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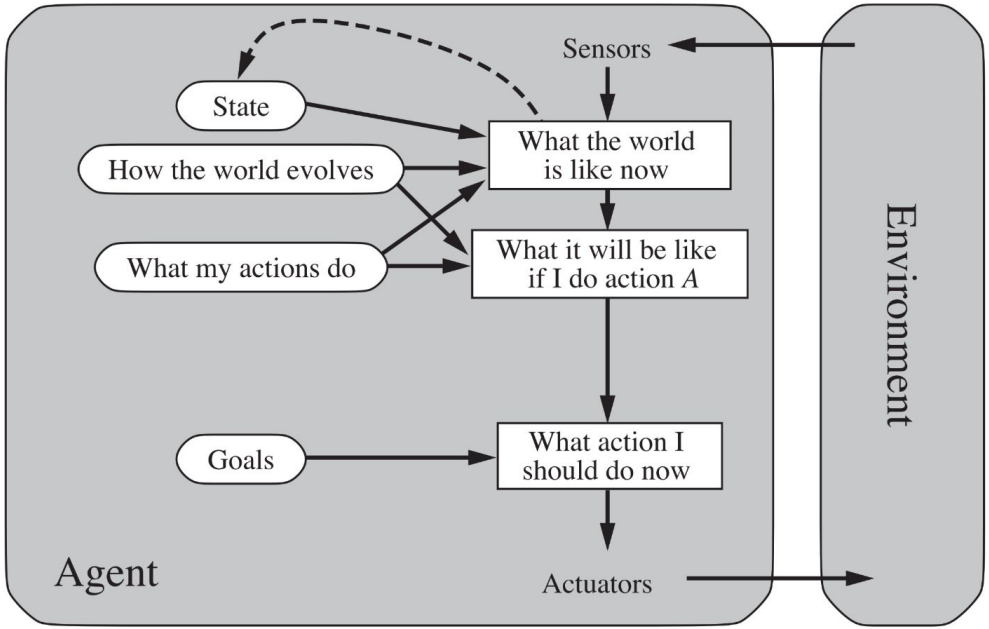
When is Tree Search Useful for LLM Planning? It Depends on the Discriminator

Ziru Chen, Michael White, Raymond Mooney,
Ali Payani, Yu Su, Huan Sun



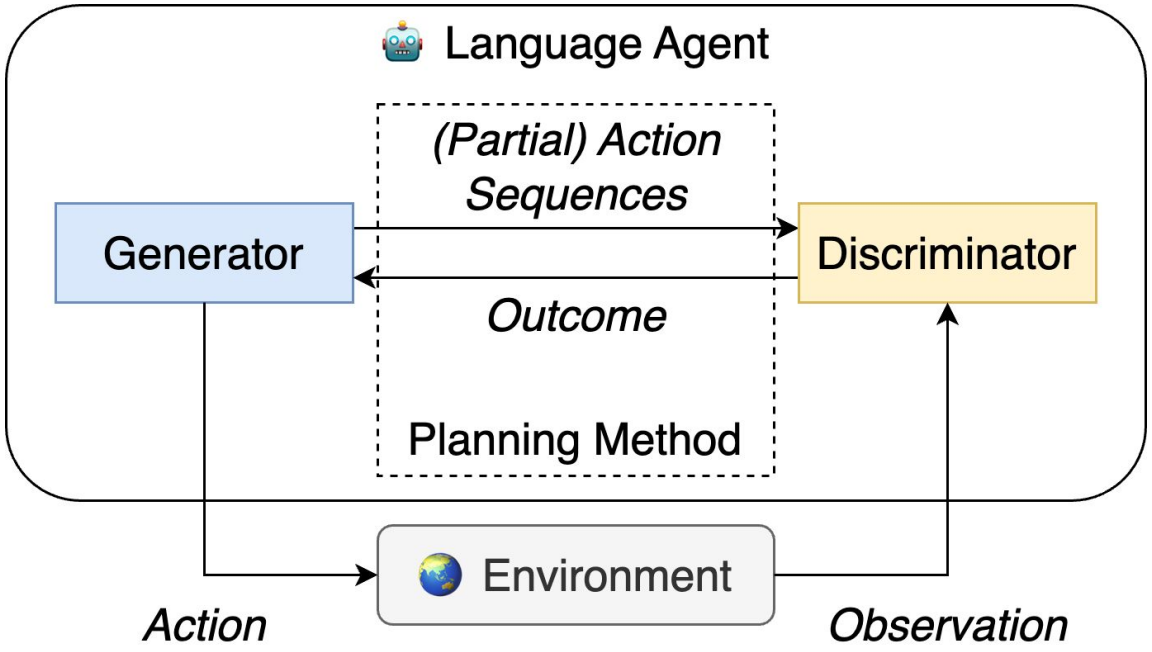



AI Agents for Problem-Solving

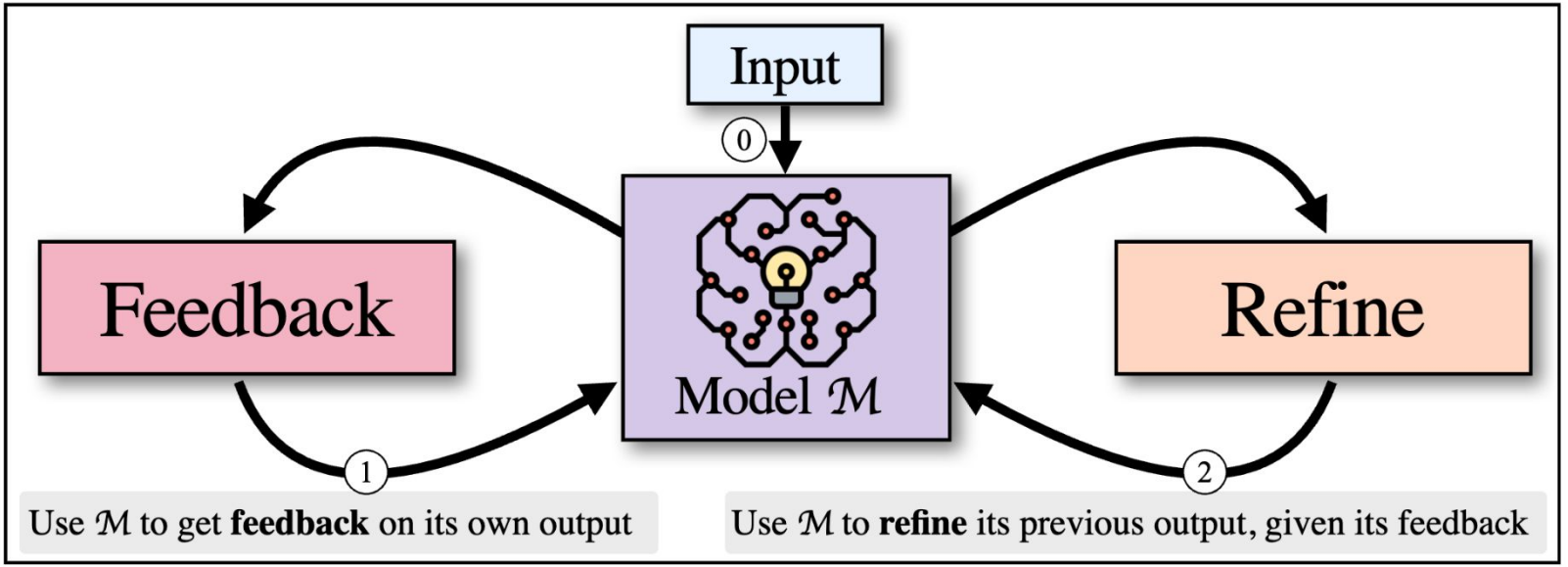


Stuart Russell and Peter Norvig. 2010. Artificial Intelligence: A Modern Approach, 3rd edition. Prentice Hall.

LLM-Based Agents for Problem-Solving

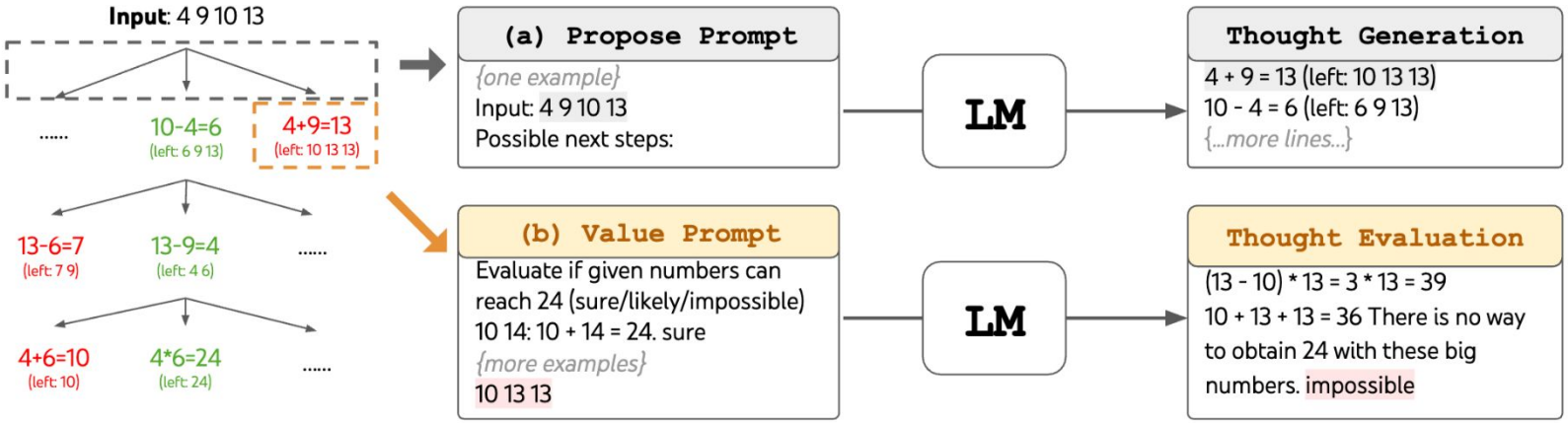


Advanced Planning Methods



Aman Madaan et al. 2023. Self-Refine: Iterative Refinement with Self-Feedback. In NeurIPS 2023.

Advanced Planning Methods



Shunyu Yao et al. 2023. Tree of Thoughts: Deliberate Problem Solving with Large Language Models. In NeurIPS 2023.

Are Advanced Planning Methods the Solution?

"*Models outperform humans in generation but underperform humans in discrimination*."

THE GENERATIVE AI PARADOX:
"What It Can Create, It May Not Understand"

Peter West[1*] **Ximing Lu**[1,2*] **Nouha Dziri**[2*] **Faeze Brahman**[1,2*] **Linjie Li**[1*]
Jena D. Hwang[2] **Liwei Jiang**[1,2] **Jillian Fisher**[1] **Abhilasha Ravichander**[2]
Khyathi Raghavi Chandu[2] **Benjamin Newman**[1]
Pang Wei Koh[1] **Allyson Ettinger**[2] **Yejin Choi**[1,2]

[1]University of Washington [2]Allen Institute for Artificial Intelligence

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Are Advanced Planning Methods the Solution?

"*LLMs struggle to self-correct their responses without external feedback*."

THE GENERATIVE AI PARADOX:
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LARGE LANGUAGE MODELS CANNOT SELF-CORRECT REASONING YET

Jie Huang[1,2*] Xinyun Chen[1*] Swaroop Mishra[1] Huaixiu Steven Zheng[1] Adams Wei Yu[1]
Xinying Song[1] Denny Zhou[1]
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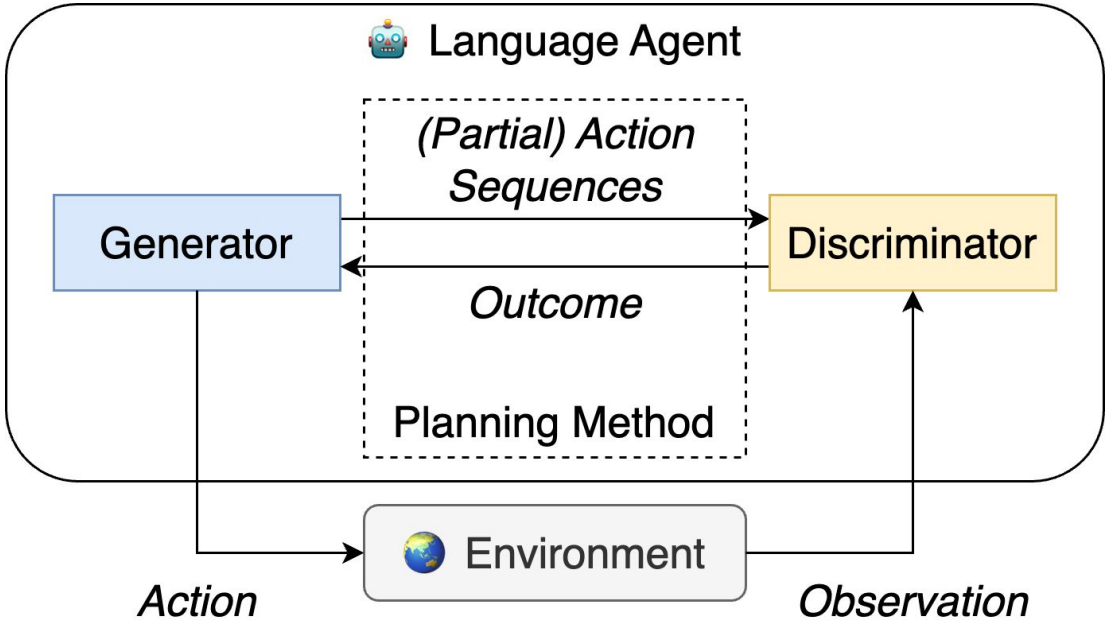
Are Advanced Planning Methods the Solution?

We hypothesize that the ***discriminator*** may be more important in LLM planning.



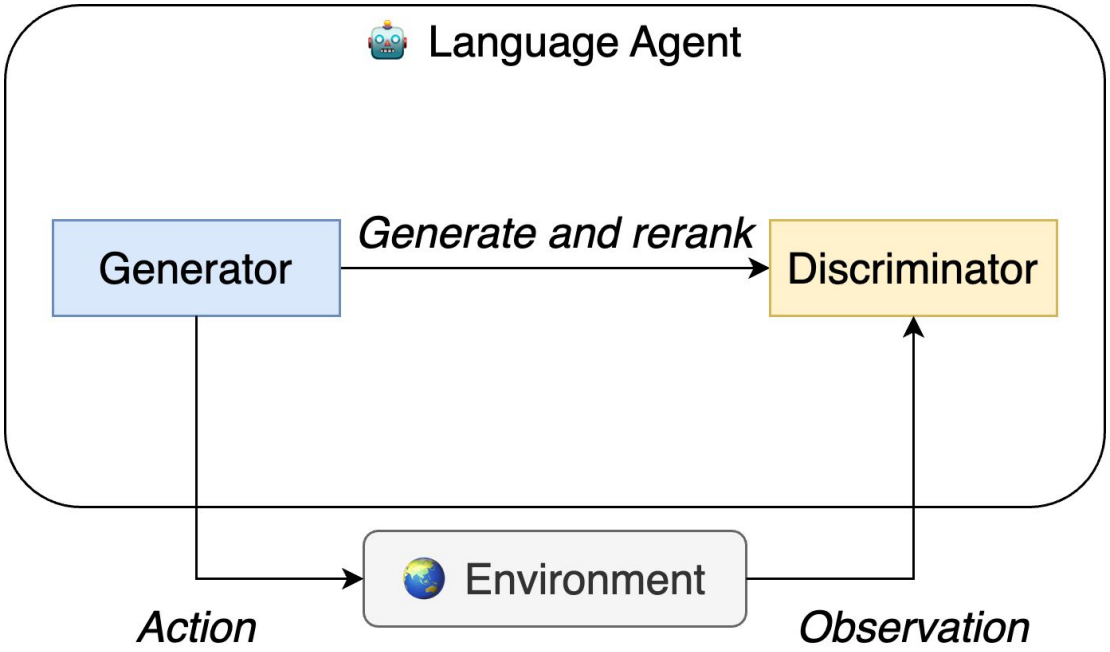
Our Contributions

- Investigation of three planning methods under a unified language agent framework

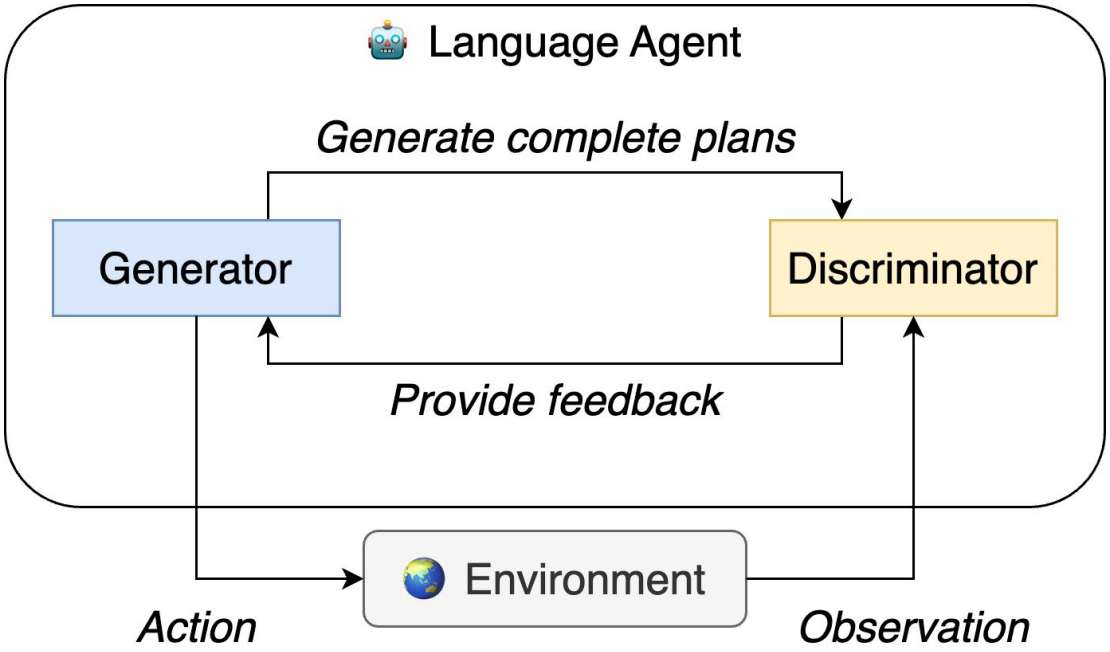
- Comprehensive experiments on two real-world tasks, text-to-SQL parsing and math reasoning

- Empirical analysis of LLMs' discrimination abilities and their impact on LLM planning

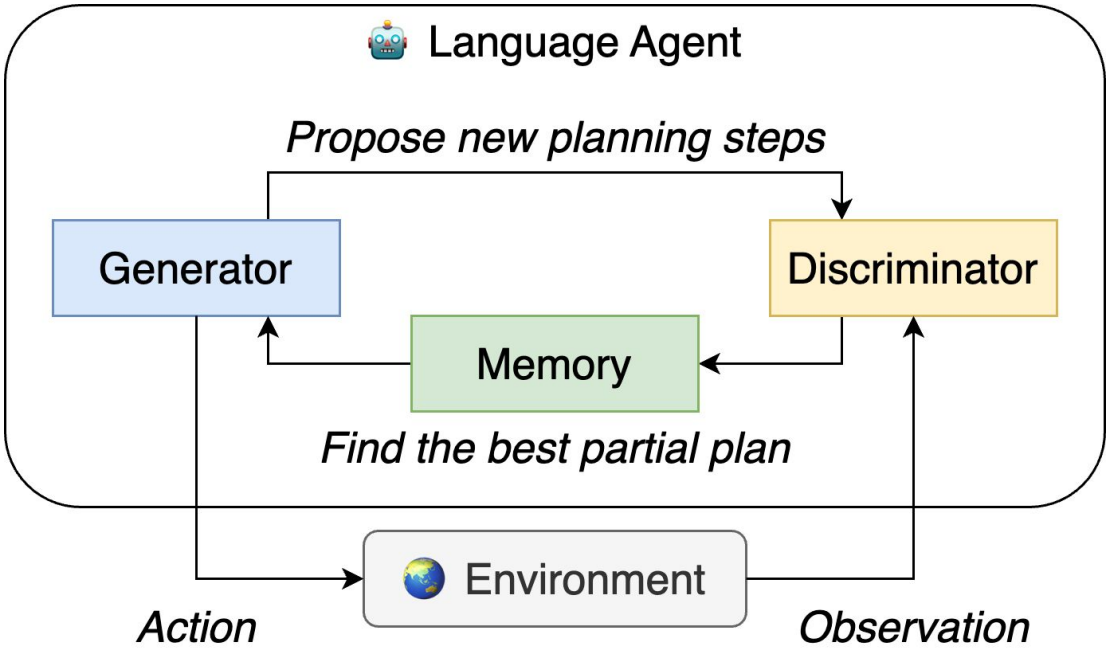
Unified View of Planning - Re-ranking



Unified View of Planning - Iterative Correction



Unified View of Planning - Tree Search



Research Questions

- **RQ1**: How does discrimination accuracy affect the performance of language agents using different planning methods?

- **RQ2**: Can LLM-based discriminators correctly assess language agents' actions in practical settings?

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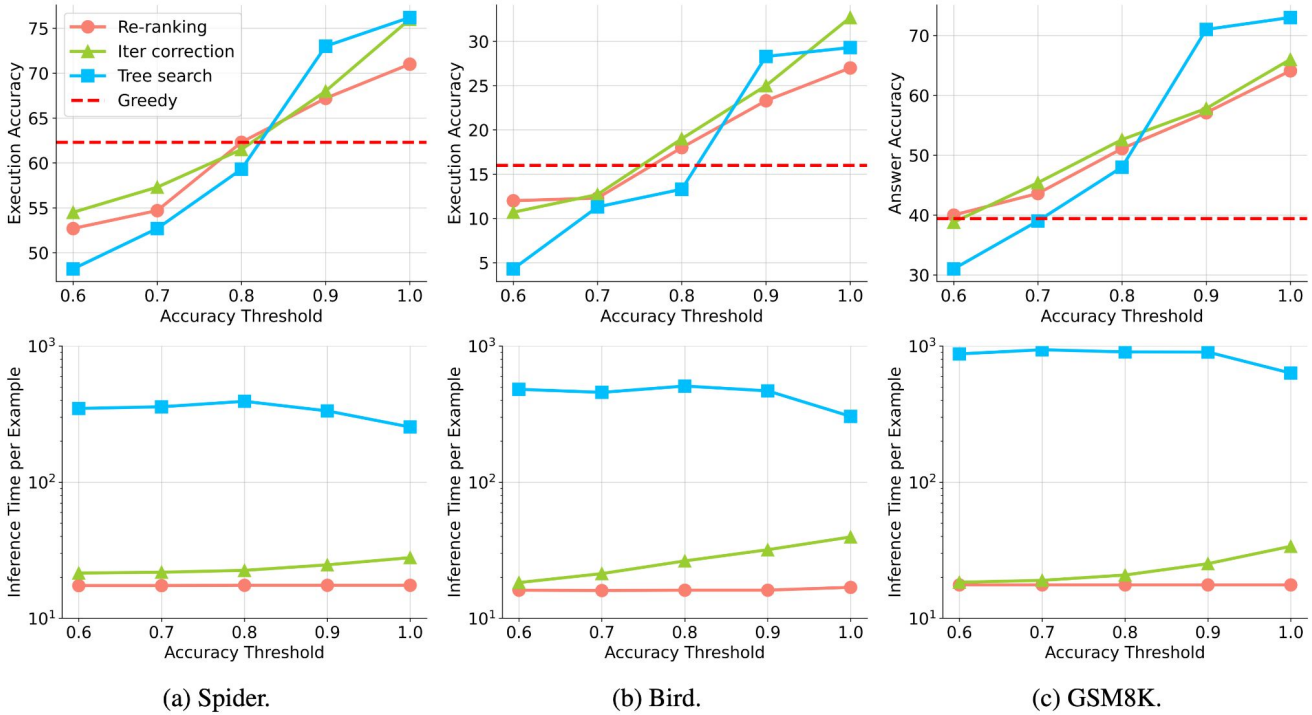
Simulation Experiments with Oracle

- Simulate a perfect discriminator with gold answers

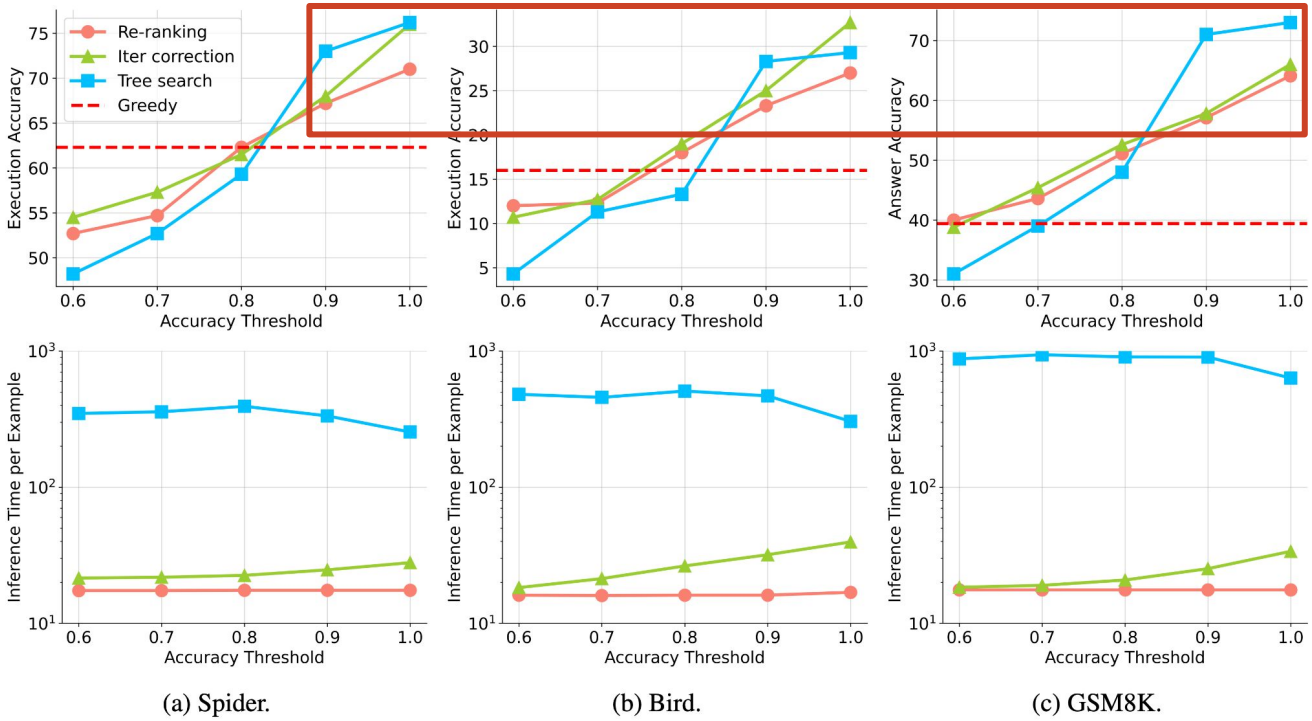
- Control the accuracy with a probability-based threshold
  - Sample a random number between 0 and 1
  - If the number is smaller than our threshold, we follow the discriminator’s score
  - Otherwise, we inverse the score

Simulation Experiments with Oracle



End-to-end evaluation results (the first row) and average inference time in log scale (the second row) of our simulation experiments with oracle-based discriminator.

Simulation Experiments with Oracle



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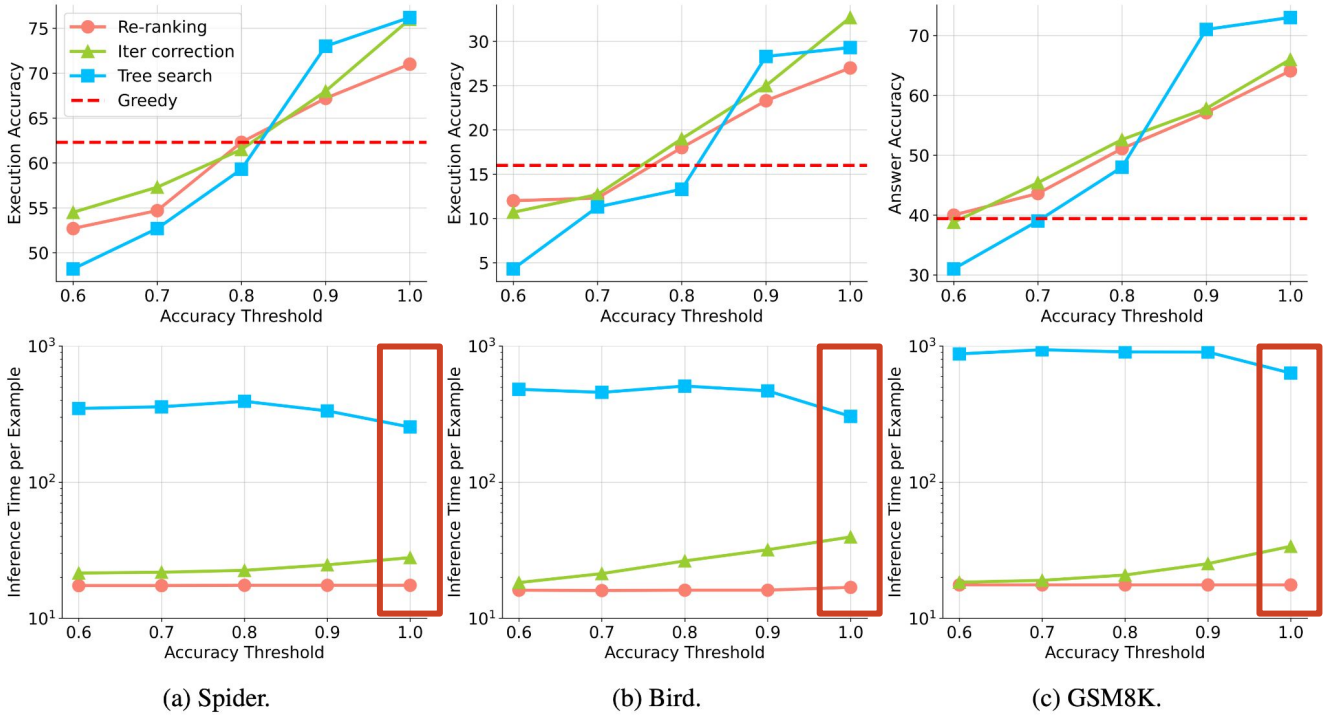

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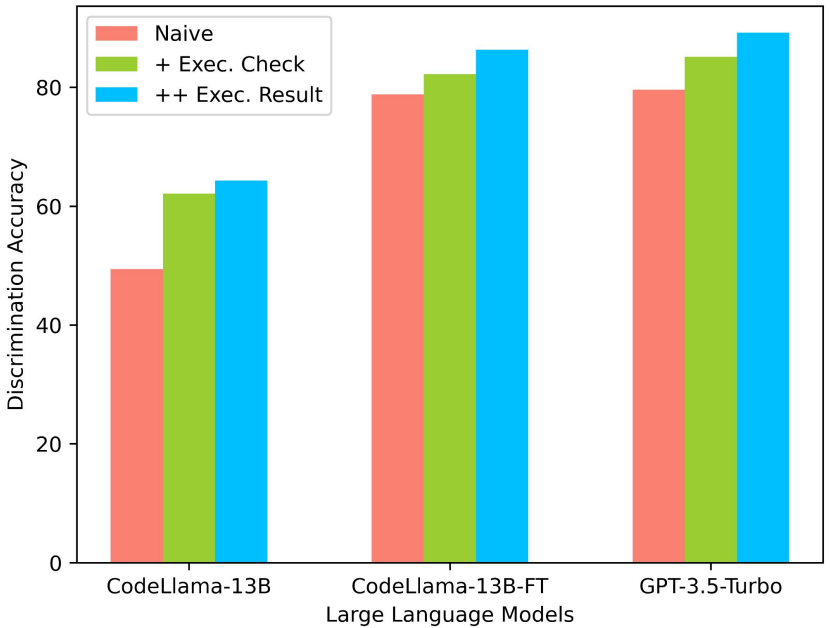
Discrimination Accuracy of LLMs

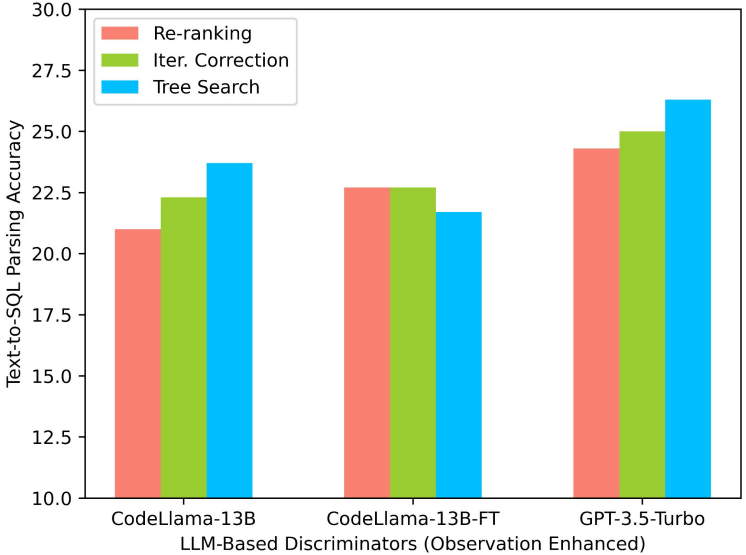
We improve LLMs' discrimination accuracy with environmental observations.

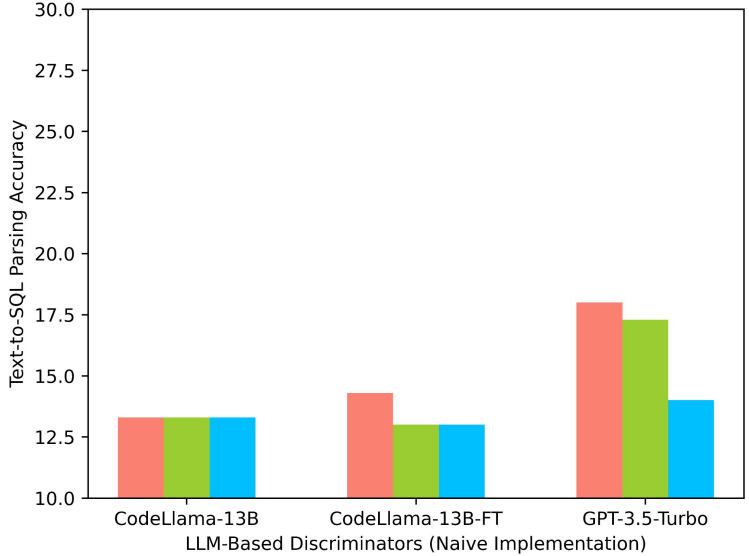


Discrimination accuracy of naive and observation-enhanced LLMs on BIRD-SQL.

End-to-End Evaluation of LLM Planning

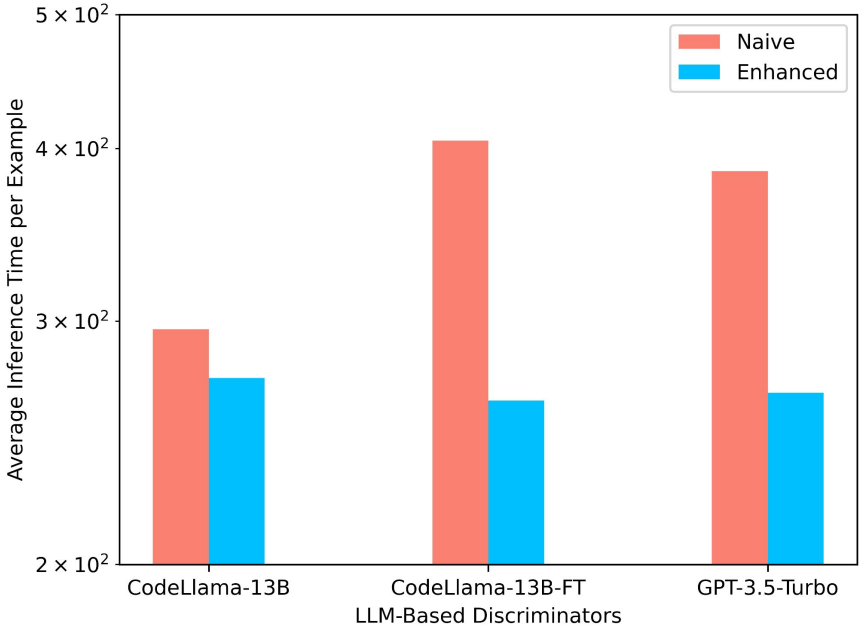
LLM-based discriminators cannot help advance planning methods to achieve significant accuracy improvement yet.





End-to-End Evaluation of LLM Planning

Observation-enhanced discriminators can largely reduce tree search latency.



Average end-to-end inference time (seconds; log scale) per example using tree search on BIRD-SQL.

Conclusions

- Advanced planning methods, i.e., iterative correction and tree search, demand highly accurate discriminators to achieve decent improvements over the simpler method, re-ranking.

- The discrimination accuracy of LLMs may not yet be sufficient for advanced planning methods.

- The accuracy-efficiency trade-off can impede the deployment of advanced planning methods in real-world applications.

Thank you!

Code and Data: https://github.com/OSU-NLP-Group/Auto-SQL-Correction

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