

Preliminary Camera Analysis

Sandia Volunteer Update

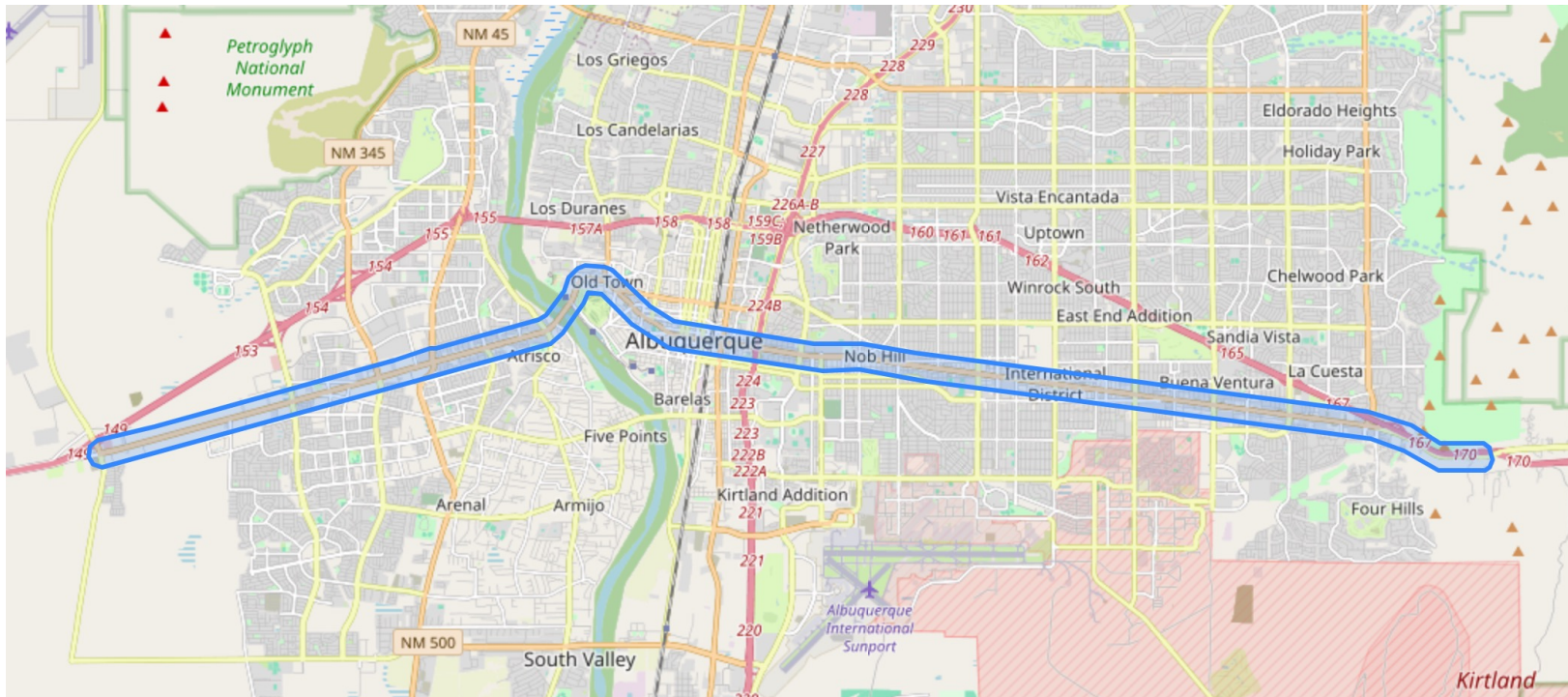
28 Jun 2024

Outline

- Problem
- Data Management
- Data Statistics
- Crime Clustering - Initial New Camera Placement
- Mapping Crime Categories to FBI UCR Categories
- Next Steps

Problem

- Determine where to place new cameras along Central Ave
- Determine if clustered areas are adequately covered by the existing cameras



Data Management

- Crime Data
 - Obtain the data
 - Curate the data
 - Load the curated data into PostGIS
- Camera Data
 - Obtain the data
 - Curate the data
 - Load the curated data into PostGIS
- Restrict datasets to a 250m buffer along Central

Obtain the data

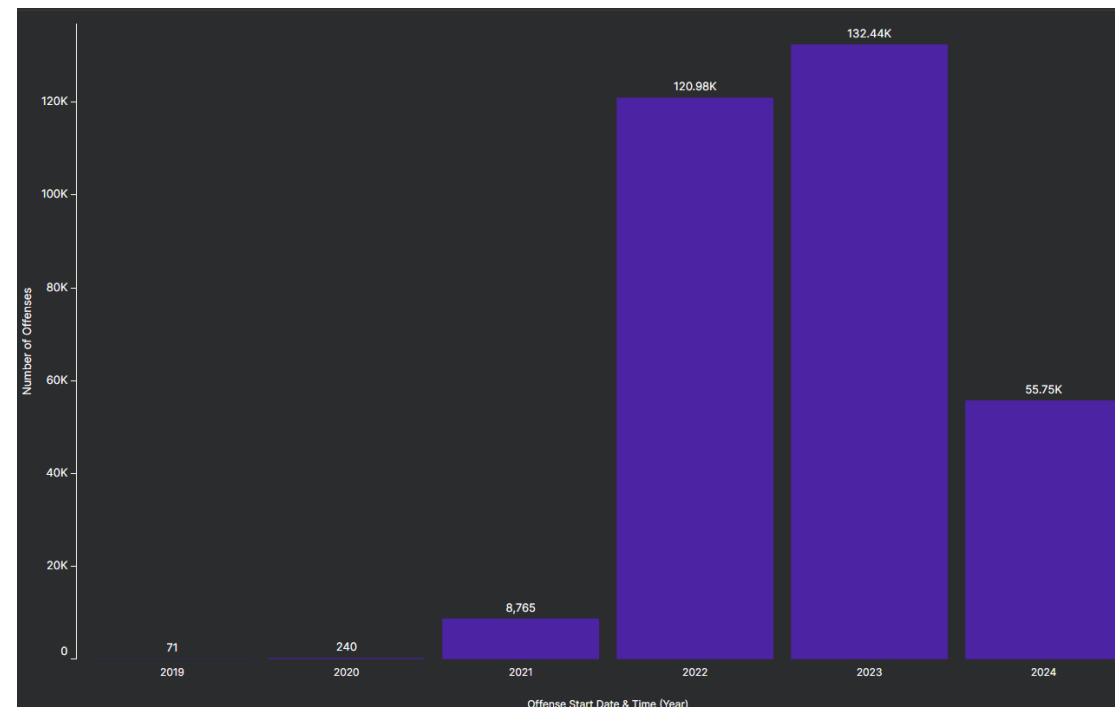
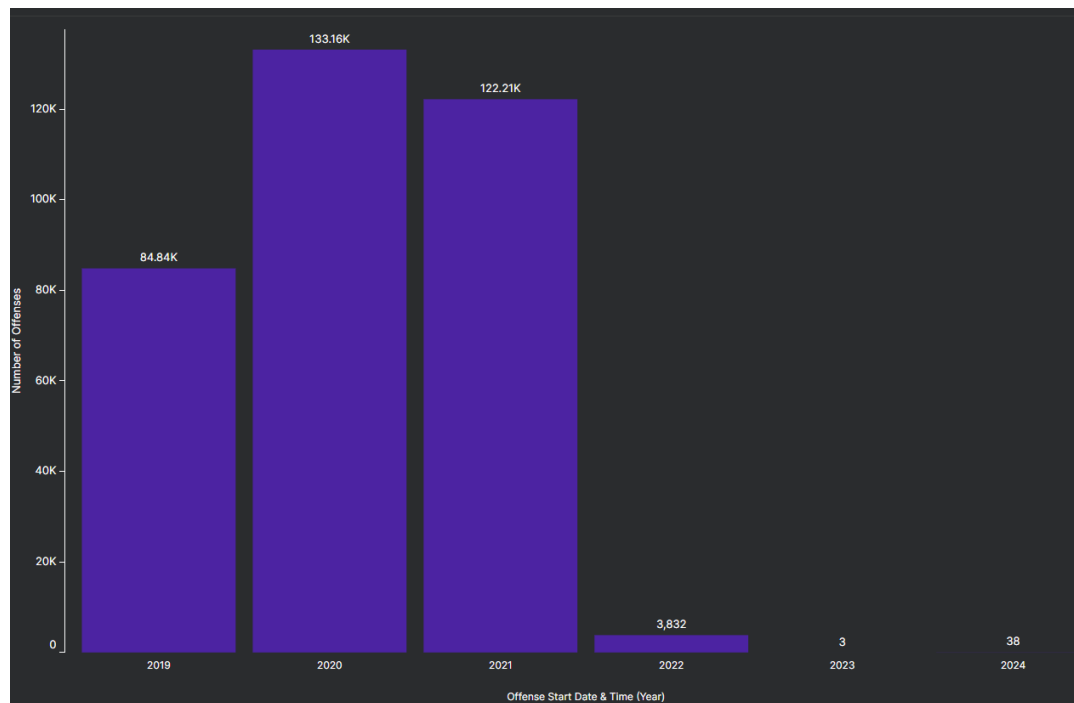
- CABQ/DTI moved data to the Sandia folder
- Sandia moved the data over to Sandia's environment which is access controlled
- 5yr_19Apr2024.zip
 - Offenses
 - sandia_5yr_offense_geocode.csv: 3262445 records
 - Arrests
 - sandia_5yr_arrest_geocode.csv: 109835 records

Data Location Discrepancies

Data was in an old format which did not move over correctly prior to 2022

Minimum Date: 2020-12-11 23:20:00

Maximum Date: 2024-03-26 21:00:15



Curate the data – (offenses)

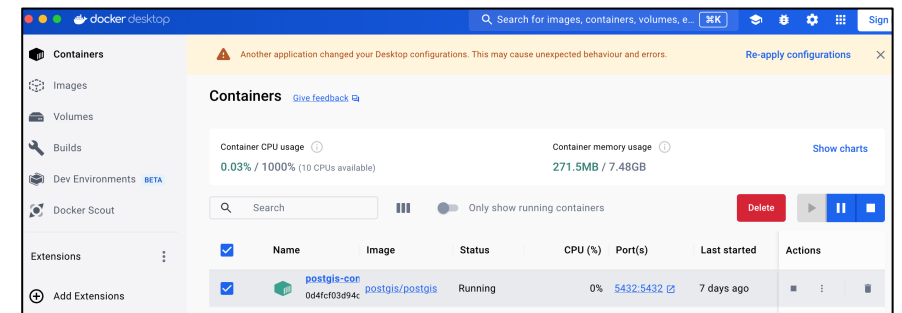
Curation Step	Number of Records	Number of Columns
Retrieve original data	3262445	65
Remove rows where there is now location data (latitude, longitude)	1255146	65
Keep rows where the person_involvement is either SUSPECT_IN_OFFENSE and SUBJECT_IN_OFFENSE	569306	65
Remove any columns that don't contain a value	569306	20
Save the updated curated data set	569306	20

```
['id', 'offense_id', 'case_id', 'case_number', 'is_confidential', 'reported_date_utc',  
'offense_code_name', 'offense_code_description', 'offense_order', 'is_offense', 'is_incident',  
'address', 'state', 'place_category', 'offense_created_by', 'person_involvement',  
'officer_name_first_name', 'officer_name_last_name', 'lat', 'lon']
```

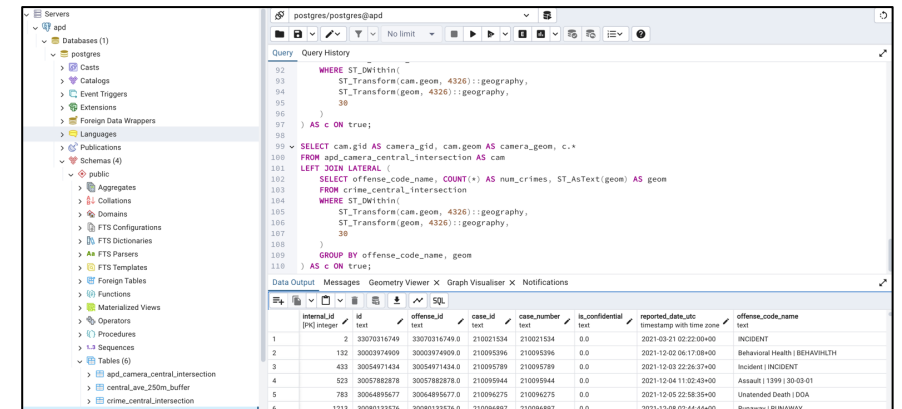
Load the data into PostGIS

- Install Docker Desktop
- Get the latest PostGIS Docker imager
 - `docker pull postgis/postgis`
- Create a Docker Container running the PostGIS docker image
 - `docker run --name postgis-container -e POSTGRES_PASSWORD=xyz -d -p 5432:5432 postgis/postgis`
- Install pgAdmin 4
 - Configure the PostGIS server
 - GUI to test out SQL queries
- Move the “updated curated data set” into the PostGIS Docker Container
 - `docker cp curated_unique_offense_data.csv 0d4fcf03d94c:/data/crime`
- Run a Python script to ingest the updated curated data set into a PostGIS table

Docker Desktop



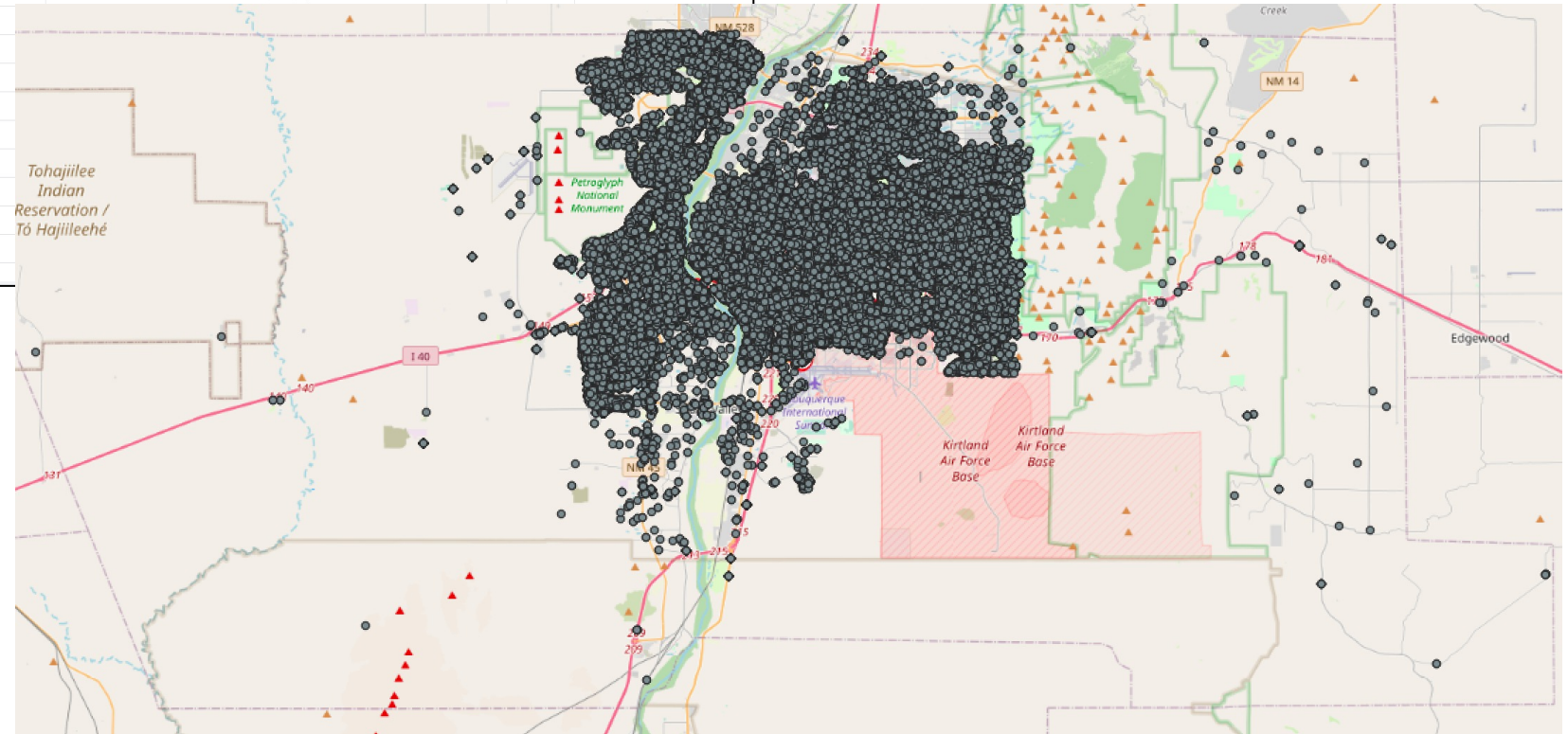
pgAdmin 4



Curated Crime Data in PostGIS

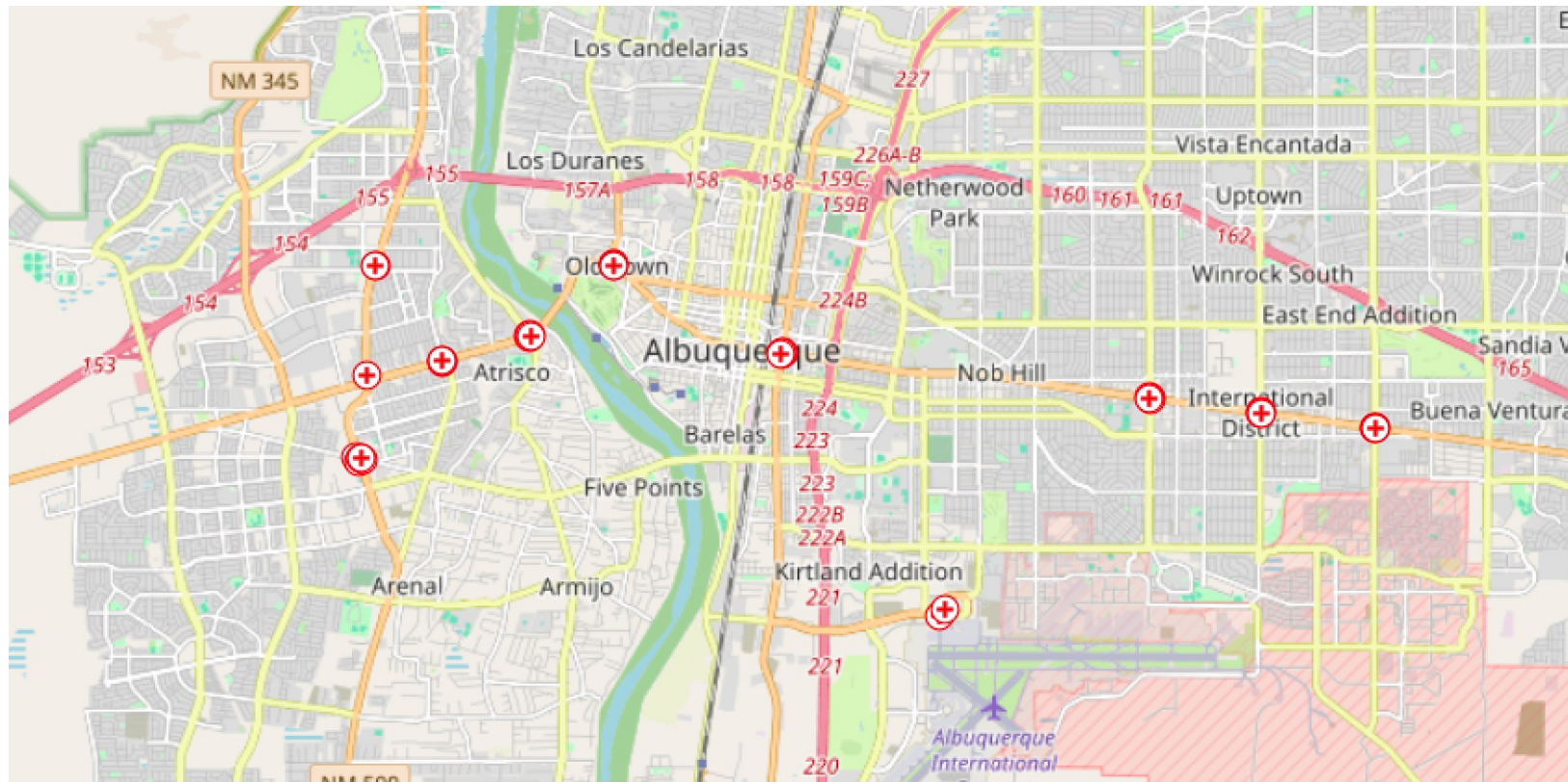
Successfully run. Total query runtime: 1 secs 659 msec. 569306 rows affected.

id	reported_date_utc timestamp with time zone	offense_code_name text	offense_code_description text	offense_order text	is_offense text	is_incident text	address text	state text	place_category text
	2021-12-03 07:24:56+00	Assault 1399 30-03-01	Assault	1.0	1.0	0.0	5403 GIBSON BLVD SE ALBUQUERQUE, NM 87108 UNITED STATES	NM	Liquor Store
	2021-12-07 01:20:58+00	Incident INCIDENT	Incident	0.0	0.0	1.0	5605 MENAUL BLVD NE ALBUQUERQUE, NM 87110 UNITED STATES	NM	Commercial/Office Building
	2021-12-11 09:15:03+00	Incident INCIDENT	Incident	0.0	0.0	1.0	7704 SANTA LUCIA ST NW ALBUQUERQUE, NM 87120 UNITED STATES	NM	Residence/Home
	2021-12-11 13:04:35+00	Incident INCIDENT	Incident	0.0	0.0	1.0	515 CENTRAL AVE NW ALBUQUERQUE, NM 87102 UNITED STATES	NM	Bar/Nightclub
	2021-12-12 14:44:28+00	Found Item FOUND ITEM	Found Item	1.0	0.0	1.0	1300 ALWOOD DR NW ALBUQUERQUE, NM 87120 UNITED STATES	NM	Residence/Home
	2021-12-13 07:41:46+00	Domestic Dispute DOM DISPUT	Domestic Dispute	2.0	0.0				
	2021-12-14 20:26:26+00	Incident INCIDENT	Incident	0.0	0.0				
	2021-12-15 22:58:50+00	Incident INCIDENT	Incident	0.0	0.0				
	2021-12-16 18:55:20+00	Robbery 1299 30-16-02	Robbery	1.0	1.0				
	2021-12-16 19:57:48+00	Agg. Assault 1304 30-03-02	Agg. Assault	1.0	1.0				
	2021-12-17 20:04:59+00	Lost Item LOST ITEM	Lost Item	0.0	0.0				
	2021-12-19 12:21:18+00	Incident INCIDENT	Incident	0.0	0.0				
	2021-12-19 20:39:19+00	Incident INCIDENT	Incident	0.0	0.0				
	2021-12-21 06:50:12+00	Incident INCIDENT	Incident	0.0	0.0				
	2021-12-25 15:28:45+00	Apparent Natural Death NATU...	Apparent Natural Death	0.0	0.0				



Camera Data

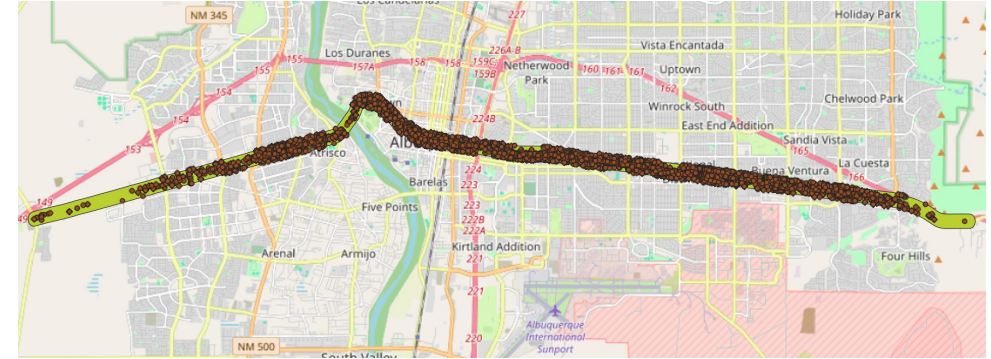
- ALPR.kmz – 69 total
 - Fixed APD Cameras – 38
 - Fixed Parking Cameras – 4
 - Quick Deploy ALPR – 27



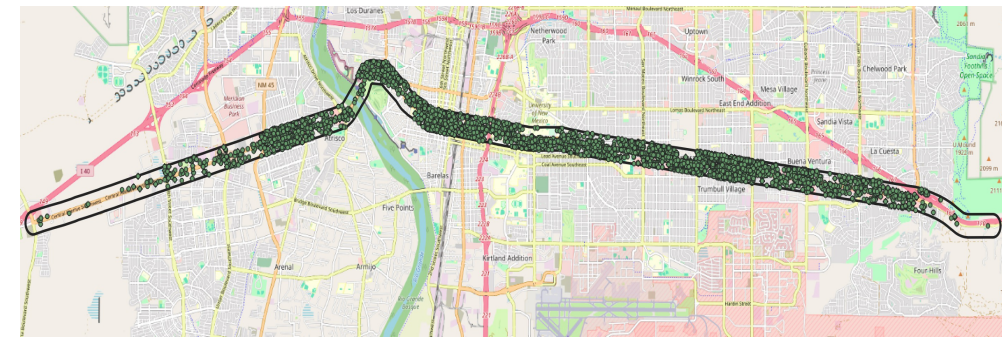
Restrict data to Central Ave

- Take Central Ave and create a buffer (min 250m)
- Intersect the Central Ave buffer with the various data (offenses, arrests, camera location)

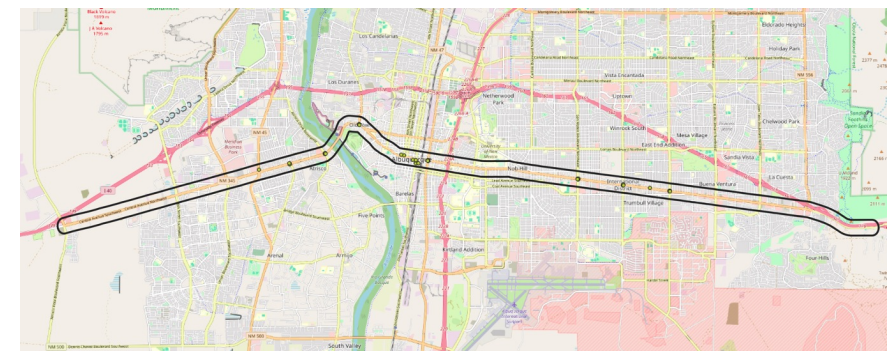
Offenses data along Central: 65915



Arrest data along Central: 18215

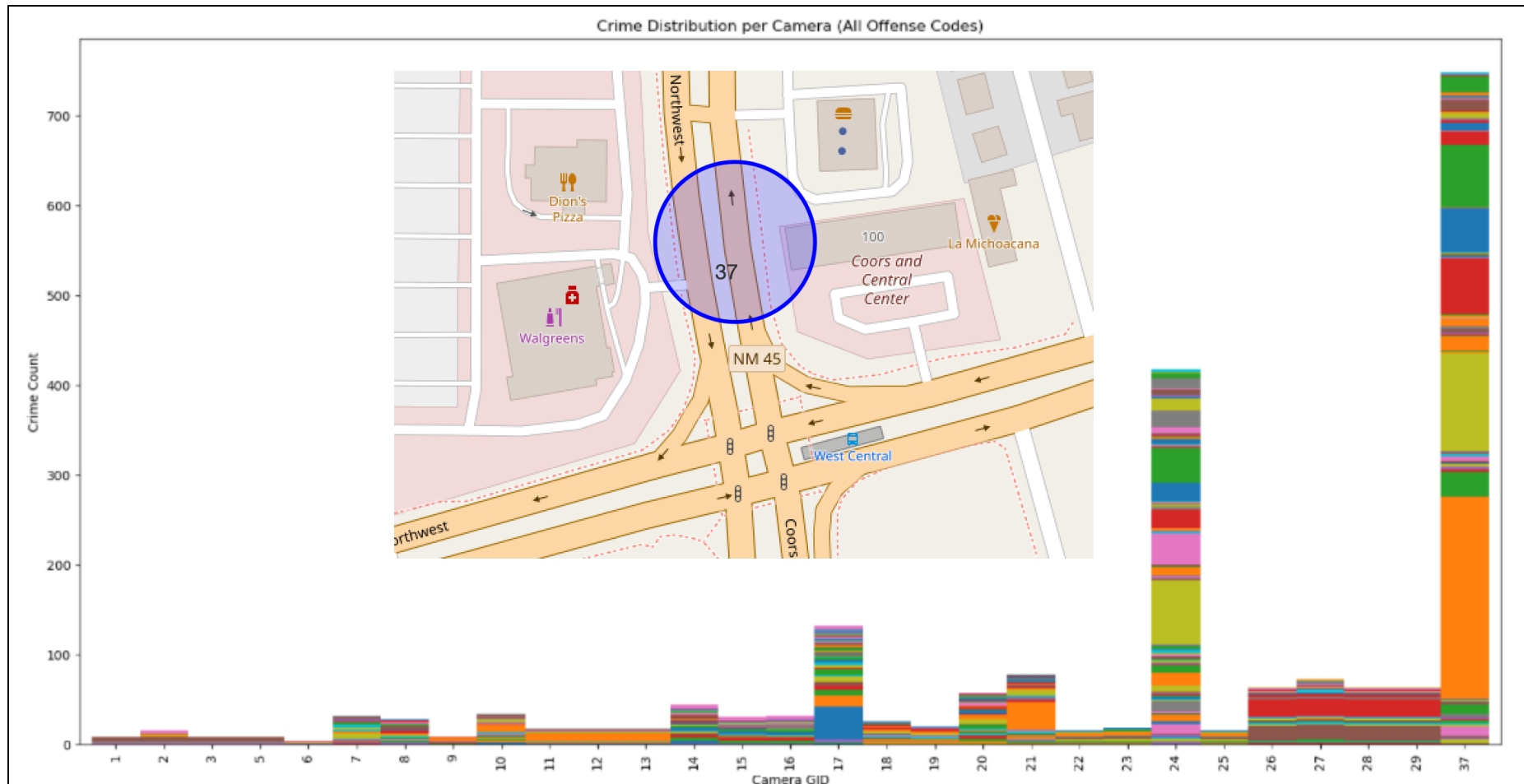


Cameras along Central: 39



Preliminary (not confirmed) Initial Crime/Camera Stats

Of the 65915 crimes along the Central Ave buffer, only 2080 are within 30m of the current cameras. 748 are located near Camera 37 (Central & Coors)



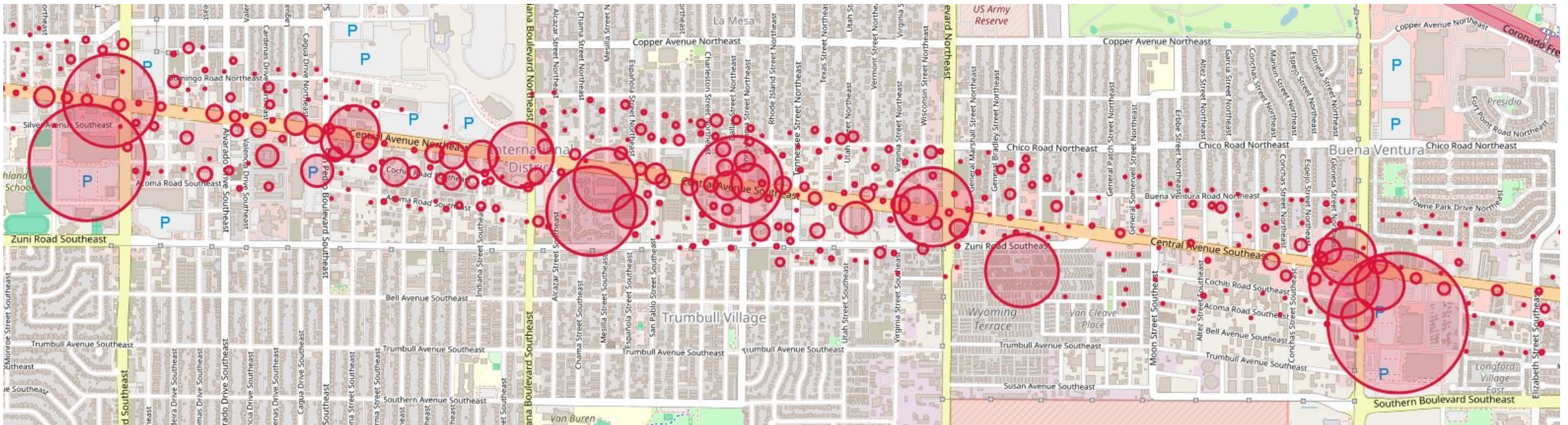
camera_gid	offense_code_name	crime_count
37	Criminal Trespass	225
37	Felony Warrant	109
37	Possession of Controlled Substance	69
37	Misdemeanor Warrant	62
37	Possession Drug Paraphernalia	49
37	Criminal Trespass Notice	28
37	Use of Poss of Drug Paraphernalia	18
37	Incident	17
37	Possession of Methamphetamine	14
37	Tampering W/Evidence	12
37	Aggravated battery (Deadly weapon)	10
37	Concealing Identity	10
37	Larceny-Theft Fr Bldg \$250 or Less	8
37	Resist/Evade/Obstruct Any Ofc	8
37	Robbery W/Deadly Wpn (1st Off)	7
37	Eluding/Evading Police (On Foot)	5
37	Aggravated Assault with Deadly Weapon	4
37	Larceny-All Oth Ov \$500/Less \$2500	4
37	Battery (Non-Household Member)	3
37	Burglary - Commercial	3
37	Criminal Damage Over \$1000	3
37	Criminal Trespass Notice	3
37	Crossing at Other Than Crosswalks	3
37	Domestic Dispute	3
37	Emergency Medical Health Eval & Care	3
37	Larceny-All Other Ov \$250/Less \$500	3
37	Resisting/Evading/Obstructin Ofc	3
37	Trafficking Controlled Substances	3
37	Unlawful Carrying Deadly Weapon - \$200	3
37	Wrongful Use of Public Property	3
37	Aggravated Driving Under Influence of Intoxicating Liquor or Drugs 1st Offense	2
37	Aggravated Fleeing An Officer	2
37	Assault (Non-Household Member)	2
37	Assault on Peace Officer	2
37	Battery On Peace Officer	2
37	Felon in Possession Firearm	2
37	Larceny All Oth/Ov \$2500 Ls \$20000	2
37	Lost Item	2
37	Agg. Assault	1
37	Battery HPM DV	1
37	Behavioral Health	1
37	Careless Driving	1
37	Criminal Damage Priv Ppty Undr \$1000	1
37	Criminal Damage Under \$1000	1
37	Criminal Sexual Contact - 4th Degree	1
37	Driving Under Influence of Intoxicating Liquor or Drugs	1
37	Driving While Lic/Revoked DWI Related	1
37	Driving While License Revoked Driving While Intoxicated Related	1
37	Extortion	1
37	Found Item	1
37	Fraud <\$250	1
37	Indecent Exposure	1
37	Larceny - Miscellaneous Under \$250	1
37	Leave Scene Accident- No Injuries	1
37	Leave Scene of an Accident Death/Inj	1
37	Marijuana - Unlawful Possession of	1
37	Muffler-Peaked Noise Emission	1
37	No Insurance/Uninsured MFA	1
37	No Registration	1
37	Obstructing Movement	1
37	Obstructing Street Veh/Ped	1
37	Obstructing Traffic	1
37	Possess Dangerous Drugs/Prescription	1
37	Possession Drug Paraph Ov 18yos	1
37	Possession of Cocaine	1
37	Receiving or transferring stolen vehicles or motor vehicles	1
37	Reckless Driving	1
37	Resisting/Obstructing/Refusing Ofc	1
37	Robbery - No Weapon	1
37	Shooting At Dwelling/Occupied Build	1
37	Speed Regulation	1
37	Stolen Vehicle	1
37	Unattended Death	1
37	Vehicle Impound or Pabection	1
37	Vehicle Nuisance-Specific Violation	1

Clustering crime

- Started with crimes occurring within a 250m buffer along Central Ave.
- Want to create clusters with a maximum width
- Algorithm:
 - Do an initial clustering using DBSCAN
 - For each cluster, if its width (greatest distance between two points) is larger than our maximum, then use K-means clustering to break it into smaller clusters
 - Must search for largest value of “K” which will satisfy max cluster width

Clustering crime

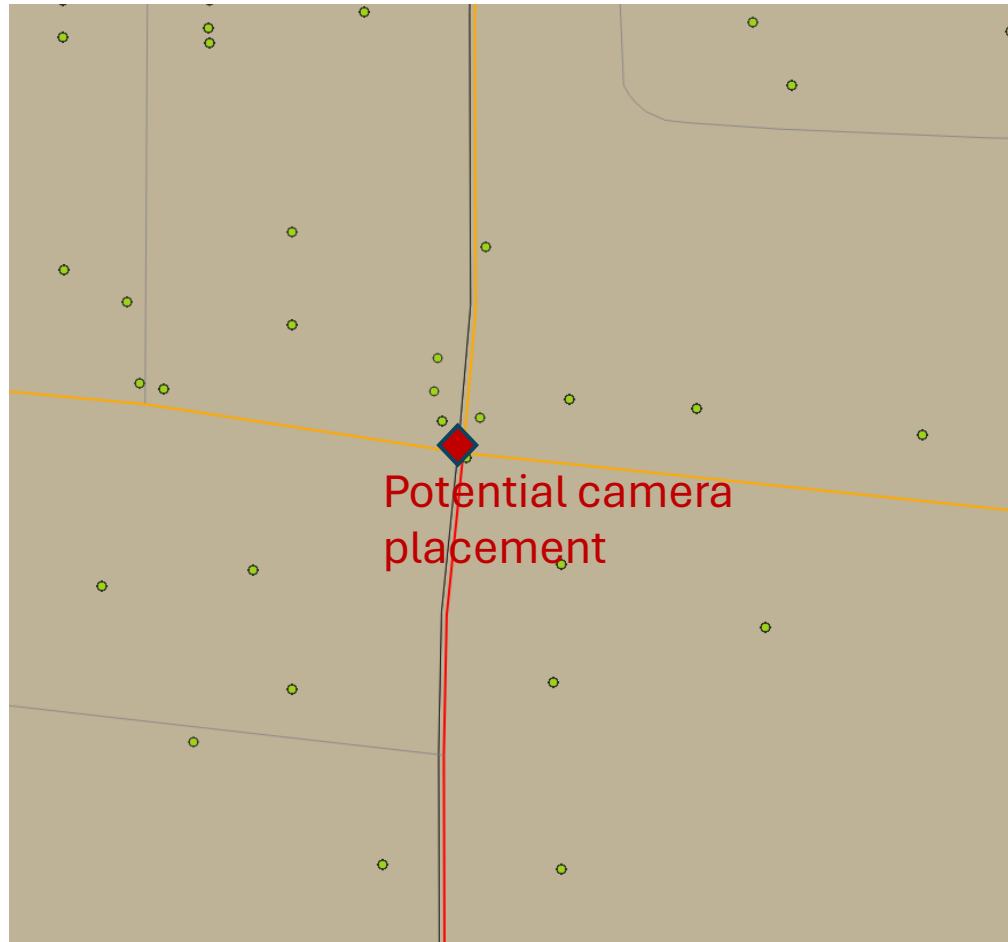
- Here is a section of Central Ave. with the clusters for an ~80m width (note: circle sizes denote relative counts of offenses within the cluster, not the physical cluster width):



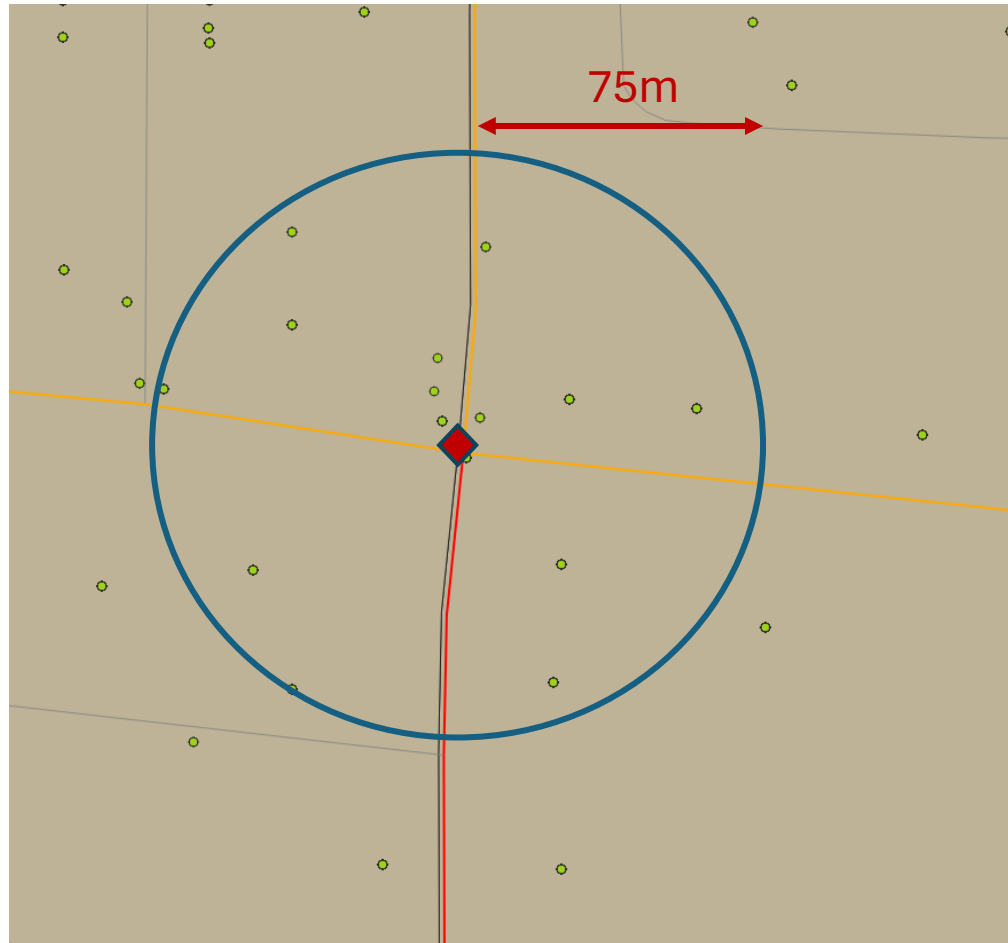
Clustering crime

- Clusters alone probably aren't enough to identify ideal camera placements
- Need directionality
- Also, cluster center determined by cluster, not by possible camera placement location
- Next step: build capability to use segmented circle around a possible camera location to count offenses within field-of-view
- Summing up segments can be used to replicate camera field-of-view

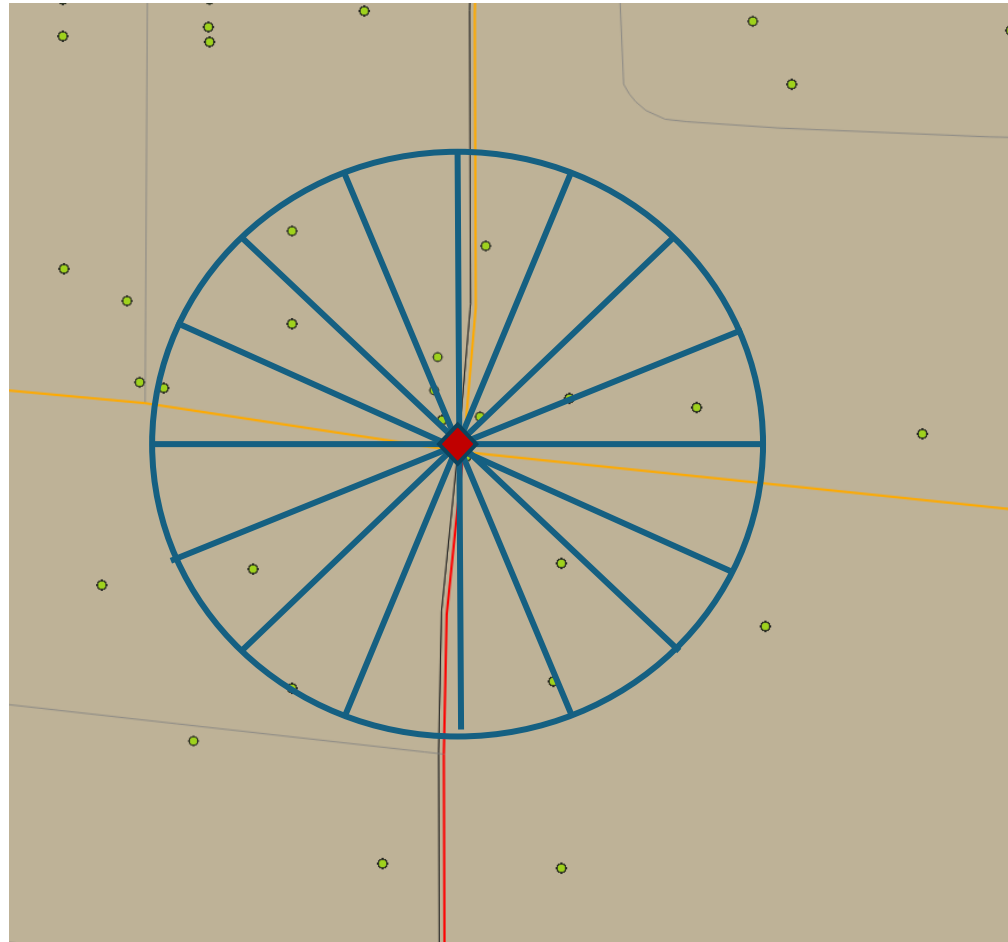
Clustering crime



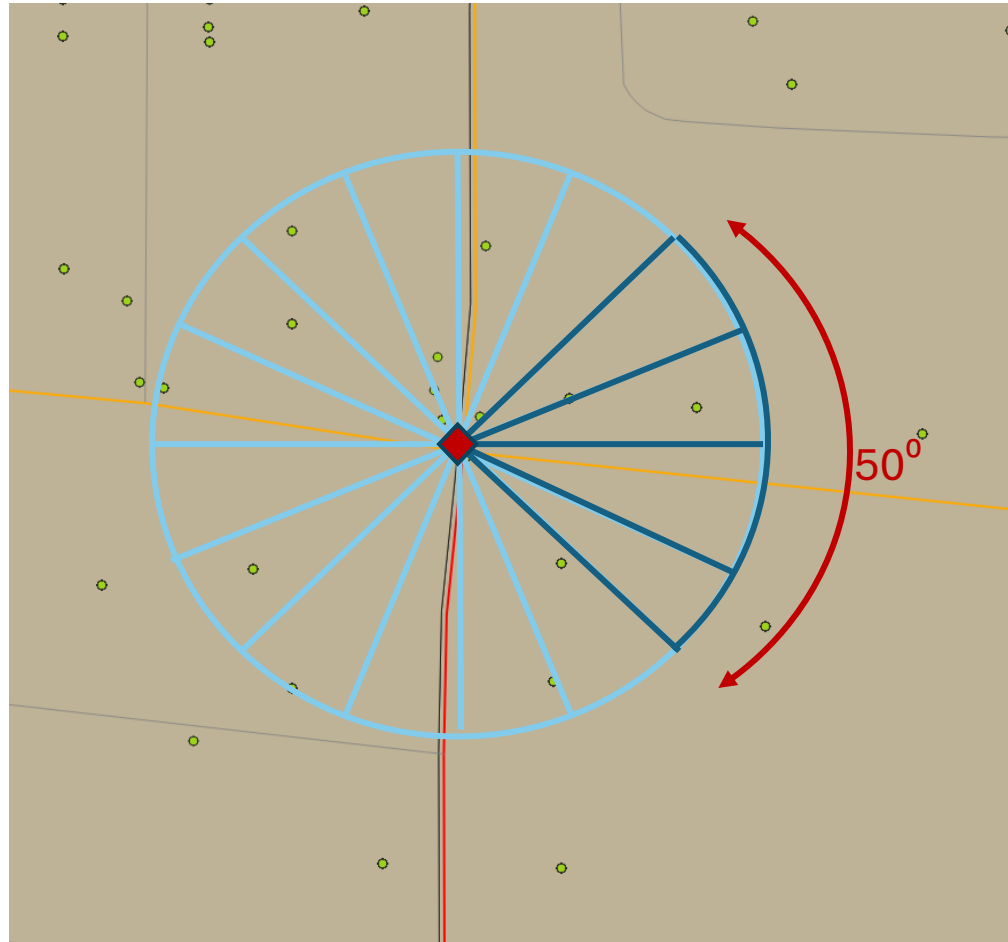
Clustering crime



Clustering crime



Clustering crime. Clustering crime



Data – Crime Categories

669 different crime categories in the Offenses data along Central (250m buffer)

669 different crime categories. Top 20 Categories by crimes reported

crime_category	category_total	preprocessed_category
Auto Burglary 2305 30-16-03 (AUTO)	10301	Auto Burglary
Felony Warrant FELONY WARRANT	10082	Felony Warrant
Criminal Damage Under \$1000 2999 30-15-01 (M)	6525	Criminal Damage Under \$1000
Auto Theft/Unlawful Take MV 1st Ofns 2404 30-16D-01(A)(1) (F4)	6380	Auto Theft/Unlawful Take MV 1st Ofns
Burglary - Commercial 2202 30-16-03A COMMERCIAL	5762	Burglary - Commercial
Criminal Damage Over \$1000 2999 30-15-01 (F)	4860	Criminal Damage Over \$1000
Shoplifting \$250 or Less 2303 30-16-20(B)(1)	4844	Shoplifting \$250 or Less
Misdemeanor Warrant MISDEMEANOR WARRANT	4659	Misdemeanor Warrant
Incident INCIDENT	4590	Incident
Criminal Trespass 5707 30-14-01	4355	Criminal Trespass
Criminal Trespass Notice CT NOTICE	4098	Criminal Trespass Notice
Domestic Dispute DOM DISPUT	3875	Domestic Dispute
Possession of Controlled Substance 3599 30-31-23(F)	3635	Possession of Controlled Substance
Battery (Non-Household Member) 1313 30-03-04 NON-HHM	3199	Battery (Non-Household Member)
Burglary Residential 2202 30-16-03(A) RESIDENTIAL	3071	Burglary Residential
Robbery W/Deadly Wpn (1st Ofn) 1299 30-16-02 (F2)	2416	Robbery W/Deadly Wpn (1st Ofn)
Possession Drug Paraphernalia 3550 30-31-25.1	2391	Possession Drug Paraphernalia
Battery HHM DV 1313 30-03-15	2204	Battery HHM DV
Negligent use of a deadly weapon 5213 30-07-04	2005	Negligent use of a deadly weapon

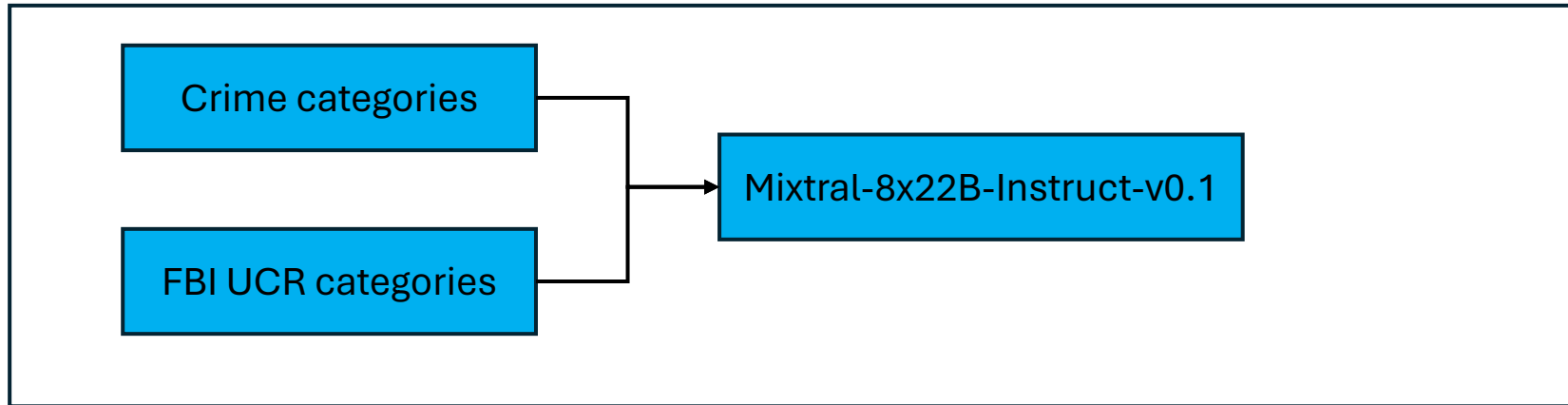
FBI's UCR Handbook (29 categories)

ucr_category	ucr_crime_classification	
Criminal Homicide	part_1_offense	Violent Crimes
Forcible Rape	part_1_offense	
Robbery	part_1_offense	
Aggravated Assault	part_1_offense	
Burglary	part_1_offense	
Larceny-theft (except motor vehicle theft)	part_1_offense	
Motor Vehicle Theft	part_1_offense	
Arson	part_1_offense	
Other Assaults	part_2_offense	
Forgery and Counterfeiting	part_2_offense	
Fraud	part_2_offense	
Embezzlement	part_2_offense	
Stolen Property: Buying Receiving Possessing	part_2_offense	
Vandalism	part_2_offense	
Weapons: Carrying Possessing	part_2_offense	
Prostitution and Commercialized Vice	part_2_offense	
Sex Offenses	part_2_offense	
Drug Abuse Violations	part_2_offense	
Gambling	part_2_offense	
Offenses Against the Family and Children	part_2_offense	
Driving Under the Influence	part_2_offense	
Liquor Laws	part_2_offense	
Drunkenness	part_2_offense	
Disorderly Conduct	part_2_offense	
Vagrancy	part_2_offense	
All Other Offenses	part_2_offense	
Suspicion	part_2_offense	
Curfew and Loitering Laws, (Persons under 18)	part_2_offense	
Runaways, (Persons under 18)	part_2_offense	

We need a mapping between the APD crime categories and FBI's UCR

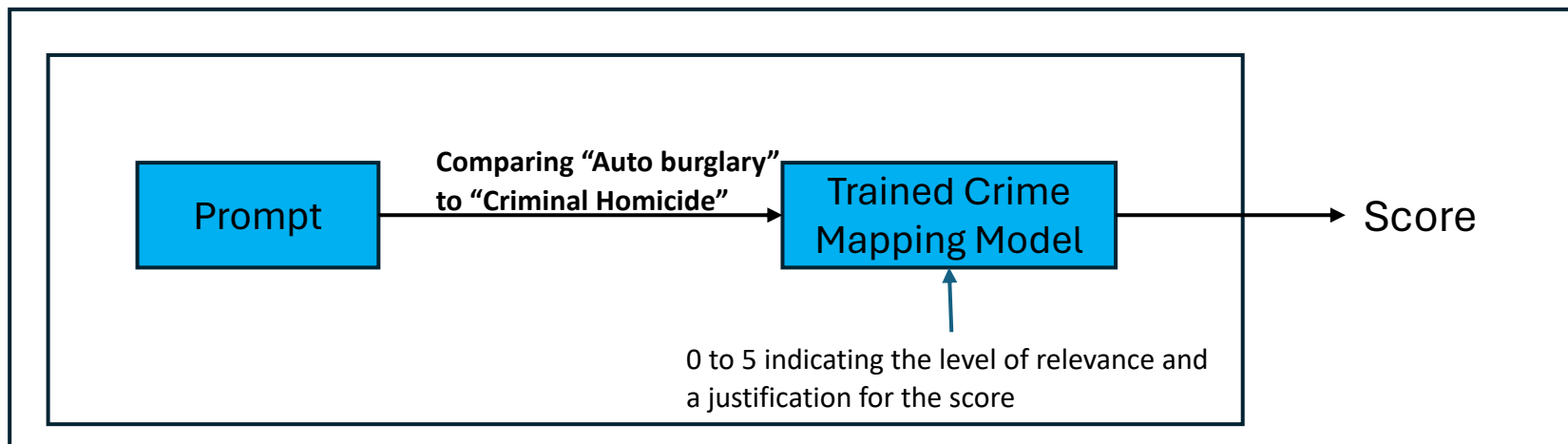
Mapping Crime Categories

An LLM is used to map crime categories to FBI UCR categories by utilizing its deep understanding of language and context, learned from analyzing millions of documents. This enables the model to accurately interpret and categorize crimes into the standardized framework provided by the UCR program, even when faced with complex or non-standard crime descriptions.



Step 1
Load relevant data
into the model

The algorithm discerns the contextual use of words, understanding "auto burglary" as a distinct concept rather than treating "auto" and "burglary" as separate entities.



Step 2:
For each crime category:
• Try to compare to all 39
FBI UCR categories

Promising Initial Results

A jupyter notebook does the analysis using prompting into a LLM. For every pair (that $669 * 29 = 19,401$ queries), it simply asks whether the APD category is relevant to the FBI query. It took, on average, just under 2min to compare and FBI query to the 669 APD queries. It took just shy of 60 min to run all the queries. Each query returned a score from 0 to 5 indicating the level of relevance and a justification for the score.

Comparing “Auto burglary” to “Criminal Homicide:”

Score: 0

- Justification: Auto burglary does not fall under the category of Criminal Homicide as it does not involve the unlawful killing of a human being.

Comparing “Drug Abuse Violations” to “Trafficking Controlled/Manufacture”:

Score: 5

- Justification: The crime category 'Trafficking Controlled/Manufacture' is directly related to Drug Abuse Violations as it involves the unlawful production, distribution, and sale of controlled substances, which is a significant aspect of drug abuse.

Comparing “Domestic Violence Report No Arrest” to “Offenses Against the Family and Children”

Score: 5

- Justification: The crime category 'Domestic Violence W/Arrest' is directly related to Offenses Against the Family and Children, as it involves violence occurring within a domestic setting, often involving family members or intimate partners. The inclusion of an arrest in the category also indicates a law enforcement response, further supporting its relevance to criminal offenses against this group.

Moving Forward

- Might want to focus on certain offenses and arrests
- Might want to understand when the crimes are occurring to determine if that impacts camera location and/or configuration (FOV, pan, tilt, zoom)