E6893 Big Data Analytics: Yelp Fake Review Detection

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Overview

1. Problem Summary
2. Technical Approach
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Introduction

- The goal of this project is to flag opinion spammers on rating websites such as Yelp.com. These users are usually receiving incentives to post positive reviews for certain businesses.
- Opinion spam creates unfair competitions, provides deceptive information for users and is detrimental to the credibility of rating websites.
- We use dataset acquired from Yelp Dataset Challenge, which provides >1 million ratings and reviews of >40,000 businesses.

Background

- Content Based Detection
  - Analyze the reviews and detect spams using computational linguistics analysis
  - Characteristics like not having been to the place and still being able to write the review differentiates it from an original review, with an accuracy of approximately 68%
- Behavioral Detection
  - Maximum number of reviews submitted by a user based on the fact that an average user does not submit more than a few reviews in a day. Percentage of positive review used to identify false accounts that submit only false reviews

Related Work

- Lin et al. (2014) Finding Valuable Yelp Comments by Personality, Content, Geo, and Anomaly Analysis
  - Used to reorder the reviews to improve visibility to the user
  - Utilized both the content and the behavior of the reviewers for the detection
  - Used Natural Language processing and Personality Analyser tool, with an accuracy of approximately 80%
- Mukherjee et al. (2012) Spotting Fake Reviewer Groups in Consumer Reviews
  - Used behavioral model among fake reviewers and relational model between different groups, individual reviewers and products they reviewed
  - Utilized GS Rank (Group Spam Rank) algorithm, a relation based algorithm to rank the spamming groups

Strategy Overview

- Opinion spam signals
  - Large deviation in ratings
  - Large deviation in text reviews
  - Interdependent feature extraction
- Our approach to detect opinion spam
  - Compute average rating similarity score between one user and all others
  - Compute average review similarity score between one user and all others
  - Cluster users with both low rating similarity score and review similarity score
  - Generate a list of opinion spam candidates

Algorithm - Compute Rating Similarity

- Let $r_1, r_2, \ldots, r_n$ be the rating of user n of the same business, with a maximum rating of 5, and let N be the number of users, then

$$rSim_n = 1 - \frac{\sum_{i=0,k=0,i \neq k}^{N} (r_i - r_k)/5}{N} \in [0, 1]$$

denotes the average rating similarity score between user n and all other users, limited for the same business

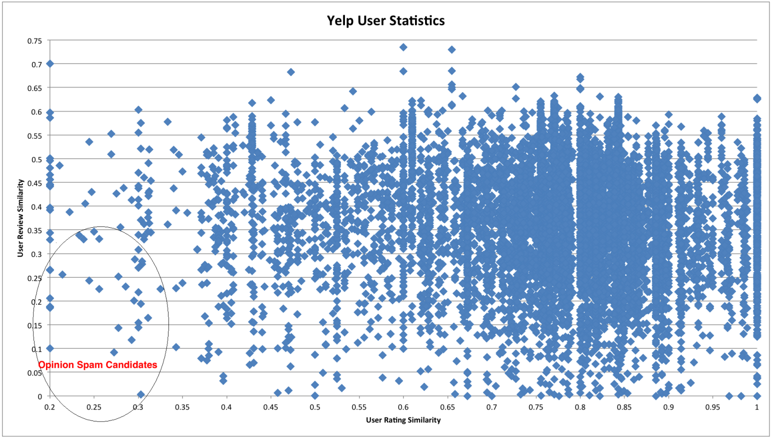
Algorithm - Compute Review Similarity

- Let $c_1, c_2, \ldots, c_n$ be the cosine similarity between review posted by user n and all other users of the same business, and let N be the number of users, then

$$cSim_n = \frac{\sum_{i=0,k=0,i\neq k}^{N} c_i \times c_k}{\sqrt{\sum_{i=0}^{N} c_i^2} \times \sqrt{\sum_{k=0}^{N} c_k^2}} \in [0,1]$$

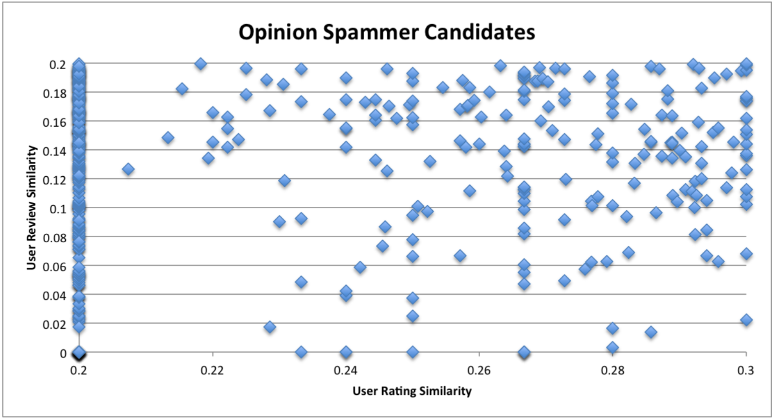
denotes the average review similarity score between user n and all other users of the same business

Result Overview



- The majority of users have high rating similarity score and decent review similarity score.
- The deviants at bottom left corner are users of interest.

Opinion Spam Candidates



- Cut-off score
  - $rSim = 0.2$
  - $cSim = 0.3$

Discussion

- The location of data points sustantiates our hypothesis that most ratings and reviews are genuine.
- Yelp.com has its own filter which may result in the lack of the true negative. Nevertheless, we still obtain several hundred potential fake review candidates.
- The threshold setting for *rSim* and *cSim* is worth further studies.
    - *cSim* seems to have larger impact on the process of determining opinion spam.
    - *rSim* is served as simply a filtering process.

Future Work

- Gather ground truth for review data
    - Domain expert
    - MTurk
- Incorporate more features into spam signals
    - Time window
    - User relationships
- Compare our approach with other learning Algorithm
    - GSRank
    - Supervised Classification

References

- Lin et al. (2014) Finding Valuable Yelp Comments by Personality, Content, Geo, and Anomaly Analysis
- Mukherjee et al. (2012) Spotting Fake Reviewer Groups in Consumer Reviews
- Dot products - the Stanford NLP, http://nlp.stanford.edu/IR-book/html/htmledition/dot-products-1.html
- Yelp Dataset Challenge, http://www.yelp.com/dataset_challenge