# Crime Hotspots Forecasting via Deep Learning Methodology

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## Introduction

Crime remains a significant social issue in the United States, with a violent crime committed every 24.6 seconds and a property crime offense occurring every 4.1 seconds, as per the 2017 FBI data. This poses a serious threat to public safety and has profound implications for the economy. The need for effective prediction and comprehension of criminal activity patterns is crucial, particularly in identifying future high-risk areas, commonly referred to as "crime hot spots."

## Methods

In this study, we leverage three deep neural network architectures to forecast future crime hotspots:

- 3D Convolutional Neural Networks (CNNs): use 3D convolutions to identify spatio-temporal patterns, capturing the complex dynamics of crime events over time and space.
- Long Short-Term Memory (LSTM): excels in analyzing sequential data, making it ideal for predicting patterns that evolve.
- CNN + RNN Hybrid: By combining CNN and RNN architectures, this hybrid approach harnesses CNN's ability to detect spatial patterns and RNN's strength in sequence prediction, offering a comprehensive model for crime hotspot forecasting.

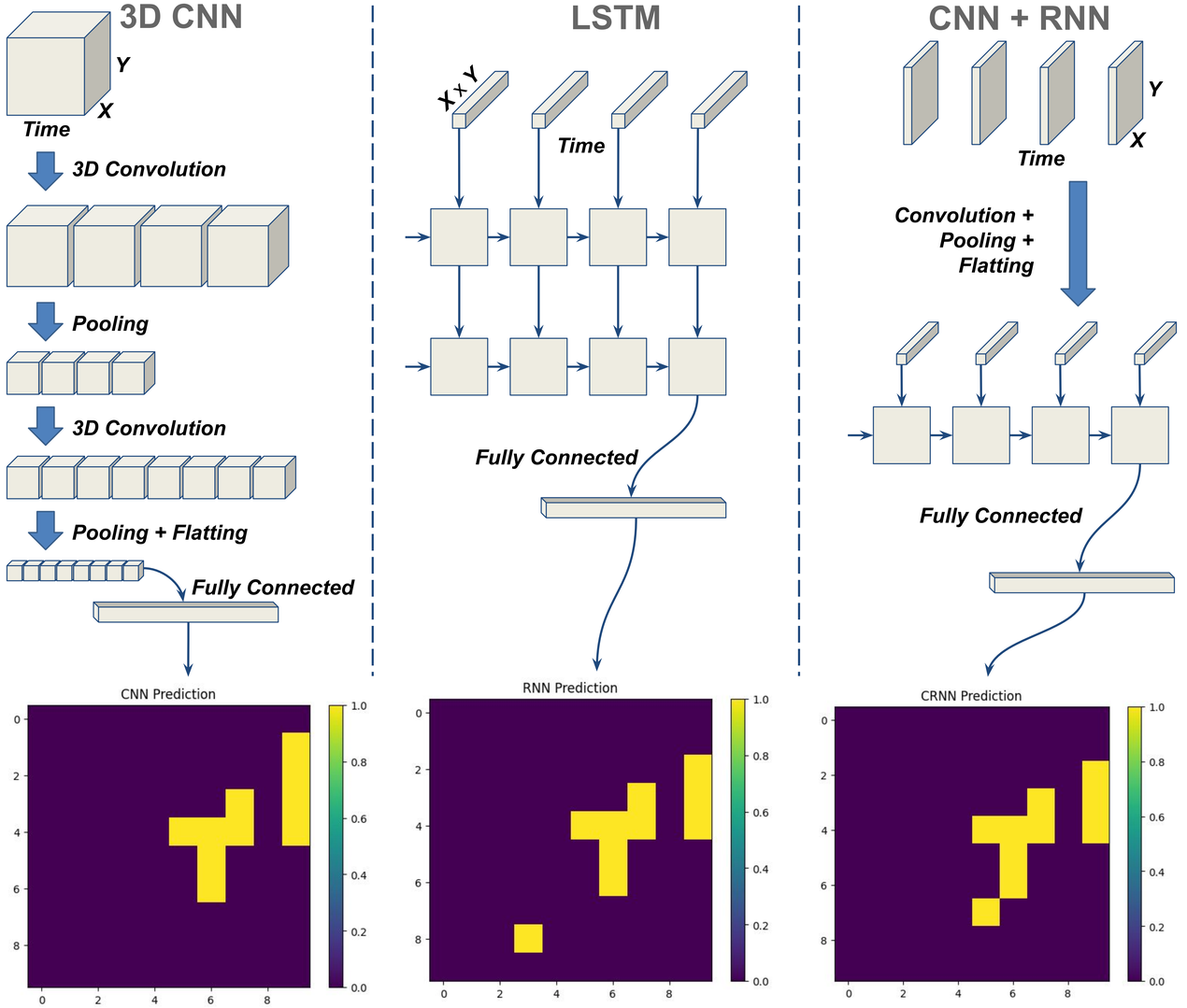
## Experiments

To validate our approach, we utilized comprehensive call-for-service data provided by the Portland, Oregon Police Bureau (PPB). Comparative analyses were conducted with various deep neural network architectures. Experiment workflow as shown below:

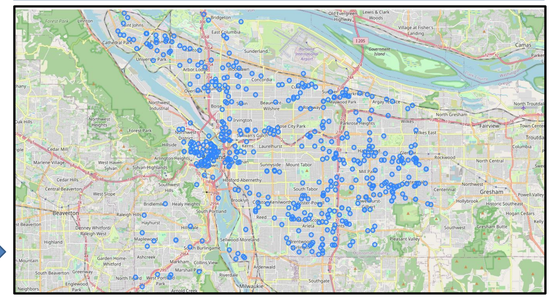
### Call For Service Data:

| | CATEGORY | CALL GROUPS | final_case_type | CASE DESC | occ_date | x_coordinate | y_coordinate | census_tract |
|---|---|---|---|---|---|---|---|---|
| 0 | STREET CRIMES | DISORDER | DISTP | DISTURBANCE - PRIORITY ... | 1/1/2013 | 7625659 | 714714 | 4101.0 |
| 1 | STREET CRIMES | DISORDER | DISTP | DISTURBANCE - PRIORITY ... | 1/1/2013 | 7628093 | 655826 | 6404.0 |

Data Preprocessing




## Data on the map



## Future work

- Enhancing Spatial Resolution: We plan to refine our models to achieve higher resolution in hotspot map predictions, allowing for more detailed and precise forecasting.
- Incorporating Additional Data: We plan to integrate additional knowledge(e.g. census data) into our deep neural network architecture to improve its predictive accuracy.

## Ground Truth