuts
75568	egion here Hope youre staying dry in this rainy weather If youd like to support SOTexas join us this morning at Dunkin Donuts off Slaughter Ln Well be here till 5am AustinPD SaferTogether
75569	ce officer Womens Info Session will be held TODAY at Rutherford Ln Bldg Austin TX at 2pm Come by or tune in live to learn about the hiring process and why this is a great career JoinAPD
75570	LT Summers here at dunkindonuts off Slaughter Lane Come out and support SOTexas with any donation we will provide you with a free donut coupon
75571	al Academy in Quantico VA She was selected to attend the intense week program because of her demonstrated leadership and professionalism here at APD AustinPD ATX Congratulations
75572	Ofc Cadenas providing a closing media briefing for our SWAT call out in SW Austin
75573	Media SWAT call out has ended subject detained and in custody Meet Officer Cadenas at 2pm at the blk of Brodie Ln for a briefing
75574	Hungry for some donuts Come visit us at the Dunkin Donuts off Slaughter Ln Well be here from 2pm to 5pm in support of Special Olympics Texas AustinPD ATX CommunityPolicing
75575	Ofc Cadenas providing a media briefing for our SWAT call out in SW Austin
75576	Media Please meet Officer Cadenas for a media briefing involving our SWAT call out Media stage at the block of Harpers Ferry Ln Media briefing to be held at 2pm PIO
75577	Media Officers are working an active call in SW Austin that originated as a Check Welfare Urgent SWAT is on the way to the scene please stand by for a staging point and for a briefing time
75578	call a friend or a cab use a rideshare or public transportation Whatever your choice dont get behind the wheel Keep our streets safe and have a plan to ArriveAlive AustinPD SaferTogether
75579	o Session TOMORROW at Rutherford Ln Bldg Austin TX at 2pm and will stream it live on Facebook Come by or tune in live to learn about the hiring process and why this is a great career



Methods

- Used Python with **GetOldTweets 3** library
 - Created list of Twitter handles for each feed to pull from
-
- For each handle: specified start date, end date and 10k limit on number of tweets to pull
 - Created a .CSV file from the tweets
- 



02

EDA & CLEANING

EDA & Cleaning

Routine EDA

Null values,
data types and
features

Filters

Discovering relative words with
Word-Vectors
Create two layers of filters
Apply filters and create two sets of
dataframes

Layer 1

Street name
and location
related

Layer 2

Filtering out
misleading words





03

MODELS

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MODEL EVALUATION

- Logistic Regression
- Random Forest
- ADABOOST Classifier
- Support Vector Classifier



7

Model Gridsearches

94.9%

Baseline Accuracy

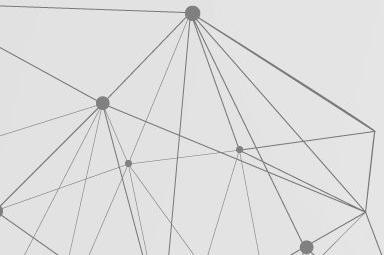
% of tweets in the train dataset that are not useful

99.7%

Model Accuracy

Logistic Regression with CountVectorizer

Cross-Validation Train Score & Test Score



PARAMETERS



max_features

= 500

Number of words
from tweets used
in the model



ngram_range

= (1, 2)

Considered
maximum of 2
words as a group



stop_words

= None

Did not remove common
English words



C

= 1.0

Strong
regularization



penalty

= l1

Lasso
regularization →
feature selection



max_iter

= 100

Iterations for
solver (liblinear) to
converge

CONFUSION MATRIX

Test Set of Train Data

	Predicted: Not Useful	Predicted: Useful	METRICS
Actual: Not Useful	39,115	73	Specificity: 99.81%
Actual: Useful	39	2074	Sensitivity: 98.15%
METRICS	FNR: 99.90%	Precision: 96.60%	



MISCLASSIFIED TWEETS?

"TxDOT offices will be closed
in observance of
NewYearsDay on Tuesday Jan
Well be back in the office on
Wednesday Jan Best wishes
for the NewYear"

CLASSIFICATION: 1
(useful)

PREDICTION: 0
(not useful)

"REMINDER Anthony
overpass is closed tonight
for bridge work Plan to exit
Vinton then take Doniphan"

CLASSIFICATION: 0
(not useful)

PREDICTION: 1
(useful)



APPLICATION



PICKLE MODEL

Export model to use
on different
platforms

Use model to predict
utility of test dataset
of tweets

GET PREDICTIONS



USEFUL TWEETS

Return only useful
tweets through filter
for further analysis

The background features a complex network of thin grey lines connecting various-sized dark grey circular nodes. These nodes are scattered across the page, with some forming dense clusters and others standing alone. The lines create a web-like structure that fills the background, giving it a technical or digital feel.

04

LOCATIONS & COORDINATES

Extracting Addresses from Tweets

- Method: regular expressions
- Each expression finds a very specific pattern of characters in a string of text
- Multiple expressions can be combined to search for more complicated patterns

Example regular expression:

`l\-[0-9]+\s[0-9a-zA-Z]+\s[0-9a-zA-Z]+\s[0-9a-zA-Z]+`
(will find ex. "l-10 East at Mesa")

- 6 regular expressions were created
- In each tweet: first expression searched for; if not found, second expression searched; and so on
- 43 address were found and compiled in a list

Obtaining Coordinates

Method Employed



- Geocoder



Methods Attempted



- Google Map



- Here.com



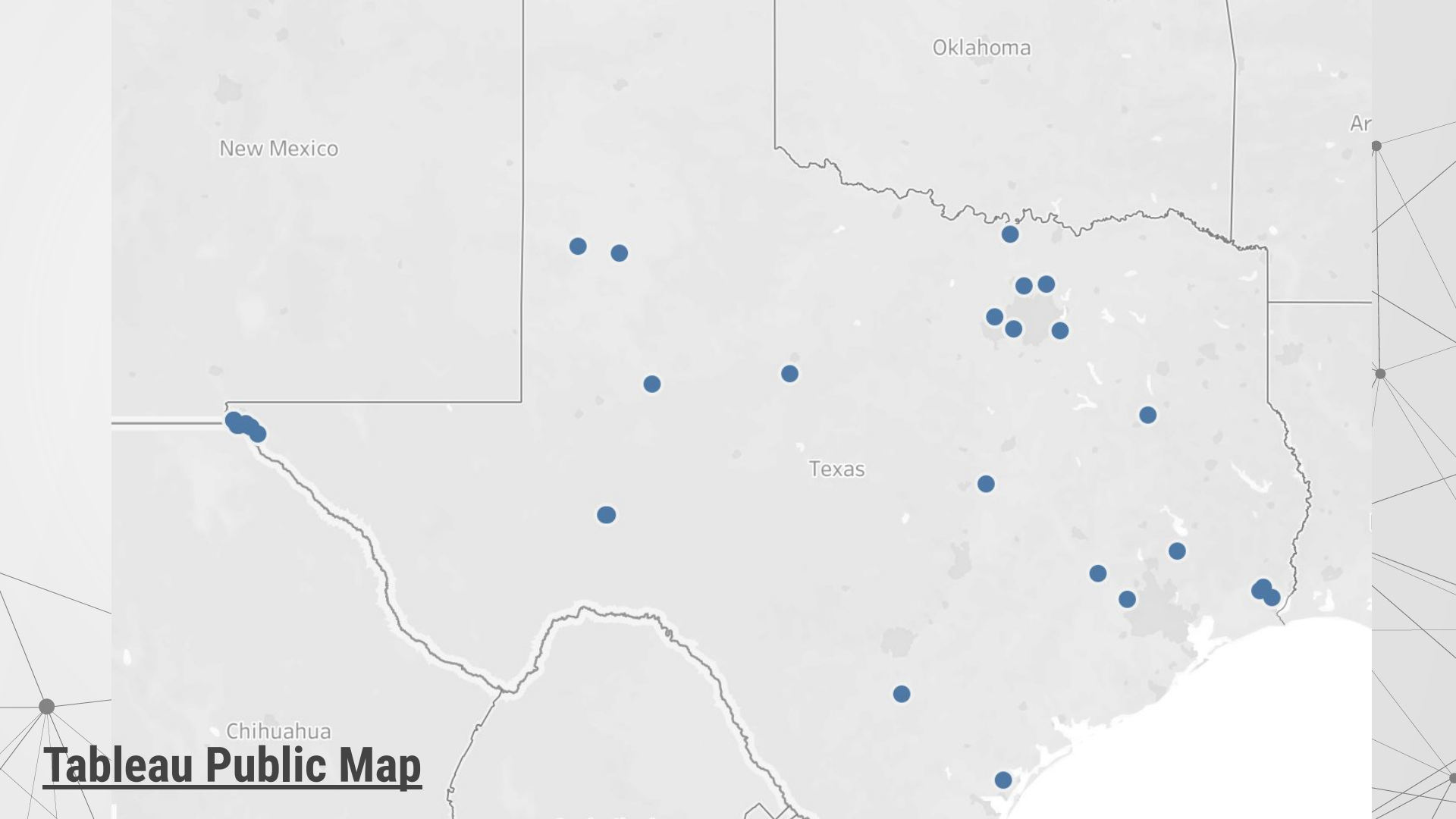
- Waze Map



The background features a light gray geometric pattern. It consists of a network of thin gray lines connecting various-sized dark gray circular nodes. These nodes are scattered across the page, with a higher concentration in the upper right and lower right areas, creating a sense of interconnectedness and complexity. The overall aesthetic is modern and technical.

05

RESULTS & RECOMMENDATIONS



New Mexico

Oklahoma

Ar

Texas

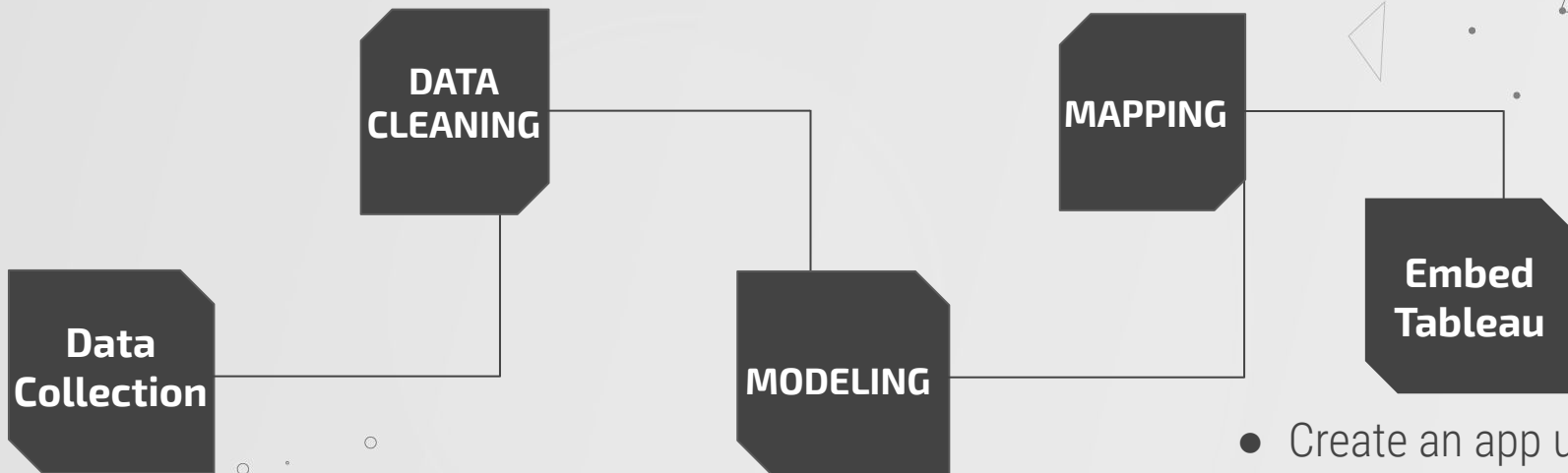
Chihuahua

Tableau Public Map

FUTURE DEVELOPMENTS

- More robust masks to include all highways

- More robust Regex filters
- Find a way to map intersections



- Other sources (Ex. FEMA, local news)
- Search query terms

- Gradient Boost Classifier

- Create an app using Flask, bokeh and embed tableau map
- Here.com, Google Maps API, etc.



06

CONCLUSION

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CONCLUSIONS

With enough resources and time, this program could benefit the public in various ways

- Upgrade to live Twitter scraping and traffic updates

More advanced deployment options



THANK YOU

Any questions?

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