Predicting Mass Casualty Events from 911 Data Streams

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Problem Statement

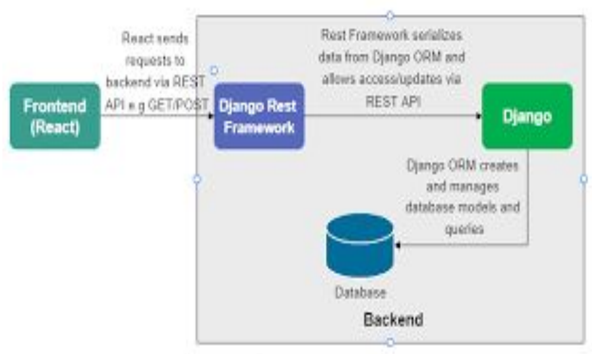
Emergency response systems are critical for public safety, requiring rapid and accurate identification of significant events to deploy resources effectively. However, the massive volume of 911 call data poses significant challenges in real - time monitoring and anomaly detection.

1. Overwhelming call volume for limited number of dispatcher
2. Time - Consuming process of gathering essential information during emergency calls.
3. Verification and confirmation of emergency situations requiring heightened response through multiple caller reports.
4. Visual interface to aid in monitoring while incorporating notification of these events in real-time.

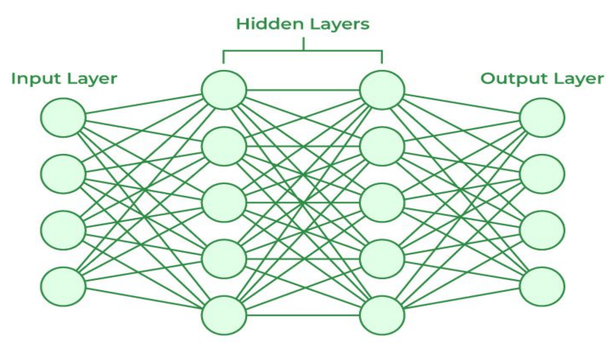
Data Science Pipeline

Our data management strategy employs PostgreSQL for robust data handling, which includes storing, indexing, and query large datasets efficiently. The integration of Kafka facilitates the real - time streaming of data, essential for system that relies on up to the minute accuracy to inform emergency response efforts. These technologies form the backbone of our data pipeline, ensuring that data flow smoothly from collection points to our models. This setup not only supports high data throughput but also ensures data integrity and rapid retrieval capabilities, crucial for time.

1. Preprocessing : Extensive preprocessing to ensure data quality and relevance. Preprocessing took almost 70% of the time
2. Model Integration : Applying Incremental DBSCAN and Neural network to detect anomalies
3. Interactive methodology : Continuously refinding models based evaluation results and emerging data trends.



FullStack Pipeline



Neural Network Approach

Solution Architecture

The final solution architecture has three main layers:

1. Data is acquired from an initial Postgres Server
2. Data is cleaned and served through Flask in a Python Backend
3. Data is utilized in a React Front-End for the end user Emergency Event Monitoring Application

This application allows the user to:

- Sign in
- View relevant dispatch area
- Monitor live call feeds, traffic, set call window
- Receive alert notifications at event detection

Key Insights

The finding of our projects demonstrate the effectiveness and potential of advanced predictive modeling techniques in the emergency response. We utilized unsupervised learning algorithms, specifically Incremental DBSCAN (Density - Based Spatial Clustering of Applications with Noise) and Neural networks to identify and categorize anomalies in 911 call data.

1. Spatial - Temporal Anomalies Detection
   a. Incremental DBSCAN proved to be highly effective in identifying high density clusters in the 911 call data, which often correspond to significant events such as mass casualty incidents
   b. Our network model, designed for detecting spatial - temporal anomalies, showed results. The model was sensitive, classifying all data points as potential events which led to a high rate of false positives.
2. Data Quality and Patterns
   a. Extensive preprocessing was essential to ensure the quality of and relevance of the data. We address related to timestamp inconsistencies, month density variations, and city density anomalies.
3. Model Performance
   a. Incremental DBSCAN
   b. Neural Network