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Machine Learning for Detecting Detrimental Online Social Behavior

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The Power and Perils of the Social Web

image by Paul Butler, http://paulbutler.org

The modern Internet amplifies our ability to communicate.

Theoretically, people can form relationships and communities regardless of location, race, ethnicity, or gender.

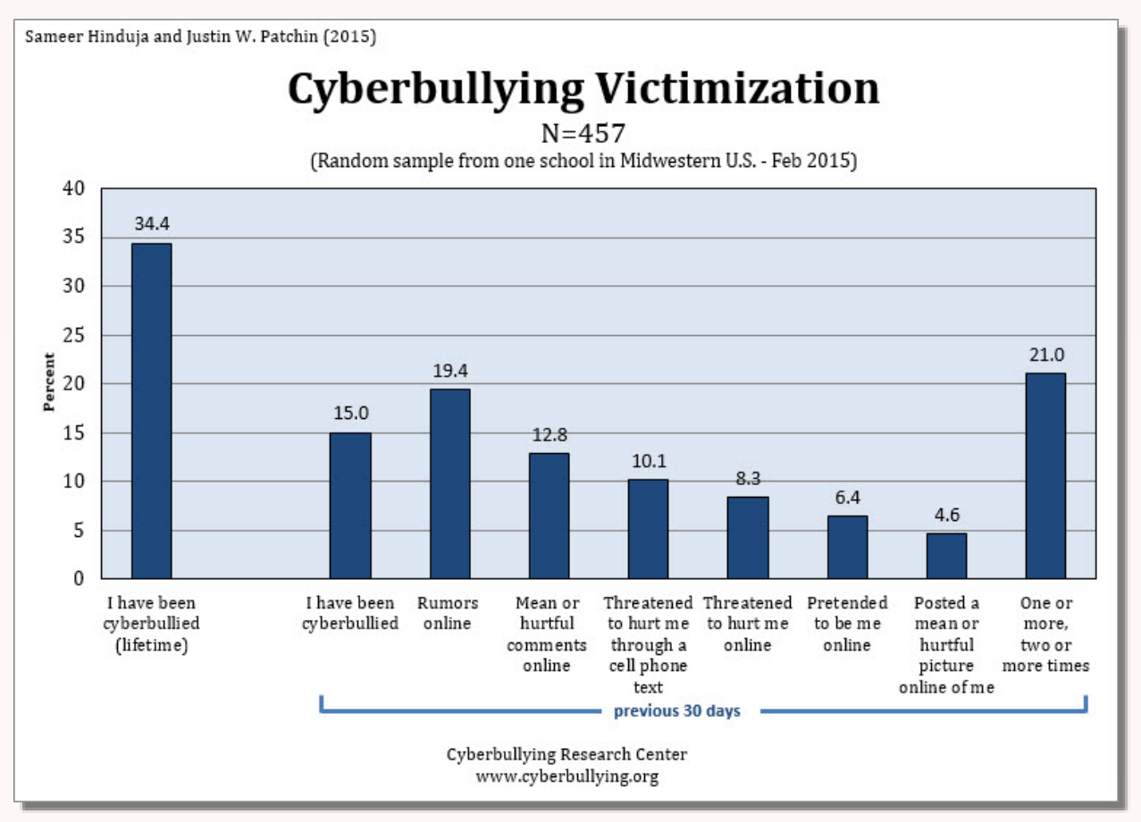
But the amplification of social interaction also includes detrimental behaviors such as harassment and cyberbullying.

These behaviors are dangerous. They create harmful, threatening environments and represent a public health hazard.

Cyberbullying

The Cyberbullying Research Center defines cyberbullying as "willful and repeated harm inflicted through the use of computers, cell phones, and other electronic devices."

According to stopbullying.gov, victims of bullying are more likely to experience depression and anxiety, health issues, and decreased academic performance.



http://cyberbullying.org

Cyberbullying is persistent and public. It is not bounded by location or time of day, and it can be instigated anonymously and at large scale.

Social Media Analytics

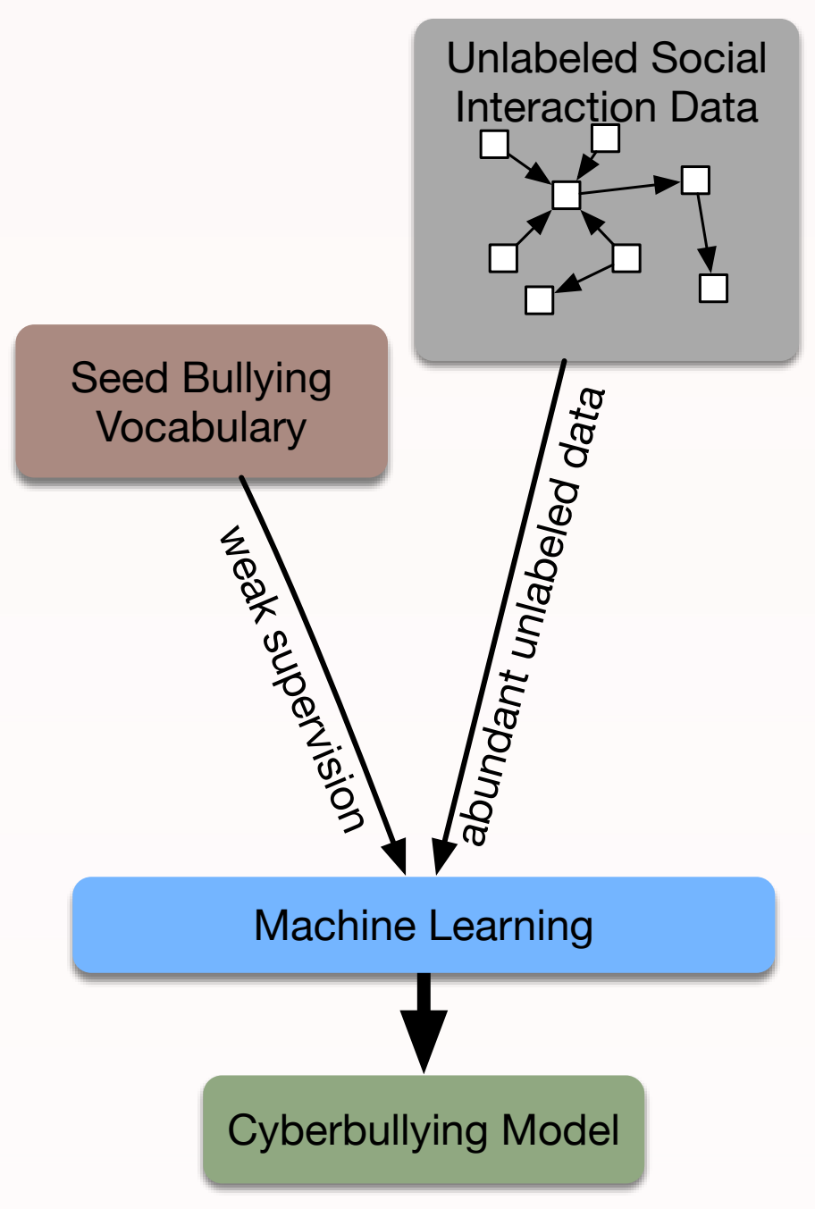
Social media is a major catalyst in the growth of data science.

Data-driven business is thriving, using human data to improve marketing, content recommendation, user retention, and advertisement allocation.

Computational methods in **graph mining** and **relational learning** extract models and analytics by considering the complex social structure of online communication.

Can we retarget some of the machine learning methods developed for business applications toward mitigating the harm from cyberbullying?

Machine Learning Challenges


Unlabeled Social Interaction Data
Seed Bullying Vocabulary
weak supervision
abundant unlabeled data
Machine Learning
Cyberbullying Model

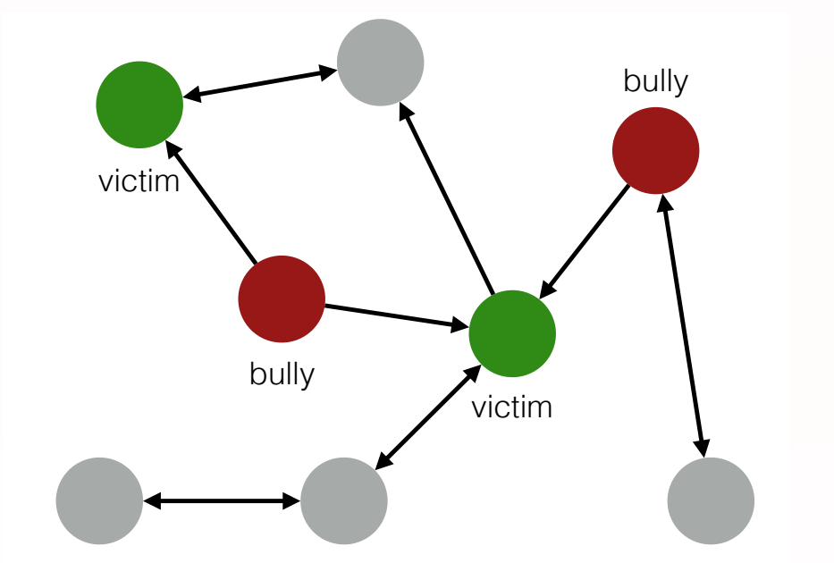
Labeled examples of bullying require costly human expertise. We must be able to learn with only **weak supervision**.

Cyberbullying involves rapidly **evolving vocabulary** and behavioral patterns.

We must consider **social structure** to distinguish harassment from banter, fighting, and other less harmful behavior.

Massive amounts of online interactions require **scalable** algorithms.

Participant-Vocabulary Consistency Model



The model attributes each user with a **bully score** and a **victim score** and each word with a harassment **word score**.

It then minimizes the discrepancy between **participant score** and **vocabulary score** for each social media post using alternating least squares.

$$\min_{\mathbf{b},\mathbf{v},\mathbf{w}} \; \frac{\lambda}{2}\overset{\text{regularizer}}{\left(||\mathbf{b}||^2 + ||\mathbf{v}||^2 + ||\mathbf{w}||^2\right)} + \frac{1}{2}\overset{\text{for all messages}}{\sum_{m \in M}} \left(\underset{\text{for words in message}}{\sum_{k: w_k \in f(m)}} \Big(\underset{\text{bully score of sender}}{b_{s(m)}} + \underset{\text{victim score of receiver}}{v_{r(m)}} - \overset{\text{vocabulary score of word}}{w_k} \Big)^2 \right)$$

$$\text{s.t.} \quad \mathbf{w}_k = 1.0 \text{ for } k \in \underset{\text{expert-provided seed set}}{S}$$

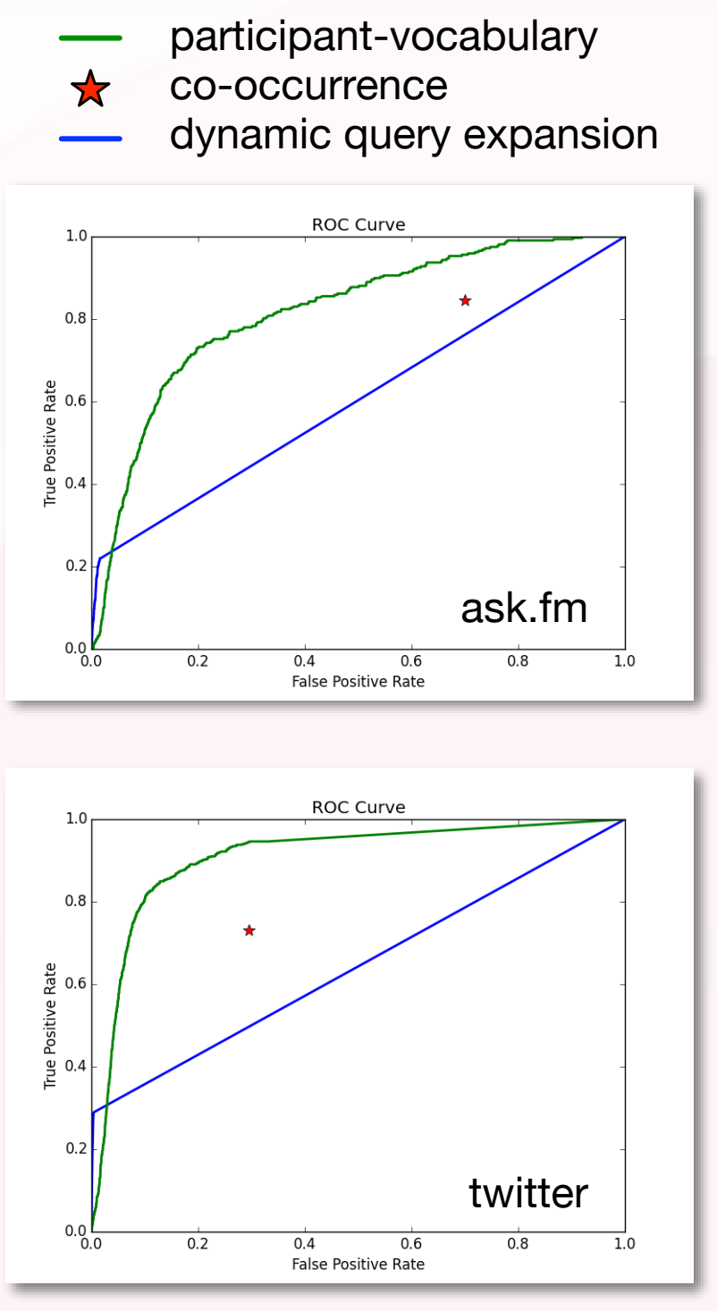
Experiments

Data: We collected 293k tweets from 180k users, and we used the Ask.fm data collected by Hosseinmardi et al. (2014).

Bullying vocabulary: We created a list of curse words and bigrams from noswearing.com.

Evaluation: We provide the learning algorithm with half of the curse words and test how well it scores the rest of the vocabulary. These ROC curves illustrate its performance.

Comparisons: we compare against direct **co-occurrence** and **dynamic query expansion** based on document frequency.



Discussion

We created an initial algorithm for training a model of cyberbullying from weakly supervised data.

The participant-vocabulary consistency model is able to recover known bullying indicators and discover new indicators (not shown here due to explicit content). We evaluated these qualitatively and were impressed.

We are currently working on creating a more formal probabilistic model for bullying to more robustly incorporate noise and uncertainty.

My group is also working on general-purpose methods for scalable learning and inference in structured models.

We also target other applications that have potential societal benefits, such as analysis of large-scale pedagogical data from MOOCs and other learning management systems.

Read about our research at http://berthuang.com.

References

H. Hosseinmardi, S. Li, Z. Yang, Q. Lv, R. I. Rafiq, R. Han, and S. Mishra. *A comparison of common users across Instagram and Ask.fm to better understand cyberbullying.* IEEE Fourth International Conference on Big Data and Cloud Computing.

E. Raisi and B. Huang. *Discovery of Cyber-Bullying Vocabulary in Social Media Data Using Weak Supervision.* In submission.

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