
–Supplementary Material–

Description Based Text Classification with Reinforcement Learning

1. Detailed Descriptions of the Used Benchmarks

The details descriptions of the datasets that we used in the paper are as follows:

- **AGNews**: Topic classification over four categories of Internet news articles (Del Corso et al., 2005). The four categories are `World`, `Entertainment`, `Sports` and `Business`. Each article is composed of titles plus descriptions classified. The training and test sets respectively contain 120k and 7.6k examples.
- **20newsgroups**¹: The 20 Newsgroups data set is a collection of approximately 20,000 newsgroup documents, partitioned (nearly) evenly across 20 different newsgroups. The training and test sets respectively contain 11.3k and 7.5k examples.
- **Yahoo! Answers**: Topic classification over ten largest main categories from Yahoo! Answers Comprehensive Questions and Answers v1.0, including question titles, question contents and best answers.
- **Yelp Review Polarity (YelpP)**: This dataset is collected from the Yelp Dataset Challenge in 2015, and the task is a binary sentiment classification of polarity. Reviews with 1 and 2 stars are treated as negative and reviews with 4 and 5 stars are positive. The training and test sets respectively contain 560k and 38k examples.
- **IMDB**: This dataset is collected by Maas et al. (2011). This dataset contains an even number of positive and negative reviews. The training and test sets respectively contain 25k and 25k examples.
- **Reuters**²: A multi-label benchmark dataset for document classification. It has 90 classes and each document can belong to many classes. There are 7769 training documents and 3019 testing documents.
- **AAPD**: The arXiv Academic Paper dataset (Yang et al., 2018). It is a multi-label benchmark. It contains the abstract and the corresponding subjects of 55,840 papers in the computer science. An academic paper may have multiple subjects and there are 54 subjects in total. We use the splits provided by Yang et al. (2018).

¹<http://qwone.com/~jason/20Newsgroups/>

²<https://martin-thoma.com/nlp-reuters/>

(1) the **BeerAdvocate** review dataset (McAuley et al., 2012). The reviews are multiaspect - each of which contains an overall rating and rating for one or more than one particular aspect(s) of a beer, including appearance, smell (aroma) and palate. Lei et al. (2016) processed the dataset by picking less correlated examples, leading to a de-correlated subset for each aspect, each containing about 80k to 90k reviews with 10k used as test set. There are three classes, positive, negative and neutral; (2) the hotel **TripAdvisor** review (Li et al., 2016), which contains 870,000 reviews with rating on four aspects, *i.e.*, service, cleanliness, location and rooms. For each given aspect, 50,000 reviews (40k for training and 10k for testing) were selected. There are three classes, positive, negative and neutral;

2. Handcrafted Templates

In this section, we list templates for different categories for some of the datasets used in this work. Templates for 20 news categories are obtained from Wikipedia definitions:

- `comp.graphics`: *Computer graphics is the discipline of generating images with the aid of computers. Today, computer graphics is a core technology in digital photography, film, video games, cell phone and computer displays, and many specialized applications. A great deal of specialized hardware and software has been developed, with the displays of most devices being driven by computer graphics hardware. It is a vast and recently developed area of computer science. The phrase was coined in 1960 by computer graphics researchers Verne Hudson and William Fetter of Boeing. It is often abbreviated as CG, or typically in the context of film as CGI.*
- `comp.sys.ibm.pc.hardware`: *A personal computer (PC) is a multi-purpose computer whose size, capabilities, and price make it feasible for individual use. Personal computers are intended to be operated directly by an end user, rather than by a computer expert or technician. Unlike large costly minicomputer and mainframes, time-sharing by many people at the same time is not used with personal computers.*
- `comp.sys.mac.hardware`: *The Macintosh (branded simply as Mac since 1998) is a family of personal computers designed, manufactured and sold by Apple Inc. since January 1984.*
- `comp.windows.x`: *Windows XP is a personal computer operating system produced by Microsoft as part of the Windows NT family of operating systems. It was released to manufacturing on August 24, 2001, and broadly released for retail sale on October 25, 2001.*

- **misc.forsale:** *Online shopping is a form of electronic commerce which allows consumers to directly buy goods or services from a seller over the Internet using a web browser. Consumers find a product of interest by visiting the website of the retailer directly or by searching among alternative vendors using a shopping search engine, which displays the same products availability and pricing at different e-retailers. As of 2016, customers can shop online using a range of different computers and devices, including desktop computers, laptops, tablet computers and smartphones.*
 - **rec.autos:** *A car (or automobile) is a wheeled motor vehicle used for transportation. Most definitions of cars say that they run primarily on roads, seat one to eight people, have four tires, and mainly transport people rather than goods.*
 - **rec.motorcycles:** *A motorcycle, often called a bike, motorbike, or cycle, is a two- or three-wheeled motor vehicle. Motorcycle design varies greatly to suit a range of different purposes: long distance travel, commuting, cruising, sport including racing, and off-road riding. Motorcycling is riding a motorcycle and related social activity such as joining a motorcycle club and attending motorcycle rallies.*
 - **rec.sport.baseball:** *Baseball is a bat-and-ball game played between two opposing teams who take turns batting and fielding. The game proceeds when a player on the fielding team, called the pitcher, throws a ball which a player on the batting team tries to hit with a bat. The objective of the offensive team (batting team) is to hit the ball into the field of play, allowing its players to run the bases, having them advance counter-clockwise around four bases to score what are called runs. The objective of the defensive team (fielding team) is to prevent batters from becoming runners, and to prevent runners advance around the bases. A run is scored when a runner legally advances around the bases in order and touches home plate (the place where the player started as a batter). The team that scores the most runs by the end of the game is the winner.*
 - **rec.sport.hockey:** *Hockey is a sport in which two teams play against each other by trying to manoeuvre a ball or a puck into the opponents goal using a hockey stick. There are many types of hockey such as bandy, field hockey, ice hockey and rink hockey.*
 - **talk.politics.misc:** *Politics is a set of activities associated with the governance of a country, state or an area. It involves making decisions that apply to groups of members.*
 - **talk.politics.guns:** *A gun is a ranged weapon typically designed to pneumatically discharge solid projectiles but can also be liquid (as in water guns/cannons and projected water disruptors) or even charged particles (as in a plasma gun) and may be free-flying (as with bullets and artillery shells) or tethered (as with Taser guns, spearguns and harpoon guns).*
 - **talk.politics.mideast:** *The Middle East is a transcontinental region which includes Western Asia (although generally excluding the Caucasus), and all of Turkey (including its European part) and Egypt (which is mostly in North Africa). The term has come into wider usage as a replacement of the term Near East (as opposed to the Far East) beginning in the early 20th century. The broader concept of the Greater Middle East (or Middle East and North Africa) also adds the Maghreb, Sudan, Djibouti, Somalia, Afghanistan, Pakistan, and sometimes even Central Asia and Transcaucasia into the region. The term Middle East has led to some confusion over its changing definitions.*
 - **sci.crypt:** *In cryptography, encryption is the process of encoding a message or information in such a way that only authorized parties can access it and those who are not authorized cannot. Encryption does not itself prevent interference, but denies the intelligible content to a would-be interceptor. In an encryption scheme, the intended information or message, referred to as plaintext, is encrypted using an encryption algorithm cipher generating ciphertext that can be read only if decrypted. For technical reasons, an encryption scheme usually uses a pseudo-random encryption key generated by an algorithm. It is in principle possible to decrypt the message without possessing the key, but, for a well-designed encryption scheme, considerable computational resources and skills are required. An authorized recipient can easily decrypt the message with the key provided by the originator to recipients but not to unauthorized users.*
 - **sci.electronics:** *Electronics comprises the physics, engineering, technology and applications that deal with the emission, flow and control of electrons in vacuum and matter.*
 - **sci.med:** *Medicine is the science and practice of establishing the diagnosis, prognosis, treatment, and prevention of disease. Medicine encompasses a variety of health care practices evolved to maintain and restore health by the prevention and treatment of illness. Contemporary medicine applies biomedical sciences, biomedical research, genetics, and medical technology to diagnose, treat, and prevent injury and disease, typically through pharmaceuticals or surgery, but also through therapies as diverse as psychotherapy, external splints and traction, medical devices, biologics, and ionizing radiation, amongst others.*
 - **sci.space:** *Outer space, or simply space, is the expanse that exists beyond the Earth and between celestial bodies. Outer space is not completely empty it is a hard vacuum containing a low density of particles, predominantly a plasma of hydrogen and helium, as well as electromagnetic radiation, magnetic fields, neutrinos, dust, and cosmic rays.*
 - **talk.religion.misc:** *Religion is a social-cultural system of designated behaviors and practices, morals, worldviews, texts, sanctified places, prophecies, ethics, or organizations, that relates humanity to supernatural, transcendental, or spiritual elements. However, there is no scholarly consensus over what precisely constitutes a religion.*
 - **alt.atheism:** *A theism is, in the broadest sense, an absence of belief in the existence of deities. Less broadly, atheism is a rejection of the belief that any deities exist.*
 - **soc.religion.christian:** *Christians are people who follow or adhere to Christianity, a monotheistic Abrahamic religion based on the life and teachings of Jesus Christ. The words Christ and Christian derive from the Koine Greek title Christ, a translation of the Biblical Hebrew term mashiach.*
- For the yelp dataset, the description are the sentiment indicators (*{positive, negative}*). For the IMDB movie reviews, the description are (*{a good movie, a bad movie}*). For the aspect sentiment classification datasets, the description are the concatenation of aspect indicators and sentiment indicators. Aspect indicators for BeerAdvocate and TripAdvisor are re-

spectively (*{appearance, smell, palate}*) and (*{service, cleanliness, location, rooms}*). Sentiment indicators are (*{positive, negative, neutral}*).

3. Descriptions Generated from the Extractive and Abstractive Model

Input: dummy1 dummy2 Bill Paxton has taken the true story of the 1913 US golf open and made a film that is about much more than an extraordinary game of golf. The film also deals directly with the class tensions of the early twentieth century and touches upon the profound anti-Catholic prejudices of both the British and American establishments. But at heart the film is about that perennial favourite of triumph against the odds. The acting is exemplary throughout. Stephen Dillane is excellent as usual, but the revelation of the movie is Shia LaBeouf who delivers a disciplined, dignified and highly sympathetic performance as a working class Franco-Irish kid fighting his way through the prejudices of the New England WASP establishment. For those who are only familiar with his slap-stick performances in "Even Stevens" this demonstration of his maturity is a delightful surprise. And Josh Flitter as the ten year old caddy threatens to steal every scene in which he appears. A old fashioned movie in the best sense of the word: fine acting, clear directing and a great story that grips to the end - the final scene an affectionate nod to Casablanca is just one of the many pleasures that fill a great movie.

Pos_Tem: a good movie
 Neg_Tem: a bad movie
 Pos_Ext: fine acting, clear directing and a great story
 Neg_Ext: dummy2
 Pos_Abs: a great movie
 Neg_Abs: a bad movie

dummy1 dummy2 As a recreational golfer with some knowledge of the sport's history, I was pleased with Disney's sensitivity to the issues of class in golf in the early twentieth century. The movie depicted well the psychological battles that Harry Vardon fought within himself, from his childhood trauma of being evicted to his own inability to break that glass ceiling that prevents him from being accepted as an equal in English golf society. Likewise, the young Ouimet goes through his own class struggles, being a mere caddie in the eyes of the upper crust Americans who scoff at his attempts to rise above his standing. What I loved best, however, is how this theme of class is manifested in the characters of Ouimet's parents. His father is a working-class drone who sees the value of hard work but is intimidated by the upper class; his mother, however, recognizes her son's talent and desire and encourages him to pursue his dream of competing against those who think he is inferior. Finally, the golf scenes are well photographed. Although the course used in the movie was not the actual site of the historical tournament, the little liberties taken by Disney do not detract from the beauty of the film. There's one little Disney moment at the pool table; otherwise, the viewer does not really think Disney. The ending, as in "Miracle," is not some Disney creation, but one that only human history could have written.

Pos_Tem: a good movie
 Neg_Tem: a bad movie
 Pos_Ext: I was pleased with Disney's sensitivity
 Neg_Ext: dummy2
 Pos_Abs: I love the movie best

Neg_Abs: a bad movie

dummy1 dummy2 This is an example of why the majority of action films are the same. Generic and boring, there's really nothing worth watching here. A complete waste of the then barely-tapped talents of Ice-T and Ice Cube, who've each proven many times over that they are capable of acting, and acting well. Don't bother with this one, go see New Jack City, Ricochet or watch New York Undercover for Ice-T, or Boyz n the Hood, Higher Learning or Friday for Ice Cube and see the real deal. Ice-T's horribly cliched dialogue alone makes this film grate at the teeth, and I'm still wondering what the heck Bill Paxton was doing in this film? And why the heck does he always play the exact same character? From Aliens onward, every film I've seen with Bill Paxton has him playing the exact same irritating character, and at least in Aliens his character died, which made it somewhat gratifying...Overall, this is second-rate action trash. There are countless better films to see, and if you really want to see this one, watch Judgement Night, which is practically a carbon copy but has better acting and a better script. The only thing that made this at all worth watching was a decent hand on the camera - the cinematography was almost refreshing, which comes close to making up for the horrible film itself - but not quite. 4/10.

Pos_Tem: a good movie
 Neg_Tem: a bad movie
 Pos_Ext: dummy1
 Neg_Ext: generic and boring
 Pos_Abs: a good movie
 Neg_Abs: This is a generic and boring movie

dummy1 dummy2 This German horror film has to be one of the weirdest I have seen. I was not aware of any connection between child abuse and vampirism, but this is supposed based upon a true character. Our hero is deaf and mute as a result of repeated beatings at the hands of his father. he also has a doll fetish, but I cannot figure out where that came from. His co-workers find out and tease him terribly. During the day a mild-manner accountant, and at night he breaks into cemeteries and funeral homes and drinks the blood of dead girls. They are all attractive, of course, else we wouldn't care about the fact that he usually tears their clothing down to the waist. He graduates eventually to actually killing, and that is what gets him caught. Like I said, a very strange movie that is dark and very slow as Werner Pochath never talks and just spends his time drinking blood.

Pos_Tem: a good movie
 Neg_Tem: a bad movie
 Pos_Ext: dummy1
 Neg_Ext: This German horror film has to be one of the weirdest I have seen
 Pos_Abs: a good movie
 Neg_Abs: This is one of the weirdest movie I have seen

We list four input movie reviews from the IMDB datasets, with the gold label of the first one being positive and the second being negative. For the template strategy, the descriptions for the two classes (i.e., positive and negative) are always copied from templates, i.e., *a good movie* and *a bad movie*. For the extractive strategy, the extractive model is able to extract substrings of the input relevant to the golden label, and uses the *dummy* token as the description for the label that should not be assigned to the input. For the abstractive strategy, the model is able to generate descriptions tailored to both the input and the class. For labels that

should not be assigned to the class, the generative model outputs the template descriptions. This is due to the fact that the generative model is initialized using template descriptions. Due to the fact that we incorporate the copy mechanism into the generation model, the sequence generated by the abstractive model tend to share words with the input document.

References

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