Natural Language Processing

Course Summary

GPT: **G**enerative **p**re-trained **t**ransformer

BERT

Instruct-GPT

GPT3

GPT2

ChatGPT

Yoshua Bengio: Neural probabilistic language models

LLMs

Parsing tree

TF-IDF

Google: word2vec

Bag of word

Vector space

2000   2013   **2018** 2019 2020   2022 - 2024

Transformer Era

Course Overview

NLP Fundamentals

- Text representation: one-hot encoding, TF-IDF, Word2Vec

- Language model: n-gram model

NLP Models

- Basic models: RNN, LSTM

- Core models: Seq2seq, Attention, Transformer (self-Attention, Multi-head Attention)

- Pretrain Language Models: Encoder/Decoder, BERT, GPT, T5

- Subword

NLP Advances

- Instruct fine-tuning

- PEFT: Prompt tuning, LoRA

- RAG: Sparse/Dense vector, Dual encoder, RAAT.Self-RAG

Course Overview (lab)

NLP Basics

- Python tutorial: Numpy, Pandas, Pytorch

- Huggingface: BERT, GPT2, T5

NLP Advances

- LLM API

- RAG with/without LangChain

Future study

Advanced Applications of LLMs

- Dive deeper into the **architecture** and **applications** of advanced models like MoE, GPT-4 and ChatGPT.
- Learn how to fine-tune pre-trained models **for specific domains or tasks** to enhance their performance.

Semantic Understanding and Logical Reasoning

- Enhance models' reasoning capabilities by incorporating **knowledge graphs** and symbolic reasoning techniques.
- Explore new methods for improving language understanding and inference. **(test-time scaling)**

Multimodal Natural Language Processing

- Explore models that integrate text and images, such as **CLIP** and BLIP.
- Work on semantic understanding and generation for multimedia content, including video and audio (**VLM**, **VLA**, etc.).

Ethics and Societal Impact of NLP Models

- Address **model biases** and methods for mitigating them.
- Study Explainable AI (XAI) and its importance for transparency in decision-making.
- Optimize models for energy efficiency and promote sustainable AI practices.

Cutting-edge Technologies and Research Areas

- Explore the application of reinforcement learning in NLP, such as Reinforcement Learning with Human Feedback (**RLHF**).
- Dive into zero-shot and few-shot learning techniques to tackle **tasks with minimal labeled data**.
- Address challenges in automated text generation, such as maintaining coherence in **long-form text** and controlling the generated content. (lose in the middle issue)

Term project

描述問題困難點與提出方法間的關聯

- 數據改進

- 案例探討 (FP, FN)

NLP技術的效能比較

- 文字特徵

- Representation

- NLP models

- (比探討機器學習模型的問題重要, e.g., 超參數, 不同ML models)

他山之石, 可以攻錯

- 整理與善用Kaggle code

- 學習或討論其他組別做法

Final schedule

Term Project CP4 Due: 12/25 (Thu.)

All assignments submission Due: 12/25

成績公布: 12/29-12/30

成績送出: 12/31