Detecting Online Conversations Going Viral

Time-series aware evaluation of change detection algorithms

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Abstract

Write abstract

Chapter 1

Problem Statement & Motivation

1.1 Problem Statement

Within the domain of change detection algorithms there are a number of available methods for evaluating the efficiency and accuracy of a given algorithm, depending on how the problem is framed. The different problem framings available are, for example:

are these definitions correct?

Classification Wherein the algorithm result fits into one of two (or more) classes, for example correct or incorrect.

Clustering Wherein the algorithm results are formed into clusters and evaluated using clustering metrics.

Partitioning Like clustering, but?

How is this different from clustering?

Retrieval Wherein the results of the algorithm are scored as a *retrieval problem*, where detection relevance is taken into account, perhaps along with some form of temporal or redundancy penalty.

With this research, it is intended to address this dichotomy between approaches, and further suggest an evaluation approach that is suitable for use when attempting to evaluate change detection algorithms applied to time-series data specifically.

While change detection itself has been around since the 1930's (and *online* change detection since the 1950's) it is still a field that attracts new thoughts and approaches - one example of which being Ginsberg et al.'s "Detecting influenza epidemics using search engine query data." [Gin+09].

Various attempts have been made to evaluate the myriad approaches to change detection ([BNZ14] for example) but each of these attempts tend to frame the problem somewhat differently, or do not take into account change detection in time-series data.

This research intends to address the following research questions:

RQ1 Are there deficiencies in existing methods for evaluating change detection algorithms?

RQ2 Do certain measures perform better as an evaluation method when applied against changes detected in a data stream with certain properties?

RQ3 Is there room for adjustment in existing measures, such that they can be made more effective for the evaluation of change detection algorithms?

this needs expansion, I think

1.2 Motivation

Change detection first came about as a quality control measure in manufacturing, and methods within this domain are generally referred to as *control charts*. Since the inception of approaches such as CUSUM that provide the possibility for on-line evaluation of continuous data streams, change detection has grown as a field. With applications such as epidemic detection, online reputation management and infrastructure error detection, change detection is hugely useful.

This particular research is motivated specifically by the online reputation management sector. The business hosting this research project (Buzzcapture International [http://www.buzzcapture.com]) is a Dutch online reputation management company that provides services to other businesses throughout europe. Chief among these is the BrandMonitor application, which, among other features, provides a rudimentary notification system for clients that is triggered once there is an increase in conversation volume of $\%n$. It is the intention of this research to provide a robust evaluation method for change detection algorithms such that an approach that is most effective for this particular use case can be selected and implemented.

Chapter 2

Research Method

2.1 Data Preparation

2.2 Scoring Metrics

Example function:

$$f(relevance, temporal\_penalty, redundancy\_penalty) \tag{2.1}$$

start designing scoring methods

Possible relevance measure, where t_0 is the earliest a spike can be detected and t_n is the time that the signal returns to normal. $f(x)$ describes the function of the curve:

$$\int_{t_n}^{t_0} f(x)dx \tag{2.2}$$

start desigining relevance measure

planning to do something with the area under the curve for relevance

Chapter 3

Background & Context

This research was primarily borne out of reading "A Brief Comparison of Algorithms for Detecting Change Points in Data" by Buntain, Natoli, and Zivkovic[BNZ14]

Chapter 4

Research

Chapter 5

Results

Chapter 6

Analysis & Conclusions

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ToDo Notes