#### Al for Social Good

#### CAIS Fall Seminar Series 2017

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#### Al for Substance Abuse Prevention

Aida Rahmattalabi, Anamika Barman Adhikari, Phebe Vayanos, Milind Tambe, and Eric Rice

#### Motivation





- Substance use: significant public health problem
- Can cause mental/physical problems
- Certain groups of youth engage in very high levels of drug use
- <u>Peer-based interventions</u>: often successful but sometimes *deviancy training*

National Institute on Drug Abuse

## **Problem Formulation**



 $\begin{array}{ll} \text{maximize} & E\left[\sum_{i\in\mathbb{E}^{+}(\mathbb{P})}(1-\mathscr{B}_{i}(\mathbb{P}))\right] \\ \text{subject to} & \mathbb{P}_{s}\subset\mathbb{V} \quad \forall s\in\{1,\ldots,S\} \\ & \bigcap_{s=1}^{S}\mathbb{P}_{s}=\emptyset \\ & \bigcup_{s=1}^{S}\mathbb{P}_{s}=\mathbb{V} \\ & \bigcup_{s=1}^{C}\mathbb{P}_{s}|\leq\overline{C} \quad \forall s\in\{1,\ldots,S\} \end{array} \right.$ 

- During intervention and based on partition:
  - friendships are broken/formed (deterministic)
  - Influence propagates (stochastic)
- Model based on expert opinion
- NP-hard



#### Synthetic Networks

#### **Real Networks**

- Propose MIP formulation and Hill Climbing Heuristic
- MIP enables us to obtain bound on solution quality: near-optimal  $\sim 10\%$

![](_page_5_Picture_0.jpeg)

#### Al for Kidney Transplantation Management Chaitanya Bandi, Nikos Trichakis, and Phebe Vayanos

# End-Stage Renal Disease

source: https://www.usrds.org

![](_page_6_Figure_2.jpeg)

- terminal disease affecting >600,000 patients in U.S.
- dialysis vs. kidney transplant (preferred)
- living donors vs. deceased donors

# Organ Shortage

3-yr trend

+20%

- 100k patients waiting
- 36k additions per year
- 19k transplants/year
  - 13.4k (70%) from deceased donors +20%
  - 5.6k (30%) from living donors -2%

### Wait Time Estimation

Patient X of blood type O is listed in a given geographic region. He is currently ranked 50th. How long until he receives an offer of a <u>particular quality</u>?

- important for:
  - dialysis management
  - planning of daily life activities
  - accept/reject decisions

### **Problem Formulation**

![](_page_9_Figure_1.jpeg)

- Estimate worst-case wait time to get offer of given quality
- NP-hard

![](_page_10_Figure_1.jpeg)

- Formulate as MIP; tractable approximation as SOCP
- Relative prediction errors: 14.96% for avg. and 11.73% for 68-percentile

![](_page_11_Picture_0.jpeg)

#### Al for Suicide Prevention

Subhasree Sengupta, Anthony Fulginiti, Bryan Wilder, Long Tran-Thanh, Phebe Vayanos, Eric Rice, and Milind Tambe

#### Motivation

![](_page_12_Figure_1.jpeg)

American Foundation for Suicide Prevention

- Suicide: serious national and international public health problem
- According to the Center for Collegiate Mental Health:
  - One-third of college students receiving mental health services report having suicidal thoughts in their lifetime
  - Nearly 10% have attempted suicide in the past 5 years
- Solution: effective gatekeeper training

### **Problem Formulation**

![](_page_13_Figure_1.jpeg)

- Can invite K people
- Nature can choose a subset of those that will not come
- Want to maximize worst-case coverage
- NP-hard

![](_page_14_Figure_1.jpeg)

Solution algorithm based on iterative scenario generation

![](_page_15_Figure_1.jpeg)

#### **Real Networks**

Synthetic Networks

 Solution algorithm based on iterative scenario generation

![](_page_16_Picture_0.jpeg)

#### Al for Prioritizing Homeless Youth for Housing Resources

Ongoing...

![](_page_17_Picture_0.jpeg)

### Al for Conservation Planning

Ongoing...

# Summary

- Very exciting projects
- Important for society
- Interesting mathematically: hard computationally (both in theory and in practice)