Chapter 14 Brute Force Search Method for Cyberbullying Detection

Michal E. Ptaszynski Kitami Institute of Technology, Japan

Fumito Masui Kitami Institute of Technology, Japan

ABSTRACT

In this chapter, the authors present a method for automatic detection of malicious internet contents, based on a combinatorial approach resembling brute force search algorithms, with application to language classification. The method automatically extracts sophisticated patterns from sentences and applies them in classification. The experiments performed on actual cyberbullying data showed advantage of this method to previous methods, including the one described in Chapter 4. Pros and cons of this method when compared to previous ones are also discussed in this chapter.

INTRODUCTION

Brute-force search algorithms, also known as exhaustive search algorithms, are a general group of algorithms applying combinatorial approach to problem solving. In particular, such algorithms firstly generate all possible answers to a problem, and then test the answer for its success. Combinatorial algorithms are especially useful in tasks where it is difficult to estimate a probable answer to narrow the scope of search. Therefore they have been traditionally used in password breaking and data decryption (Narayanan & Shmatikov, 2005; Paar, Pelzl & Preneel, 2010).

DOI: 10.4018/978-1-7998-1684-3.ch014

However, due to their minimal requirements when it comes to initial knowledge base, combinatorial algorithms have been also useful in Natural Language Processing, for example, in dependency parsing (Covington, 2001), stemming (Mishra & Prakash, 2012), or specific and novel tasks, such as extraction and analysis of emoticons (Ptaszynski et al., 2010).

However, brute-force approach often faces the problem of exponential and rapid growth of function values during combinatorial manipulations. This phenomenon is known as combinatorial explosion (Krippendorff, 1986). Since this phenomenon often results in very long processing time, combinatorial approaches have been often disregarded. We assumed however, that combinatorial explosion can be handled on modern hardware to the extent needed in our research. Moreover, optimizing the combinatorial approach algorithm specifically to problem requirements should shorten the processing time making it advantageous in the task of processing harmful language.

The method proposed in this chapter is original in following regards. As was pointed out by previous research (Ptaszynski et al., 2010), language used in cyberbullying messages is often deceptive and messy, and it is difficult to grasp a simple set of features to detect it. Therefore, to create a flexible model of cyberbullying, we applied a novel automatic feature extraction procedure. In research on machine learning, or applying any kind of machine learning to solve real world problems, one can use one of two approaches to feature extraction, namely, either automatic feature extraction (later called bottom-up approach) or select some custom predefined features (later called top-down approach, e.g., hand-crafting a lexicon of characteristic terms, etc.). The latter, although sometimes providing satisfying results, requires deep knowledge of the problem beforehand, meaning that the researchers need to figure out valid features themselves, which is inefficient.

In grand majority of NLP research, also in cyberbullying detection, applying the bottom-up approach, the features extracted automatically are typically based on separate words (as in e.g., bag-of-words) (Ptaszynski et al., 2010). Although instead of simple words one can use in text classification parts-of-speech or concepts (Sahlgren & Cöster, 2004), the sophistication of extracted pattern still does not exceed one token. A smaller number of research applies ngrams (usually unigrams to tetragrams of words or letters) (Damashek, 1995; Ponte & Croft, 1998; Siu & Ostendorf, 2000).

Recently, researchers have started to apply slightly more generalized version of ngrams, namely, skip-grams (Guthrie et al., 2006), which allow one controlled "skip", or a gap of a controlled distance. This however is still far from the definition of a pattern proposed here, namely, allowing any number of "skips" with a flexible dynamic distance, which in mathematical terms refers to "ordered combinations without repetitions." This kind of pattern extraction has not been widely applied till 44 more pages are available in the full version of this document, which may be purchased using the "Add to Cart"

button on the publisher's webpage: www.igi-

global.com/chapter/brute-force-search-method-for-

cyberbullying-detection/241513

Related Content

Internet Practices and Differences in Youths' Acceptability of Online Verbal Violence

Nadia Gauducheau (2019). International Journal of Cyber Behavior, Psychology and Learning (pp. 19-33).

www.irma-international.org/article/internet-practices-and-differences-in-youths-acceptability-of-online-verbal-violence/234423

Psychological Study of Cyber-Bullying Against Adolescent Girls in India Using Twitter

Kavya Sharmaand Krishna Kumar Singh (2023). *International Journal of Cyber Behavior, Psychology and Learning (pp. 1-22).*

www.irma-international.org/article/psychological-study-of-cyber-bullying-against-adolescentgirls-in-india-using-twitter/327867

Using the Internet to Attract and Evaluate Job Candidates

William Rossand Ross Slovensky (2012). *Encyclopedia of Cyber Behavior (pp. 537-549).*

www.irma-international.org/chapter/using-internet-attract-evaluate-job/64783

Digital Privacy Across Borders: Canadian and American Perspectives

Lorayne P. Robertson, Heather Leatham, James Robertsonand Bill Muirhead (2020). Developing Safer Online Environments for Children: Tools and Policies for Combatting Cyber Aggression (pp. 266-289). www.irma-international.org/chapter/digital-privacy-across-borders/241509

Linking Psychological Attributes, Gratifications and Social Networking Site Use to Social Capital of the Net Generation in China

Pei Zhengand Louis Leung (2016). *International Journal of Cyber Behavior, Psychology and Learning (pp. 17-33).*

www.irma-international.org/article/linking-psychological-attributes-gratifications-and-socialnetworking-site-use-to-social-capital-of-the-net-generation-in-china/160695