

Fangjun Li (Ph.D. Student)

Leeds, UK lifangjun95@gmail.com GitHub Webpage LinkedIn Google Scholar

Research Interests: Artificial Intelligence; Knowledge representation & Reasoning; Spatial Reasoning; Data Fusion; Foundation Models; Evaluating Machine Learning Models

Education

Ph.D. in Computing, University of Leeds, UK *Oct. 2020 – Sep. 2024 (Expected)*

Supervisors: **David C. Hogg** and **Anthony G. Cohn**

M.A. in Information and Communication Engineering, Shandong University, China *Sep. 2017 - June 2020*

Supervisors: **Minggao Zhang** and **Dongfeng Yuan**

B.A. in Communication Engineering, Shandong University, China *Sep. 2013 - June 2017*

Publications

Fangjun Li, David C. Hogg, and Anthony G. Cohn (2024). **Advancing spatial reasoning in large language models: An in-depth evaluation and enhancement using the stepGame benchmark.** *The 38th Annual AAAI Conference on Artificial Intelligence*.

Fangjun Li, David C. Hogg, and Anthony G. Cohn (2024). **Reframing spatial reasoning evaluation in language models: A real-world simulation benchmark for qualitative reasoning.** *32nd International Joint Conference on Artificial Intelligence (IJCAI, under review)*.

Fangjun Li, David C. Hogg, and Anthony G. Cohn (2022). **Ontology knowledge-enhanced in-context learning for action-effect prediction.** *The Tenth Advances in Cognitive Systems (ACS) Conference*.

Fangjun Li, David C. Hogg, and Anthony G. Cohn (2022). **Exploring the GLIDE model for human action-effect prediction.** *LREC2022 Workshop People in Vision, Language And the Mind*, 1.

Alomari M, Fangjun Li, David C. Hogg, and Anthony G. Cohn (2022). **Online perceptual learning and natural language acquisition for autonomous robots.** *Artificial Intelligence (AIJ)*, 303(103637).

Fangjun Li, Mu Yang, et al. (2020). **An improved clear cell renal cell carcinoma stage prediction model based on gene sets.** *BMC bioinformatics*, 21(1), 1-15.

Fangjun Li, Dongfeng Yuan, et al. (2019). **Multi-scale stepwise training strategy of convolutional neural networks for diabetic retinopathy severity assessment.** *International Joint Conference on Neural Networks (IJCNN)*. (pp.1-5).

Major Research Projects

Enhancing LLMs' Logical Reasoning Capabilities through Hybrid Reasoning

Institution: University of Leeds & Microsoft *April. 2023-June 2024*

- Analyzed and refined the spatial reasoning benchmarks and datasets - bAbI, StepGame and SpartQA, leading to a more precise evaluation of spatial reasoning capabilities in Large Language Models (LLMs).
- Combined logic-based reasoning methods (Prolog, answer set programming) with LLMs, pinpointing LLMs' proficiency in mapping natural language to spatial relations and but limitations in complex multi-hop reasoning.
- Deployed prompting strategies (Chain-of-Thought and Tree-of-Thought) to delve into the cognitive processes of LLMs, achieving significant accuracy improvements in StepGame. With GPT-4, we achieved a consistent accuracy rate of approximately 90%, a substantial improvement from the 25% baseline, even as task complexity increased.
- Created a novel benchmark utilizing realistic 3D simulation platform that features diverse room layouts and object spatial arrangements for assessing spatial reasoning in LLMs. This benchmark covers a wide range of qualitative spatial relationships (topology, orientation, and distance). It includes scenarios from various viewpoints, with different levels of detail and density of relational constraints to reflect the complexity of real-world environments.

Naive Physics Aware Language Model: What will Happen Next?

Institution: University of Leeds

Oct. 2020-March 2023

- Investigated knowledge retrieval within OpenCyc-based knowledge base (KnowRob) and knowledge graph (ConceptNet). Explored both the transformation of graph knowledge to text and the grounding of knowledge in formal textual representations, aiming to bridge the gap between symbolic knowledge and textual data.
- Introduced unseen knowledge learning via LLMs to infer knowledge for concepts that do not have definitions in knowledge bases.
- Boosted the reasoning capabilities of Pre-trained Language Models (PLMs) through the incorporation of external knowledge (entity information from knowledge graphs) using in-context learning, with GPT-2 gaining over 10 BLEU points and GPT-3 achieving a 4.4 increase in BERTScore on the action-effect prediction dataset.
- Evaluated the capabilities of the GLIDE diffusion model in handling both visual and textual inputs for image editing applications. Explored how input image masks (fixed mask , hand and object masks, segmetation mask) and a variety of text prompts influence the effectiveness of diffusion models.

Hierarchical Prediction of Transparent Renal Cell Carcinoma based on Gene Big Data

Institution: Second Affiliated Hospital of Shandong University *Oct. 2018-May 2019*

- Study gene data, extract RNA and pathological information from the Cancer Genome Atlas.
- Analysis on gene data including missing value examination, analysis of extreme values, and differentiation analysis; developed a feature selection algorithm aimed at eliminating irrelevant, redundant, and noisy features from the gene data set.
- Exploration of ML algorithms such as random forests, logistic regression, neural networks, and support vector machines for disease prediction using gene data, achieving statistically superior predictive performance with an AUC of 0.879, surpassing the baseline models (AUROC 0.81).

Deep Learning Model for Classification of Diabetic Retinopathy

Institution: Shandong Shi'erming Eye Hospital &Shandong University *Jan. 2017-Oct. 2018*

- Implemented a stepwise strategy for diagnosing diabetic retinopathy using high-resolution pathological images by training two deep convolutional neural network (CNN) models within the lasagne and nolearn frameworks.
- Utilized data augmentation techniques (i.e., flipping, rotation, scaling, cropping, and translation) and dynamic resampling strategy to enhance CNN models' performance under limited data conditions.
- Investigated how image resolution affects, finding that improvements in performance scale logarithmically, while time and space complexity increase exponentially with higher resolution of pathological images.
- Achieved advancements over current state-of-the-art solutions on the EyePACS dataset using convolutional networks with an input size of 896 × 896, surpassing the previous top performer on Kaggle.

Awards

Excellent graduation thesis (Top 1%)	2017
The 1st award of academic scholarship of graduate students, Shandong University	2017
National Scholarship and National Inspirational Scholarship	2014 & 2016
The 3rd award of National Undergraduate Student Mathematics Competition	2014

Skills

Software Skills:	Coursework:
<ul style="list-style-type: none"> • Text editing: LaTeX • Programming languages: R, Python • Deep learning frameworks: PyTorch • Logical reasoning tools: Prolog, ASP 	<ul style="list-style-type: none"> • Machine Learning (COMP5611M) • Artificial Intelligence(COMP5623M) • SENSE Earth Observation CDT PhD Training