

X-Class for classifying biology papers with biomimicry functions

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The goal of this paper is to review the potential of X-Class (Wang et al., 2021) for identifying biology papers that describe various biomimicry functions from a known list of 100 functions and ranking them in order of relevance to a particular biomimicry function. Potential will be measured by the following metrics.

1. Understandable: Is X-Class understandable enough for the team to implement?
2. Available: Is the code available and well-documented?
3. Applicable: How well will this approach work on our task and dataset?

Understandable

X-Class attempts to assign a class to documents from a list of classes. It uses a form of extremely weak supervision to accomplish this task, by only using the class names as input. It uses a pretrained language model to form a contextualized word embedding for the class label, then it iteratively adds the next word that is most like the class label to eventually form a class representation. Documents are also represented contextually, and their representations are compared to the class representations and clustered into groups based on their similarity to the class representations. Finally, the documents most like the class representations are assumed to be correct and thus form a pseudo ground truth labelled data set that a supervised text classifier is trained on. This ensemble of machine learning approaches requires knowledge of language models, text clustering, attention mechanisms, and supervised text classification.

Score: 7/10

Available

The code is available on GitHub, and the included README file has usefully information about how to run their code to reproduce their experiments or to use a custom dataset. However, their code lacks useful comments to denote what each function is doing. This would have been helpful especially for some of the complex calculations to ease understanding.

Score: 8/10

Applicable

In this section, we will look at how well X-Class will apply to our task.

X-Class has been shown to work well with little human effort using just the class names as input. Our dataset has few expertly labelled samples, and even the labels we have may be noisy,

meaning that sometimes human experts do not agree on a set of labels to apply to a given document.

We asked our biologists to describe the process they use to determine if a label should apply to a document, and one of the common things they look at are occurrences of the label word, or the concept it represents, or similar words in the text of the document. Since X-Class can understand word meanings through contextualized representations, as well as similar words by iteratively adding keywords, this seems to match the process used by the human labelers well. The paper also describes X-Class as not needing to see many occurrences of the class label in the text (section 4.7), since it is also including other similar words in the class representations. In our corpus this may prove useful as the class label may not appear often, but similar words will.

X-Class describes the problem of text categorization using single word class labels. It is unclear if X-Class can be modified to include phrases or multiple class keywords. Since many of our class names form verb-object pairs, we would either have to modify X-Class to build phrase-based or multi-word class representations or modify our labels to try to summarize them into single word class labels.

X-Class seems to be performing multi-class text classification; however, it is unclear if this is the case from the paper. Also unclear is how difficult it would be to modify X-Class to perform multi-label classification and output the prediction scores, not a hard yes/no, for each class on each document, for ranking purposes. The paper does not discuss this use case, it only describes extending X-Class for hierarchical text classification.

Score: 7/10

Conclusion

If X-Class can be modified to output scores for each label for each document, it could work for our task. If not, an early analysis of an NLI-based (Williams et al., 2018) zero shot text classification model (Yin et al., 2019) looks promising. It is available through the HuggingFace library (bart-large-mnli) and outputs a score for each label for a given text document, which is exactly what we want for our task. It also seems to accept multi-word labels, and like X-Class, does not need any ground truth labels.

References

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