GENERATIVE CONTRASTIVE LEARNING FOR STRUCTURAL FRAMING ANALYSIS

BY

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THESIS

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Abstract

Framing is the act "to select some aspects of a perceived reality and make them more salient in a communicating text" [1]. Framing has been widely used in journalism to influence public opinion. However, analysis of news framing has majorly relied on human expert efforts. Efforts have been put into developing automatic framing analysis via computational linguistic approaches. In this work, we propose a novel large-scale, multi-agency news dataset with crowd-sourced political stances and factuality labels to facilitate framing analysis. We propose two ways of conducting framing analyses on this dataset, the first is via learning a "switch" in the embedding space to change the generation trend, and the second utilizes a Generative Adversarial Network under a contrastive learning framework. We further create an interactive demo website to directly display results. Our code and dataset will be released to facilitate future research.

To my parents, for their love and support.

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Chapter 1

Introduction

News is an important medium through which the members of society get to understand the world. However, despite the normative expectation of neutrality and objectivity [2], news articles covering the same event can vary among different news agencies. The same story can be covered from different perspectives, conventionally referred to as "frames" [1, 3, 4]. The act "to frame" is "to select some aspects of a perceived reality and make them more salient in a communicating text" [1]. As a linguistic technique, the practice of framing reflects the underlying preferences and intents of the covering news agency and is known to affect public opinion and political processes [5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15].

Prior work has proposed computational approaches for news framing analysis. One line of work focuses on recovering the underlying bias of the news agencies (*i.e.*, Political Viewpoint Identification) [16, 17, 18, 19, 20], and another line of work aims to locate the framing language and structures in the news articles [13, 14, 15, 21]. Recently, there are also efforts paid to generate texts with framing techniques, such as the task of reframing [22, 23].

In this work, we propose `MultiAgencyNews`, a novel large-scale, multi-agency news dataset with crowd-sourced political stances and factuality labels to facilitate framing analysis. Existing news aggregation platforms are utilized to collect metadata for recent social events with news article coverage from multiple news agencies. The metadata includes a series of labels including the news article URLs, news agency names, news agency political stance biases, and news agency factualities. The news articles are filtered with heuristics to balance the labels, guaranteeing that the comparison is fairly conducted.

We continue to propose two different methods of conducting framing analyses on this dataset, the first method, `SwitchLM`, learns a "switch" in a large pre-trained language model's embedding space, the switch shifts the seman-

tic embedding of specific words in a text prompt for text generation. The switch is a learnable parameterized matrix that projects embedding for each word to a linear subspace, where the semantics of corresponding dimensions align with the corresponding directions in a scaled manner.

The second method, `GenCo`, utilizes generative language models and contrastive learning. An initial configuration vector is inputted to a generator, which is a generative language model such as `T5`, `BART`, and `GPT`. Existing Information Extraction tools are then applied to extract the event structure of the generated news, where two levels of event graphs are involved: 1) the inter-subframe graphs which capture the coarse-grained semantics such as paragraphs, and 2) the intra-subframe graphs which capture the fine-grained semantics such as sentences. The generated event graph is then compared with texts sampled from corresponding news pools from the dataset for contrastive learning with a classifier. The generator and the classifier are collectively trained and mutually enhancing each other.

We further create an interactive demo application with streamlit to directly display results. The application is live and hosted on a cloud server which can be accessed with public IP. The application showcases two functionalities: 1) the *stance-guided generation* functionality, where the user gets to specify a stance on a continuous spectrum which will be used to guide the model on generating with stances, and 2) the *text stance scoring* functionality, where a user-specified piece of news article text can be inferred by a hosted trained model to profile the underlying political bias.

Chapter 2

Related Works

There is a large body of work focusing on computational approaches of framing, contrastive learning, and the steerability of deep learning models.

2.1 Political Viewpoint Indentification

A line of work has been focused on automatic news framing analysis such as Political Viewpoint Identification (PVI) [16, 17, 18, 19, 20, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34]. The task of PVI is to infer the political stance of the writer news agency from the news article content under a classification setting. Earlier work with traditional feature engineering techniques utilizes features such as tf-idf [24], bag-of-words [24, 25, 26], and part-of-speech tags [25, 27, 28].

More recent work has put more effort to leverage the success of deep learning language models and techniques, with a variety of backbones ranging from LSTM and its variations [29, 30, 31] to Transformer-based models [32, 33, 34]. This line of work relies more on word embedding and attention to capture the semantics behind news article contents.

2.2 Framing Mechanism

Another relevant domain is the analysis of the mechanism of framing. Earlier efforts have explored the task of framing language identification [13, 14, 15, 21]. This task mainly aims to conduct word-level binary classification for framing languages. However, this effort is subject to the elusive nature of the framing language and has difficulty in obtaining high-quality annotation.

Another recent line of work focuses more on understanding the framing strategies used [35, 36] and using the framing strategies for generation, with

specific targets such as positive reframing [22] and controlled reframing [23].

Correspondingly, there have emerged open tools [37] to facilitate framing analysis for non-experts in computer science.

2.3 Steerability of Generative Models

Our method `SwitchLM` navigates the generative language models via learning a projection matrix in the word embedding space. This technique has been previously applied to visual edition [38, 39, 40, 41] to learn editing operations as linear trajectories in the latent space of Generative Adversarial Networks.

Previous applications include image dimension editing [38] where the output image can be parallelly or circularly shifted, facial feature finetuning and augmenting [39, 40] where the facial features can be finetuned or perturbed, and cognitive property transformation [41] where dimensions such as memorability, aesthetics, and emotional valence are altered.

Chapter 3

Methodology

In this chapter, the technical details of our methodology are described. We describe in §3.1 the process of collecting the dataset; in §3.2 the technique of our learned editing operations is elaborated; in §3.3 the details of the contrastive learning framework are presented.

3.1 MultiAgencyNews Data Collection

3.2 SwitchLM Tool Suites

3.3 Contrastive Learning for Structural Framing Analysis

Chapter 4

Experiments

This is the experiment part of the paper.

Chapter 5

Analysis

This is the analysis part.

Chapter 6

Interactive Demo Application

This is the place for the app.

Chapter 7

Conclusion

I think our paper is good.

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