Wentao Wan

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Education

Ph.D. of Computer Science, Sun Yat-sen University, CN	2019.9 - 2025.12
RA in Sun Yat-sen University	2018.9 - 2019.6
Master of Software Engineering and Technology, Huazhong University of Science and Technology, CN	2015.9 - 2018.6
Bachelor's Degree in Internet of Things Engineering, Central South University, CN	2011.9 - 2015.6

Research Statement

My research aims to construct efficient, self-evolving, general-purpose agents by integrating **cognitive reasoning and planning with physical world interaction** (multimodal/embodied AI), underpinned by **lifelong adaptation(continual learning)**. My doctoral dissertation, titled "Research on Enhancing Cognition and Behavior of Large Language Model-based Agents", **developed** methods to bolster the general reasoning and knowledge-updating capacities of LLMs—the agent's cognitive core—and **addressed** efficient tool learning within non-differentiable agent systems for Visual Reasoning. Through my doctoral research and reflections, I have developed **a personal definition of intelligence** that differs from the Turing Test: an adaptive computational process for understanding the world or changing it to achieve specific goals. My future research will target **three key directions**: (1) developing next-generation models and learning paradigms to truly understand and purposefully reshape the real world, with a focus on world models, physical intelligence, and reasoning/planning; (2) advancing highly data-efficient (reinforcement) learning paradigms for the era of experiential learning; and (3) establishing authentic continual learning paradigms for long-term agent evolution.

Paper List (* Co-first author)

[1] Wentao Wan, Zhuojie Yang, Yongcan Chen, Chenglin Luo, Ruilin Wang, Kehao Cai, Nan Kang, Keze Wang. SR-FoT: A Syllogistic-Reasoning Framework of Thought for Large Language Models Tackling Knowledge-based Reasoning Tasks. Accepted by AAAI (CCF A) 2025

[2] Wentao Wan*, Qiqin Lao*, Zhiwei Xie*, Hefeng Wu, Runnan Lin, Keze Wang. Massive Editing for Large Language Models Based on Dynamic Weight Generation. Accepted by ICLR (CCF A) 2026

[3] Wentao Wan, Kaiyu Wu, Qingyang Ma, Nan Kang, Chen Yunjie, Liang Lin, Keze Wang. Enhancing Visual Programming for Visual Reasoning via Probabilistic Graphs. preprint

[4] Wentao Wan*, Nan Kang*, Zhuojie Yang, Zeqing Wang, Keze Wang, Liang Lin. A Stepwise Distillation Learning Strategy for Non-differentiable Visual Programming Frameworks on Visual Reasoning Tasks. Under Review in TIP (CCF A, SCI Q1) 2025 (2 minor revisions, 1 major revision)

[5] Zhuojie Yang*, **Wentao Wan*(Project Leader)**, Keze Wang. ORACLE: Optimizing Reasoning Abilities of Large Language Models via Constraintt-Led Synthetic Data Elicitation. Accepted by AAAI (CCF A) 2026

[6] Zeqing Wang, **Wentao Wan(Project Leader)**, Qiqing Lao, Runmeng Chen, Minjie Lang, Keze Wang, Liang Lin. Towards Top-Down Reasoning: An Explainable Multi-Agent Approach for Visual Question Answering. Accepted by TMM (CCF A, SCI Q1) 2025

[7] Zeqing Wang, Qingyang Ma, **Wentao Wan(Project Leader)**, Haojie Li, Keze Wang, Yonghong Tian. Is this Generated Person Existed in Real-world? Fine-grained Detecting and Calibrating Abnormal Human-body. Accepted by CVPR (CCF A) 2025 (**Highlight Paper**)

[8] Hao Jiang, Haowei Li, Junhao Chen, **Wentao Wan**, Keze Wang. Interactive Learning for Interpretable Visual

Recognition via Semantic-Aware Self-Teaching Framework. Accepted by PRCV (CCF C) 2023
[9] Qingxing Cao, **Wentao Wan**, Keze Wang, Xiaodan Liang, Liang Lin. Linguistically Routing Capsule Network for Out-of-distribution Visual Question Answering. Accepted by ICCV (CCF A) 2021
[10] Wentao Wan, Guohui Li, Peng Pan. CS-DeCNN: Deconvolutional Neural Network for Reconstructing Images from Compressively Sensed Measurements. Accepted by PCM (CCF C) 2018

Selected Research Experience

Continual Learning for Large Models

Massive Knowledge Editing Based on Weight Generation. To enable large-scale knowledge updates in large language models while **mitigating catastrophic forgetting** of existing knowledge, we propose a novel method. Specifically, we introduce **an additional neuron** to specific layers of the large language model, **with its weights dynamically generated by a diffusion model based on the query prompt for the knowledge**. Additionally, a familiarity network based on an entropy criterion is applied to route queries. Experiments show that our method **significantly outperforms current state-of-the-art approaches** in terms of overall performance metrics (editing accuracy, generalization, and locality for forgetfulness mitigation) under large-scale and ultra-large-scale knowledge editing scenarios. Notably, our method **achieves an absolute performance gain of over 20% in forgetfulness mitigation metrics**. This work has been **accepted by ICLR-26 (CCF-A)**.

Enhancing Explainable Visual Understanding in Vision-Based Agent Systems

Top-Down Reasoning-Assisted Visual Understanding System. We designed an interactive agent system that **leverages the world knowledge stored in large language models to provide top-down guidance and correction for the perception results of the visual understanding system**, further improving its performance on various question-answering tasks. This demonstrates that world knowledge can enhance the performance of visual understanding systems. This research has been **accepted by the TMM'25 journal (CCF-A, SCI Q1)**.

Stepwise Distillation Strategy. We employ a learning strategy called "**Stepwise Distillation**," which enables the non-differentiable Visual Programming (VProg) Agent framework to fine-tune for specific Visual Reasoning (VR) tasks while maintaining the cross-task generality of the framework. **Performance improvements of 2.4% and 6.2%** were achieved on the popular visual reasoning task datasets GQA and NLVRv2, respectively.

End-to-End Optimization Based on Probabilistic Graphs. We creatively constructed a directed probabilistic graph based on the variable dependency relationships in the visual programs of the Visual Programming (VProg) Agent framework. **This reconstructs the non-differentiable visual programming reasoning process into a differentiable and precise probabilistic inference process on the directed probabilistic graph**. This enables the VProg framework to perform efficient gradient-based optimization with outcome supervision on complex Visual Reasoning (VR) tasks, achieving end-to-end supervised learning. **The accuracy on popular visual reasoning and question-answering datasets, including GQA, NLVRv2, and OpenImages QA, further surpasses that of the Stepwise Distillation method**.

Generated Human Anomaly Detection and Restoration

We observed that generated human figures from contemporary open-source generative models (especially video generation models) often exhibit anomalies, such as excessive or missing limbs and abnormal structures. Our experiments revealed that **even the most advanced multimodal understanding models at that time, such as GPT-4V, are unable to detect such anomalies**. Based on this, we developed a learning system that **learning only from normal data to effectively detect and repair various anomalies in generated human figures**. Experiments demonstrated the effectiveness of our approach, showing that we **can repair anomalies while preserving other unaffected parts**. (This study has **inspired me to explore research directions in visual self-supervision and world models**.) This research was **accepted as a Highlight Paper by CVPR-25 (CCF A)**.

General Reasoning on LLMs

Knowledge-Based Reasoning Enhancement. We designed a system called the ”Syllogistic Reasoning Framework of Thought” (SR-FoT) to **guide models in imitating the human syllogistic deductive reasoning** paradigm for answering knowledge-based reasoning questions. Experiments conducted on GPT-3.5, DeepSeek-V2, and Qwen1.5-32B models demonstrate that our approach significantly outperforms the current state-of-the-art methods in knowledge-based reasoning question-answering scenarios, **achieving accuracy improvements of 2.9%, 3.1%, and 3.3%**, respectively. Additionally, manual statistical sampling shows that the reasoning rigor of our method is notably higher than that of traditional chain-of-thought approaches, further validating its effectiveness. This research has been **accepted by AAAI-25 (CCF A)**.

LLM Reasoning Rigor Enhancement. To enhance the rigor of reasoning processes in natural language for large language models (LLMs), we propose a general reasoning synthesis data construction paradigm focused on process rigor. By fine-tuning LLMs on the synthesized data with rigorous reasoning processes, we improve both the reasoning rigor and the accuracy of answers in general reasoning and question-answering tasks. Building upon our previous work on the ”Syllogistic Reasoning Framework of Thought (SR-FoT),” we leverage and extend this framework to **decompose original reasoning problems into multiple atomic reasoning steps** (e.g., minimal syllogistic reasoning premises). These steps are then **translated into formal language representations, executed by external logic engines for formalized reasoning, and subsequently converted back into natural language atomic reasoning steps**. This process results in synthesized data containing rigorous reasoning processes, which are then used for LLM fine-tuning. Experiments on Llama-3.1, Mistral-v0.3, and Qwen-2.5 models show that our method **significantly outperforms other approaches in general reasoning and question-answering scenarios**. This research has been **accepted by AAAI-26 (CCF A)**.