Crime prediction and policy planning in european city

Evagelos Boulougouris, NTUA, Greece;
Angelos Aveklouris, NTUA, Greece;
Konstantin Ushenin, UrFU, Russia;
Anastasia Lantseva, ITMO, Russia.

What we will do?

First part: real-time prediction of crime in europeans city

Second part: policy planning

Goals:

- Lower rates of criminality
- Reduce spending on police

Crime prediction (simulation)

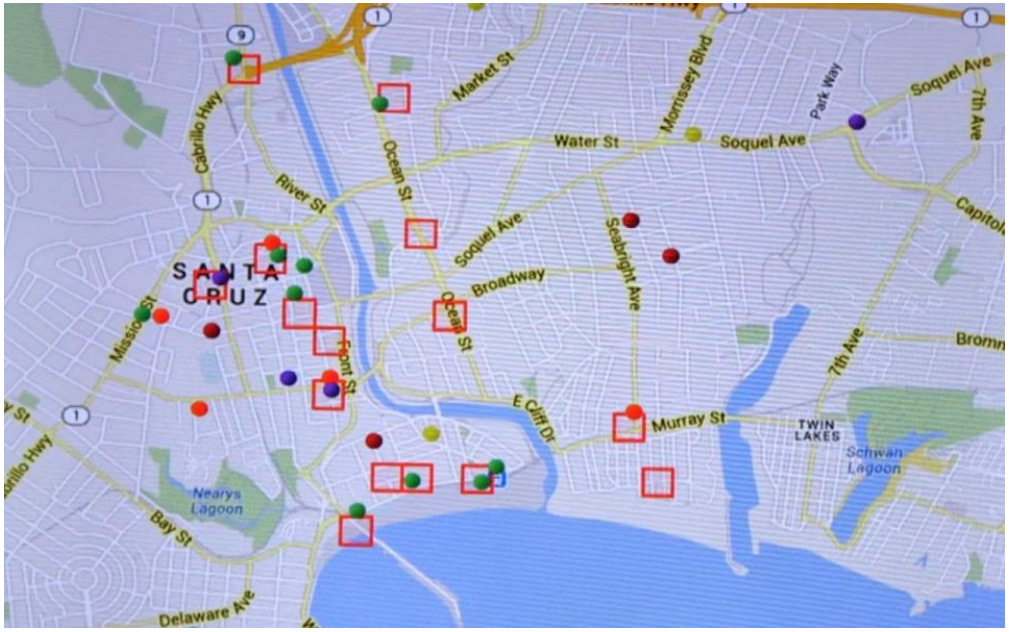
- Predict next event locations
  - Type of crime
  - Place of crime
  - Time of crime
- Criminal route after crime
  - Car chase
- Predict count of people in mass riots

No personal data is utilized in making these predictions

Predpol

- USA: Atlanta, LA, Richmond, 3+ city
- Richmond stat.
  - 21% drop in violent crime
  - 28% decrease in property crime
  - 50% drop in residential burglaries
  - 34% decrease in vehicle theft

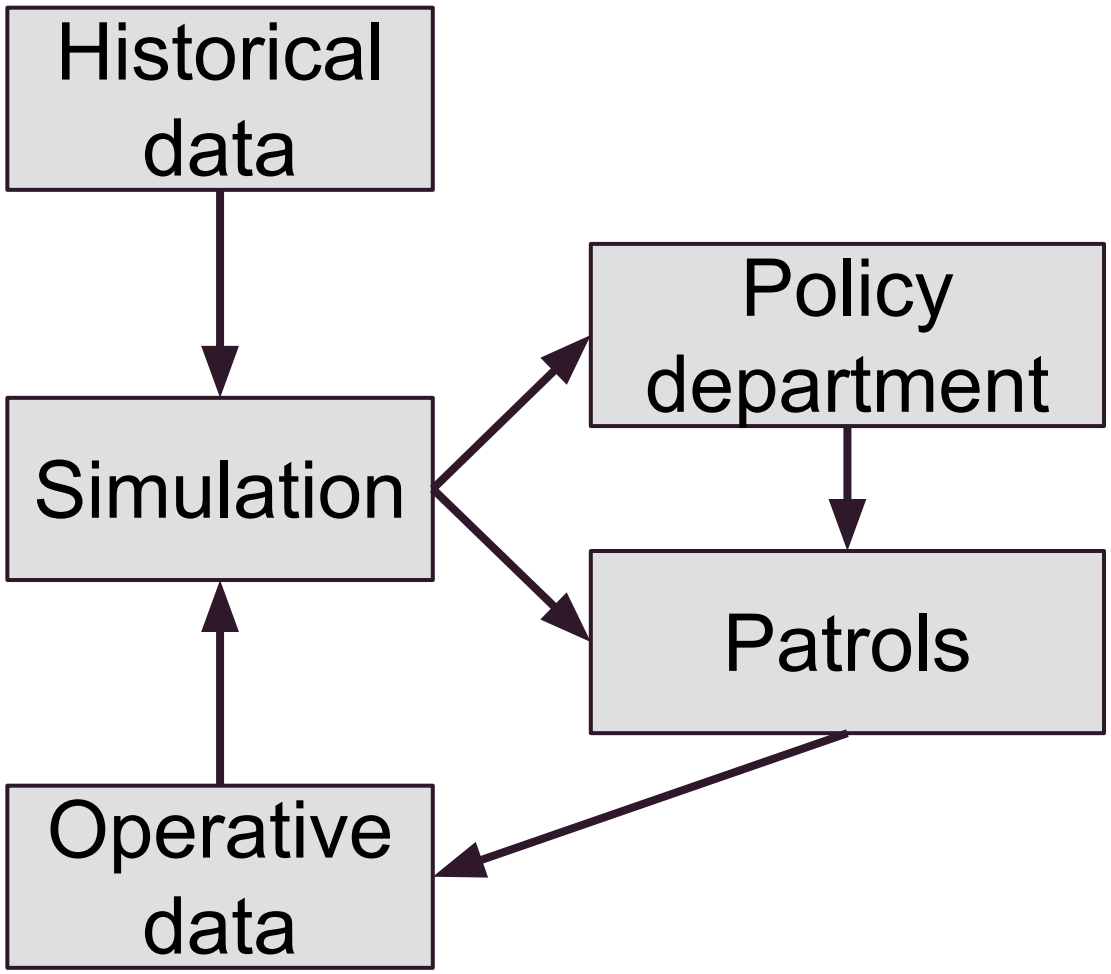
PREDICTIVE POLICING



Policy planning (application)

- Macro: year planning
  - Allocation of resources
  - Multiple-year horizon
- Meso: month
  - Investigation
  - Gathering statistics
- Micro: real-time
  - Optimal route of patrolling (nearest to crime, minimize uncovered area)
  - Investigation while the trail is still warm
  - Car chase helping

System conception



- Big data based
- Real-time human+machine decision making
- Complex system modelling
- Interdisciplinary:
  - math
  - CS
  - sociology
  - criminology
  - urbanistic
- System effect

Sources of data

- Open data
  - City maps (OpenStreet maps, Google maps)
  - Demographics information
  - Social media (twitter, …)
- Administrative data
  - Real-time info about crimes
  - Crime statistics
  - Reports of crime in the past year

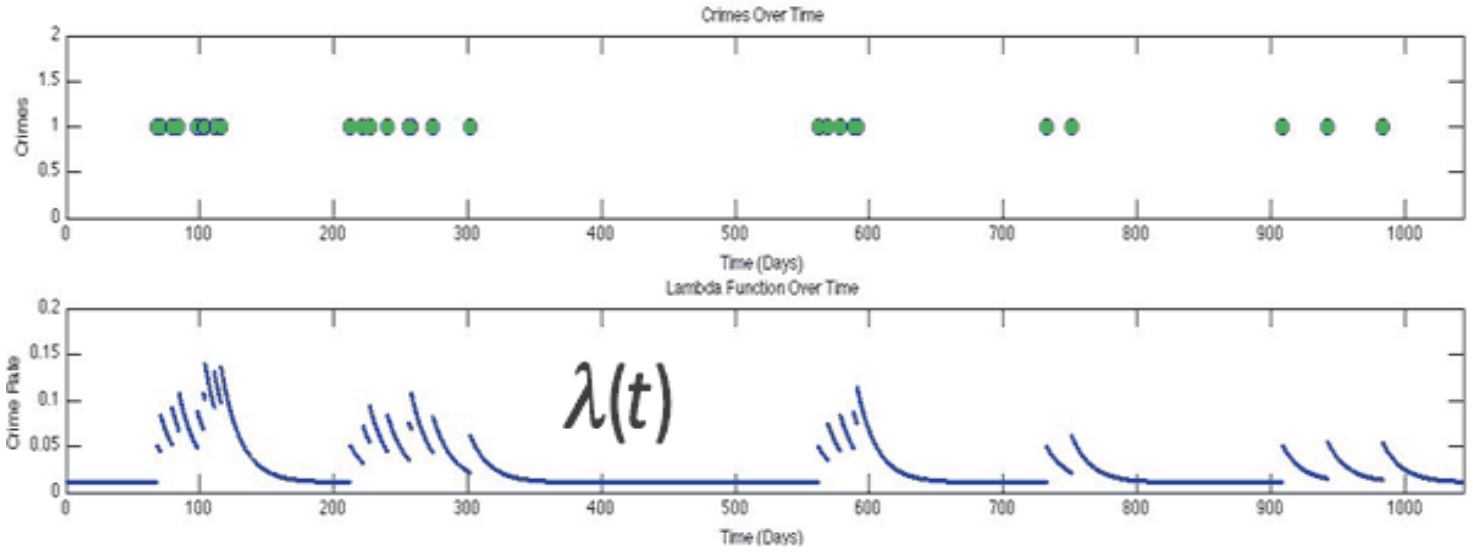
NO PERSONAL DATA UTILIZED FOR MAKE PREDICTION

Related works

- **Once Upon a Crime: Towards Crime Prediction from Demographics and Mobile Data**
  Andrey Bogomolov, Bruno Lepri, Jacopo Staiano, Nuria Oliver, Fabio Pianesi, Alex Pentland (2014) http://arxiv.org/abs/1409.2983
- **Statistical model of criminal behavior**
  Short, M.B., D'Orsogna, M.R., Pasour, V.B., Tita, G.E., Brantingham, P. J., Bertozzi, A.L., Chayes, L.B. (2008) Mathematical Models and Methods in Applied Sciences, 18 (SUPPL.), pp. 1249-1267.
- **Spatiotemporal Correlations in Criminal Offense Records**
  Toole, J.L., Eagle, N., Plotkin, J.B. (2011) ACM Transactions on Intelligent Systems and Technology, 2 (4), art. no. 38
- **Development of Crime Forecasting and Mapping Systems for use by Police**
  Jacqueline Cohen, Wilpen L. Gorr. (2005) H. John Heinz III School of Public Policy and Management, Carnegie Mellon University

Crime prediction system (1/2)

- Divide city in small regions: **Voronoi analysis**, Geographic Analysis Machine;
- Markov chain for approximate function of crime frequency in each block;



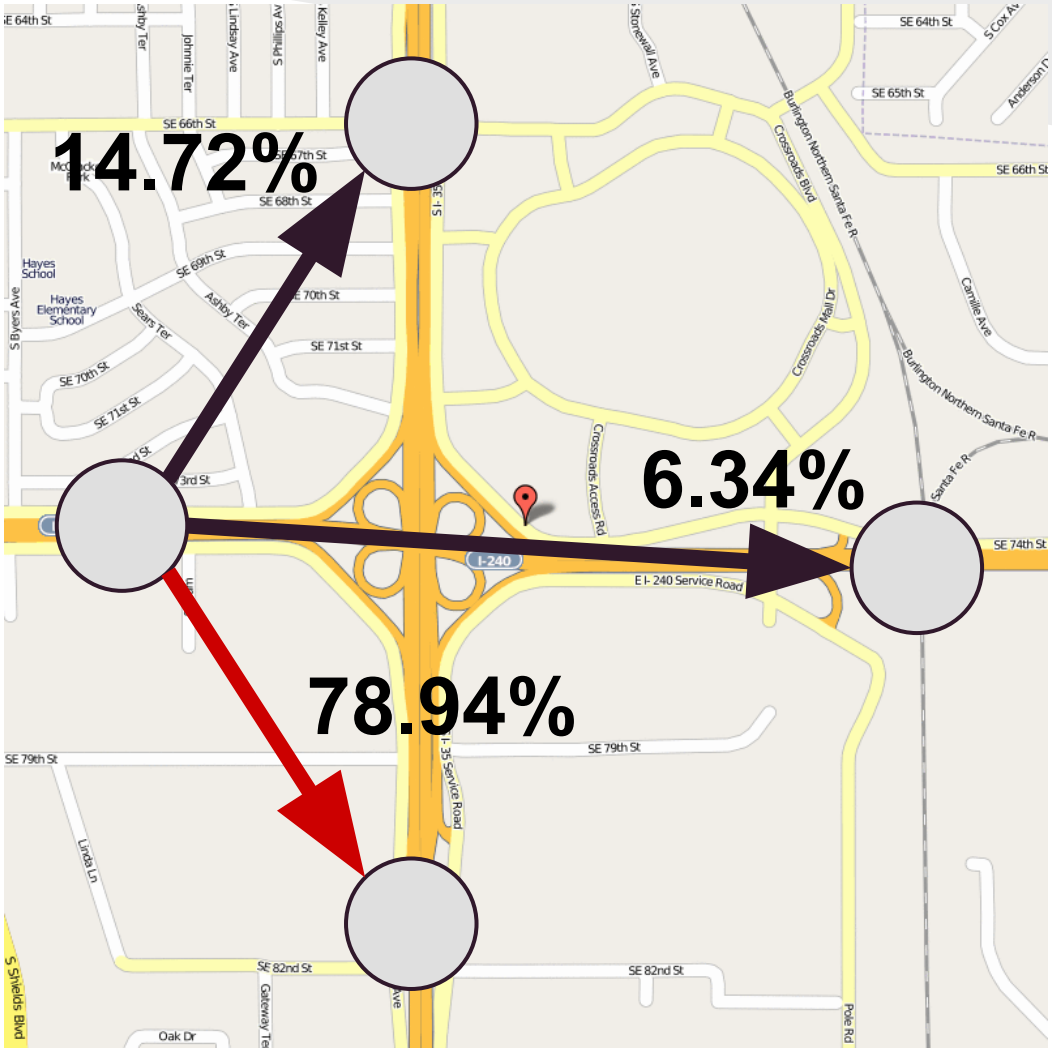
conversion of crime statistics in frequency

Crime prediction system (2/2)

- Spatial ellipse for creating density map
- Switching MC state based on time and density map

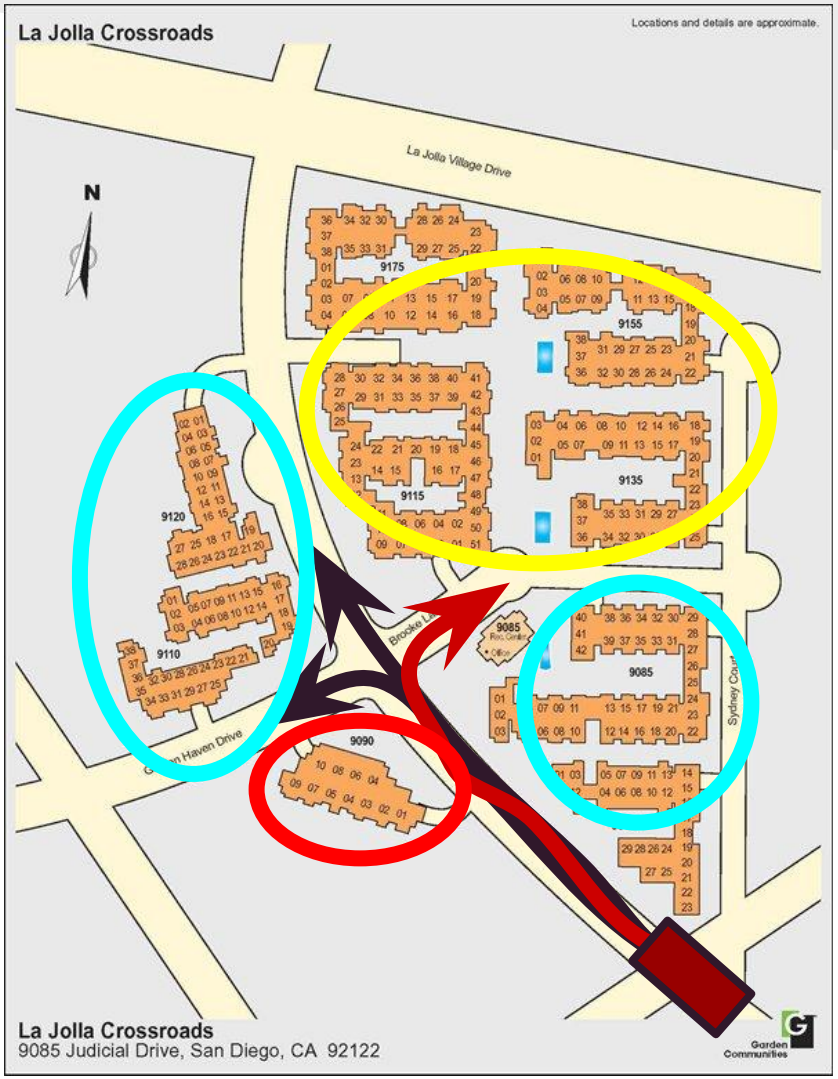
Criminal route in chase

- Points - routes
- Edges - chance of selection
- Markov chain model of road selection
- Frequency - from historical data



Patrol route planning

- Agent-based approach to route and schedule problem
- Enumeration of route with heuristics
- Integrate map of scalar value under route
- Minimizing target function (functional)



Technical solution

- HPC cluster
- For headquarters
  - Web-based solution
  - Interactive table
  - Projectors
- For patrols
  - Android tablets with internet

Our team

- Evagelos Bouloυgouris, NTUA, Greece
  - Econometrics
- Angelos Aveklouris, NTUA, Greece
  - Mathematical Modelling
  - Stochastic processes
- Anastasia Lantseva, ITMO, Russia
  - Criminal networks
  - Urbanistics
- Konstantin Ushenin, UrFU, Russia
  - IT integration
  - Technical solution

Σας ευχαριστώ για την προσοχή σας!

Thank you for your attention!