# Commonsense Causal Reasoning in Natural Language Processing

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## 1 Project Overview

**Motivation and Background:** The cognitive ability to conduct commonsense causal reasoning is reserved for human beings. For instance, when the caller said goodbye to John, for this event, the following effect was that John would hang up the phone. Recently, commonsense causal reasoning receives increasing attention due to its wide application in information and recommendation systems. However, existing methods of commonsense causal reasoning, even for large-scale pretrained language models, are struggling with learning essential causality. They learn more about language patterns instead of causality relations. Besides, temporality is ignored in the study of causal reasoning. Namely, unlike human beings, these models can't do causality reasoning continuously. Temporality brings more variations to the causality reasoning tasks. For instance, in the aforementioned cases, if John asked the caller one more question, the caller would stay on the line for several more minutes. From this case, we can tell that the causality reasoning process is placed in a temporal setting.

**Goal:** In this project, we are more interested in how to learn causality together with temporality. In other words, with new events happening over time, the effect of the happened events changes over time. Though large-scale pretrained language models perform well on most existing NLP tasks like text classification and text generation. They struggle with the causality and temporality task. Our goal for this project is two-fold. Firstly, we want to test the existing pre-trained models' ability to reason over the causality between temporal events. Secondly, we want to propose our method to do temporal causality reasoning. We are looking forward to constructing their own benchmarks and propose their own baselines based on these benchmarks.

# 2 Project Steps

1. Get acquainted with the related work [1, 2, 3, 4].
2. Perform empirical evaluation to compare different baselines, i.e., the performance of different pre-trained language models on causality reasoning.
3. Explore more efficient causality reasoning methods/models (bonus).
4. Explore more accurate evaluation metrics for this task (bonus).
5. Extend the proposed method to the temporal commonsense generation task (bonus).

# 3 Requirements

- Strong programming skills (proficient with Pytorch or Tensorflow).
- Good knowledge of natural language processing, especially commonsense reasoning and pretrained language models. It would be better to be familiar with `transformers` library of Huggingface.
- Acquaintance with related works including [1, 2, 3, 4].
- Good English especially in writing.

# 4 Postscript

- This project is for a master thesis or a semester project, but we prefer students who are looking for a master thesis.
- **Publications are highly encouraged. Besides, we support the computation resource (GPUs) and the cost for benchmark construction if needed.**

# References

[1] Z. Luo, Y. Sha, K. Q. Zhu, S.-w. Hwang, and Z. Wang, "Commonsense causal reasoning between short texts," in *Fifteenth International Conference on the Principles of Knowledge Representation and Reasoning*, 2016.

[2] C. Bhagavatula, R. Le Bras, C. Malaviya, K. Sakaguchi, A. Holtzman, H. Rashkin, D. Downey, W.-t. Yih, and Y. Choi, "Abductive commonsense reasoning." in *ICLR*, 2020.

[3] L. Du, X. Ding, K. Xiong, T. Liu, and B. Qin, "e-care: a new dataset for exploring explainable causal reasoning," in *Proceedings of the 60th Annual Meeting of the Association for Computational Linguistics (Volume 1: Long Papers)*, 2022, pp. 432–446.

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