PromptAgent: Strategic Planning with Language Models Enables Expert-level Prompt Optimization

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We Need Expert Prompts

Expert prompts: Highly effective, task-specific prompts that are crafted by domain experts.

- Unleash the full potential of **very large LLMs**, e.g., GPT-3.5/4
- Spearhead the **next era of prompt engineering**, with more powerful LLMs that can understand intricate instructions

Biomedical Name Entity Recognition Task Input

Linkage studies in this family suggested a close linkage between the c2 deficiency gene and genes coding for B18 , Dw2 , and BfS antigens .

"c2 deficiency" is a disease entity to be extracted

Ordinary User Prompt

Extract the disease or condition from the sentence, if any is mentioned.

Expert-level Prompt

Task Description	You're tasked with extracting diseases or conditions from the given sentence …
Domain Knowledge	Avoid associated elements: inheritance patterns, genes or gene loci (like PAH) …
Solution Guidance	Consider both specific diseases and broader categories, common abbreviations...
Exception Handling	The term 'locus' should be recognized as a genomic location, not a disease name
Output Formatting	Provide the identified diseases in this format: {entity_1,entity_2, ...} …
.....	

Ordinary User/Sampled Prompt Output

c2 deficiency gene

Expert Prompt Output

c2 deficiency

The above example shows how an expert with **richer domain knowledge and structured guidance** that help solve the task.

Goal: Automatically craft expert-level prompts equivalent in quality to those handcrafted by domain experts

How to craft expert-level prompts?

Manual prompt engineering?

- Require expert that understand both LLM and task domain.

Existing automatic prompt engineering?

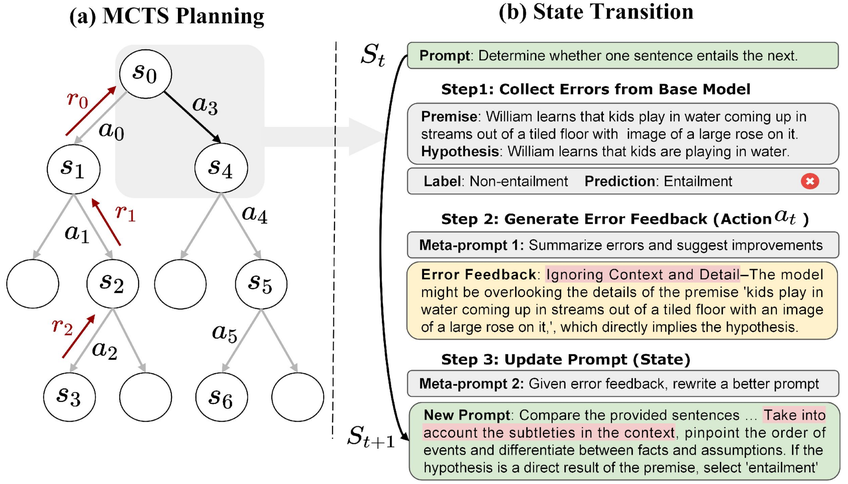
- Tend to **overlook the depth of domain knowledge**
- Struggle to efficiently **explore the vast prompt space**

PromptAgent Saves Your Time

Key innovations (check more details in the paper):

1. Reframing prompt optimization as **a strategic planning problem**
   - **State**: One single prompt
   - **Action**: One prompt optimization step
   - **Reward**: Task specific metric
2. **Self-reflection on model errors** to mirror human's trial-and-error

MCTS planning for prompt optimization pipeline:

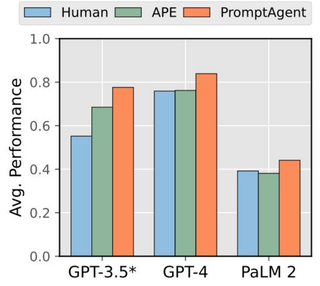


Superior Prompts Unlocked

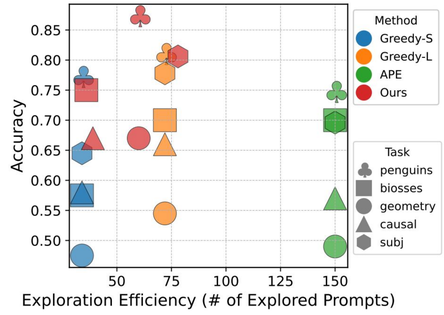
1. PromptAgent performs well on both Domain-specific tasks and General NLU tasks

	Domain-specific Tasks				General NLU Tasks			
	NCBI (F1)	Biosses	Med QA	*Avg.*	Subj	TREC	CB	*Avg.*
Human (ZS)	0.521	0.550	0.508	0.526	0.517	0.742	0.714	0.658
Human (FS)	0.447	0.625	0.492	0.521	0.740	0.742	0.429	0.637
CoT (ZS)	0.384	0.425	0.508	0.439	0.656	0.63	0.750	0.679
CoT	0.376	0.675	0.542	0.531	0.670	0.784	0.643	0.699
GPT Agent	0.125	0.625	0.468	0.406	0.554	0.736	0.339	0.543
APE	0.576	0.700	0.470	0.582	0.696	0.834	0.804	0.778
PromptAgent	**0.645**	**0.750**	**0.570**	**0.655**	**0.806**	**0.886**	**0.911**	**0.868**

2. Transferable to different LLM base models



3. Balance searching efficiency and effectiveness



The Road Ahead with PromptAgent

LLM Reasoners

A library for advanced reasoning with large language models

- **LLM Reasoners library** provides a standardized modular framework of LLM reasoning with search algorithm, reward function, and world model.
- We are integrating **PromptAgent2.0** into the **LLM Reasoners** to generate more efficient and adaptable prompts for various domains, improving the user experience.