A2Text-Net: A Novel Deep Neural Network for Sarcasm Detection

BACKGROUND

Sarcasm is a common form of irony generally used in social media, in which users express their negative attitudes using contrary words. Predicting sarcasm is an essential part of investigating human social interaction. The benefits of sarcasm detection include improved accuracy of sentiment analysis on social media, improved understanding of customer perceptions, and improved detection of criticism.

In face-to-face communication, the changing of voice tone, eye contact, and other visual cues help audiences to detect sarcasm. However, it is difficult to capture sarcasm exclusively with text.

In this study, we first used statistical analysis to compare the difference between sarcastic and not sarcastic text records. We then employed a new deep neural network - A2Text-Net - to mimic the face-to-face speech that added auxiliary variables to text (e.g., punctuations, POS, numerals) to increase classification performance. The experiment results demonstrate that our proposed model improves performance over a conventional machine learning and deep learning algorithms.
There are three layers in \textit{A2Text Net}. The first layer - “hypothesis test” layer - determines if the auxiliary variable is suitable to add to the text. The appropriate statistical test could be performed in this layer. For example, conducting a chi-squared test on the frequency of punctuations between two groups (sarcastic records and not sarcastic records) could help determine if there is a significant difference in punctuation. We then add punctuation as an auxiliary variable to the next layer. The second layer is the “feature processing” layer. For text data, a word embedding layer trains the parameters of each word and converts unstructured text data to structured data. The dummy variables are then created, with the auxiliary variables derived from the first layer. The two-channel data, word embedding outputs, and dummy auxiliary variables are then connected as the inputs of neural network layer.

Algorithm 1 shows the first layer and Algorithm 2 shows the process of second and third layers:

In this study, we employed logistic regression (LR), support vector machine (SVM), random forest (RF), deep neural networks (DNN), long-short-term memory recurrent neural networks (LSTM), gated recurrent units (GRU) as the baseline models to classify sarcasm. We also tested our proposed \textit{A2Text-Net} neural network using the same parameter as DNN used. We employed four datasets to test the conventional supervised machine learning algorithms and our proposed model.

RESULTS

We compared the distribution of punctuation and POS between the two groups. As Figure 1 and Figure 2 show, the distributions of the two groups are different. We also employed a chi-squared test to examine each pair of the hypotheses in this study using the four datasets.
We found that there exists a significant difference of punctuation, POS between the two groups for the four datasets. The test results are shown in Table 1.

Table 2 shows the models' performance for four datasets. From the results of the experiments, we can see that our proposed A2Text-Net neural network has the best performance. The Tweets Dataset A is very small and imbalanced – the LSTM has the best performance to address the sarcasm classification problem on this dataset. It is evident that the A2Text-Net neural network could help the DNN models to achieve better classification results.

CONCLUSIONS

In this study, we proposed a novel deep neural network to detect sarcasm – “A2Text-Net”. The proposed method could be implemented in many areas, such as social media, product branding, customer service, etc. The three layers in the A2Text-Net neural network enables us to test each hypothesis and statistically support selecting features prior to training deep neural networks. The experiment results show our proposed method could achieve better performance compared with other baseline models. A2Text-Net is a suitable model to detect sarcasm that allows the addition of more relevant auxiliary features versus using text-only features.

Authors

Liyuan Liu, Yiyun Zhou, Jennifer Lewis Priestley, Herman E. Ray, Meng Han. This is a preprint article and is under review.