

# Sitao Cheng

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## RESEARCH INTEREST

I am passionate about Language Agents, Reasoning and Retrieval-augmented Generation. I have worked on reinforcement learning (*e.g.*, mechanistic analysis and automatic reward modeling) and knowledge-intensive reasoning (*e.g.*, structured and unstructured data). Currently, I focus on compositional generalization in real-world tasks.

## EDUCATION

• <b>University of Waterloo</b>	09.2025 - Now
<i>Ph.D. in Computer Science - advised by Prof. Victor Zhong</i>	Waterloo, Canada
• <b>Nanjing University</b>	09.2021 - 06.2024
<i>M.S. in Computer Science and Technology - advised by Prof. Yuzhong Qu</i>	Nanjing, China
• <b>University of Electronic Science and Technology of China</b>	09.2017 - 06.2021
<i>B.E. in Software Engineering - GPA: 3.98 / 4.00 (Top 3)</i>	Chengdu, China

## PUBLICATIONS

\*EQUAL CONTRIBUTION

### Preprints.

- [1] **From Atomic to Composite: Reinforcement Learning Enables Generalization in Complementary Reasoning.** [\[Paper\]](#) [\[Code\]](#)  
**Sitao Cheng**, Xunjian Yin, Ruiwen Zhou, Yuxuan Li, Xinyi Wang, Liangming Pan, William Yang Wang, Victor Zhong
- [2] **Differentiable Evolutionary Reinforcement Learning.** [\[Paper\]](#) [\[Code\]](#)  
**Sitao Cheng\***, Tianle Li\*, Xuhan Huang\*, Xunjian Yin, Difan Zou
- [3] **Reverse Language Model.** [\[Paper\]](#)  
Xunjian Yin, **Sitao Cheng**, Yuxi Xie, Xinyu Hu, Li Lin, Xinyi Wang, Liangming Pan, William Yang Wang, Xiaojun Wan

### Selected Conference paper.

- [1] **Understanding the Interplay between Parametric and Contextual Knowledge for Large Language Models.**  
ACL KnowFM Workshop (Oral), 2025. [\[Paper\]](#) [\[Code\]](#)  
**Sitao Cheng**, Liangming Pan, Xunjian Yin, Xinyi Wang, William Yang Wang
- [2] **Call Me When Necessary: LLMs can Efficiently and Faithfully Reason over Structured Environments.**  
ACL findings, 2024. [\[Paper\]](#) [\[Code\]](#)  
**Sitao Cheng**, Ziyuan Zhuang, Yong Xu, Fangkai Yang, Chaoyun Zhang, Xiaoting Qin, Xiang Huang, Ling Chen, Qingwei Lin, Dongmei Zhang, Saravan Rajmohan, Qi Zhang
- [3] **QueryAgent: a Reliable and Efficient Reasoning Framework with Environmental Feedback-based Self-Correction.** ACL (Oral), 2024. [\[Paper\]](#) [\[Code\]](#)  
Xiang Huang\*, **Sitao Cheng**\*, Shanshan Huang, Jiayu Shen, Yong Xu, Chaoyun Zhang, Yuzhong Qu
- [4] **MarkQA: a Large Scale KBQA Dataset with Numerical Reasoning.** EMNLP, 2023. [\[Paper\]](#) [\[Code\]](#)  
Xiang Huang, **Sitao Cheng**, Yuheng Bao, Shanshan Huang, Yuzhong Qu
- [5] **Question Decomposition Tree for Answering Complex Questions over Knowledge Bases.**  
AAAI (Oral), 2023. [\[Paper\]](#) [\[Code\]](#)  
Xiang Huang, **Sitao Cheng**, Yiheng Shu, Yuheng Bao, Yuzhong Qu
- [6] **EfficientRAG: Efficient Retriever for Multi-Hop Question Answering.** EMNLP, 2024. [\[Paper\]](#) [\[Code\]](#)  
Ziyuan Zhuang\*, Zhiyang Zhang\*, **Sitao Cheng**, Fangkai Yang, Jia Liu, Shujian Huang, Qingwei Lin, Saravan Rajmohan, Dongmei Zhang, Qi Zhang
- [7] **Disentangling Memory and Reasoning Ability in Large Language Models.** ACL, 2025. [\[Paper\]](#) [\[Code\]](#)  
Mingyu Jin, Weidi Luo, **Sitao Cheng**, Xinyi Wang, Wenyue Hua, Ruixiang Tang, William Yang Wang, Yongfeng Zhang
- [8] **RuleArena: A Benchmark for Rule-Guided Reasoning with LLMs in Real-World Scenarios.**  
ACL, 2025. [\[Paper\]](#) [\[Paper\]](#)  
Ruiwen Zhou, Wenyue Hua, Liangming Pan, **Sitao Cheng**, Xiaobao Wu, En Yu, William Yang Wang

## RESEARCH EXPERIENCE

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### • University of Waterloo (R2L Lab)

09.2025 - Now

Waterloo, Canada

*Advisor: Prof. Victor Zhong. Role: Ph.D. Student*

- **Topic 1:** Evaluation and understanding of RL in compositional generalization. Exploration of RL as a synthesizer or amplifier with controlled experiments. Investigation of the condition of RL-driven generalization.

- \* Findings: RL is genuinely a synthesizer instead of a probability amplifier, under a strict condition that the base model captures sufficient atomic skills.

- \* Results: One Preprint.

- **Topic 2:** A differentiable evolutionary training framework for reinforcement learning (DERL).

- \* Description: Introduce a bi-level evolutionary training framework with a meta-optimizer to automatically generate reward functions for RL learning from validation signals. Introduce a bi-level evolutionary loop to jointly train the meta-optimizer and policy model.

- \* Results: One Preprint.

### • University of California, Santa Barbara (NLP Group)

07.2024 - 06.2025

Santa Barbara, U.S.A

*Advisor: Prof. William Wang. Role: Visiting Research Scholar*

- **Topic:** Understanding how effective LLMs leverage parametric knowledge when contextual knowledge is given.

- \* Findings: LLMs consistently suppress their own knowledge given the context, regardless of models, knowledge types, the relations between two knowledge sources, and various levels of instructions.

- \* Results: One publication on ACL 2025. Four other collaboration projects published.

### • Microsoft Research Asia (DKI Group)

10.2023 - 06.2024

*Advisor: Yong Xu, Fangkai Yang, Chaoyun Zhang. Role: Research Intern & Mentor of Junior Interns*

Beijing, China

- **Topic 1:** LLMs reasoning framework over structured environments with retrieval-augmented generation (Readi) or neural symbolic reasoning (QueryAgent).

- \* Description: Explore how LLMs can reason both efficiently and faithfully on large-scaled and heterogeneous structured environments? Adopt LLMs to either directly maintain a reasoning path (Readi), or step-by-step build a query (QueryAgent), both incorporating pertinent information for correction.

- \* Results: Two publications on ACL 2024.

- **Topic 2:** Efficient iterative retrieval with solely encoder-based models (EfficientRAG) and a new data organization paradigm (THREAD) for RAG systems.

- \* Description: Model the link between the chunks. Leverage strong understanding ability of LLMs to reason the link between chunks. Design novel retrieval methods for smaller encoder-based models (EfficientRAG) and re-organize the documents (Thread), to model such link.

- \* Results: One publication on EMNLP 2024. One publication on EMNLP 2025.

- **Topic 3:** LLM-based Personalized AI Assistant with Structured Knowledge Graphs.

- \* Results: One submission on CHI.

### • Nanjing University (Websoft Lab)

09.2021 - 06.2024

*Advisor: Prof. Yuzhong Qu. Role: Student Researcher*

Nanjing, China

- **Topic 1:** Step-by-step query building (QueryAgent) with self-correction based on environmental feedback.

- \* Description: Introduce a functional tool-set with environmental feedback and a zero-shot correction method for both reliability and efficiency.

- \* Results: One publication on ACL 2024.

- **Topic 2:** A KBQA benchmark (MarkQA) requiring both multi-hop and numerical reasoning ability.

- \* Description: Propose NR-KBQA to challenge both reasoning ability over knowledge bases. Automatically build a large-scale dataset (MarkQA). Design PyQL query, a function toolset able to seamless SPARQL conversion, as symbolic reasoning steps, alleviating labeling burden.

- \* Results: One publication on EMNLP 2023.

- **Topic 3:** A question decomposition method (QDT) for better multi-hop reasoning over knowledge bases.

- \* Description: Propose a serializable tree-based structure (QDT) to represent complex questions, which can sufficiently split questions with complex structures.

- \* Results: One publication on AAAI 2023.

## HONORS AND AWARDS

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- Layer 6 – TD Graduate Scholarship in Data & AI For Fall 2025 –UWaterloo

- MCM/ICM H Prize, Outstanding Student of Sichuan Province, Outstanding Student Award –NJU, UESTC

## OTHERS

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- **Academic Services:** ACL volunteers, ARR Rolling Reviewers

- **Professional Skills:** Popular NLP models (LLM applications, Transformers, attention mechanism, etc.), Pytorch, C++, LaTex, Python, SQL

- **Interests:** Body building (over 6x body weight in the Big 3), Basketball (member of department team), Swim

- **Social Service:** I serve as a personal assistant for a senior impressionist artist in UC Santa Barbara.