

Every day we are encountering and absorbing a large amount of knowledge. The idea of “knowledge” first struck me in a movie recommendation project, I realized daily events could be transferred to “knowledge” and contribute to the real issue, which drives me to think about how to efficiently link ‘knowledge’ to AI in better service for our daily lives. After being exposed to several research areas, including computer vision, recommendation systems, and data mining, which strengthened my knowledge of machine learning and shaped my interests in natural language processing(NLP), especially in natural language understanding(NLU), information extraction(IE), information representation(IR), and their application to the real world. I hope to make machines understand nature with three main research directions:

- **NLU:** How can we better understand the sides of text knowledge?
- **IE & IR:** How can we efficiently explore the information and represent it?
- **Real-World QA:** How can we collaborate our models with humans?

I majored in computer science in my undergraduate and graduate studies and was fortunate to have conducted some relevant research projects, and I am passionate to further my interest in my Ph.D. The following describes my research journey.

Research in Knowledge Tracing(TAL AI Lab)

We, as human beings, are difficult to keep track of knowledge, and I was wondering how we can build a model to tackle this issue. This research proposed a deep knowledge tracing(DKT) model to monitor student knowledge state or skill acquisition level. Even though deep neural networks already grasp the sequential dependencies, the **intrinsic relation** of information has great potential to enrich our understanding of knowledge states and advance knowledge tracing.

We built a question graph based on semantic and feature-based knowledge, then obtained the representation combined with graph embedding, and finally as supervision information for DKT. This approach demonstrates the importance of the side relation information and the proposed framework outperforms state-of-the-art baselines significantly. At the same time, I innovatively extend my research to adaptive learning, which is critical for tutoring systems. In this research, I was involved in data mining, knowledge graph, graph representation learning, etc. All of this contributes to my co-author conference submission to AIED 2019(top conference of education AI). As I realized that question series could be explored as the intrinsic relation, and graphs could be used as a knowledge network, moreover, can predict people’s future state precisely, which is really appealing to me. I am eager to bring up more research ideas in **information extraction and representation** by combining knowledge graphs.

Semantic & Emotional NLP(Mobvoi AI Lab):

Apart from knowledge information, I also did research on **language understanding** regarding semantics and emotions. I gained related research experience when I joined an AI company (Mobvoi) in 2019 as a speech algorithm engineer. I have mainly been involved in **text information extraction** of text-to-speech(TTS), which can be divided into two sides: semantic NLP and emotional NLP.

For semantic NLP, my work is to convert non-standard text into representations with accurate

pronunciation, prosody, and spoken events, based on cross-language (Mandarin, English, etc.). I led the construction or optimization of these modules. I proposed the “Unified Frontend” to mitigate the problems of out-of-vocabulary, ambiguity, and performance of the online system, which combined with a pre-trained language model, multi-task training, and knowledge distillation as well as linguistic knowledge. In multi-level prosody prediction, I imposed prompt learning, a general method, to alleviate data imbalance and inconsistency, which led to a co-author conference submission to PRML 2022.

The emotional NLP, on the other hand, focuses on the intrinsic aspect of language understanding, such as style, stress, and emotion. These tasks are subjective and thus do not have clear definitions and benchmarks. In this research, I experienced creative attempts and continuous verification, like criterion establishment, cross-validation, linguistic knowledge learning, literature research and finally setting up the model solutions. For instance, in text stress prediction, I proposed a two-stage pipeline to construct the coarse-to-fine model with auxiliary granularity supervision to decrease deviation and ensure global diversity, which led to a first-author conference submission to ICASSP 2023 (reviewing, top conference of speech). Deriving inspiration from **supervision (semi- or non-) and linguistic learning**, I am interested in extending my experience in **unstructured or multi-language text information extraction and understanding**.

Conclusion

I am strongly motivated and passionate to pursue a Ph.D. since it would allow me to do more focused research. In the past few years, I came across several excellent researchers and Ph.D. students, I wish I could have a chance to heavily collaborate with salient researchers and contribute to my fields with fulfillment. I have mentored five interns, where I developed my teamwork ability and enhanced my problem-solving ability. Getting research results inspires me, makes me no longer satisfied with my current life, and guides me to pursue a Ph.D., so I can further my research interest in NLP. I plan to continue my research after my Ph.D., either as a faculty in academia or as a research scientist in industry.

At USC, there are several professors whose projects are especially appealing to me. Professor **Jieyu Zhao's** research about efficiently learning knowledge, robust learning (bias reduction), and applications interests me. Linked to this, I am also interested in professor **Muhao Chen's** research on knowledge acquisition, language understanding, and knowledge-driven intelligent systems, and Professor **Sean (Xiang) Ren's** research on knowledge acquisition and information extraction and representation. I believe my related research experience and solid engineering and research skills, willingness to develop real and cutting-edge technology, and collaborative mindset make me a clear fit for USC. Moreover, I hope USC can be the launchpad for my journey in further exploring and contributing to NLP research. Thank you!