

STAYFE

Stay safe, wherever you are.

By Seung Woo Son, Ki Hyun Won,
Avery Yip, Bilal Halabi

Team Stayfe

Fantastic team of data scientists, data and software engineers

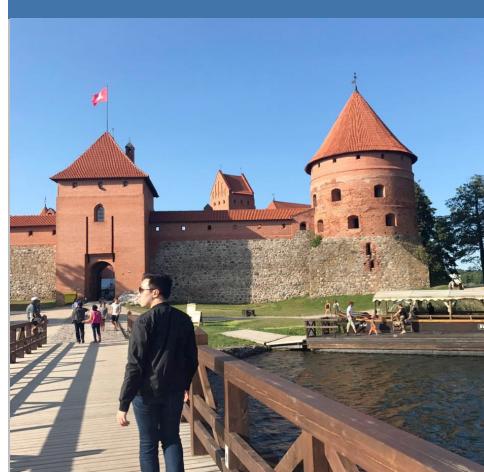


Seung Woo Son

Data Scientist

B.A. in Computer Science

Former Intern at Samsung
Former Intern at Salesforce

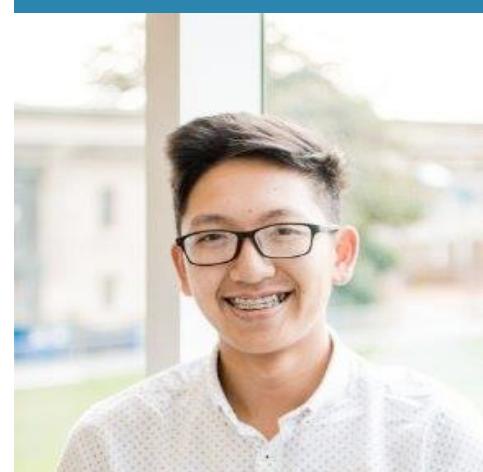


Ki Hyun Won

Data Engineer

B.A. in Computer Science

Researcher at UCSF Med
Researcher at Berkeley SETI



Avery Yip

Software Engineer

B.A. in Computer Science

Former Intern at Infosys
Former Intern at Salesforce



Bilal Halabi

Data Analyst

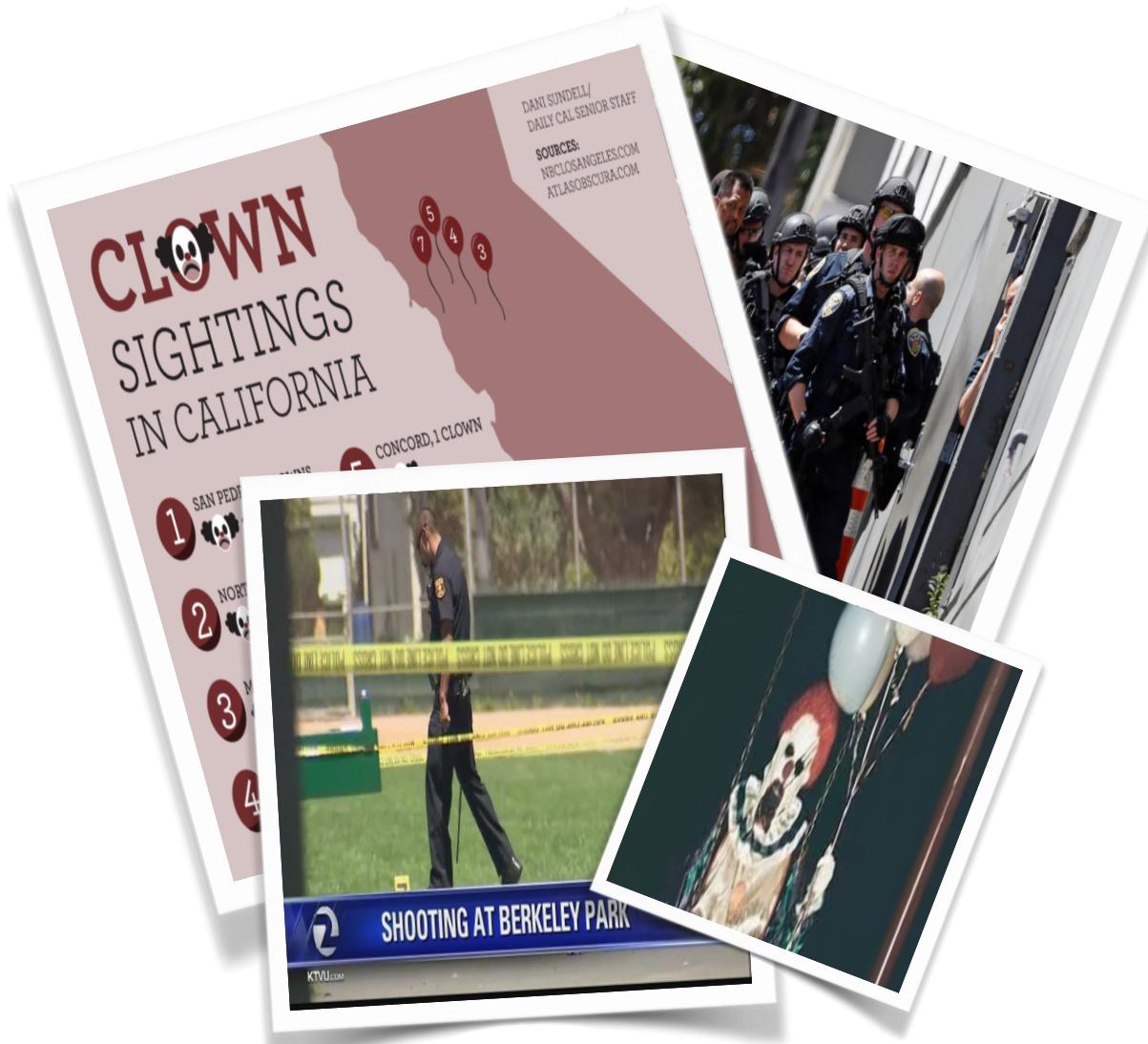
**M.S. in
Transportation
Engineering**

Class of 2018



Project Description

Real-time Crime Visualization / Safest Path Suggestion



01

Real-time Crime Visualizer - this app will visualize where crime is happening around the world (near real-time) from collecting and analyzing news sources around the world

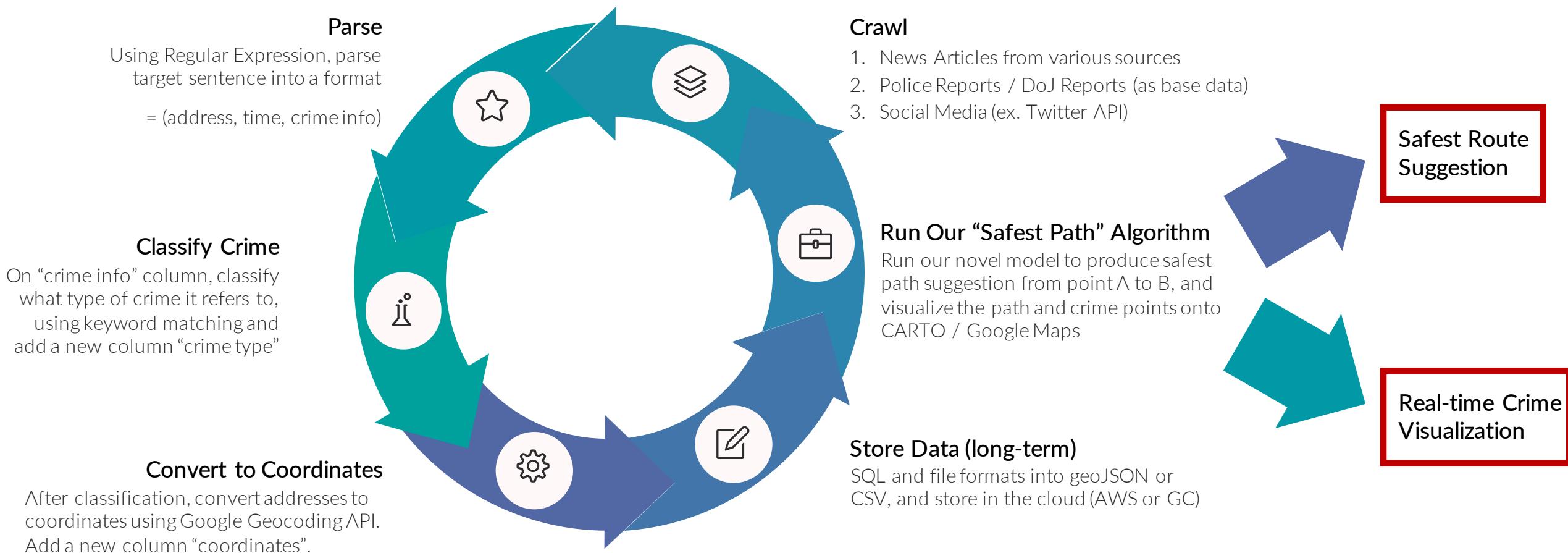
02

Mobile/Web Navigation App for pedestrians – tourists, college students, children, parents – everyone! Using our crawled crime data, we will attempt to suggest the safest path you should walk in to your destination.

User Validation – Google Maps works well for cars, but not necessarily for walking purposes – we will attempt to resolve this issue by suggesting the safest and shortest path to walk

Solution Architecture

Real-time Crime Visualization / Safest Path Suggestion



1. Crime Visualization

Methodology & Final Product

User Interface

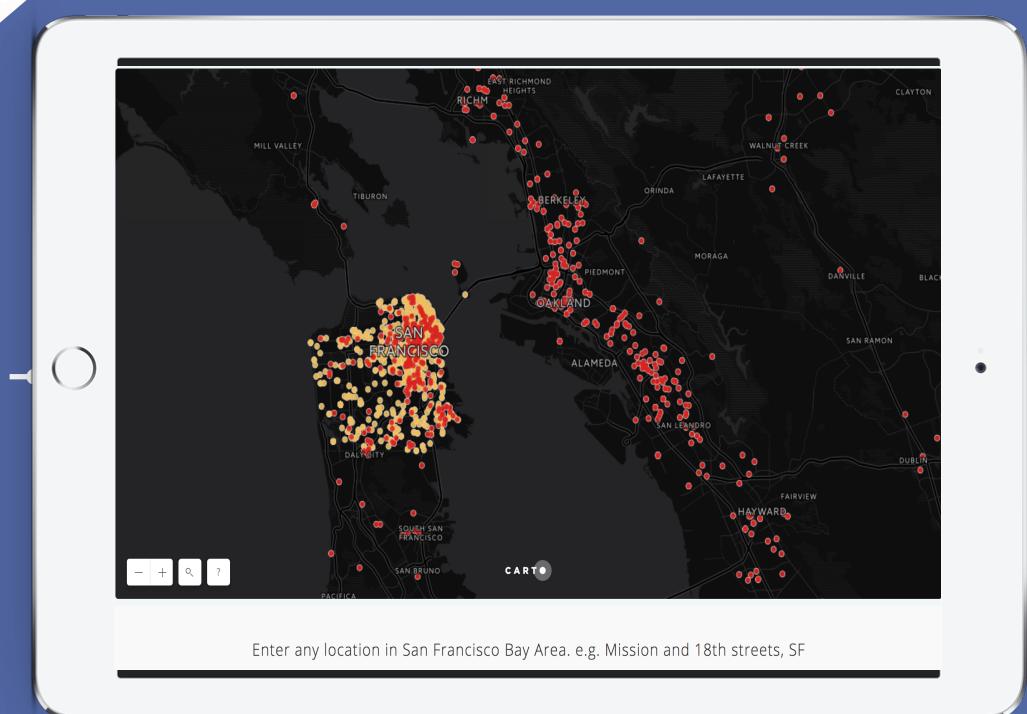
Mobile/Web App

Real-time Crime Visualization

We will build an automatic crawler and parser for news article texts from various credible news sources (such as San Francisco Chronicle, NYT, WP, etc), a crime classification model (type of crime) using ML and NLP techniques, and then visualize the geocode onto a self-designed map.

Safest Path Suggestion

We will suggest the safest path for pedestrians, by default using the user's current location as starting node and the destination, with weights given respective to the distance between crime locations (crime density) and the rate of occurrence around certain areas (crime rate)



Presentation

Accessibility

Data Crawling

We will crawl real-time data from the news media sources.

Screenshot of a news website showing various crime-related stories and images:

Top Navigation: abc7news.com/tag/crime/ | SECTIONS | TRAFFIC | WATCH | Weather: 71° San Francisco, CA P/SUNNY EDIT

Stories:

- 3 SF city officials may face trial on corruption charges** (Image: A man sitting in a red cage-like structure.)
- VIDEO: 4-year-old, nanny find burglar inside home** (Image: A young girl in a pink hoodie holding a plate of food.)
- BART report shows increase in crimes system-wide** (Image: A scene of debris and damaged property after a crash.)
- South Bay community comes together for carnival-like National Night Out event** (Image: People gathered at a National Night Out event.)
- Neighbors gather for National Night Out events in the Bay Area** (Image: People gathered at a National Night Out event.)
- Suspect crashes into Fremont home after police chase** (Image: A scene of debris and damaged property after a crash.)
- Pediatric dentist visiting Oakland hit by thieves** (Image: A close-up of hands holding a dental device.)
- 2 Yuba County sheriff's deputies shot, wounded** (Image: A map of Yuba County, California, showing locations like Oregon House, Dobbins, and Marysville.)
- SJ residents upset about illegal fireworks citations** (Image: A bright, colorful fireworks display against a dark sky.)

Show More ▾



Data Crawling

We will crawl real-time data from the news media sources.

Screenshot of a web browser showing a news article from abc7news.com/tag/crime/ about stolen carnival trains. The browser's Network tab in the developer tools is open, showing the requests made to the site.

The screenshot shows two news items:

- Stolen train used for children's carnivals found in Walnut Creek**
- Train used for carnivals stolen from Pleasant Hill**

The developer tools Network tab displays the following requests:

Name	Status	Type	Initiator	Size	Time	Waterfall	↳ 0.00 s
ping?h=abcotv.com&p=%2Ftag%2Fcrime%2F&u=BLvv6vDSaEp8...	200	gif	Other	213 B	200 ms	1	
ping2h-abcotv.com?p=%2Ftag%2Fcrime%2F&u=BLvv6vDSaEp8...	200	gif	Other	213 B	202 ms	2	
paginationCollapsed?optionsJSONString=%7B%22expandCollaps...	200	xhr	top.min.js:3	3.2 KB	301 ms	3	
080117-kao-costco-suspect-img_00-00-56.24.jpg?contentl...	200	jpeg	Other	169 KB	608 ms	4	
080117-south-pas-split-new.jpg?contentID=2266548&w=630	200	jpeg	Other	108 KB	320 ms	5	
080116_kao_nightout.jpg?contentID=1451066&w=630	200	jpeg	Other	262 KB	617 ms	6	

16 requests | 1.4 MB transferred



Data Crawling

We will crawl real-time data from the news media sources.

The screenshot shows a Google Chrome browser window with the title bar "Chrome". The menu bar includes "File", "Edit", "View", "History", "Bookmarks", "People", "Window", and "Help". The toolbar includes standard icons for search, refresh, and navigation. The address bar shows the URL "abc7news.com/common/modules/pagination/paginationCollapsed?optionsJSONString=%7B\"expandCollapseDivName\"%3A\"more-stories-ex...\"". The main content area displays a list of news headlines:

- Woman blinded in bleach attack in SF's Tenderloin
- Police release surveillance videos of Costco jewelry robbery in Novato
- South Pasadena father pleads guilty to killing 5-year-old son
- FULL LIST: National Night Out events in the Bay Area
- Sheriff lists Selena's brother on most wanted list
- Social media post leads to happy ending after children's train stolen from Pleasant Hill
- Fremont man accused of videotaping couple having sex
- Suspect in custody after deadly shooting, police standoff in SF
- Suspects accused of stealing \$50,000 jewelry from Costco in Novato
- Morgan Hill man accused of attempted sex with teen
- Stolen train used for children's carnivals found in Walnut Creek
- Train used for carnivals stolen from Pleasant Hill

Data Crawling

We will crawl real-time data from the news media sources.

The screenshot shows a Sublime Text editor window with a dark theme. The title bar reads "Sublime Text" and "urlcrawler.py". The status bar at the bottom shows "Line 4, Column 21", "Spaces: 4", and "Python". The code in the editor is a Python script named "urlcrawler.py". A red rectangular box highlights the URL definitions in lines 19-21:

```
1 #!/usr/bin/env python3
2 # -*- coding: utf-8 -*-
3 """
4 Created on Sat Aug 5 22:37:19 2017
5
6 @author: seungwooson
7 """
8
9 import requests
10 from bs4 import BeautifulSoup
11 import time
12 from datetime import datetime
13 import logging, logging.handlers
14 import random
15
16 base_path = "./hackathon/"
17 today = datetime.strftime(datetime.now(), "%Y%m%d")
18
19 ABC_URL_FRONT = "http://abc7news.com/common/modules/pagination/paginationCollapsed?optionsJSONString=%7B%22expandCollapseDivName%22%3A%22more-stories-expan"
20 ABC_URL_BACK = "%22%2C%22contentType%22%3A%22post%22%2C%22tag%22%3A%22crime%22%7D%7D%2C%22numberOfItems%22%3A%2212%22%7D"
21 x = 0
22 while (True):
23     ABC_URL = ABC_URL_FRONT+str(x)+ABC_URL_BACK
24     html = requests.get(ABC_URL).text
25     bs = BeautifulSoup(html)
26     possible_links = bs.find_all('a')
27     if possible_links == []:
28         print("No More Links! Congratulations")
29         break
30     for link in possible_links:
31         if link.has_attr('href'):
32             with open(base_path+"urlcrawler.txt", 'a+') as dataset:
33                 try:
34                     print(link.attrs['href'])
35                     dataset.write(link.attrs['href'] + '\n')
36                     time.sleep(random.uniform(6, 8))
37                 except Exception as e:
38                     print (e)
39                     continue
40             dataset.close()
41     x = x + 12
42     print(str(x) + "th article URL finished crawling.")
43 print ("Finished crawling through all. Check file and now will parse.")
44 time.sleep(random.uniform(5, 10))
```

Data Parsing



A	B	C	D	E	F	G	H
	Label	URL	Title	Published_Date	Body_Text	Tokenized_List	Sentence
0	abc7news	http://abc7news.com/	Man found guilty in b	2017-07-06 21:34:24	SAN FRANCISCO -- An	['SAN FRANCISCO -- An Antioch man was t	White was on trial for the attack at Victoga Inc., a jewelry store i
1	abc7news	http://abc7news.com/	San Francisco church	2017-07-05 22:33:21	SAN FRANCISCO (KGO)	['SAN FRANCISCO (KGO) -- A volunteer for	Marvin Sotorizo helped out at a small Protestant Evangelical chur
2	abc7news	http://abc7news.com/	NYPD officer 'assassi	2017-07-05 11:27:26	NEW YORK -- An NY	['NEW YORK -- An NYPD officer died after	RELATED: Suspected gunman in NYPD officer shooting was on pa
3	abc7news	http://abc7news.com/	Report: Oakland drive	2017-07-05 01:53:24	OAKLAND, Calif. (KGO)	['OAKLAND, Calif. (KGO) -- Oakland police	Police say the 23-year-old victim was driving down 58th Avenue n
4	abc7news	http://abc7news.com/	Family of Antioch Val	2017-07-04 23:07:28	ANTIOCH, Calif. (KGO)	['ANTIOCH, Calif. (KGO) -- The widow and	He worked at the gas station on East 18th Street and Hillcrest Ave
5	abc7news	http://abc7news.com/	San Francisco police i	2017-06-26 20:07:16	SAN FRANCISCO (KGO)	['SAN FRANCISCO (KGO) -- San Francisco p	Police say the suspect pulled alongside a car near Bayshore Boule
6	abc7news	http://abc7news.com/	South Bay police war	2017-06-24 02:07:57	SAN JOSE, Calif. (KGO)	['SAN JOSE, Calif. (KGO) -- Police in the So	Burglary trends in San JoseJudicial processInformation on how to
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8	abc7news	http://abc7news.com/	South Bay police war	2017-06-24 02:07:57	SAN JOSE, Calif. (KGO)	['SAN JOSE, Calif. (KGO) -- Police in the So	Foothill Division: July 27, 2017- 7:00pm-8:30pm Hillview Library M

Regular Expression

Sentence => Address

```

# 1900 block of Ellsworth st.
# 10000 block of 18th st.
# 11000 block of Mill Fred Way
regex_by_blocks = "([0-9]+ (B|b)lock of ([0-9]+(st|rd|nd|th)+|[A-Z][a-z]+|[A-Z][a-z]+ [A-Z][a-z]+) ((S|s)t\.|(S|s)tree
#2306 Ellsworth St.
#17000 Arnold Drive
regex_by_exact = "([0-9]+ ([0-9]+(st|rd|nd|th)*|[A-Z][a-z]+|[A-Z][a-z]+ [A-Z][a-z]+) ((S|s)t\.|(S|s)tree
#Ellsworth St. and Mill avenue
#23rd street and Mill avenue
#18th Street and Mill Fred Way
#Alemany Boulevard and Santa Rosa Avenue
#58th Avenue near Tevis Street
#Creek Bend Drive and Meek Mill St.
regex_by_intersection = "(([0-9]+(st|rd|nd|th)*|[A-Z][a-z]+|[A-Z][a-z]+ [A-Z][a-z]+) ((S|s)t\.|(S|s)tree
#12th and Mill Fred streets
#Ashby and 18th avenues
regex_by_combination = "(([0-9]+(st|rd|nd|th)*|[A-Z][a-z]+|[A-Z][a-z]+ [A-Z][a-z]+) and ([0-9]+(st|rd|nd|th)*|[A-Z][a-z]+|[A-Z][a-z]+ [A-Z][a-z]+) ((S|s)t\.|(S|s)tree

regex_full = regex_by_blocks + " | " + regex_by_exact + " | " + regex_by_intersection + " | " + regex_by_combination

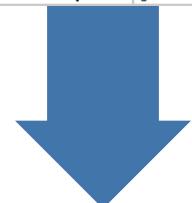
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Regular Expression

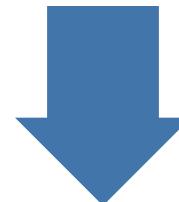
Sentence => Address



I	J
Sentence	Address
I White was on trial for the attack at Victoga	888 Brannan St, San Francisco, CA 94103, USA
I Marvin Sotorizo helped out at a small Protes	25th St & San Francisco Bicycle Rte 25, San Francisco, CA 94110, USA
I RELATED: Suspected gunman in NYPD office	Morris Ave & E 183rd St, Bronx, NY 10453, USA
I Police say the 23-year-old victim was driving	58th Ave & Tevis St, Oakland, CA 94621, USA
I He worked at the gas station on East 18th St	Hillcrest Ave & E 18th St, Antioch, CA 94509, USA
I Police say the suspect pulled alongside a car	Marin St & San Francisco Bicycle Rte 25, San Francisco, CA 94124, USA
I Burglary trends in San JoseJudicial processIn	5585 Cottle Rd, San Jose, CA 95123, USA
I Burglary trends in San JoseJudicial processIn	3050 Berryessa Rd, San Jose, CA 95132, USA
I Foothill Division: July 27, 2017- 7:00pm-8:30	1600 Hopkins Dr, San Jose, CA 95122, USA

Data Parsing

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LABEL	URL	Title	Published_Date	Body_Text	Tokenized_List	Time	Sentence	Address	
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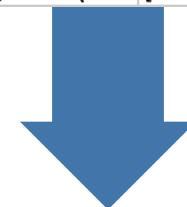
Google Geocoding API

Address => Coordinates

J	K	L
Address	Lat	Lon
888 Brannan St, San Francisco, CA 94103, USA	37.7721234	-122.40529
25th St & San Francisco Bicycle Rte 25, San Francisco, CA 94110, USA	37.7517357	-122.40617
Morris Ave & E 183rd St, Bronx, NY 10453, USA	40.8580946	-73.901924
58th Ave & Tevis St, Oakland, CA 94621, USA	37.7633751	-122.20337
Hillcrest Ave & E 18th St, Antioch, CA 94509, USA	38.0041363	-121.78768
Marin St & San Francisco Bicycle Rte 25, San Francisco, CA 94124, USA	37.7481323	-122.40355
5585 Cottle Rd, San Jose, CA 95123, USA	37.2522766	-121.80469
3050 Berryessa Rd, San Jose, CA 95132, USA	37.3918919	-121.84939
1600 Hopkins Dr, San Jose, CA 95122, USA	37.3378318	-121.83118

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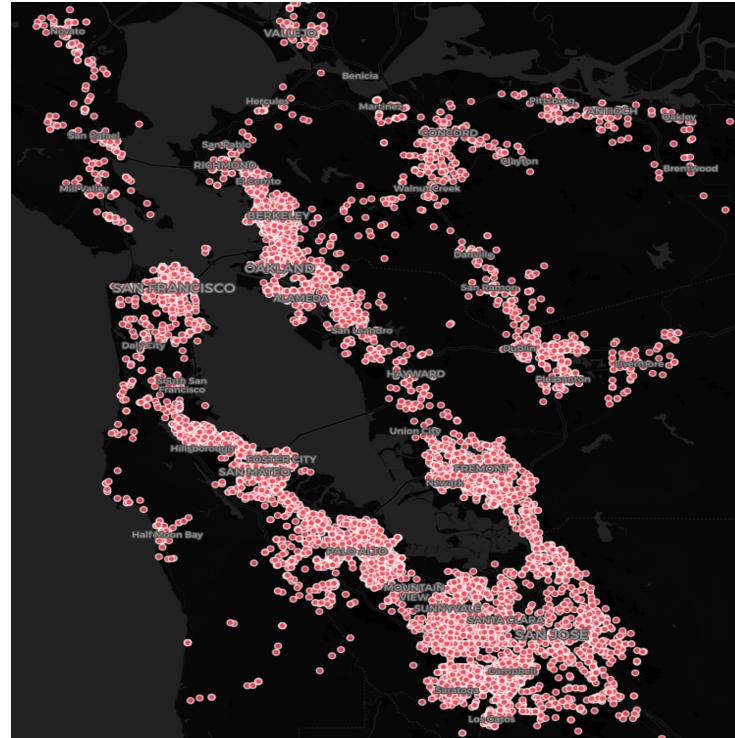
Crime Classification by Keyword

Sentence => Crime type

I	J	K	L	M
Sentence	Address	Lat	Lon	Crime_Type
White was on trial for the attack at Victoga	888 Brannan St, San Francisco, CA 94103, USA	37.7721234	-122.40529	murder,assault
Marvin Sotorizo helped out at a small Protes	25th St & San Francisco Bicycle Rte 25, San Francisco, CA 94110, USA	37.7517357	-122.40617	rape,assault
RELATED: Suspected gunman in NYPD officer	Morris Ave & E 183rd St, Bronx, NY 10453, USA	40.8580946	-73.901924	robbery,murder,assault
Police say the 23-year-old victim was driving	58th Ave & Tevis St, Oakland, CA 94621, USA	37.7633751	-122.20337	murder
He worked at the gas station on East 18th St	Hillcrest Ave & E 18th St, Antioch, CA 94509, USA	38.0041363	-121.78768	robbery,murder
Police say the suspect pulled alongside a car	Marin St & San Francisco Bicycle Rte 25, San Francisco, CA 94124, USA	37.7481323	-122.40355	murder,assault
Burglary trends in San JoseJudicial processInf	5585 Cottle Rd, San Jose, CA 95123, USA	37.2522766	-121.80469	theft,assault
Burglary trends in San JoseJudicial processInf	3050 Berryessa Rd, San Jose, CA 95132, USA	37.3918919	-121.84939	theft,assault
Foothill Division: July 27, 2017- 7:00pm-8:30pm	1600 Hopkins Dr, San Jose, CA 95122, USA	37.3378318	-121.83118	theft,assault

Final Product

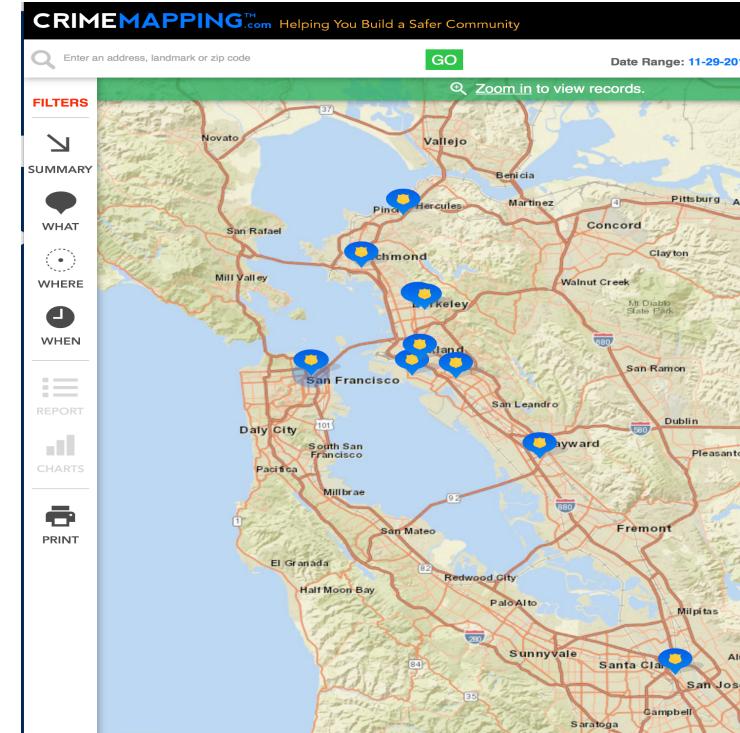
Real-time Crime Visualization



Stayfe

- More than 50,000 data points from ~6 news sources
- Wider coverage
- More data
- Higher scalability

VS



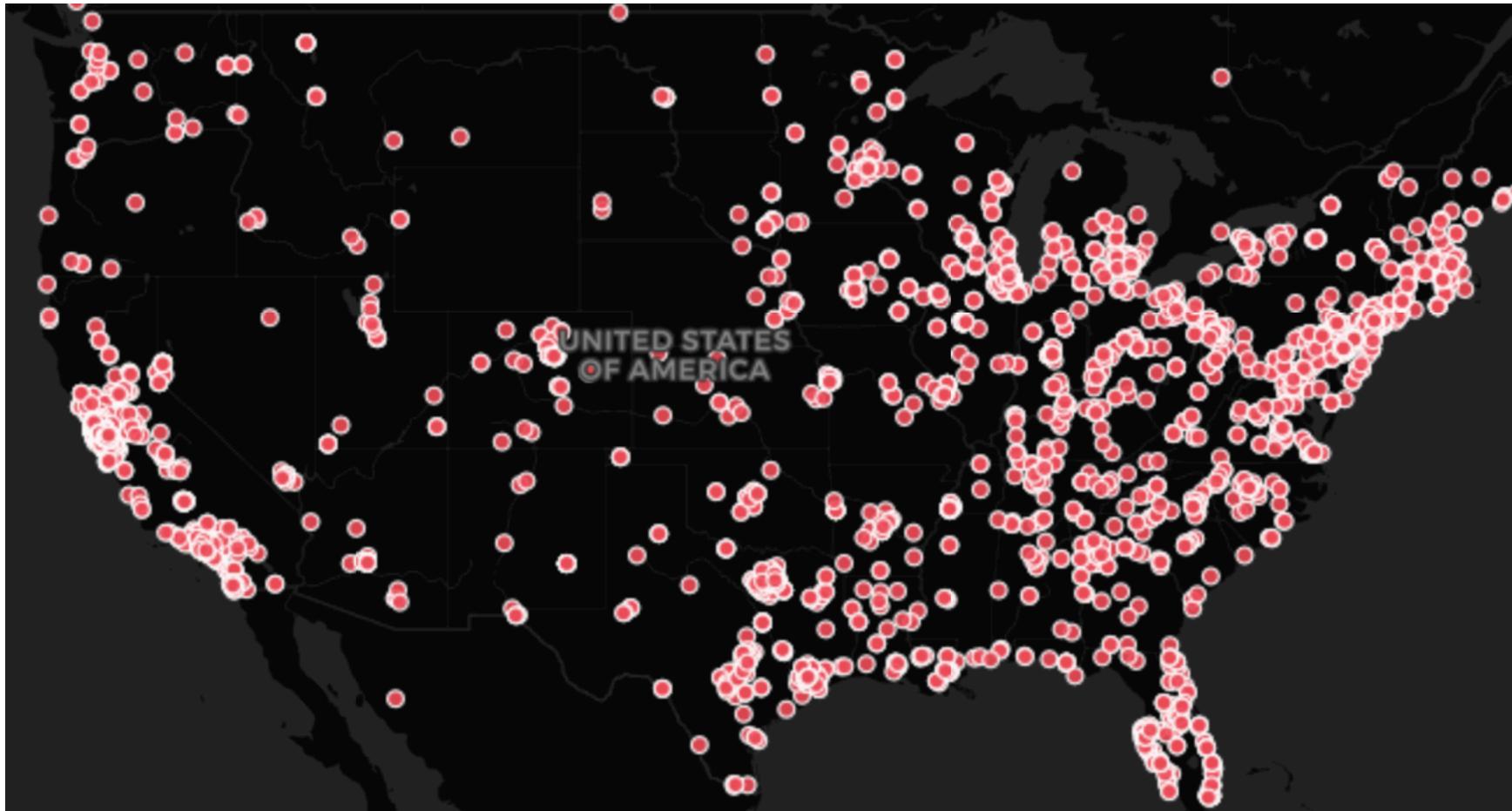
CrimeMapping.com

- Existing major police crime data collection & visualization platform
- Localized to major cities/counties



Final Product

Real-time Crime Visualization



Watch live visualization here: <https://seungwooson.carto.com/builder/9de37341-04e4-47d7-89d9-f9602d27a11a>

2. Safest Path Suggestion

Methodology & Final Product

User Interface

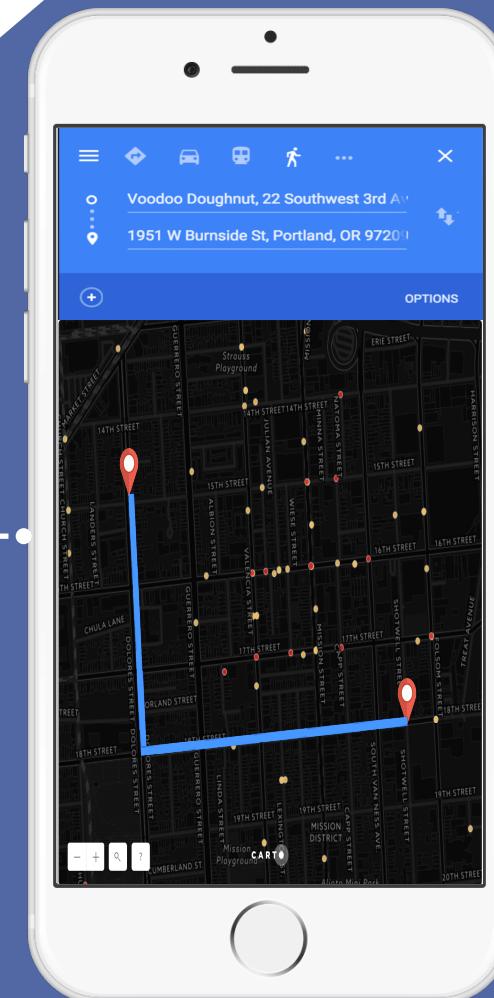
Mobile/Web App

Safest Path Suggestion

We will suggest the safest path for pedestrians, by default using the user's current location as starting node and the destination, with weights given respective to the distance between crime locations (crime density) and the rate of occurrence around certain areas (crime rate)

Real-time Crime Visualization

We will build an automatic crawler and parser for news article texts from various credible news sources (such as San Francisco Chronicle, NYT, WP, etc), a crime classification model (type of crime) using ML and NLP techniques, and then visualize the geocode onto a self-designed map.



Accuracy

Speed

Safest Path Algorithm

We will construct a parameterized function for “safest” path.

We represented each crime data as a Gaussian distribution with different amplitude and widths depending on types of crime (“Assault”, “Murder”, etc)

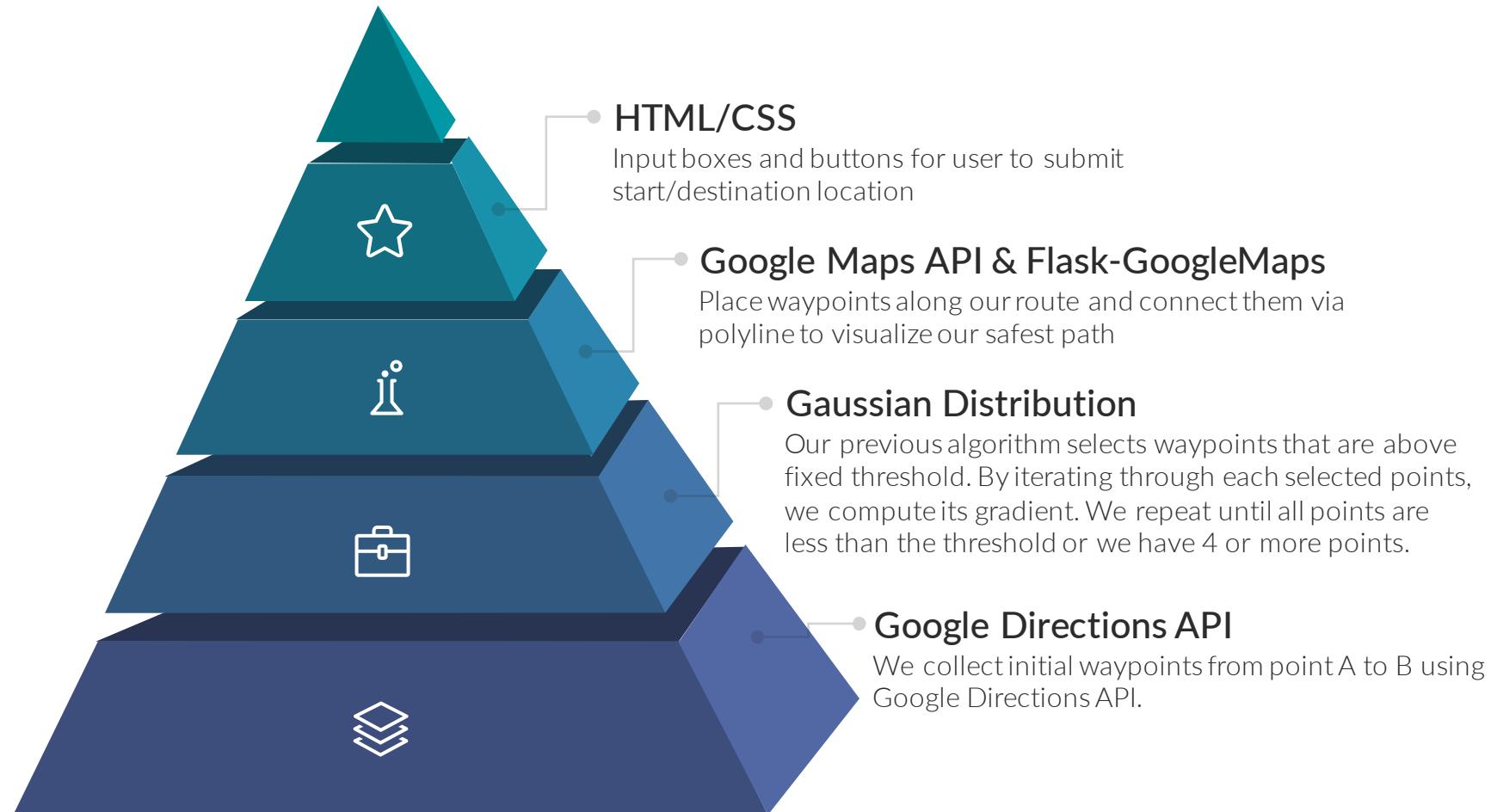
$$\text{Weight} = \sqrt{\sum_{i=1}^n A e^{-\frac{\text{Mean}\left(\left(\frac{\text{pathpoint}_i - \text{crimepoint}_i}{\text{width}}\right)^2\right)}{}}}, \text{ where width depends on type of crime}$$

We also took into account that impact of a crime event decays as time passes. To calculate the impact (amplitude), we modelled a exponential decay function, as follows:

$$A_{(\text{Amplitude})} = e^{(-\frac{\text{currentTime} - \text{crimeTime}}{\beta})}, \text{ where } \beta \text{ is some large constant}$$

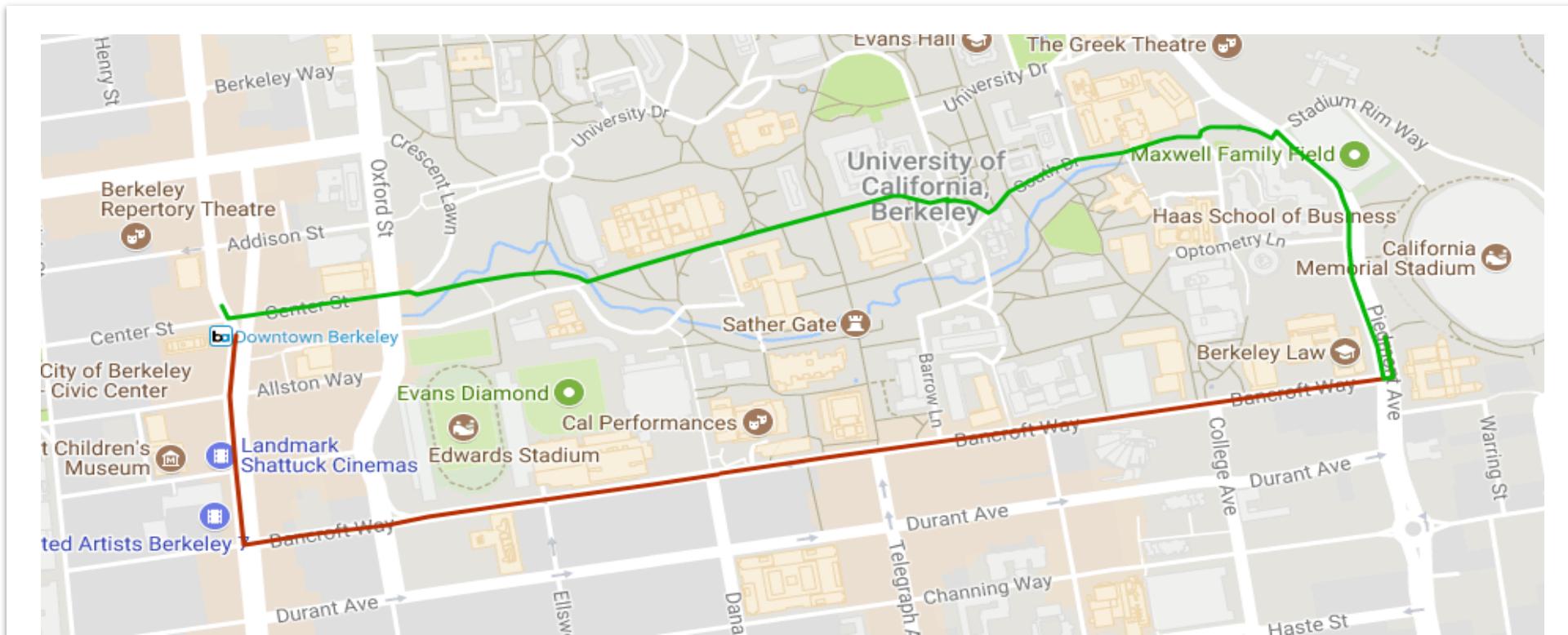
Safest Path Algorithm

Implementation Process



Final Product

Safest Path Suggestion

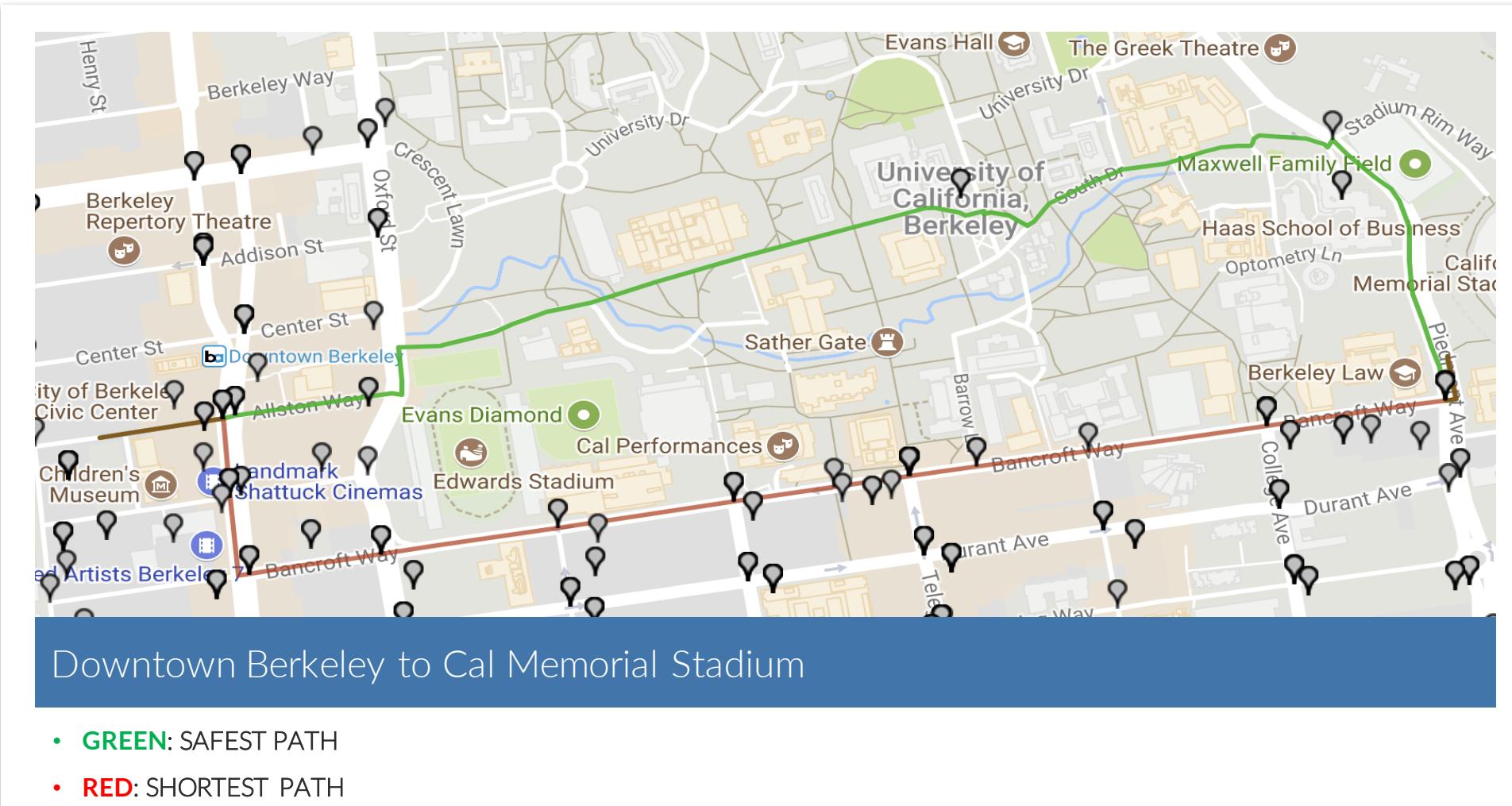


Downtown Berkeley to Cal Memorial Stadium

- **GREEN:** SAFEST PATH
- **RED:** SHORTEST PATH

Final Product

Safest Path Suggestion



Future Work & References

1

Transition into a Mobile App

We would like to have users use our app on their mobile phones, so that they can be notified of crime in real time and find their safe way back home.

2

User-based Reporting

We would love to incorporate user-based reporting to make it even closer to real-time.

References

- Google Geocoding API Documentation
<https://developers.google.com/maps/documentation/geocoding/start>
- Google Directions API Documentation
<https://developers.google.com/maps/documentation/directions/intro>
- Gaussian Distribution (Coursera)
<https://www.coursera.org/learn/machine-learning/lecture/ZYAyC/gaussian-distribution>
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- Regular Expression Reference
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THANK YOU

Questions ?

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