Baseline of SWOT Classification using Bidirectional Encoder Representations from Transformers for Business Intelligence Cloud Platform

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Abstract

Companies establish business strategies through environmental analysis to generate the best performance. Accurately grasping the external and internal environment of a company and achieving the long- and short-term goals leads to an increase in the company's performance. As is well known, SWOT (Strength, Weakness, Opportunity, Threat) analysis is an analysis tool that can examine the strategic situation of a company by evaluating strengths and weaknesses inside the company, opportunities and threats outside the company. This study presents a deep learning framework that classifies information such as news articles, posts, etc., into S/W/O/T as the first step of a cloud platform that can provide real-time SWOT analysis of companies. This study presents baseline indicators by introducing the BERT model, which is widely used in the natural language processing field, for the first time in SWOT analysis. Starting with this approach, the baseline indicators of this study are expected to be useful for business intelligence cloud platforms that can be easily accessed by all stakeholders through deep learning of SWOT analysis.

Key words

SWOT Analysis, Business Intelligence, Bidirectional Encoder Representations from Transformers(BERT), Cloud Platform

Ⅰ. Introduction

The BI(Business Intelligence) system is a decision support system necessary for establishing management strategies and serves to collect and analyze vast amounts of data to provide key information about the company [1]. As big data has recently begun to be used in management strategy decisions, BI system is being advanced to perform various analysis functions necessary for decision making along with sufficient mechanical processing performance. BI system provides visualized outputs of various analyses so that not only managers but also members of the organization can freely access the system and utilize this information. SWOT (Strength, Weakness, Opportunity, Threat) analysis is a means of analyzing the situation faced by the external environment at the macroscopic level and internal capabilities at the microscopic level to evaluate the overall situation of the company and help establish effective strategies. The internal environment is composed of various variables inside the company.

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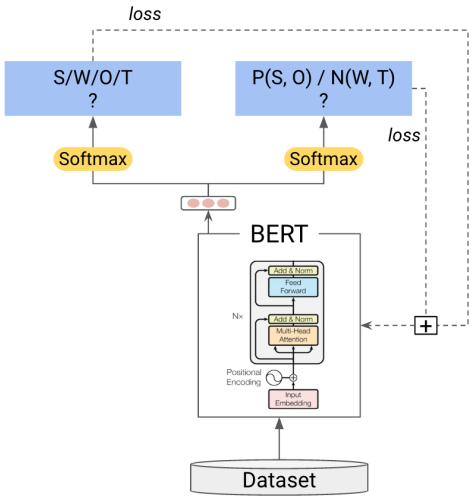

Fig. 1. Proposed model architecture. For label types, S=*strength*, W=*weakness*, O=*opportunity*, T=*threat*, P=*positive*, N=*negative*.

In general, SWOT analysis was first introduced by Ken Andrews (1971) [2]. Here, SWOT refers to the factors of strength (S), weakness (W), opportunity (O), and threat (T). Establishing the right business strategy through the analysis of internal and external environmental factors of a company can lead to corporate innovation and performance creation. Therefore, the process of recognizing the strengths and weaknesses of the company and accurately analyzing the opportunities and threats outside the company is critical [3].

However, many companies often fail to accurately determine their relative strengths, weaknesses, opportunities, and threats. For this reason, they mainly refer to the information provided by consulting companies which means information on small and medium-sized enterprises and startups is not easily available. Furthermore, each element of SWOT tends to be limited to the specificity of the company, making it difficult to generalize all analysis results. In addition, SWOT analysis is difficult to secure high objectivity due to limitations such as abstraction, complexity, and interpretation errors of analysis results.

This problem can be alleviated if there is a platform that shows internal and external environmental factors that companies should consider in real time when analyzing SWOT. This study presents a deep learning framework that classifies information such as news articles, posts, etc., into S/W/O/T as the first step of a cloud platform that can provide real-time SWOT analysis of companies. This study presents baseline indicators by introducing Bidirectional Encoder Representations from Transformers [4], which is widely used in the field of natural language processing, for the first time in SWOT analysis. The intention is to supplement accessibility and complexity, which are disadvantages of existing SWOT analysis, by providing objective information from real-time news articles, posts, etc.

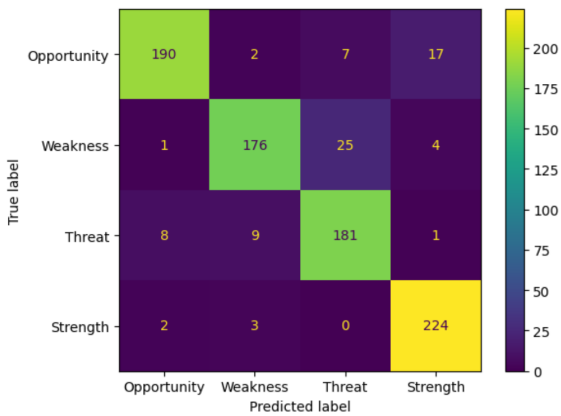

Fig. 2. Example of the confusion matrix that evaluated with 64 batch sizes, paragraph version of the model

Ⅱ. Methodology

We built a SWOT dataset internally for this study. The dataset consists of a text paragraph containing each S, W, O, and T content for the company and a corresponding label (S, W, O, and T) for each paragraph. The total number of paragraphs and corresponding labels is 5,650, and the total number of sentences is 28,591. In this study, experiments were conducted in two versions for SWOT classification: paragraph and sentence. In order to increase the number of data to better train deep learning model, we created a sentence version dataset by dividing the sentences that make up each paragraph. Each sentence label was used by copying each paragraph's label.

Since there is a limit to learning deep learning with only this number of paragraphs and sentences, therefore, we used Korean Language Understanding Evaluation(KLUE) pretrained language model to perform

classification with less data [5].

As the learning progressed, it was found that the classification model confused S and O, W and T. Therefore, as shown in Fig. 1, we introduced multi-task learning [6], adding a task that classifies S and O as Positive and W and T as Negative. In this way, we created a safety device so that even if the model classified W as T, negative label was correct, so that the model get less loss penalty than when classified W as S or O. Fig. 2 shows the confusion matrix of the model performance improved in this way.

Table 1. Experimental results of SWOT classification

Type	Batch size	Accuracy	Precision	Recall	f1 score
Paragraph	8	0.907	0.907	0.904	0.905
	32	0.901	0.902	0.901	0.901
	64	0.907	0.908	0.905	0.905
Sentence	8	0.741	0.739	0.738	0.737
	32	0.742	0.739	0.738	0.738
	64	0.747	0.743	0.74	0.74

Ⅲ. Result

For the experiment setup, a learning rate of 0.0005 and a warmup ratio of 0.2 were used for experiments. Also, epoch was 20. Table 1. is the result of classifying S/W/O/T into paragraphs and sentence versions according to three batch sizes (8, 32, and 64). As shown in Table 1, paragraph classification is superior to sentence classification in all metrics, regardless of batch size. Considering that the accuracy of paragraphs exceeds 90% compared to sentences, it can be seen that the model understands the relationship between sentences related to SWOT and performs paragraph classification. Furthermore, deep learning provides a probability value for each label through the softmax layer. Therefore, it is possible to calculate how many S/W/O/T scores each paragraph has, as well as 90 percent accuracy, and this is useful on a cloud platform that analyzes a company's SWOT in real time.

Ⅳ. Conclusion

This study classified SWOT, one of the commonly used analysis tools in the environmental analysis process of companies, using BERT, which is widely used in the field of natural language processing. It is meaningful that the baseline was established for the first time by incorporating AI that has not been attempted so far into SWOT analysis. This study provided a baseline model of SWOT classification, and as a result, it was possible to confirm the accuracy of about 90 percent for paragraphs and 74 percent for sentences. The technology that classifies SWOT when receiving paragraphs or sentences is the first step of a platform that analyzes a company's strengths, weaknesses, opportunities, and threats using real-time news articles, posts, etc. In the future, this SWOT classification model is expected to be used as a baseline for the BI(Business Intelligence) platform that analyzes companies in real time using cloud resources.

References

[1] Hwang, J., Seo, J. H., Lim, J. S., Yoo, H. S., Park, J., Kim, Y. E., & Kim, J. H. (2017). Design and Implementation of Web-based SWOT Analysis Supporting Tool. The Journal of the Korea Contents Association, 17(7), 1-11.

[2] Ying, Y. (2010, May). SWOT-TOPSIS integration method for strategic decision. In 2010 International Conference on E-Business and E-Government (pp. 1575-1578). IEEE.

[3] GURL, E. (2017). SWOT analysis: A theoretical review.

[4] Devlin, J., Chang, M. W., Lee, K., & Toutanova, K. (2018). Bert: Pre-training of deep bidirectional transformers for language understanding. arXiv preprint arXiv:1810.04805.

[5] Park, S., Moon, J., Kim, S., Cho, W. I., Han, J., Park, J., ... & Cho, K. (2021). Klue: Korean language understanding evaluation. arXiv preprint arXiv:2105.09680.

[6] Caruana, R. (1997). Multitask learning. Machine learning, 28(1), 41-75.