Seattle Crime

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Business Goal

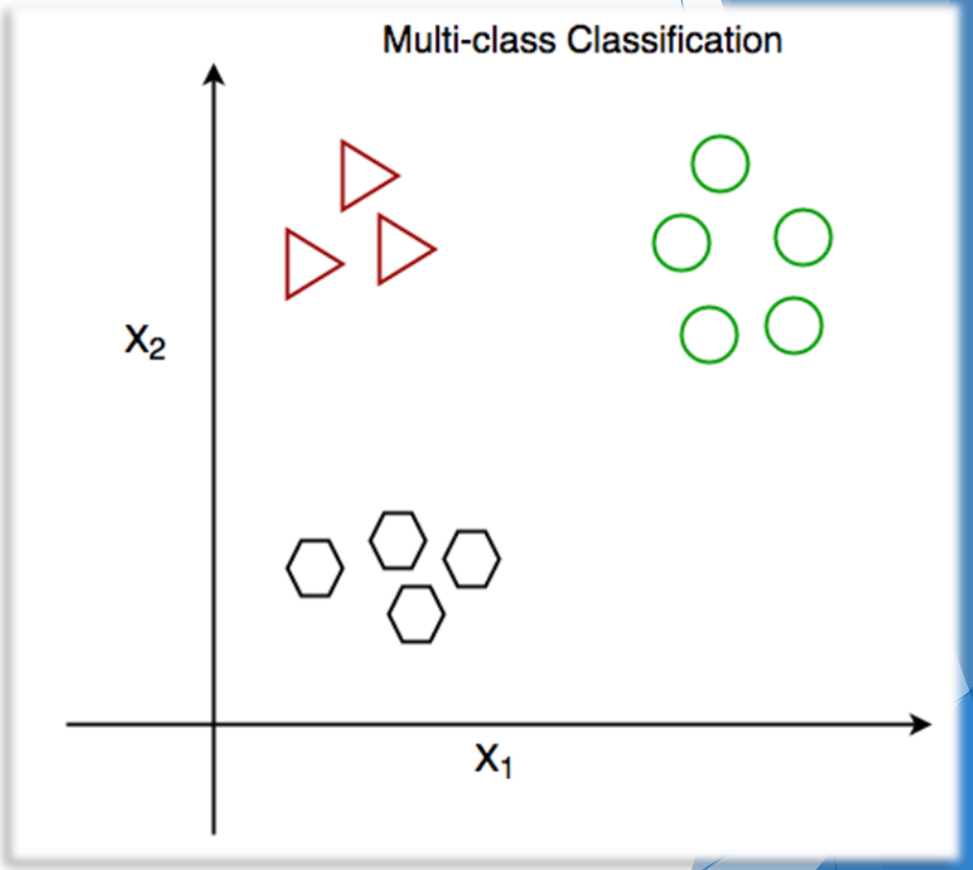
- Seattle one of top 50 largest US cities
- One of the fastest growing in US
- Seattle recently ranked among least safest cities in US
- Make city and people feel safer
- Generate positive image
- Preventative action
- Classify/predict crimes as they occur

Method

- Use of Multiclass Classification models
- Pick best one
- Able to classify types of new crimes
- New crime location
- What is Multiclass Classification?

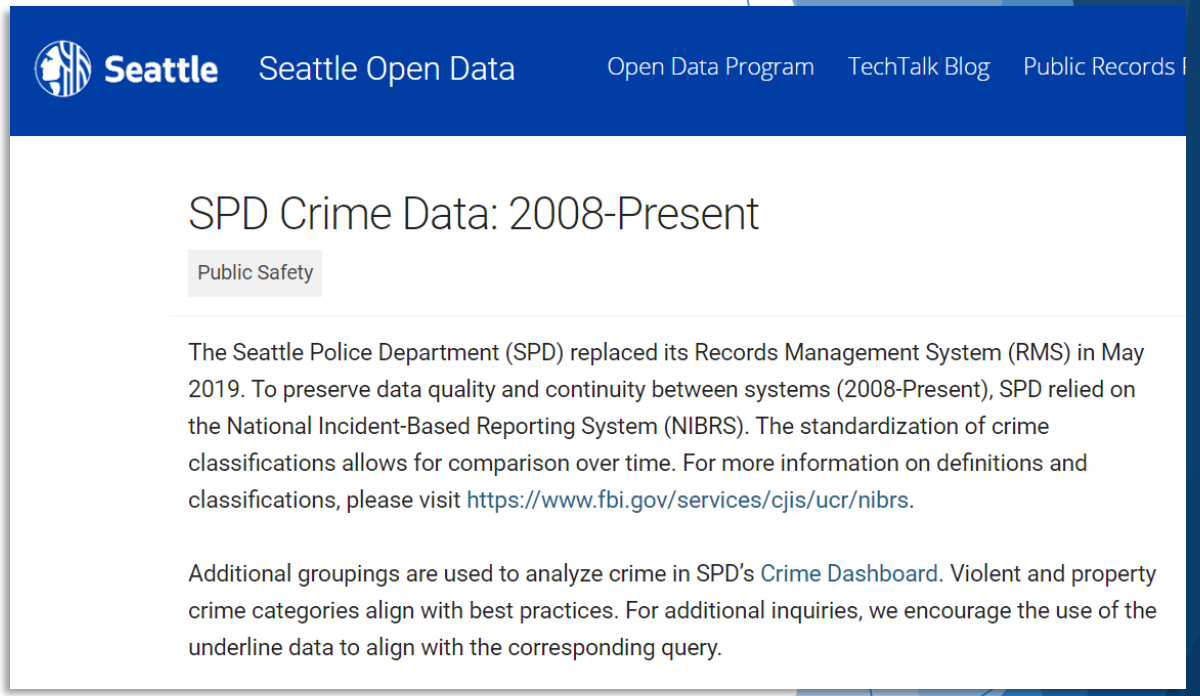
Multiclass Classification

- Process of dividing data into classes/categories
- More than 2 categories
- Can be used to predict future values
- Crime type and location
- Crime data



The Data

- City of Seattle's site (Seattle.gov)
- SPD crime dataset(2008-present)
- Publicly available
- Over 1 million rows
- Crime date, crime category, crime location, etc
- Data categorical

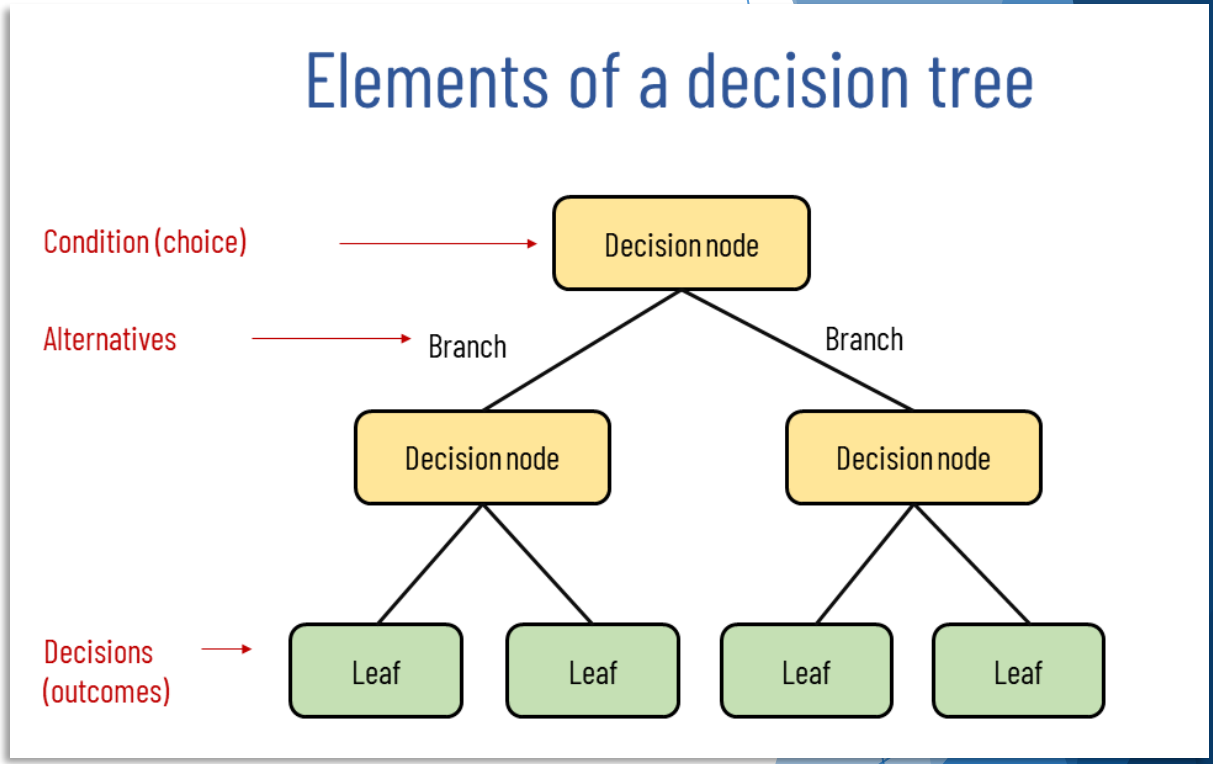


The Models

- 2020-2023
- Built two separate models
- Used two different algorithms
- Built initial models then improved
- CatBoost (gradient boosted decision tree)
- Random Forest

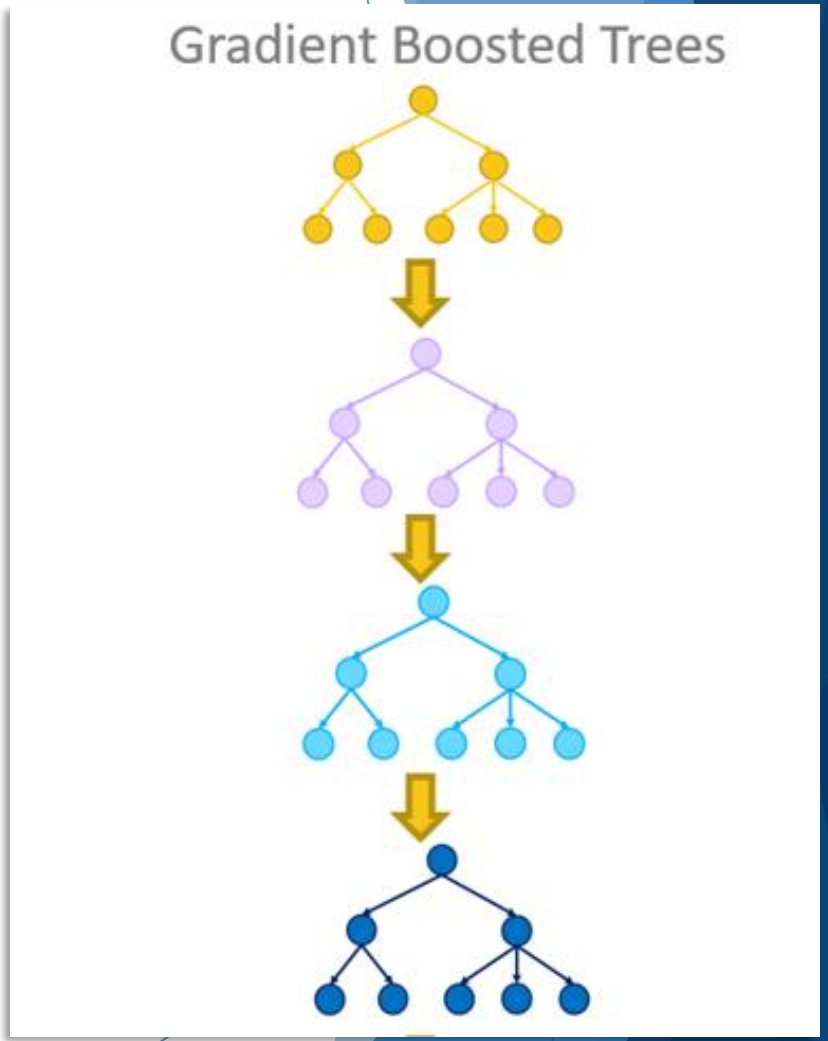
CatBoost

- Gradient boosted Decision Tree
- Used when data is categorical
- Decision tree splits data into series of decisions
- At end, final decision reached and data is categorized
- Decision Trees prone to overfitting



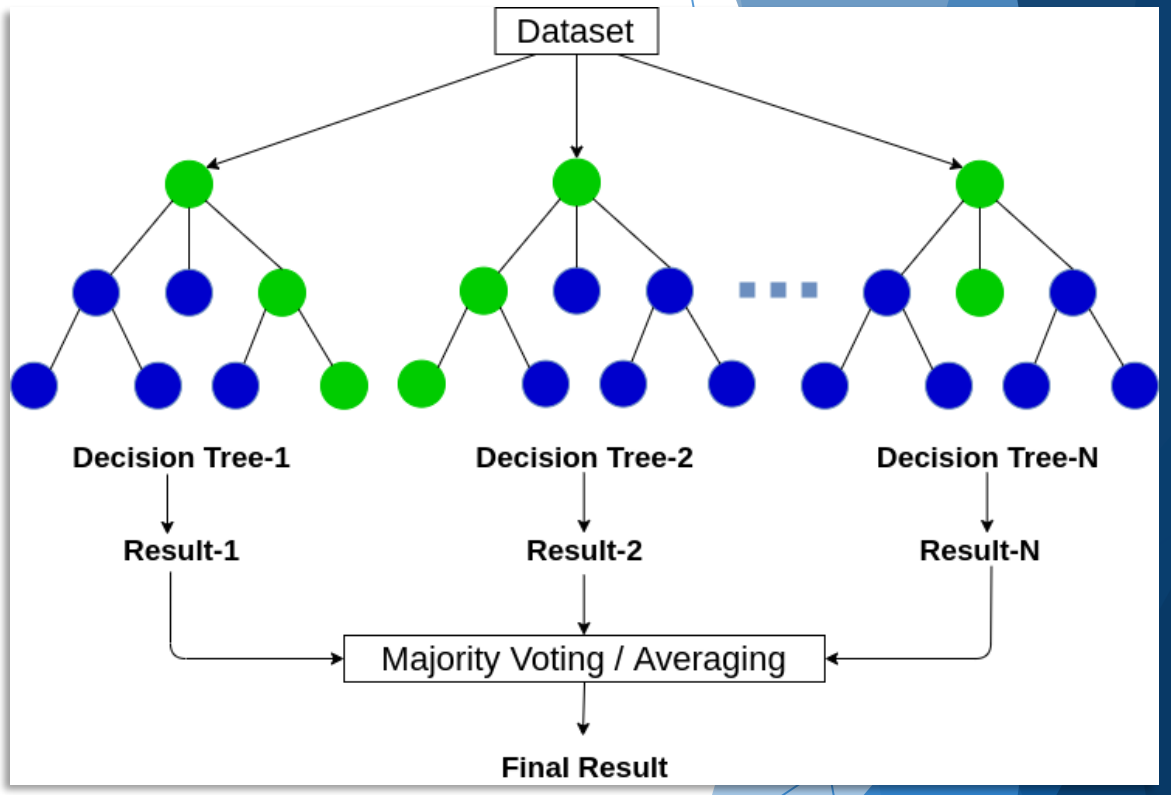
CatBoost Continued

- Reduce overfitting with gradient boosting
- Adding series of decision trees, each one improves upon last
- Great default models
- Train on computer part called GPU



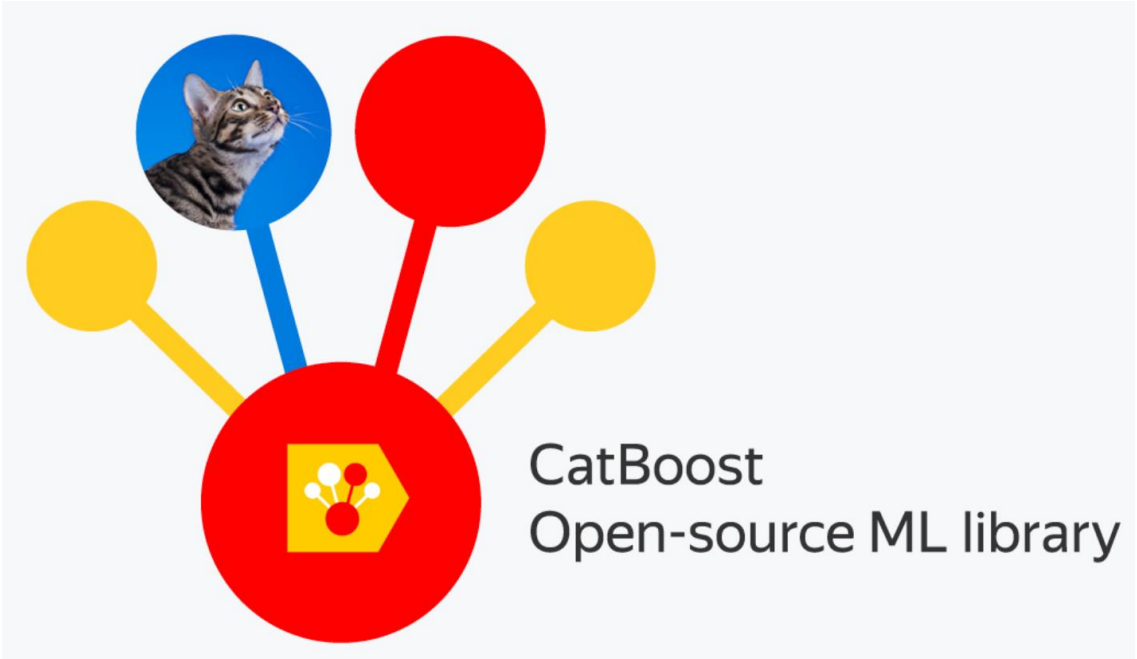
Random Forest

- Random samples created from data
- Individual decision trees made for each sample
- All tree predictions compared together
- Majority vote for best prediction
- Which model best



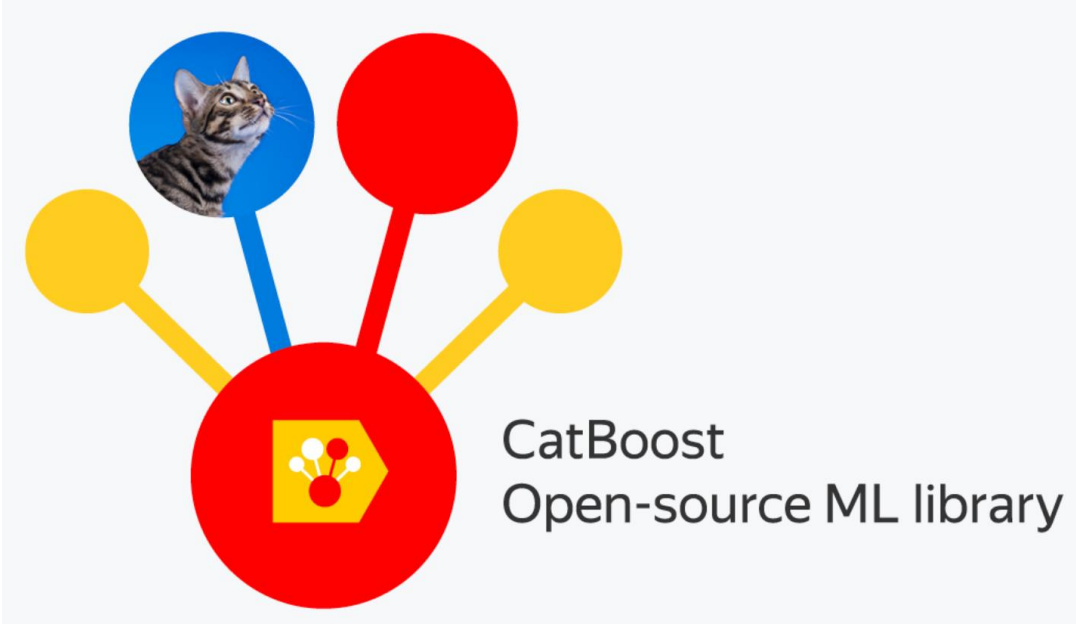
Crime Type Best Model

- Compared Random Forest and CatBoost models
- Found our CatBoost model to be the best model



Crime Location Best Model

- Compared a default CatBoost model and a tuned CatBoost model
- Found initial CatBoost model was our best one



Results

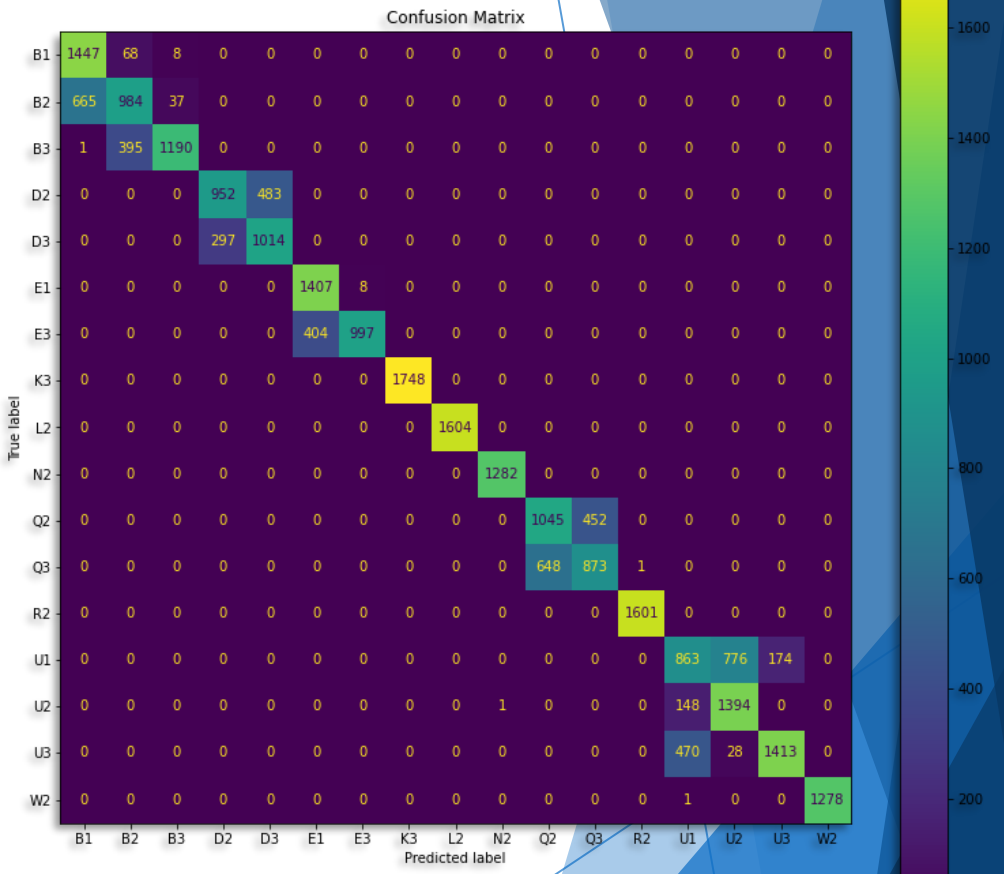
- Crime type, crime locations
- Cover major ones
- Recall, True Positives, False Negatives

Results Continued

- Recall
- Total number of certain type crime/crime location, what percent did model correctly predict

Results Continued

- TP, FN
- How many crimes/crime locations were correctly predicted
- How many crimes/crime locations wrongly predicted as not belonging to a certain class

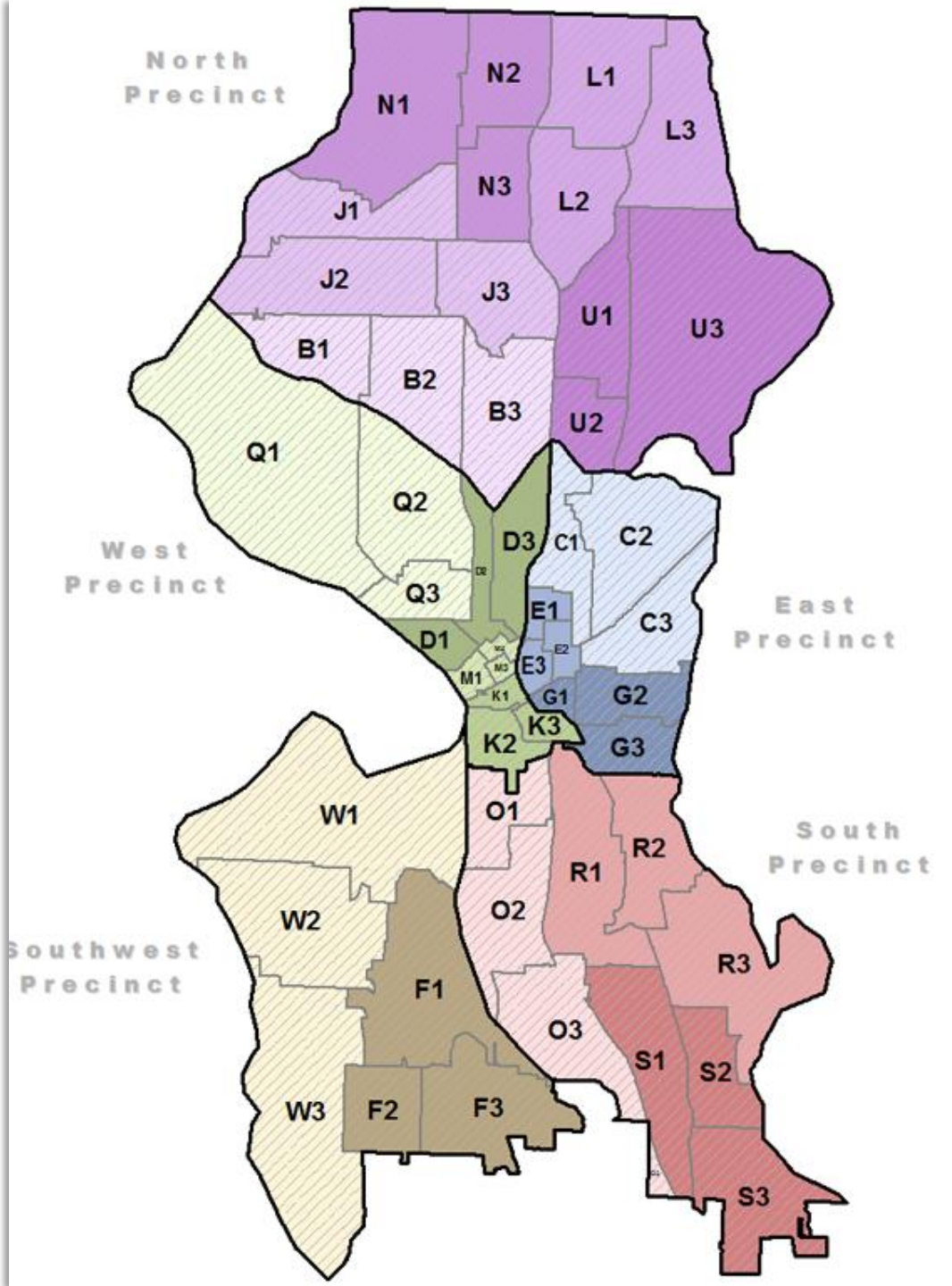


Crime Type Results

- Best predicted crimes were Shoplifting and Simple Assault
- Shoplifting recall was .62
- 1,859 true positive instances, 1,116 false negative instances
- Simple Assault recall was .56
- 2,139 true positive instances, 1,651 false negative instances
- Low recall
- High FN instances

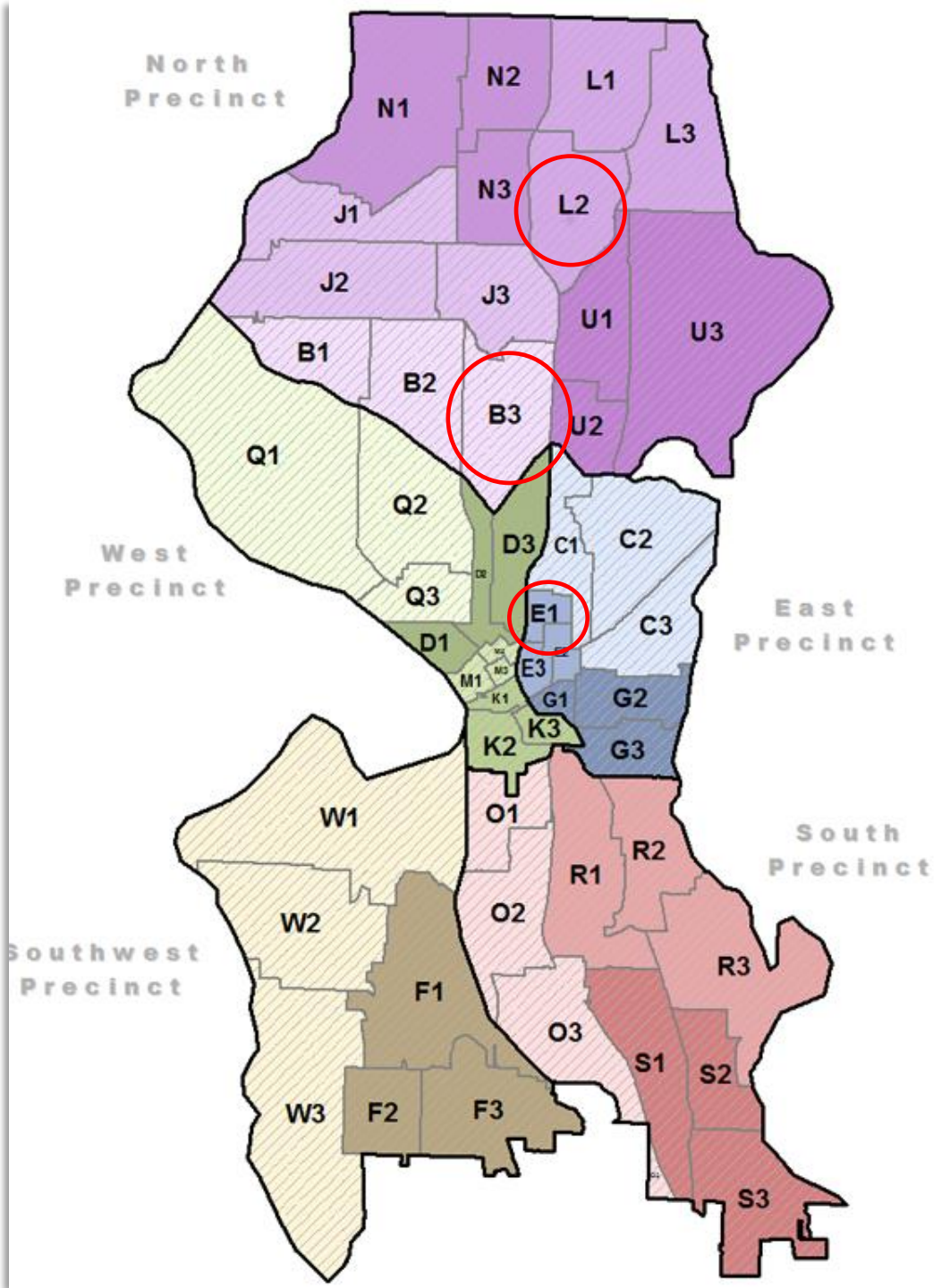
Crime Location Results

- Important to know how Seattle separated
- Seattle separated into precincts, sectors, and beats
- Precincts are police station general locations
- Sectors smaller areas within precincts
- Smallest area within sectors called Beats
- Beats are what we use



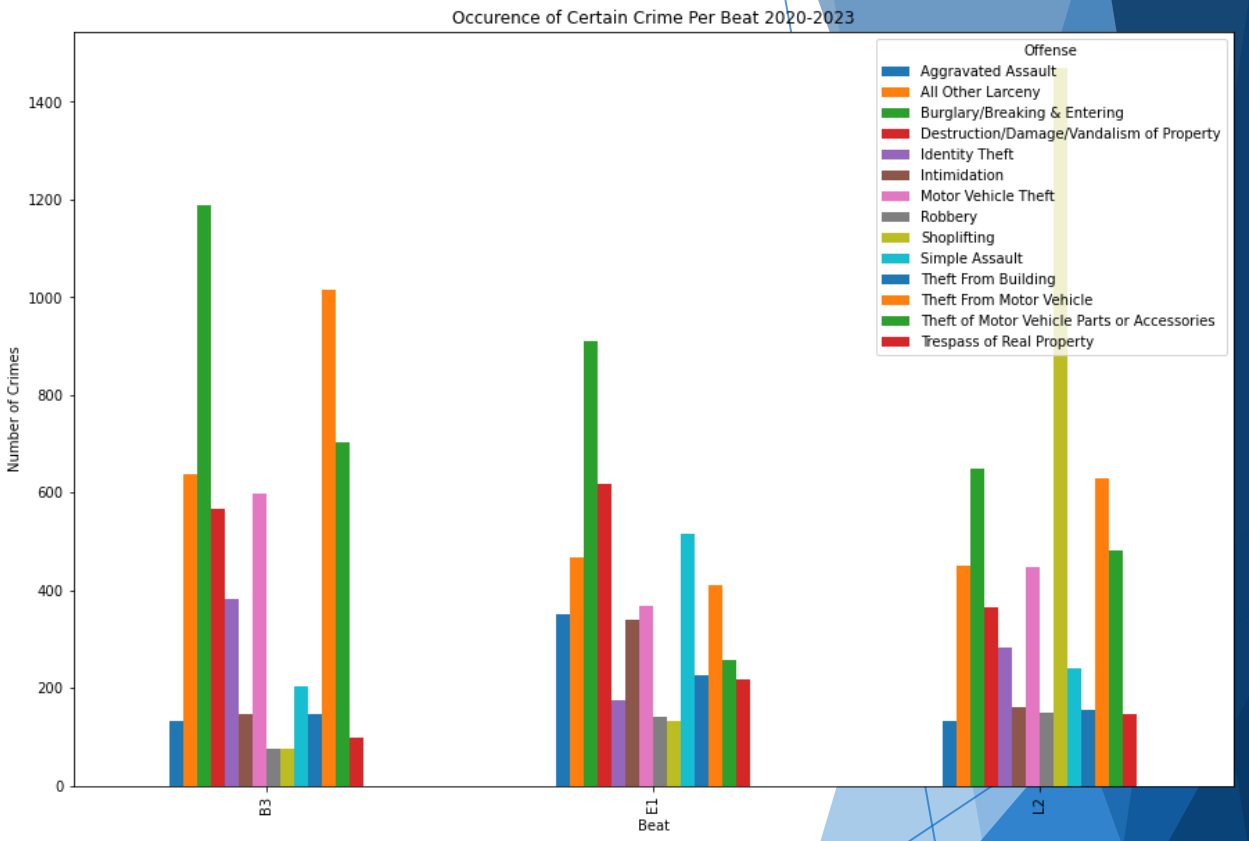
Crime Location Results

- Best predicted crime locations were B3, E1, L2 Beats
- For recall B3(.75), E1(.99), L2 (1.0)
- For TP instance B3(1,187), E1(1,406), L2(1,604)
- For FN instances B3(399), E1(9), L2(0)
- High recall, High TP
- Low FN



Additional Analysis

- Looked at data without the use of ML models
- Looked at which crimes occurred the most in our best predicted Beats
- We can see top crimes between the 3 Beats are Burglarly/Breaking & Entering and Theft From Motor Vehicle crimes

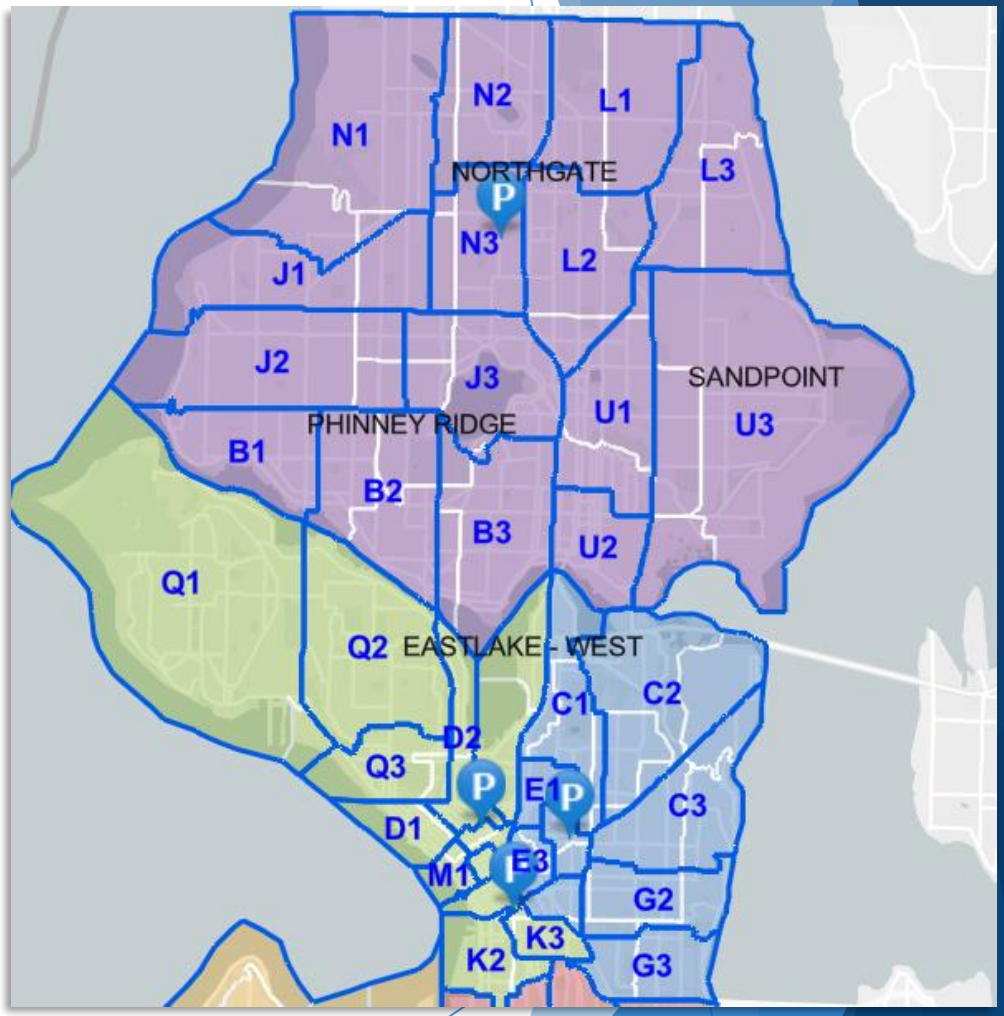


Final Results

- Our model best classifies new crimes as occurring in the B3, E1 and L2 Beats
- Top crimes are Shoplifting, Simple Assault, Burglary/Breaking & Entering and Theft From Motor Vehicle
- Can focus on preventative measures

Recommendations

- B3, E1, L2 and police stations on map
- Need more station(s) between B3 and L2
- Alternatively divert some southern police forces north
- Lead to faster response times, deterrence of future crimes (all types)
- Shortage of officers, due to staffing crisis and quitting
- Another option to form neighborhood watch for each Beat
- Build/improve relations with the public



Recommendations Continued

- Install more security cameras in strategic places, with 24-hour surveillance
- Dimly lit areas, areas of lower foot traffic
- Easier to track all crimes, may also deter crime
- Lastly, build more monitored, affordable parking
- Reduce theft and create positive feedback from public

Recommendations Continued

- Implementing model
- Implement model in Dispatch center
- Police laptops
- Will allow for instant notification and response
- Integrate with social media
- Any social media posts will alert model

Next Steps

- Results are great starting point
- Reduce overfitting in location model
- Obtain higher recall scores in crime type model
- Don’t filter data
- Model takes while to train
- Run faster on GPU
- May be expensive to buy GPUS, but can rent GPUs (less than 3$ per hour)

Next Steps

- Once model successfully tuned and implemented, will have numerous positive effects
- Decrease crime, improve police-public relations, increase business/tourism
- Once proven successful, model may even be implemented in other parts WA, and then even other states

Sources

- https://www.rexmontrealestate.com/blog/seattle-economy/#:~:text=Seattle%2C%20Washington%2C%20has%20a%20long,is%20home%20to%20many%20industries.
- https://wallethub.com/edu/safest-cities-in-america/41926
- https://www.infoplease.com/us/cities/top-50-cities-us-population-and-rank
- https://www.king5.com/article/news/local/seattle/mayor-bruce-harrell-new-seattle-police-recruitment-plan-staffing-reaches-30-year-low/281-e98429ee-fc88-47f6-8890-b961393e2047

Questions and Contact Information

- Questions?
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