ROBUST INFLUENCE MAXIMIZATION FOR HYPERPARAMETRIC MODELS

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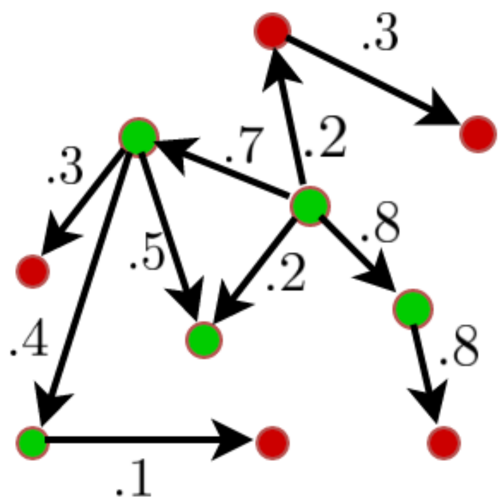
ICML 2019

DIFFUSION IS MODELED AS INDEPENDENT CASCADE



Independent cascade (IC) [KKT 03]:

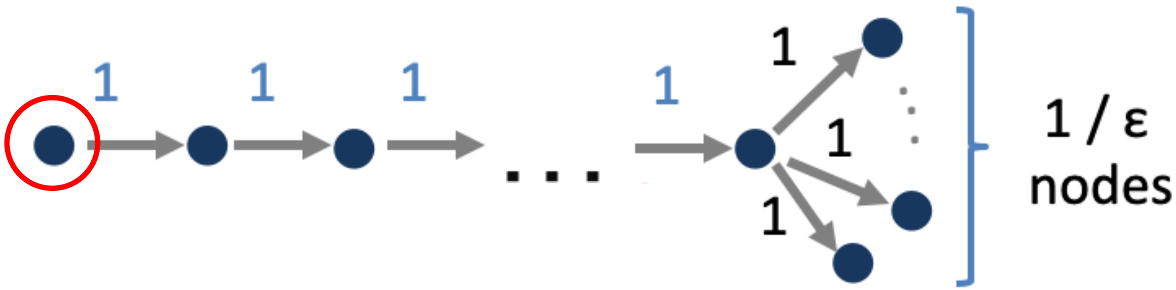
- Each active node tries to influence its neighbors independently
- Diffusion proceeds in discrete steps

Why is this model nice?

1. It is approximable: simple greedy alg obtains constant apx [KKT 03]
2. It is learnable: we can learn the diffusion probabilities [NPS 15]

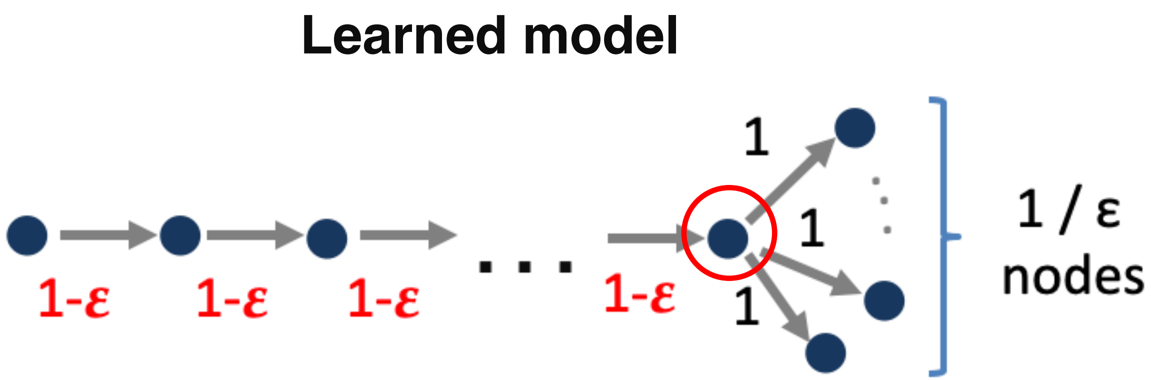
INFLUENCE MAX IS NOT ROBUST TO LEARNING ERRORS

True model



$$E[\#\text{nodes infected}] = n$$

INFLUENCE MAX IS NOT ROBUST TO LEARNING ERRORS



E[#nodes infected] = *const*

$$\frac{\text{E[\#nodes estimated to be infected]}}{\text{E[\#nodes that are really infected]}} \xrightarrow[n \to \infty]{} \mathbf{0}$$

ROBUST OPTIMIZATION TO THE RESCUE

Confidence intervals for each edge: $P = \times_{e \in E}[l_e, u_e]$

$$\max_S \min_{p \in P} f_p(S)$$

nodes influenced by S when probs are p

- f is monotone in p
- The problem is trivial

What is the right formulation of the robust optimization problem?

FORMULATE ROBUST OPTIMIZATION VIA HYPERPARAMETER

Hyperparametric model: Every edge is associated with feature $x_e \in [-1,1]^d$ and p_e is determined by **hyperparameter** $\boldsymbol{\theta} \in \Theta \subseteq [-\mathbf{1},\mathbf{1}]^{\boldsymbol{d}}$

$$p_e = \sigma(\theta \cdot x_e) = \frac{1}{1 + e^{-\theta \cdot x_e}}$$

Example features: gender, age, location, degree, pagerank, etc.

Robust IM restated: $\max_S \min_{\theta \in \Theta} f_\theta(S)$

MAIN RESULT

Let $F = \{f_\theta : 2^V \rightarrow R \mid \theta \in \Theta \subseteq [-B, B]^d\}$ be a family of influence functions. There exists a randomized poly-time algorithm that produces a solution $\widehat{S}$ s.t.

$$\min_{\theta\in\Theta} \mathbb{E}[f_\theta(\hat{S})] \geq (1 - 1/e) \max_{S:|S|\leq k} \min_{\theta\in\Theta} f_\theta(S) - \epsilon$$

Details about the algorithm and experiments in poster #268

Thanks!