K y o t o A I

～AI Project from Kyoto～

CEO & Founder　Kentaro Seki

Executive Summary

Background	Recent AI research shows that LLMs can enhance their thinking through reinforcement learning, but deep thinking with corporate documents and code remains challenging. Our company has developed SEIMEI, a model integrating AI Agents with reinforcement learning of search engine, to provide to businesses.
Research Result	Using bigcodebench, we created over 1,000 AI Agents from training data. By applying reinforcement learning to their search engines, we observed an approximately 16% improvement in accuracy on evaluation data.
Application	This approach can be applied to AI Agents capable of advanced thinking, enabling tasks such as corporate document analysis, code analysis, debugging, auto-generation, and automated presentation materials.

Content

01

What's KyotoAI?

KyotoAI. Inc

Through research focused on memory in machine learning, we aim to achieve AGI, the ultimate goal of AI research, and contribute to the development of a prosperous society.

Name	KyotoAI.Inc
Foundation	Mar/5th/2024
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02

Current Issues On LLM

The current limitations of LLM inference

Current LLMs are surpassing humans in simple question-and-answer tasks.

However, the use cases for complex tasks involving AI Agents and RAG still face limitations.

I will show you 3 examples

The current limitations of LLM inference ①

SWE-Lancer Benchmark [OpenAI arXiv:2502.12115]

this paper showed that the performance of RAG on tasks required of actual software engineers still does not match that of real engineers.

While LLM can surpass humans in simple coding problems during hackathons, using them in initial tasks results in a sudden drop in accuracy.

The current limitations of LLM inference ②

Agentless [C. Xia arXiv:2407.01489]

This paper showed that simpler systems with fewer Agents have higher accuracy compared to systems with many Agents.

As the number of AI Agents increases, they become unstable in handling long thought processes.

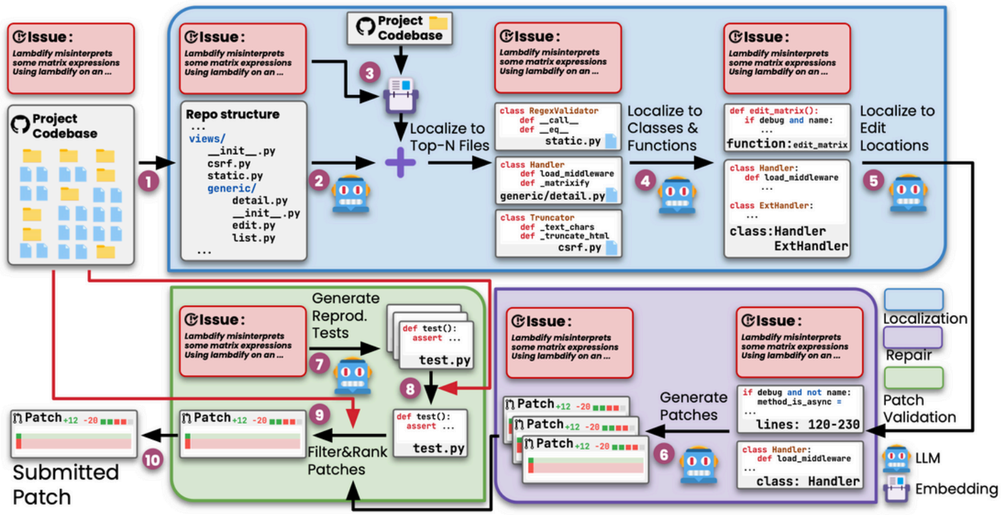
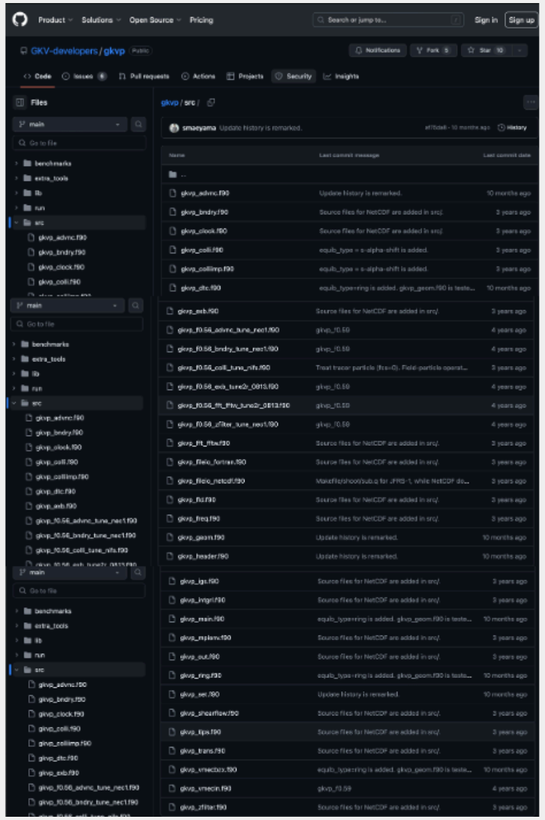


Figure 1: Overview of AGENTLESS.

The current limitations of LLM inference ③

Our Research: AI Agent on Nuclear Fusion Similation



Big Simulation Code

Analyze

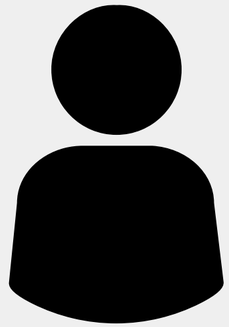
Dialog

AI Agent
RAG

Complex Tasks

Ex. Convert the coordinate of the simulation

Explain what happens when running the code



The current limitations of LLM inference ③

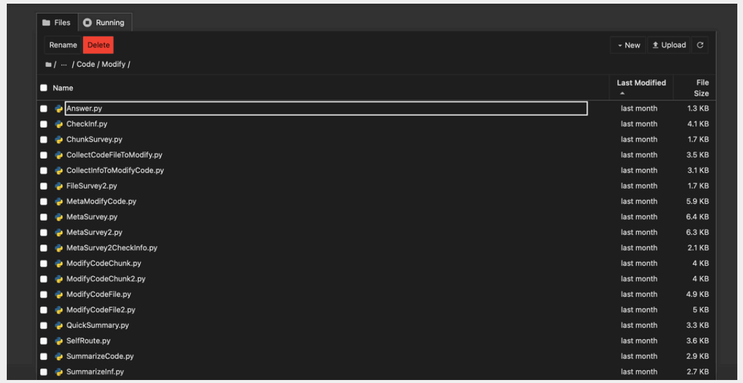
Result :

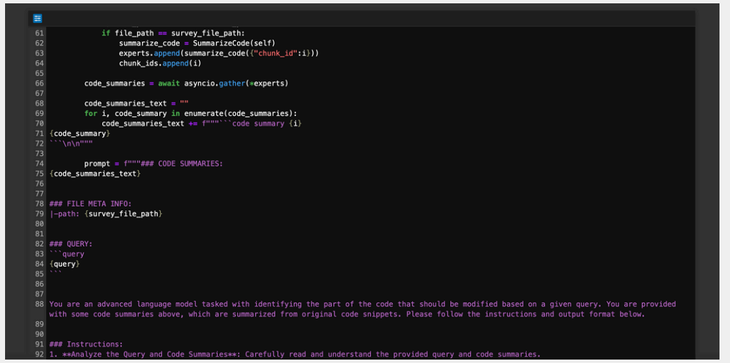
Not accurate on complex problems

Cause :

- AI Agent cannot think coherently
- So many things to think over many files

Agents





```
        if file_path == survey_file_path:
            summarize_code = SummarizeCode(self)
            experts.append(summarize_code({"chunk_id":i}))
            chunk_ids.append(i)

    code_summaries = await asyncio.gather(*experts)

    code_summaries_text = ""
    for i, code_summary in enumerate(code_summaries):
        code_summaries_text += f"""```code summary {i}
{code_summary}
```\n\n"""

    prompt = f"""### CODE SUMMARIES:
{code_summaries_text}

FILE META INFO:
|-path: {survey_file_path}

QUERY:
```query
{query}
```


You are an advanced language model tasked with identifying the part of the code that should be modified based on a given query. You are provided
with some code summaries above, which are summarized from original code snippets. Please follow the instructions and output format below.

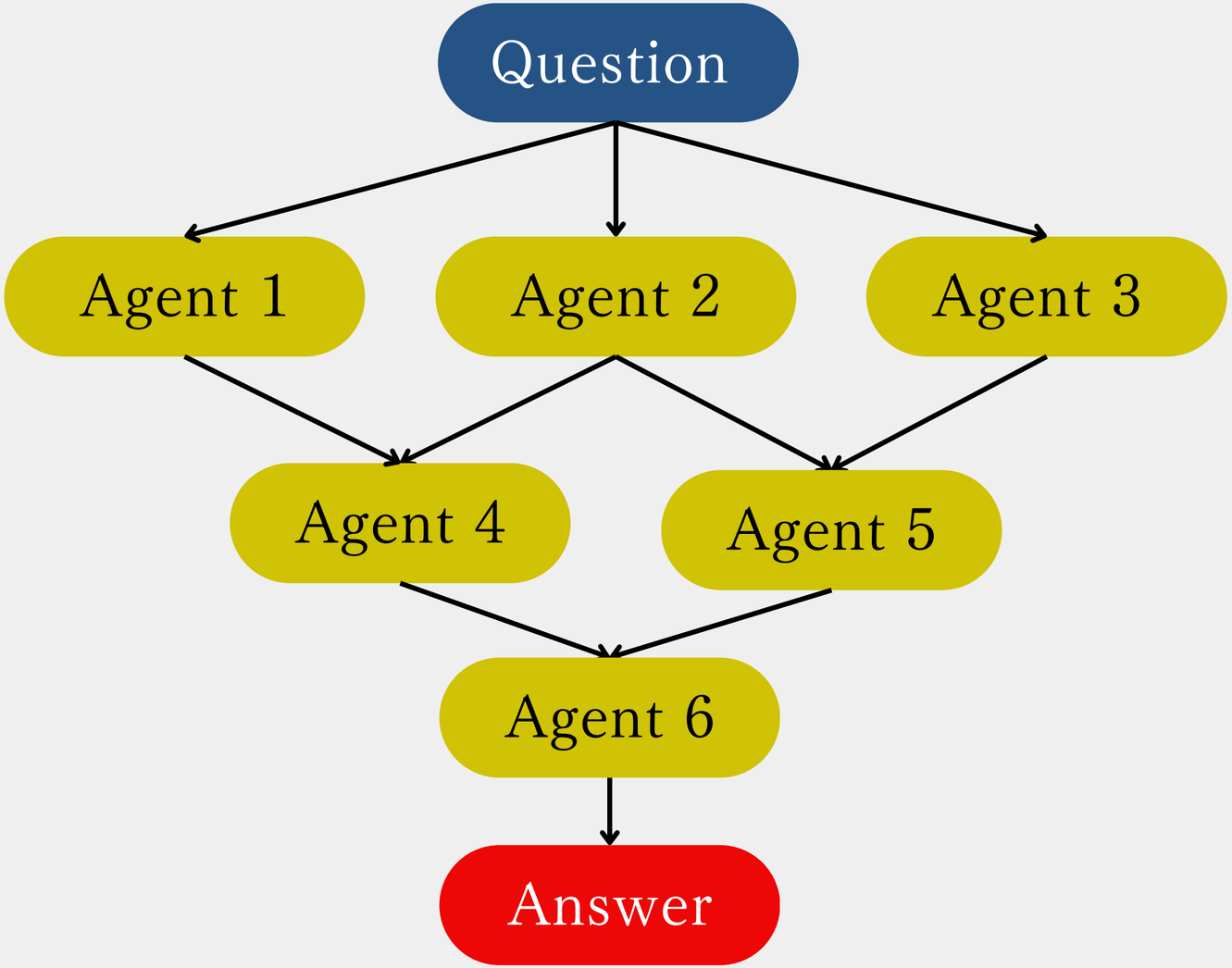
Instructions:
1. **Analyze the Query and Code Summaries**: Carefully read and understand the provided query and code summaries.
```

prompts
```

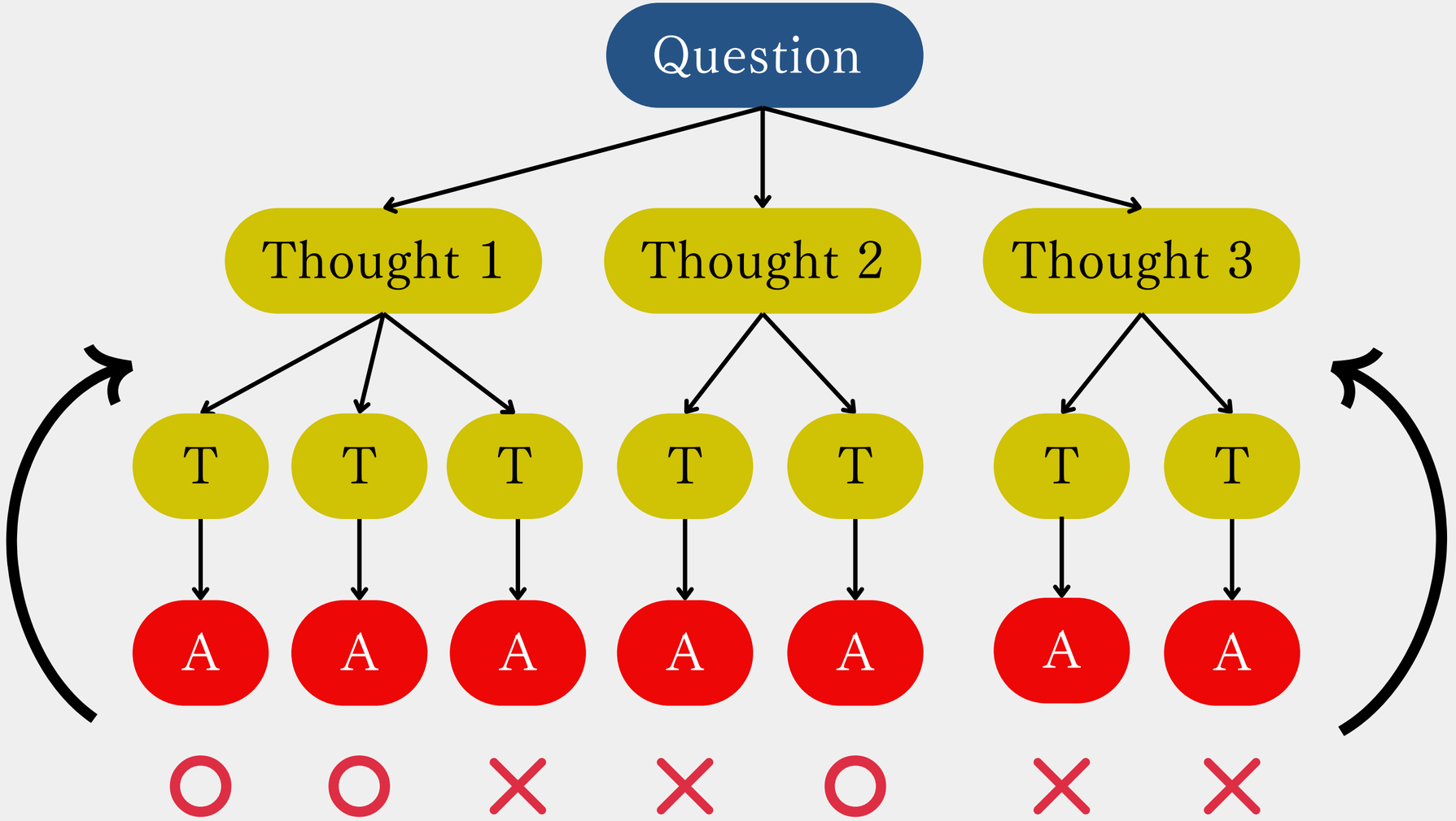
Why Can’t AI Agent Think Deeply ?

Let’s compare AI Agent model of reasoning with Deepseek-r1 training method [DeepSeek-AI arXiv:2501.12948]

AI Agent Model



Deepseek Model



Reinforce-ment Learning

Strength of DeepSeek-r1

Learn by Practice: Reinforcement Learning (RL) on Complex Tasks

But, AI Agent is not optimized through Reinforcement Learning

Weaknesses of Deepseek-r1

① Requires too many labeled dataset
② RL of LLM is too expensive...
③ It’s not designed for a specific AI Agent system...

=> Each company cannot make it on its own

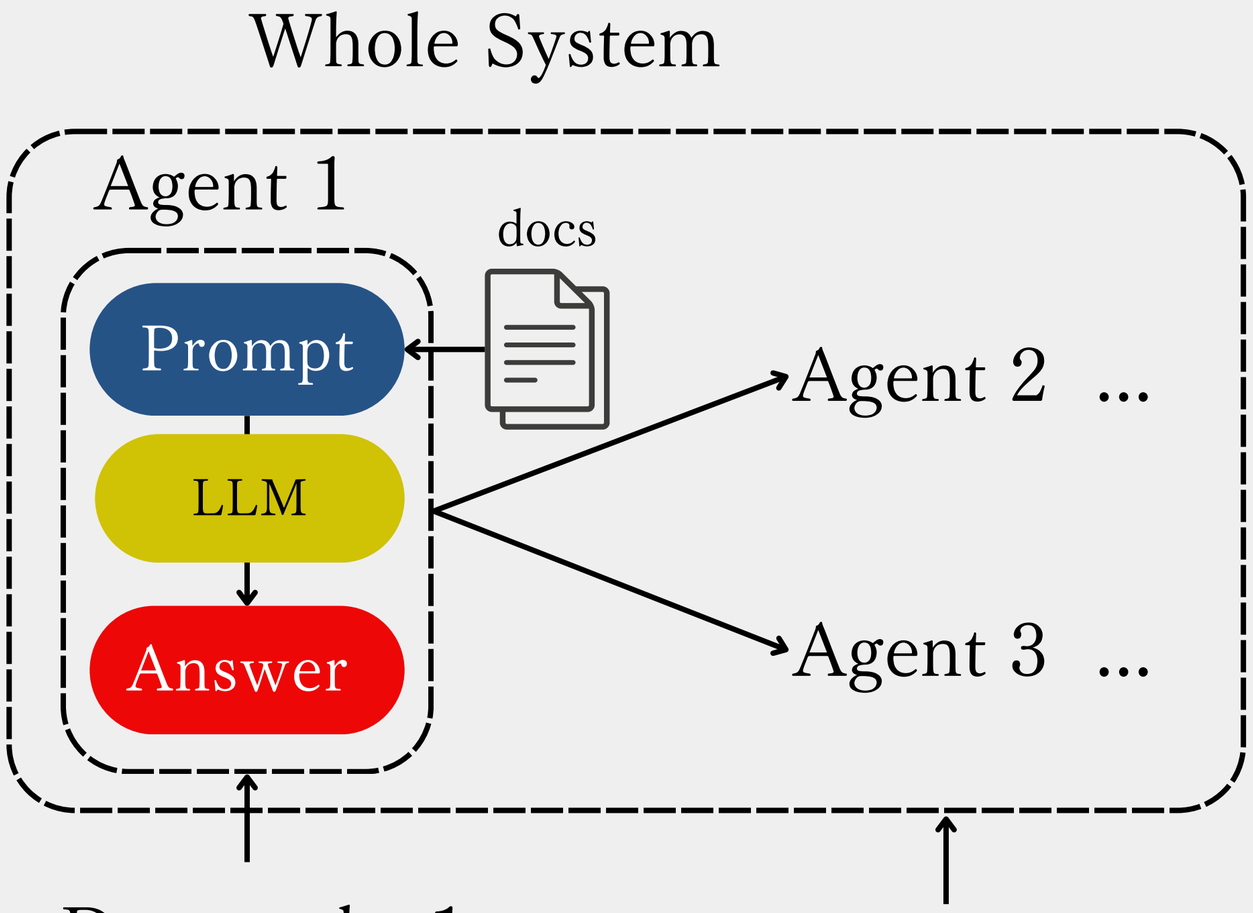
03

KyotoAI Model SEIMEI

Idea

What if we integrate AI Agents by Search Engine?

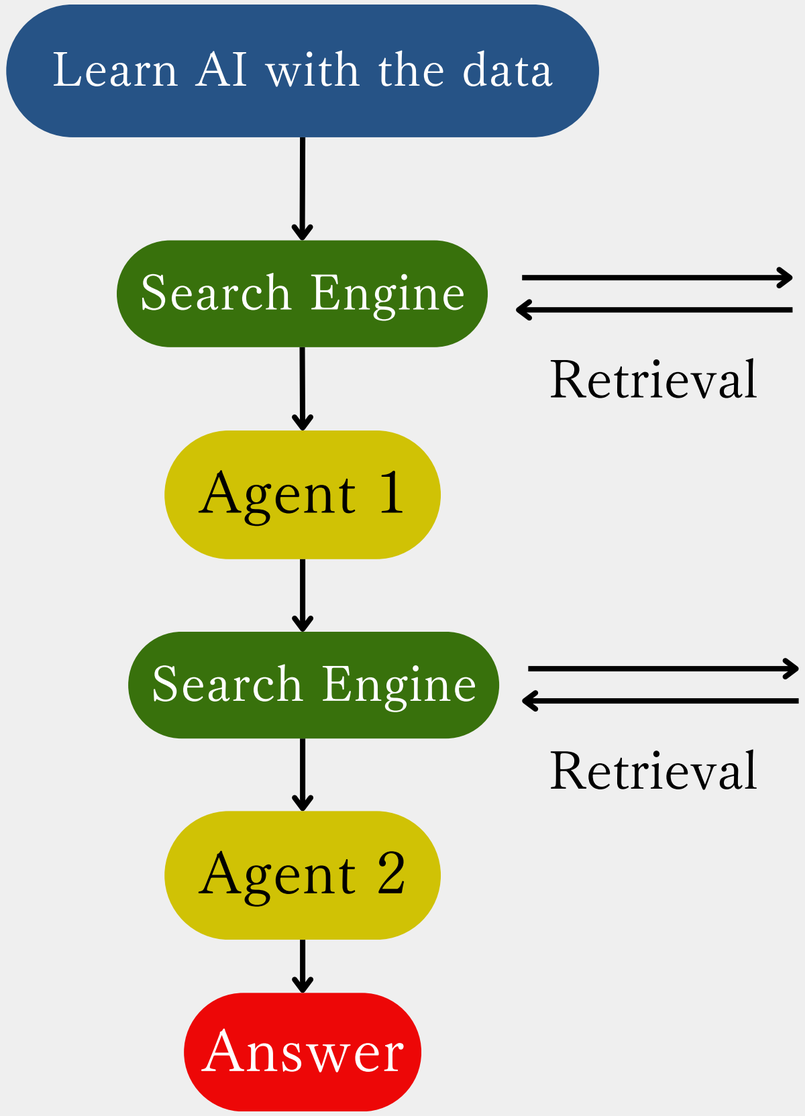
Structure of Agent



Reinforcement Learning on AI Agent Path may improve the system!!

Example

Search Engine decides the path of chain of thoughts



Agent 1: Change Learning Rate

Agent 2: Debug on Evaluation Function

Agent 3: Design Custom Trainer class

...

Agent群

We call this model SEIMEI

(Search-Engine-Integrated Multi-Expert Inference)

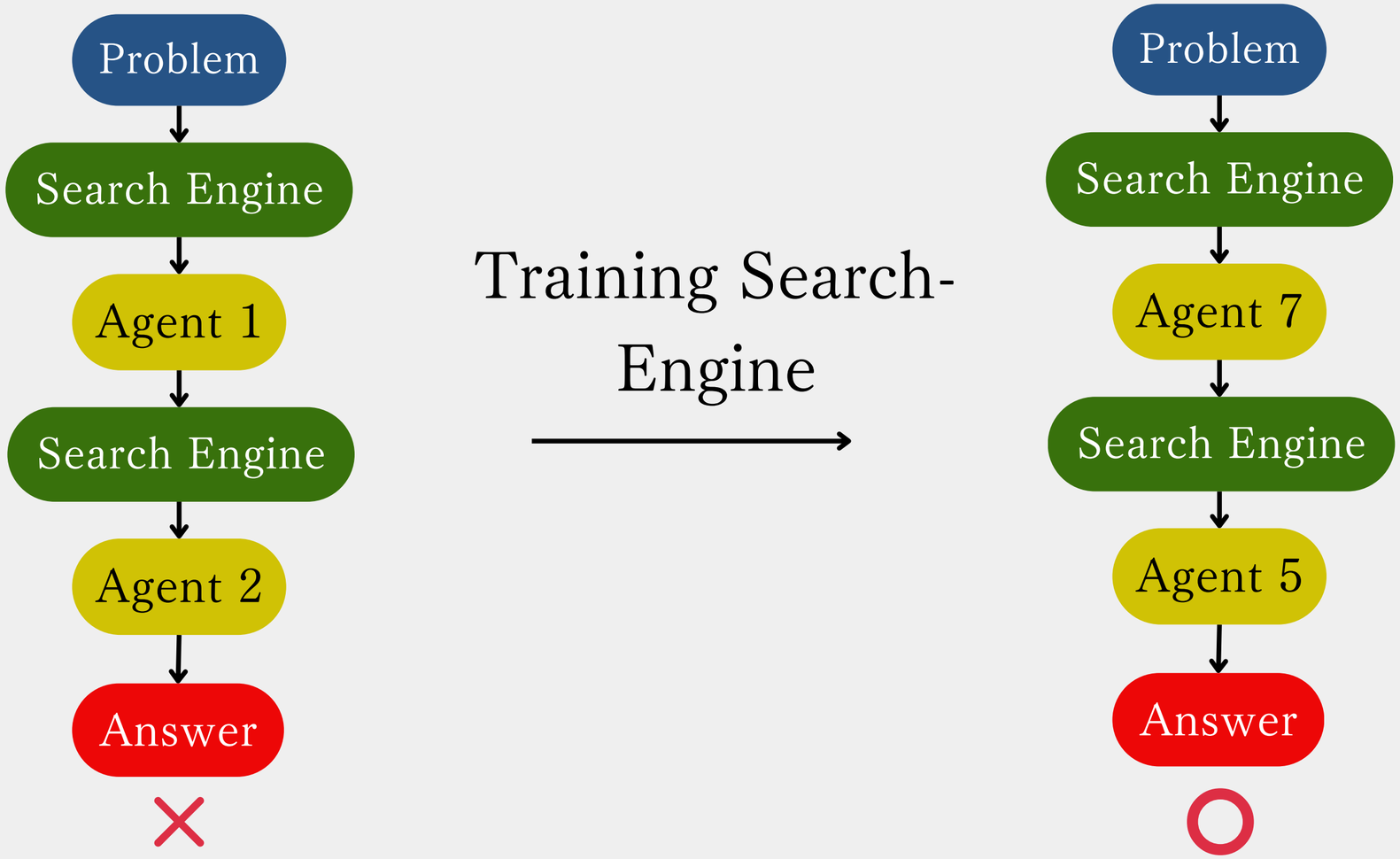
Strength of SEIMEI

① Reasoning path is optimized by training search engine （like Deepseek-r1）
② System is directly improved by adding Agents
③ Human can modify the agent （More open AI system）
④ From Agentless to Agentmore
⑤ Training Search Engine is 1000~10000 times cheaper than LLM

=> SEIMEI lets a lot more people be able to create
AI system optimized for their tasks!!!!

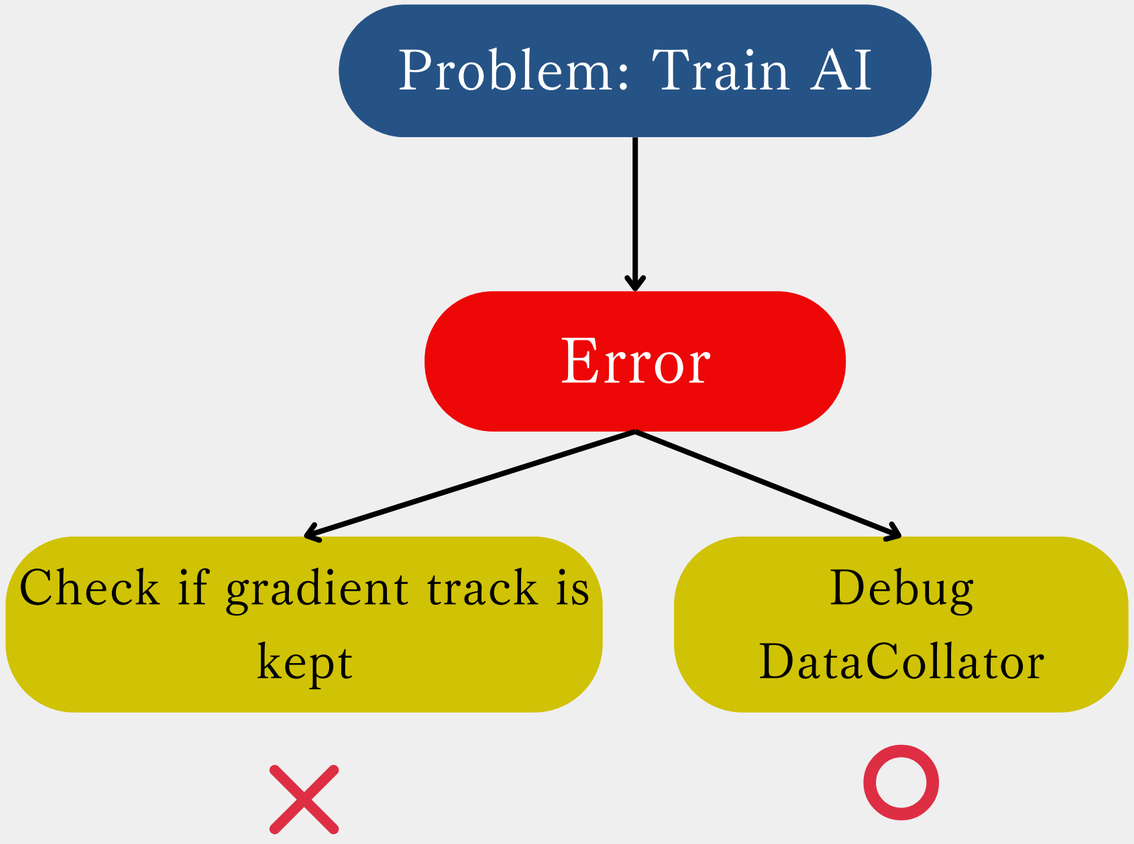
Strength of SEIMEI ①

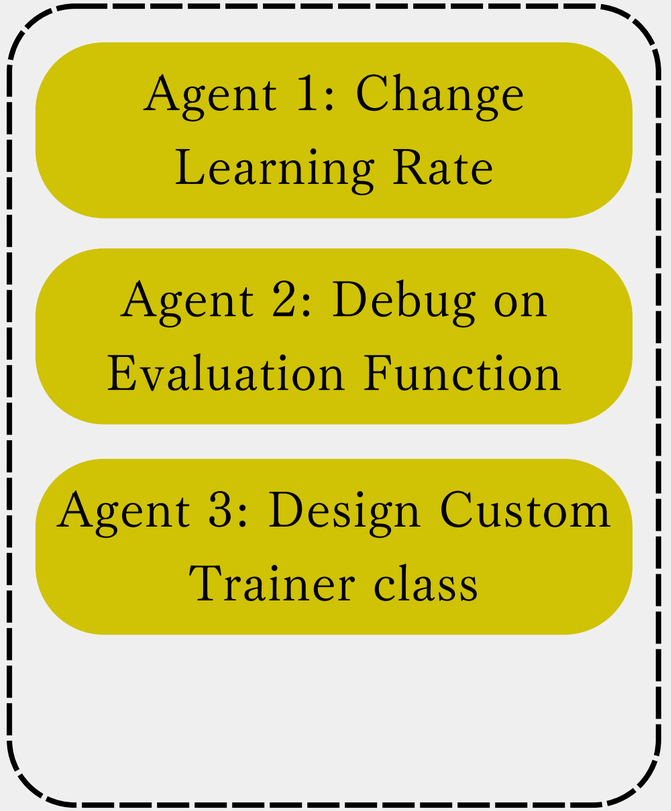
Optimize Thinking Process by Training Search Engine



Strength of SEIMEI ②

Learn More Directly by Adding Agent

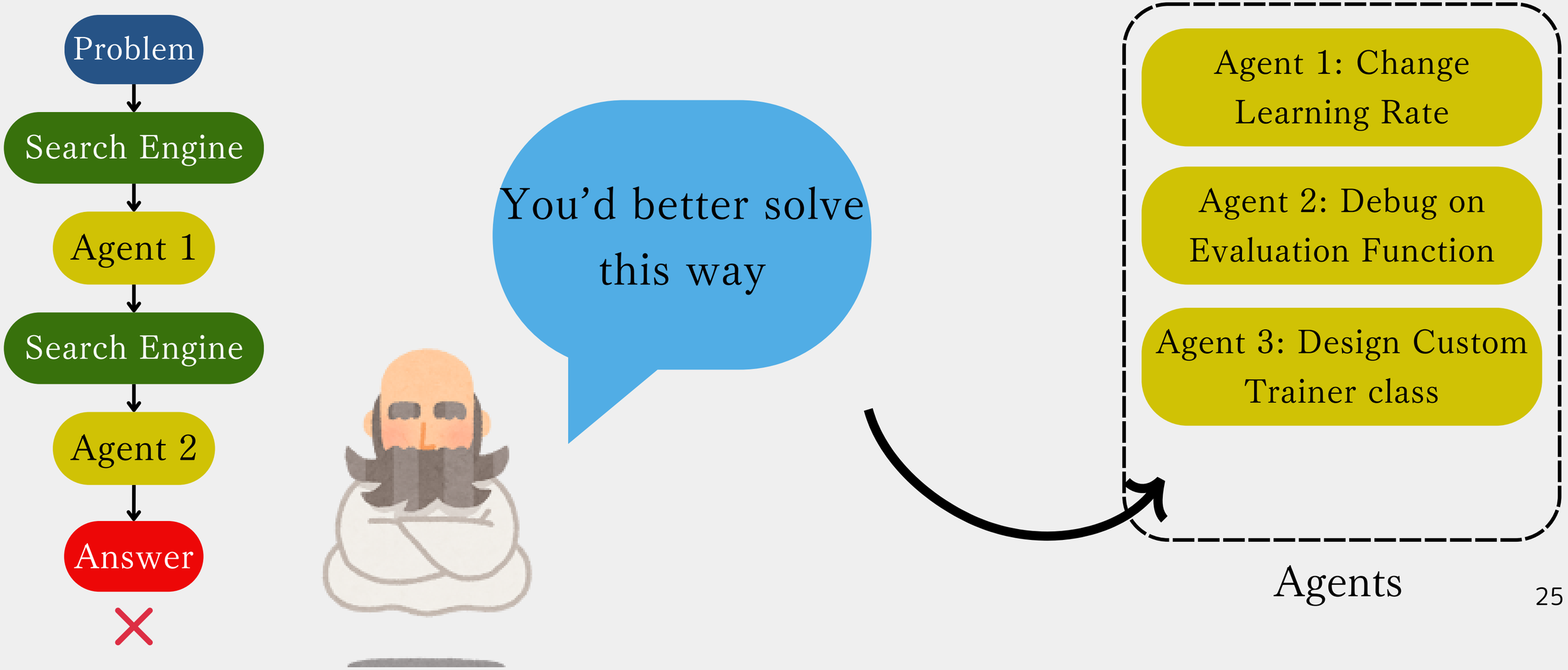




Agents

Strength of SEIMEI ③

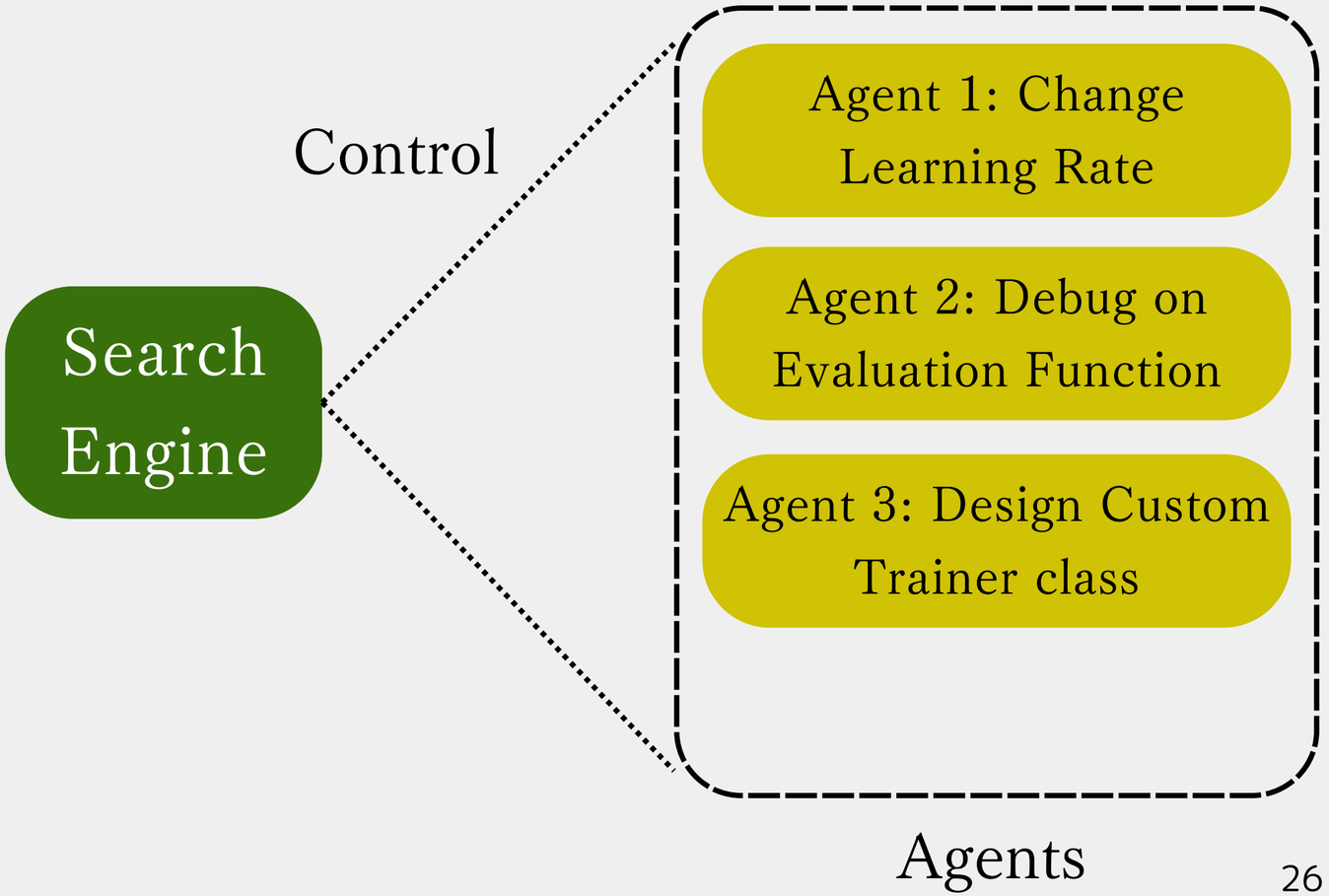
Human Expert can Improve the model through Agent



Strength of SEIMEI ④

From Agentless to Agentmore

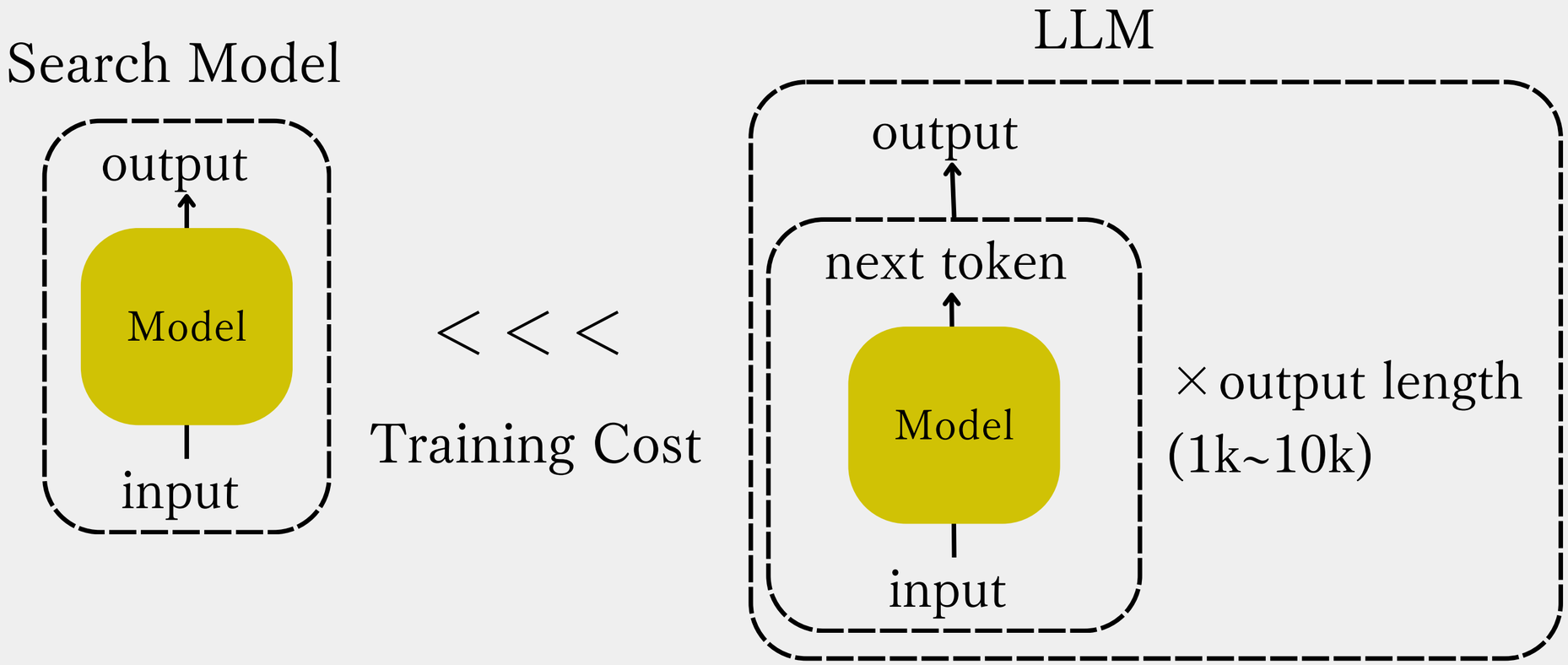
Overcome the instability of more agents by search engine controlling the agents



Strength of SEIMEI ⑤

Training Cost：Search Model ＜＜＜ LLM

Even some children can train search model with their pocket money



04

Research Result

Research Result Summary

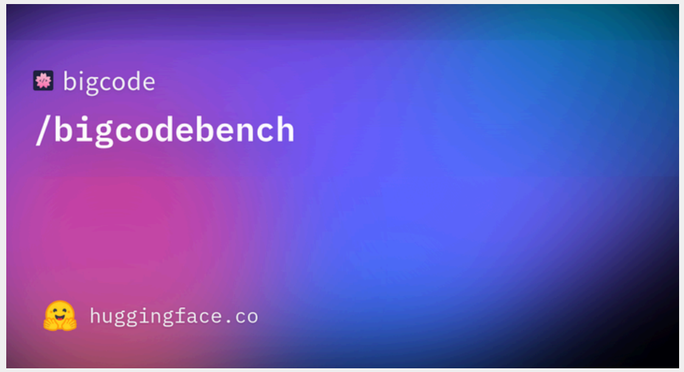
Result of Training Search Model in SEIMEI

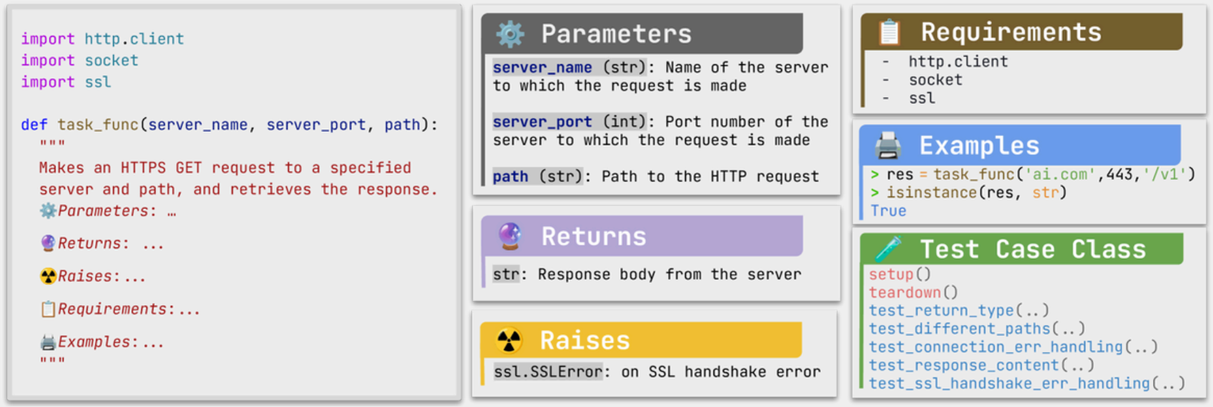
3 Key Discoveries:

1. Proprietary Search Model Achieves Stable Training
2. Proprietary Training Method Improves Evaluation Accuracy
3. Search Model Improves Code Generation by 16% on bigcodebench

Dataset

- bigcodebench : dataset for python coding tasks





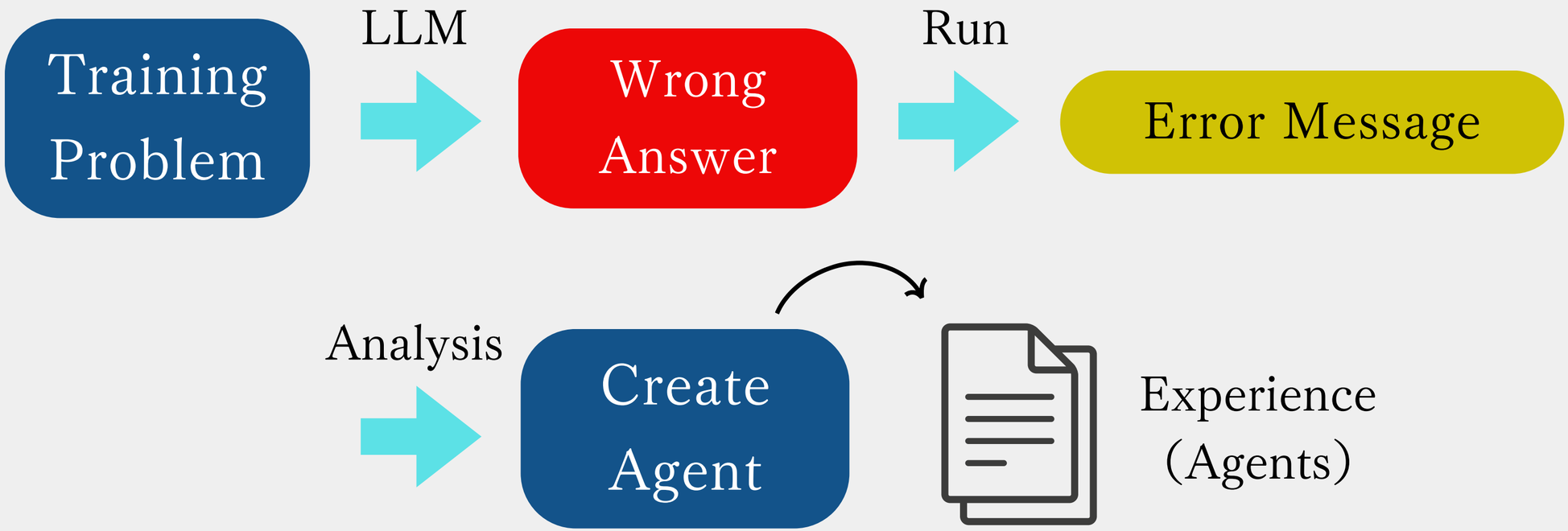
Contents

1. python code problems
2. correct answers
3. test code for checking the answer

1000 problems are included

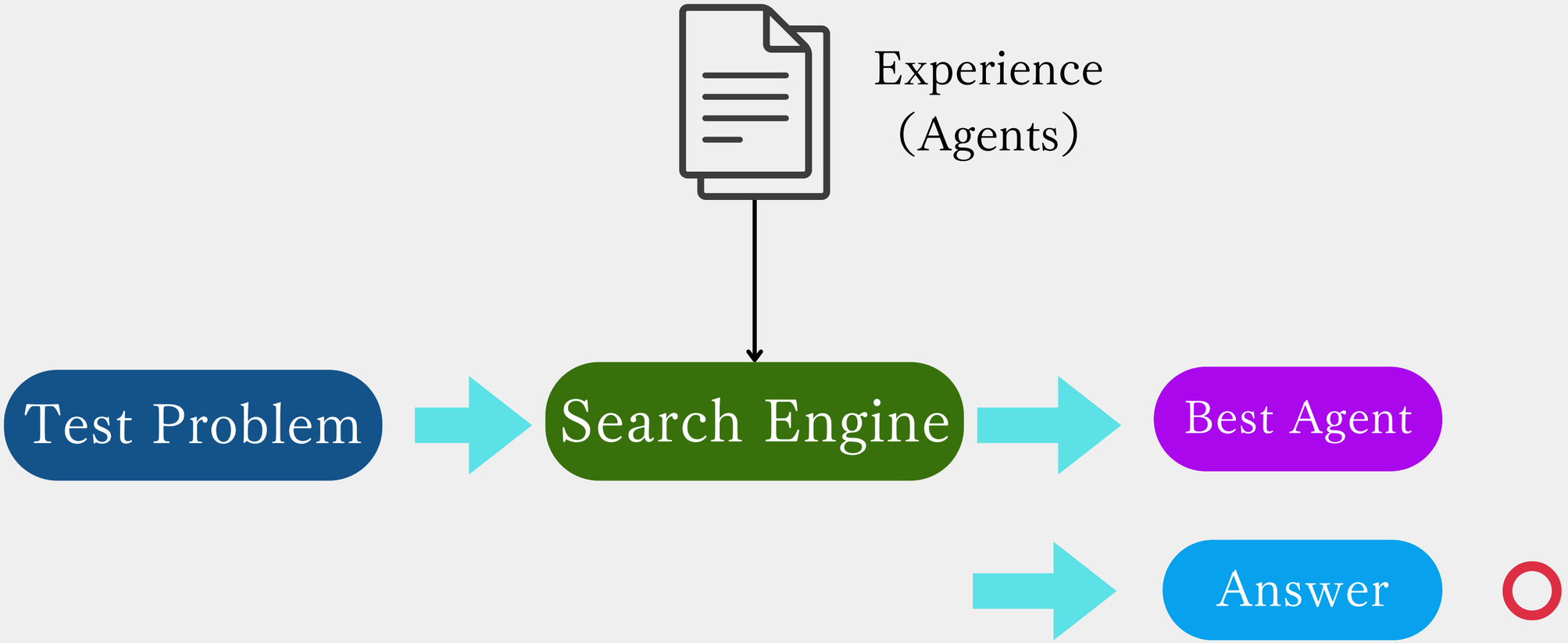
Method: Create Agent

① Error Message → Figure Out the Cause of Error
② Cause of Error → Create Agent which Leads to Answer



Method: Training Search Model

③ Train Search Model to Retrieve the Best Agent



Novelties

2 Novelties of KyotoAI Search Engine

1. We use different search model other than semantic vector search and achieved stable training

2. Our improved method of training shows better evaluation accuracy than current method

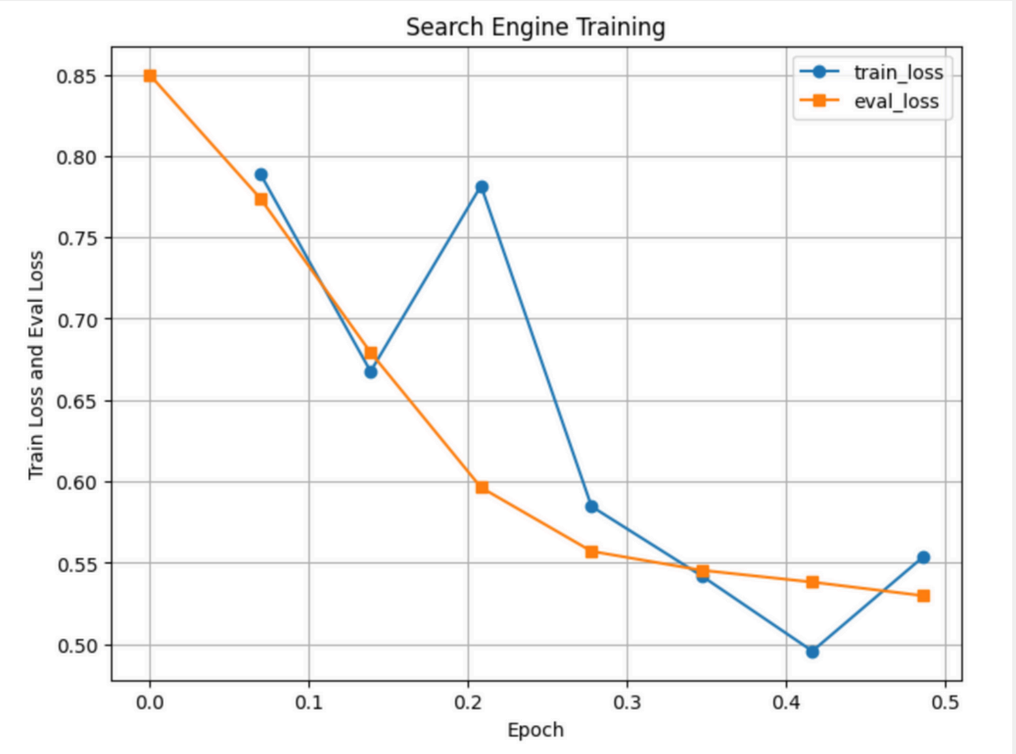
Result

1 . Stability of Our Proprietary Search Model

As the model learns from the training data (🔵), its performance on the evaluation data (🟧) also improves, demonstrating effective learning.

⬇

Stable Training

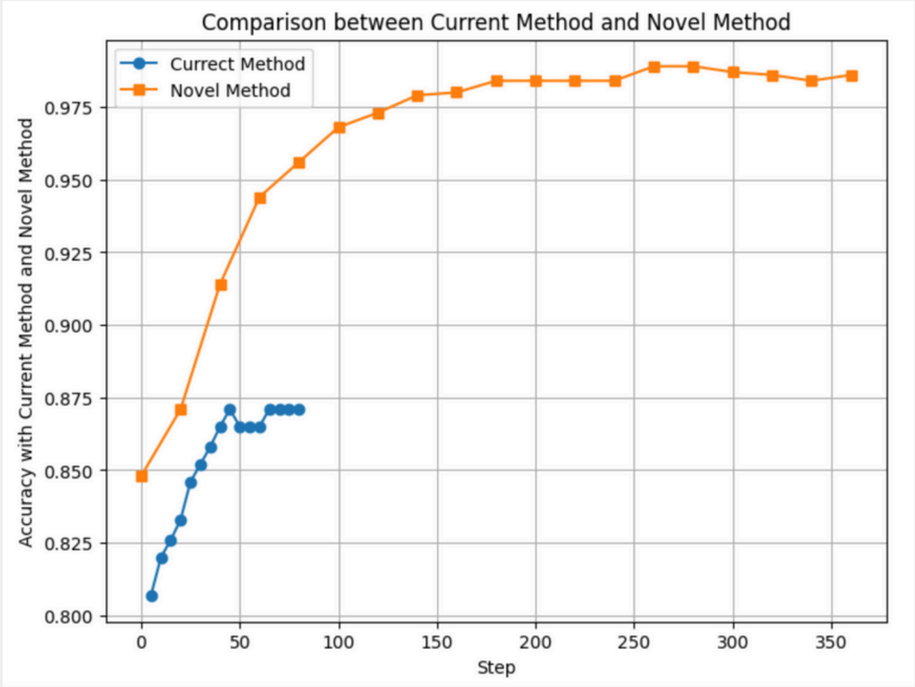


Result

2 . Improvement by Our Proprietary Model

・The graph on the right compares the conventional method (🔵) with KyotoAI's proprietary efficient learning method (🟧) for search tasks.

・Using the same search model and data, our proprietary method achieves a higher accuracy rate compared to the conventional method.

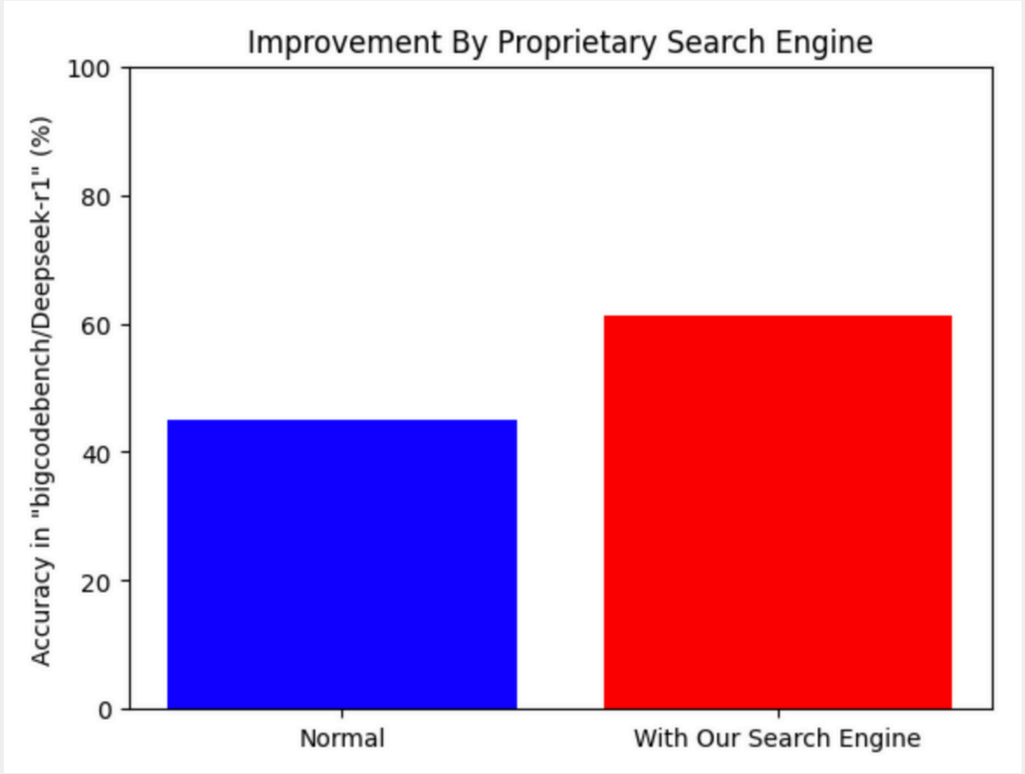


Result

3 . Improve LLM by Trained Search Engine

• The graph on the right compares Deepseek-r1 without a search engine (🟦) to Deepseek-r1 enhanced with a trained search engine (🟥). (Test data: bigcodebench)

• The AI agent enhanced with the search engine shows an improvement of approximately 16%.



05

Application

SEIMEI Application

SEIMEI covers AI Agent tasks that generally require more cognitive effort.

For example:

- Analyzing company documents
- Analyzing, auto-generating, and debugging code
- Conducting online surveys and proposing new business ideas
- Automatically creating presentations and writing papers

Debug

Currently in progress. Using datasets like SWE-benchmark to automatically generate AI Agents, we train the search model and evaluate the results, similar to previous research.

One of SEIMEI's advantages is that it can teach AI Agents and RAG search models to optimize based on human experience.

In the future, we aim to collaborate with debugging companies to achieve automated debugging.

Automatic Presentation Generation

To automatically generate presentation materials, it is necessary to convert HTML content into PPTX files using AI.

However, generating the XML content within PPTX files is challenging for language models. Therefore, we need to use an advanced AI agent (SEIMEI) to perform the complex conversion from HTML to XML.

Currently, we are exploring a joint venture with Company A to achieve this.

Company's Senior AI Advisor

We are considering implementing a system for Company B that analyzes all company documents to serve as a reliable senior AI advisor.

By leveraging SEIMEI's cognitive capabilities, we aim to uncover hidden connections within the documents and resolve uncertainties.

This research paves the way for a new era of company-specific trained AI.