

Siyuan (Wilson) Sun

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EDUCATION

University of Arizona

Tucson, AZ

B.S. in Artificial Intelligence; GPA: 4.0/4.0

Aug. 2025 – May 2027 (Expected)

- **Relevant Coursework:** Deep Learning for NLP, Neural Networks, Reinforcement Learning, Principles of ML, Text Retrieval and Web Search.

East China University of Science and Technology

Shanghai, China

B.S. in Artificial Intelligence (Transferred to UArizona)

Sep. 2023 – July 2025

RESEARCH EXPERIENCE

CLULab, University of Arizona

Tucson, AZ

Undergraduate Research Assistant (Advised by Prof. Mihai Surdeanu)

Sep. 2025 – Present

- Conducting research at the intersection of **Large Language Models (LLMs)** and **Information Retrieval (IR)**.
- Developing a unified joint-optimization framework for neural retrieval systems to transcend modular performance ceilings.
- Exploring generalization-aware optimization for Transformer-based LMs and architectural innovations in Neural IR.

TECHNICAL SKILLS

Languages: Python, Java, C/C++, Shell (Bash), Linux (Remote Dev), Git

NLP & Deep Learning: PyTorch, Hugging Face (Transformers, Accelerate, PEFT, TRL), LangChain, Scikit-learn

LLM & IR Techniques: SFT, RLHF (PPO/DPO), LoRA/QLoRA, Dense Retrieval, Query Expansion, Reranking, EM-based Optimization, FAISS, Milvus, Elasticsearch (BM25), vLLM

Infrastructure: Multi-GPU Parallel Training, Mixed Precision (FP16/BF16), CUDA Memory/OOM Management

SELECTED RESEARCH & PROJECTS

Joint Optimization of Neural Retrieval System | *Qwen2.5, BGE, EM Algorithm* EMNLP 2026 (In Prep)

- Designed an end-to-end **Expectation-Maximization (EM)** optimization framework to align LLM-based query expansion with retriever preferences.
- **E-Step:** Utilized LLMs for diverse expansion path exploration; **M-Step:** Performed LoRA fine-tuning on high-reward samples evaluated by a Cross-Encoder Reranker.
- Proposed **Reward Margin** mechanism and **DDL P (Delta-Driven Laziness-Penalty)** loss to mitigate "negative return" in expansion, ensuring robustness and generalization.
- Achieved a **4% absolute gain in NDCG@10** on the TREC DL 2019 benchmark by integrating the tuned expander into a state-of-the-art Retrieve-and-Rerank pipeline.

Emotion Classification in Creative Text | *RoBERTa, Domain Adaptation*

- Investigated domain adaptation for RoBERTa-base on metaphorical texts (poetry/lyrics) using a two-stage training pipeline to transfer emotional priors from social media data.
- Compared LoRA vs. Full Fine-tuning, demonstrating that full tuning yields superior performance ($F1 \approx 0.60$) in capturing deep semantic relationships in figurative language.

Learning Dense Reward Functions in Chess (IRL) | *Gymnasium, ResNet, IRL*

- Built an **Inverse Reinforcement Learning (IRL)** framework to infer dense reward functions from expert demonstrations to solve temporal credit assignment problems in sparse chess rewards.
- Developed a custom Gymnasium environment and a ResNet-based reward model to capture human-like positional intuition, validated via saliency map analysis.

Brain-to-Text: Decoding Intracortical Speech | *BERT, GPT-2, LoRA*

Brain-to-Text '25 Competition

- Developed a hybrid Encoder-Decoder framework coupling a BERT encoder with a GPT-2 decoder to translate neural activity into natural language for ALS patients.
- Integrated **Masked Phoneme Modeling (MPM)** and LoRA, achieving a **Word Error Rate (WER) of 12.4%**.
- Engineered a Day-Specific Adaptation Layer to address non-stationary neural signals across recording sessions.

孙思源

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美国亚利桑那州图森 / 中国上海

教育背景

亚利桑那大学 (University of Arizona)

图森, 美国

人工智能理学学士; GPA: 4.0/4.0

2025年8月 - 2027年5月 (预计毕业)

– 相关课程: NLP 深度学习, 神经网络, 强化学习, 机器学习原理, 文本检索与 Web 搜索。

华东理工大学

上海, 中国

人工智能理学学士 (后转学至亚利桑那大学)

2023年9月 - 2025年7月

科研经历

亚利桑那大学 CLULab

图森, 美国

本科研究助理 (导师: Mihai Surdeanu 教授)

2025年9月 - 至今

- 在大语言模型 (LLM) 与信息检索 (IR) 的交叉领域开展研究。
- 开发用于神经检索系统的统一联合优化框架, 旨在突破模块化系统的性能瓶颈。
- 探索基于 Transformer 的语言模型的泛化感知优化, 以及神经信息检索中的架构创新。

专业技能

编程语言: Python, Java, C/C++, Shell (Bash), Linux (远程开发), Git

NLP 与深度学习: PyTorch, Hugging Face (Transformers, Accelerate, PEFT, TRL), LangChain, Scikit-learn

LLM 与检索技术: SFT, RLHF (PPO/DPO), LoRA/QLoRA, 稠密检索, 查询扩展, 重排序, 基于 EM 的优化, FAISS, Milvus, Elasticsearch (BM25), vLLM

基础设施: 多 GPU 并行训练, 混合精度训练 (FP16/BF16), CUDA 显存/OOM 管理

代表性研究与项目

神经检索系统的联合优化 | Qwen2.5, BGE, EM 算法

EMNLP 2026 (在投)

- 设计了一个端到端的期望最大化 (EM) 优化框架, 使基于 LLM 的查询扩展与检索器的偏好对齐。
- **E-步**: 利用 LLM 探索多样化的扩展路径; **M-步**: 使用 Cross-Encoder 重排序器评估高奖励样本并进行 LoRA 微调。
- 提出 Reward Margin 机制和 DDLP (增量驱动懒惰惩罚) 损失函数, 以减轻查询扩展中的“负收益”问题。
- 在 TREC DL 2019 测试中, 实现了 NDCG@10 绝对值 4% 的提升。

创意文本中的情感分类 | RoBERTa, 领域迁移

- 研究了 RoBERTa-base 在隐喻文本 (诗歌/歌词) 上的领域迁移, 从社交媒体数据中迁移情感先验。
- 对比了 LoRA 与全参数微调, 证明全参数微调在捕捉修辞语言中的深层语义关系方面表现更优 ($F1 \approx 0.60$)。

国际象棋中的稠密奖励函数学习 (IRL) | Gymnasium, ResNet, 逆强化学习

- 构建了一个逆强化学习 (IRL) 框架, 从专家演示中推断稠密奖励函数, 解决稀疏奖励问题。
- 开发了基于 ResNet 的奖励模型以捕获局面直觉, 并通过显著性图 (Saliency Map) 分析进行了验证。

Brain-to-Text: 解码皮层内语音信号 | BERT, GPT-2, LoRA

Brain-to-Text '25 竞赛

- 开发了一个混合 Encoder-Decoder 框架, 为 ALS 患者将神经活动转化为文字。
- 集成了掩码音素建模 (MPM) 和 LoRA 技术, 实现了 12.4% 的词错率 (WER)。
- 设计了日期特定自适应层, 以解决跨采集周期的非平稳神经信号问题。