Integrated Safety Incident Forecasting and Analysis

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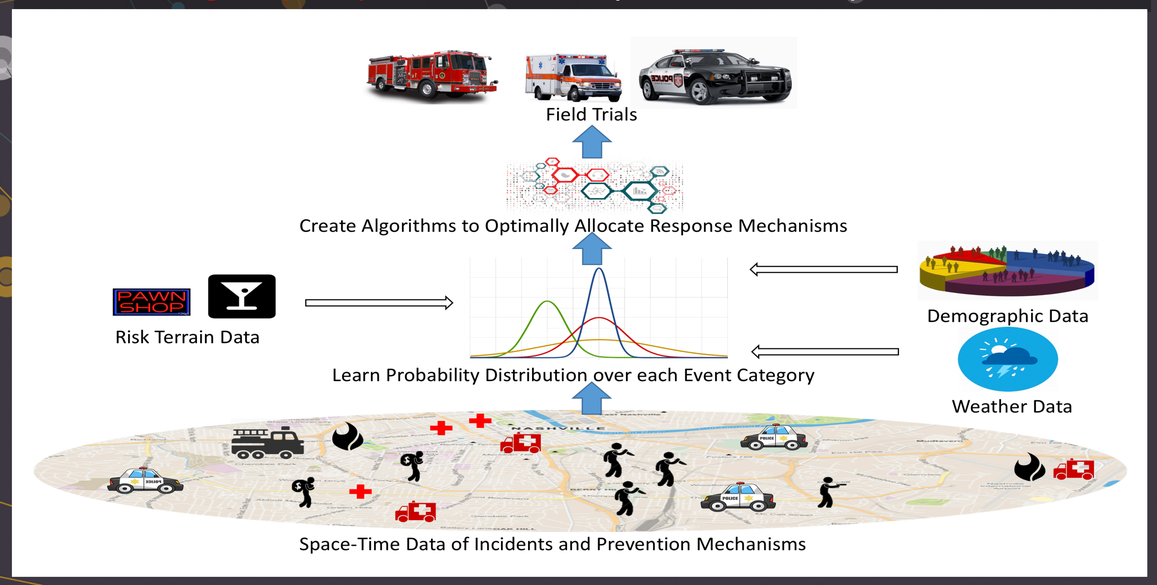
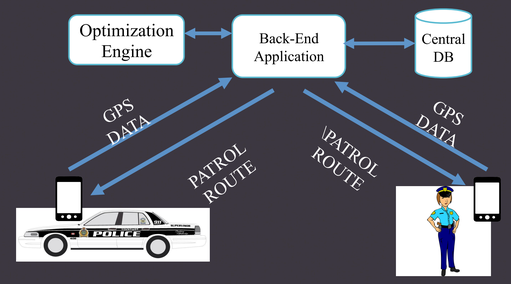
Project Objectives

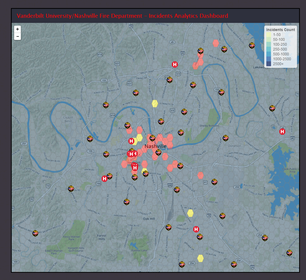
- Develop methods to effectively forecast urban incidents.
- Develop an integrated stochastic optimization-based architecture for emergency responder in anticipation and response.

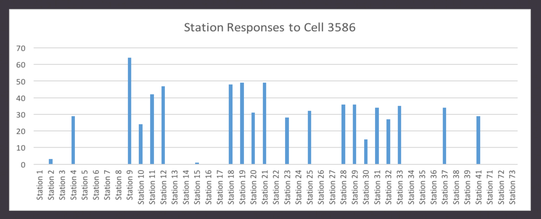


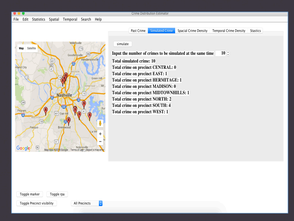
- Research to Practice : develop tools for easy access, visualization and analysis of incident data, its prediction and the optimization framework.

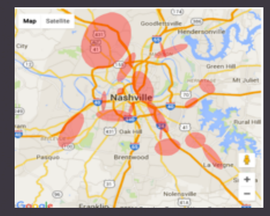


Basic Software Architecture









Incident Forecasting

- A decomposable model to predict time to incidents (*t*) and the urgency (*k*) to respond to them, based on covariates *w*.

$$f(t,k|w) = f(t|w)f(k,t|w)$$

- Use Censored Accelerated Failure Survival Analysis Model for *f(t|w)* and Multinomial Logistic Regression for *f(k|t,w)*.
- Any arbitrary set of covariates can be included in to the model.
- Principled estimation technique of MLE.
- Use Hierarchical and SBAC clustering to learn distribution over number of models.

Responder Placement to Minimize Response Time

- High-dimensional dynamic optimization problem under uncertainty.
- Formally, the model is

$$\min_q \mathbb{E}_{s\sim f}[D(q;s)]$$

  we try to find optimal allocation of resources *q* minimize the expected response time *D* to incidents *s,* distributed as *f.*
- Use decomposition techniques and heuristic-based approaches to solve hard optimization problems.

Responder Placement to Maximize Deterrence

- Create Patrolling Algorithms to prevent incidents like crimes, traffic violations etc.
- Formally, create a model such that

$$\max_q C_{f|q}$$

  we try to maximize the coverage in anticipation of incidents distributed according to *f.*
- Create an optimization framework that achieves both deterrence while minimizing response times.

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