

Course Title: Computer science applications and advancements

Thesis Title: Crime Rate Prediction and Visualization Using Data Science Techniques



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## Abstract

Crime is a global social challenge, affecting public safety, economic stability, and national development. This research uses machine learning and data science techniques to predict crime using crime datasets from Chicago and Denver. The system identifies high-risk areas, frequent crime types, and temporal trends. The study supports supervised learning as the most widely adopted approach, but challenges remain in model accuracy and data integration.



## Introduction

Crime rates are on the rise globally, causing disruption to societal order, economic development, and public safety. Governments and research institutions are adopting data-driven methods for crime prevention and prediction. Machine learning and data visualization techniques have emerged as transformative approaches to understanding crime patterns, predicting future incidents, and identifying crime hotspots. In Nigeria, increasing violence across geopolitical zones has prompted calls for predictive solutions. International datasets and U.S. cities have shown correlations between demographic and economic factors with crime trends. Supervised machine learning algorithms, such as Random Forest, Decision Trees, and Support Vector Machines, have been widely used in crime prediction applications. However, concerns over data privacy, algorithmic bias, interpretability, and ethical implications persist.

## Related Work

Big cities are grappling with high crime rates, necessitating the use of data mining and deep learning techniques for crime analysis. Big data analytics can aid businesses in efficient operations and high profits. It has been applied in healthcare, manufacturing, maintenance, electronic markets, and tourism. Machine learning and deep learning techniques can identify crime patterns and trends in crime prevention. Immersive analytics is gaining popularity for data visualization, incorporating human-in-loop interaction. Reehl & Sharma developed a tool to visualize Baltimore crime data in both immersive and non-immersive environments, incorporating 3D interaction techniques. Sharma et al. used Unity 3D and Multitude GIS to visualize COVID-19 data and crime data in Baltimore, focusing on African Americans' vulnerability to the virus.



## Analysis of Crime

Crime hinders a nation's development by weakening social cohesiveness, diverting funds from essential industries, and hindering human capital development. Crime is a harmful act that can be both direct and indirect, causing harm to individuals and groups. It is a social construction that varies depending on time and place, and is influenced by shared conventions, values, and beliefs. To combat crime, nations should adopt comprehensive methods that promote growth, social well-being, and sustainable development. By addressing crime through comprehensive methods, nations can establish a climate conducive to growth, social well-being, and sustainable development.

## Comparison of crime statistics for the cities of Denton, Baltimore, Chicago, and Dallas

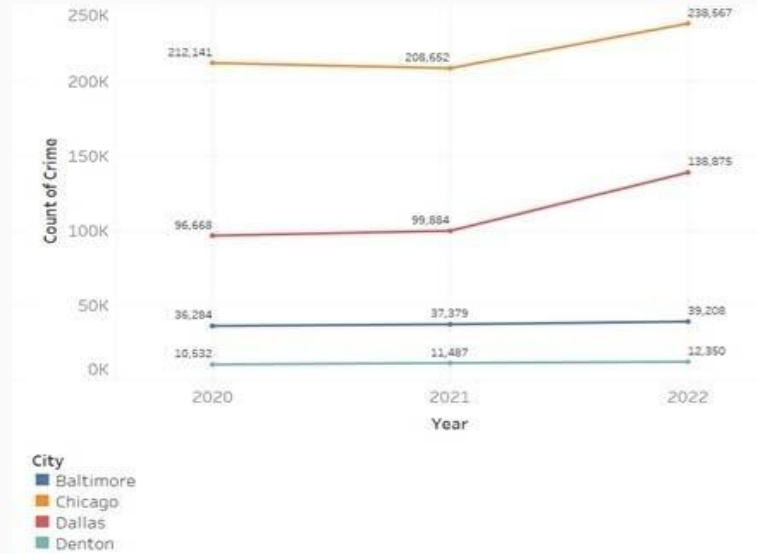


Figure 1. Shows the plot of the count of crime made using Tableau.  
The color shows each city. The view is filtered by year, which ranges from 2020 to 2022

# Comparison of crime statistics for the cities of Denton, Baltimore, Chicago, and Dallas

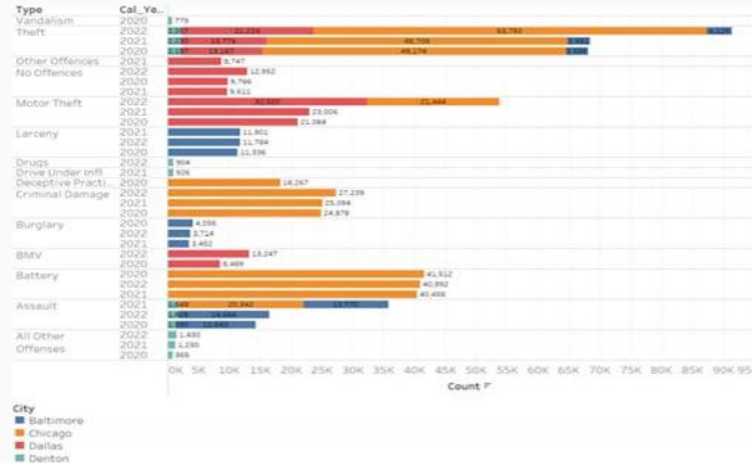


Figure 2. Crime types in Chicago, Baltimore, Dallas, and Denton

# Crime Types

**Table 1. Statistics of Crime rate**

	<b>Chicago</b>	<b>Baltimore</b>	<b>Dallas</b>	<b>Denton</b>
<b>Violent crime rate</b>	4.728	11.93	5.473	1.723



# Crime based on demographics

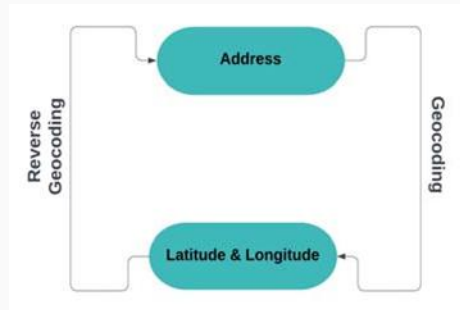


Figure 3. Flow representation of Geocoding and Reverse Geocoding

## Crime based on demographics

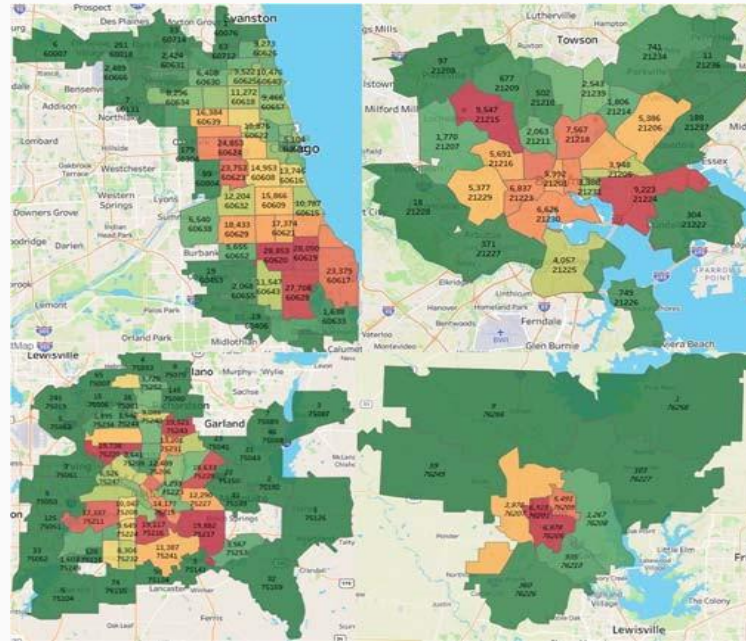


Figure 4. Flow Count of Crimes based on Zip code in Chicago, Baltimore, Dallas, and Denton from 2020 to 2022.

# Population

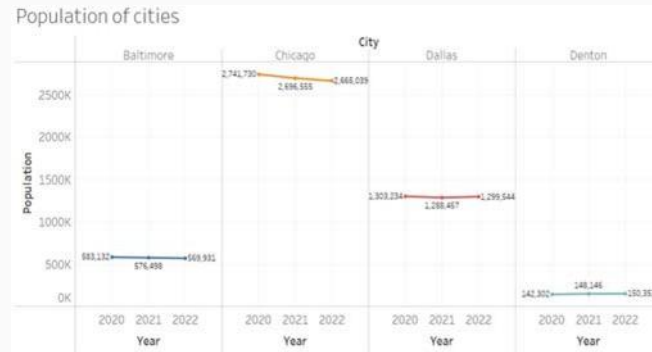


Figure 5. Count of Population in 4 Cities from 2020 to 2022



## Analysis of Crime with Population

Crime about the population provides insight into crime distribution and effects in a area, identifying patterns, assessing community safety, and guiding targeted interventions. Crime per capita is a standardized metric that compares crime rates across different population sizes, indicating higher risks and the need for targeted intervention. However, population alone doesn't determine crime rates.



## Conclusions

Denton and Dallas show a correlation between population and crime rates, while Chicago and Baltimore experienced a 3% decrease in population but increased crime rates between 2020 and 2022. The Chicago region's red zones, with more commercial districts, are more likely to be prone to crime. Dallas' population distribution is medium, but the red zone areas are crowded with retail stores, airports, parks, and schools.



## References

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THANK YOU

Any Question ?