

Cross-language Sentiment Analysis for Social Media

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Abstract—This document is a model and instructions for L^AT_EX. This and the IEEEtran.cls file define the components of your paper [title, text, heads, etc.]. *CRITICAL: Do Not Use Symbols, Special Characters, Footnotes, or Math in Paper Title or Abstract.

Index Terms—sentiment analysis, machine translation

I. INTRODUCTION

Social Media has been becoming more and more widely used. There are lots of text comments on different discussion topics every day. It would be impossible to analyse the huge amount of data generated manually. These topics are discussed by speakers of different languages, from different cultural backgrounds, further complicating any analysis. Most people encounter language and cultural barriers during cross-language communication. In this paper, the use of machine translation and sentiment analysis tools to solve this problem of analysing cross-cultural and cross-language data is explored and discussed. Sentiment analysis is a part of text data mining. The aim of sentiment analysis is to determine the attitude of speakers or writers with respect to particular topics or the overall contextual polarity or emotional reaction to a text document. It is usually equated with opinion mining, which involves the use of natural language processing and machine learning to ascertain the possibility of positive or negative opinions [1]. Sentiment analysis is useful for analyzing a huge amount of data relating to personal opinions. It can be used in an e-business context. For example, business managers can analyse customers' attitudes, as to whether they like or dislike their product or service. Also, government can use sentiment analysis to analyze citizen perspectives. In a word, sentiment analysis is coming into widespread use. As Dr. Haiyun mentions, English language sentiment analysis research has undergone major developments in recent years [2]. However, less research has been undertaken in other languages, such as Chinese. Today, a lot of English language sentiment analysis theories have been developed. Also, a variety of Machine Translation tools

is available, such as Google translation, Bing translation and Yandex translation. Machine Translation uses computational linguistic programs and natural language processing theory [3]. However, nobody working in a combination of these two fields of research has undertaken non-English sentiment analysis. Therefore, the research described and discussed in this paper aims to create a testing model to find the best-combination of English sentiment analysis tools and machine translation tools to obtain reliable sentiment analysis results from non-English texts, for non-English speakers who do not have such sentiment analysis tools to analyze their own language. Eventually, everyone will be able to understand different language speakers' attitudes (positive or negative), emotions and opinions.

II. LITERATURE REVIEW

This research consists of three components; measuring machine translation service quality; testing sentiment analysis service quality; finding the best compound mode for machine translation service and sentiment analysis service. As a result, this section will focus on a review of literature review about machine translation, Testing methodology and sentiment analysis.

A. Testing in Machine translation

There are two research articles about testing modeling of machine translation(MT).

a) *Round Trip Translation method*: As Somers argues, an Around Trip Translation (RTT) method has been established to detect the quality of machine translation [4]; for example, testing English to Chinese translation tools. Firstly, an English to Chinese translation tool is used to translate test data to Chinese. It is then used to translate Chinese data back to English. Finally, compare the similarity for two English data sets. They also mention two metrics of similarity, BLEU and F-score, to judge the translations. The limitations of RTT model are it cannot distinguish the best MT tool from a group of poor

MT tools as well as it cannot find which sentences are easier for translation and which sentences are harder for translation.

b) *A Monte Carlo Method for machine translation services*: Another article is about using third-party language to test the quality of machine translation [5], for example, if testing an English to Chinese translation tool. Firstly, random choose an Intermediate third-party language. Secondly, translation English test data to the third-party language, after translates the third-party language to Chinese. These two steps constitute one path. Another path is translation from English directly to Chinese. In the end, the two path results need to compare similarity. In this article, the main finding is that Google Translate is the best machine translation compare with Yandex, Youdao as well as Bing. In addition, the better results to be produced in European languages, use ANOVA Statistics method and Pairwise T tests getting this conclusion. In my experiment, I also got Google Translator is the best machine translation compare with Yandex and Baidu. Pairwise T tests also can be useful for find best-combination of English sentiment analysis tools and machine translation tools to obtain reliable sentiment analysis results. The highlight of this model is using third-party language, which can decide preference language of machine translation.

B. Testing methodology

Accounting to Sethi, there are two categorized testing techniques, which are Static Testing and Dynamic Testing. The Dynamic Testing are divided into three categories, which are Functional Testing, Structural testing and Non-Functional Testing [6]. In my research project, I will focus on Functional Testing on this project.

a) *Metamorphic Testing*: This research project is based on Metamorphic Testing. Metamorphic Testing is for testing function correctness. There is a research article written by Zhou in 2016. This article is well-explained for what is Metamorphic Testing. As Zhou said, Metamorphic Testing (MT) is a property-based software testing method developed for automated test case generation and automated result verification, based on the effects of some expected properties of the target program [7]. These properties, recognized as metamorphic relations (MRs), serve as essential relations among the inputs and outcomes of multiple executions of the target program. For instance, test calculator function correctness will be shown if input $1 + 1$, and the result will be 2. In this example people can easily make the judgment, correct or not. However, people will not easy to make this judgment quickly if input $\sin(3.7)$, and the calculator gives a output. In a generally acknowledged, $\sin(3.7) = \sin(3.7 + 360)$ is correct. In metamorphic testing, the name of 3.7 is the test case. The name of $3.7 + 360$ is the follow-up test case. Metamorphic Relation is the relationship between two input test cases as well as the two outputs. Metamorphic testing is based on Metamorphic Relation. The two outputs need an existing mathematical relation. In this example, the relation is “ $=$ ”. However, MR does not must be an equation, it also can be a relation. The advantage of Metamorphic testing (MT) method;

addressing the test oracle problem; testing case generation problem. The disadvantage is that cannot detect memory leak or some others insensitivity failure situation. However, Metamorphic Testing is appropriate for testing translation tools and sentiment analysis tools. Effectiveness of Metamorphic Relations Therer is another article which was written by Zhou in 2013. The main purpose of reading this article is to find the best one among the three testing modelings. This article is based on white-box testing, which have source code, as well as the most important conclusion is if the Metamorphic Relations can get bigger distance (dissimilarity) that will have more chance to detect failures. In other words, MRs with very different initial and follow-up execution are more likely to detect failures than those with similar initial and follow-up executions. The concept of “difference” are defined in namely coverage Manhattan distance (CMD), frequency Manhattan distance (FMD), and frequency Hamming distance (FHD) in regard to adaptive random testing (ART), where CMD metric on the basis of branch coverage execution profiles performs the best fault-detection effectiveness. I think the advantage of this article is suitable for finding the most effectiveness of Metamorphic Relations in White-box. However, this article is not suitable for Black - Box Testing. The reason is Black Box Testing have not source code available, so it cannot calculation the program’s distance. In this research project, my testing modeling have not source code available. So, I have found another research article (Henard2016)talking about the difference between black-box testing and white-box testing.

White-box VS Black-box Henard (2016) have done some research for difference between white box testing and black - box testing in 2016. They have two finding is useful in my research black-box testing and white-box testing performance just have a little difference (at most 4 fault detection rate difference). They also found black-box testing and white-box testing the overlap is very high. The first 10 of the prioritized test data already agree on at least 60 of the faults found. As the result, this research article has given me a lot of idea for how similar between white box testing and black box testing. I still have opportunity for compare those three modelings, which one is better.

The three different machine translation testing modeling, we can call the three different Metamorphic Relations. So, I have found a research article(Cao,2013) about the effectiveness of metamorphic relations.

Also, when I finished reading all of the details, I have found Two-way ANOVA is also suitable for part 3 of my research (finding the best compound mode for machine translation service and sentiment analysis service). I think that the disadvantages of those three-testing modeling will be involved some of the noise. It is clear the Round-Trip will be involved translation back path noise. Using the third language will be involved in third language translation path noise. My modeling will be involved sentiment analysis tools’ noise. However, my modeling does not involve any noise from translation tool. I think my modeling is better than the other two testing modeling. I am total from another aspect to test translation

tool.

III. METHOD

IV. TEST DATA

Total Ranking	have Number	46180 of Test Data	movies Percentage	reviews.
Ranking 10		7353	15.92 %	
Ranking 20		11209	24.27 %	
Ranking 30		16223	35.13 %	
Ranking 40		7663	16.59 %	
Ranking 50		3732	8.08 %	

V. IQR, MEAN, MEDIAN, Q1, Q3, LOWER EXTREME, UPPER EXTREME, MEAN SLOPE, MEDIAN SLOPE

A. Baidu Chinese Sentiment analysis Positive Probability Base On (Chinese Origin Data)

Ranking	IQR	Mean	Median	Lower Extreme	Upper Extreme	Mean Slope	Median Slope
10	0.3426533	0.2404781	0.1789910	0.0489987	0.3916530	0.008788344	0.0116933
20	0.3817485	0.2949725	0.2489580	0.0878135	0.4695620		
30	0.4504405	0.3980354	0.3808120	0.1416095	0.6020500		
40	0.5255830	0.5123376	0.5385910	0.2461685	0.7717515		
50	0.5368080	0.5712128	0.6188395	0.3101650	0.8469730		
Mean Slope Median Slope							
0.008788344 0.0116933							

VI. QUESTIONNAIRE

- What is your gender?
O Male O Female O prefer Not to say
- What is your age group?
O <18ys O 18-24ys O 24-30ys O 30-40ys O 40-50ys O >50ys
- What are your areas of interest? (many answers possible)
O Science and Technology O engineering O entertainment O military O politics O law O literature O Other (please specify)
- How often do you use social media ?
O Hourly O Daily O Weekly O monthly O yearly
- How long do you use social media each time?
O time <= 1 hour O time 30 minutes O 1 hour O 10 minutes to 30 minutes O less than 10 minutes
- Which social media platforms do you use regularly ? (many answers possible)
O Facebook O Twitter O YouTube O Instagram O WeChat O LinkedIn O Weibo O I don't use social media O Other (please specify)
- Which language(s) can you understand easily ?
O English O French O Chinese O Spanish O Vietnamese O Arabic O Indian O Russian O German O Other (please specify)
- How interested are you in other culture?
O Extremely interested O Very interested O Somewhat interested O Not so interested O Not at all interested
- How willing are you to understand the contents in an foreign language?

O Very likely O Likely O Neither likely nor unlikely O Unlikely O Very unlikely

- How often do you read others' opinion ?
O Always O Usually O Sometimes O Rarely O Never
- Which machine translation tool do you use most?
O Google Translation O Microsoft Bing Translation O Yandex Translation O Baidu Translation O Youdao Translation O Other (please specify)
- Sentiment analysis tool can determine the attitude (positive or negative) of writers, which can be useful for analyzing a huge amount of comments. Are you willing to use this tool to analyze your interests in social media, such as product comments or restaurant review, etc?
O Very likely O Likely O Neither likely nor unlikely O Unlikely O Very unlikely

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