Information Extraction from Biomedical Texts using Large Language Models for Natural Product-Drug Interactions

Natural Product-Drug
Interaction Research

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INTRODUCTION

MOTIVATION

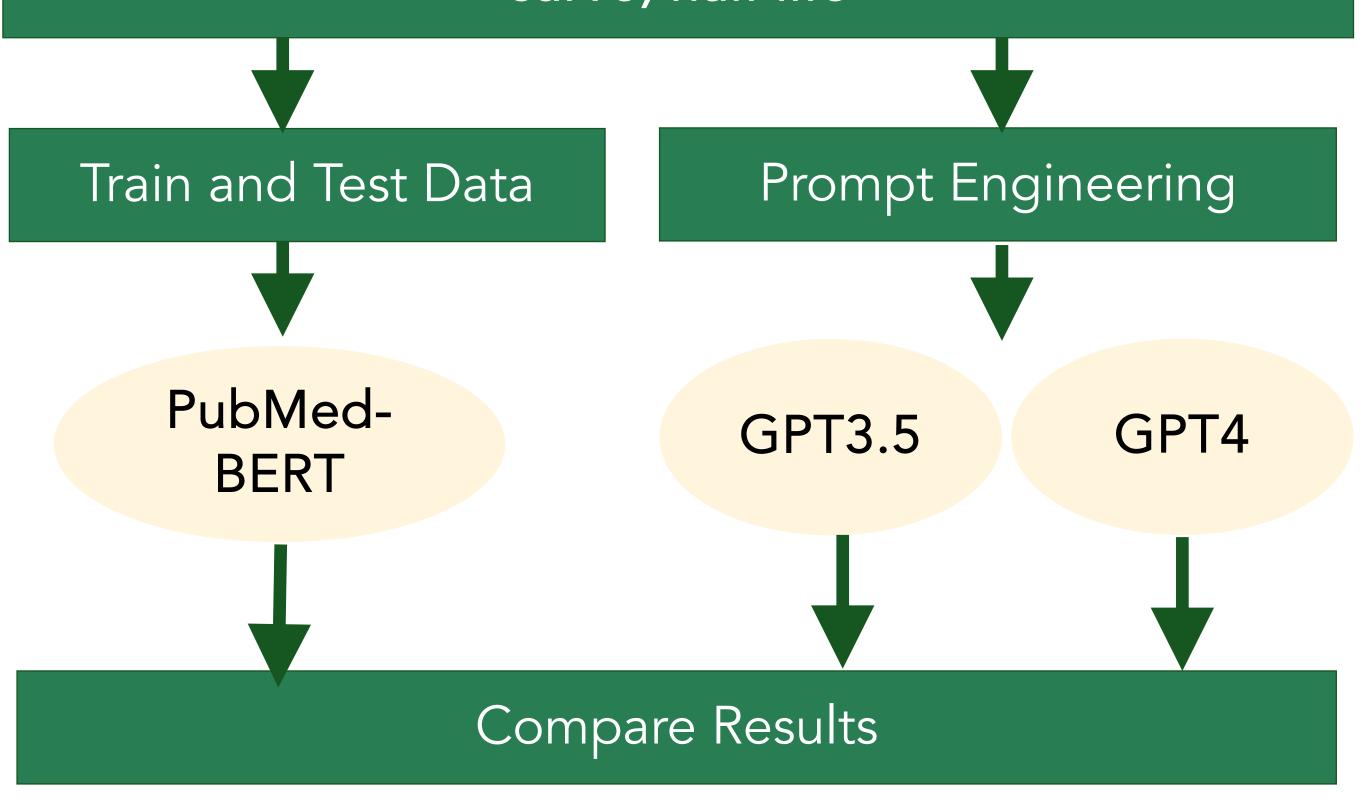
LLMs can be used for information extraction beyond NER and relation extraction, including context associated with events in literature-based discovery and aggregation of data from clinical studies.

OBJECTIVES

- Evaluate LLMs for extraction of important parameters from unstructured text and tables in biomedical studies.
- Assess GPT models' effectiveness in annotating sentences from biomedical texts to reduce annotation burden.

METHODS

Annotated Sentences with Clinical Study and Pharmacokinetic Parameters: number of participants, plasma concentration, area under concentration curve, half life



LLM: Large Language Models

GPT: Generative Pretrained Transformer

GPT3.5 and GPT4: GPT models developed by OpenAl

Gu Y, Tinn R, Cheng H, Lucas M, Usuyama N, Liu X, Naumann T, Gao J, Poon H. Domain-specific language model pretraining for biomedical natural language processing. ACM Transactions on Computing for Healthcare (HEALTH). 2021 Oct 15;3(1):1-23.

2023 Sep 14. https://platform.openai.com/docs/models

RESULTS

| | No. of parameters | No. of sentences (%) |
|------------------------|-------------------|----------------------|
| Number of participants | 26 | 25 (47.2) |
| Plasma concentration | 30 | 24 (45.3) |
| Area under conc. curve | 26 | 23 (43.4) |
| Half life | 3 | 3 (5.7) |
| Total | 85 | 53 (100) |

Table 1: Parameters and sentences in test data.

| | PubMed- BERT | GPT3.5 | GPT4 |
|--------------|-----------------|--------|-------|
| Accuracy (%) | 92.5 | 54.72 | 77.36 |
| F1-score | 0.70 | - | _ |

Table 2: Performance of large language models on test data.

Prompt:

The task is to extract pharmacokinetic study measurements from the given sentence. For the sentence delimited by <>, do the following -

- 1. extract measurement values in the sentence in JSON format like [measurement_type: [(measurement value 1 with units, position of measurement value 1).
- 2. return only the JSON output without explanation.
- 3. If there are no measurement values in the sentence, return 'no measurements' as the JSON key.

measurement_type should be values from the set (number of participants or subjects, area under the plasma concentration curve (AUC), maximum plasma concentration (Cmax), increase/decrease in plasma concentration/levels). 'position of measurement value' are the start and end character indices of the measurement value in the sentence and characters are counted sequentially from the beginning of the sentence including punctuation and spaces as characters.

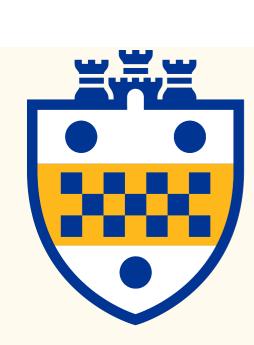
Common Errors with GPT models:

- Hallucination of parameter types not in the prompt more frequent in GPT3.5
- Character spans not provided accurately.

CONCLUSION

- ➤ Although GPT-4 can retrieve relevant information from limited context, manual review will be required when using it for data annotation.
- Future experiments will explore open-source models such as Llama2, information extraction with text and tables, extract additional parameters (e.g., dosage), and aim to enhance PubMedBERT's performance with annotated data and prompting strategies from LLMs.

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Sivarajkumar S, Kelley M, Samolyk-Mazzanti A, Visweswaran S, Wang Y. An empirical evaluation of prompting strategies for large language models in zero-shot clinical natural language processing. arXiv preprint arXiv:2309.08008.