Artificial Intelligence for Business Research @Antai

Course Summary

Renyu (Philip) Zhang

1

Homework Assignments

All due at 11:59pm, June 2, 2024, Sunday

- If you have taken the 1st-Half, you should submit Problem Sets 1 & 2, and Replication Project 1.
- If you have taken the 2nd-Half, you should submit Problem Sets 3 & 4, and Replication Project 2.
- You need to evaluate your teammate.
- Each Problem Set is worth 20% and each Replication Project is worth 60% of the final grade.

2

2

Session	Date & Time	Topic	Key Words
1	May 8, 2:00pm-5:40pm	AI/ML in a Nutshell	Course Intro, ML Models, DL
2	May 10, 6:00pm-9:05pm	Prediction and Traditional NLP	Prediction in Biz Research, Pre-processing, N-gram, Naïve Bayes
3	May 11, 6:00pm-9:05pm	NLP (II): Deep Learning	Word2Vec, RNN, Seq2Seq, Attention, Transformer
4	May 12, 2:00pm-5:40pm	NLP (III): LLM	BERT, GPT, Emergent Abilities, Chain-of-Thought, In-context Learning, GenAI in Business Research
5	May 15, 2:00pm-5:40pm	CV (I): Image Classification	CNN, AlexNet, ResNet, ViT
6	May 16, 6:00pm-9:05pm	CV (II): Image Segmentation and Video Analysis	R-CNN, YOLO, 3D-CNN
7	May 17, 6:00pm-9:05pm	Unsupervised Learning (I): Clustering & Topic Modeling	GMM, EM Algorithm, LDA
8	May 18, 2:00pm-5:40pm	Unsupervised Learning (II): Diffusion Models	VAE, DDPM, LDM, DiT

What Happened in the Past 2 Weeks?

- A lot of Natural Language Processing.
- Some Computer Vision.
- Some Unsupervised Learning.
- Decent amount of their applications in biz/econ research.

3

3

Application of AI/ML in Business Research

AI/ML could help us obtain the otherwise unavailable data that could lead to business insights and/or decisions.

Setting & Problems → Data Generation → Prediction/ Optimization Models

ML as Subjects

ML as Data Source

Our Course

Hypothesis Testing → Mechanisms

ML for Causal Inference

Prediction/ Optimization Models → Decisions

ML for Predictive Decision-Making Optimization

Structural Models → Counterfactuals

ML for Structural Estimation

AI/ML has become an indispensable part of our life, society, and economy.

4

4

Our Goal

1. Have a basic understanding of the fundamental concepts/methods in machine learning (ML) and artificial intelligence (AI) that are used (or potentially useful) in business research.
2. Understand how business researchers have utilized ML/AI and what managerial questions have been addressed by ML/AI in the recent decade.
3. Nurture a taste of what the state-of-the-art AI/ML technologies can do in the ML/AI community and, potentially, in your own research field.

5

5

Course Takeaways

- The necessary knowledge of AI/ML that could help you:
  - Keep up with the literature development in the relevant domains in both CS and business;
  - Develop the necessary sense to do rigorous business research using the relevant methods;
  - Identify important and interesting questions in your own field where AI technologies are useful;
  - Invent new applied methods (most likely without any theoretical guarantee) in your own research.

Impact of a CS Paper = Problem Importance * Technical Novelty * Performance Improvement

Impact of a Business Paper = Problem Importance * Identification Rigor * Insight Novelty

- Academic research is a kind of craft: You can only learn by doing it on your own.
  - So, take your Replication Projects seriously!

6

6

When Will Things Go Wrong?

- Most AI applications are only useful if actionable insights can be derived:

$$\frac{d\pi(X_0, Y)}{dX_0} = \frac{\partial \pi}{\partial X_0} \underbrace{(Y)}_{\text{prediction}} + \frac{\partial \pi}{\partial Y} \underbrace{\frac{\partial Y}{\partial X_0}}_{\text{causation}}.$$

Your prediction of Y is not accurate.

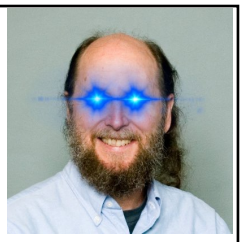
Your causal identification is not clean.

- You should be able to judge whether you should seek for accurate prediction and/or clean identification.
- Empirical model: $Y = a + b \cdot D + g(X) + \epsilon$
  - Key parameter of interest: b
  - If D is predicted by a ML model, the prediction error is likely to be correlated with ϵ, giving rise to the bias to estimate b.

7

7

The Bitter Lesson



- Reference: http://www.incompleteideas.net/IncIdeas/BitterLesson.html
- The biggest lesson that can be read from 70 years of AI research is that general methods that leverage computation are ultimately the most effective, and by a large margin.
- Leveraging domain knowledge (short-term & specific) vs. Leveraging computation (long-term & general).
- Bitter lesson: Leveraging domain knowledge is self-satisfying and intellectually inspiring, but plateaus in the long-run or even inhibits further progress.
- Are you ready to control the machine intelligence to create great knowledge?

8

8

Want to Learn More?

- This course will be offered again in the next AY at CUHK Business School (and maybe at Antai as well).
  - Feel free to join it online.
- What to expect:
  - Deep Dive into Generative AI
    - Use AI to (a) generate strategies/content valuable to business; and (b) simulate human behaviors in response to business strategies.
  - AI/ML-based Causal Inference (https://causalml-book.org/)
  - Reinforcement Learning
  - AI Ethics/Safety/Society (not sure whether AI will become a new species then……) https://www.aisafetybook.com/
- Stay tuned and hope to see you all again!

9

9

Keep in Touch

- Stay in contact and keep me posted of your academic and career successes.
- Feel free to send me an email/WeChat message. I am always happy to discuss topics related to AI research and business. We may work on something interesting together ☺
- Let me know if you need a job referral from me to comment on your academic/career potential.

10

10

Finally

Thank You & All the Best!

谢谢！
祝前程似锦！

Renyu (Philip) Zhang
张任宇

philipzhang@cuhk.edu.hk
https://rphilipzhang.github.io/rphilipzhang/index.html
WeChat: rphilip_zhang
WhatsApp: 85246828057

Hope to see you all again!

11

11