中國人民大學
RENMIN UNIVERSITY OF CHINA

中国人民大学高瓴人工智能学院
Gaoling School of Artificial Intelligence, Renmin University of China

# 从Autocomplete到CLI Agent：Vibe Coding and Anything

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# 个人信息

**卫雅珂**

**中国人民大学高瓴人工智能学院博士，**导师为胡迪副教授

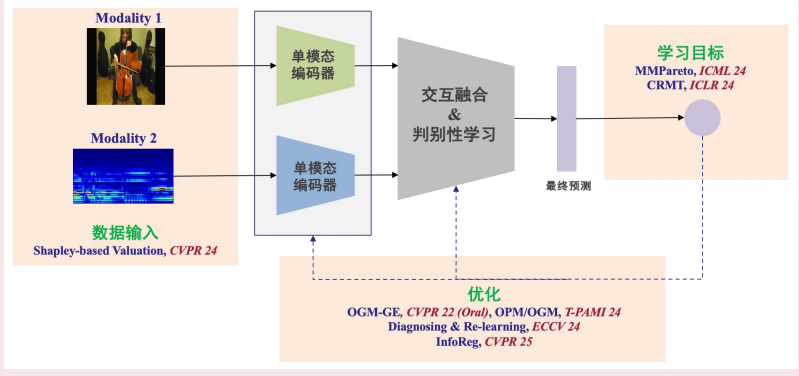
研究方向：多模态学习、多模态大模型

曾获博士生国家奖学金、百度奖学金（全球遴选10人）、入选CVPR博士生论坛等

8月将入职中国人民大学高瓴人工智能学院

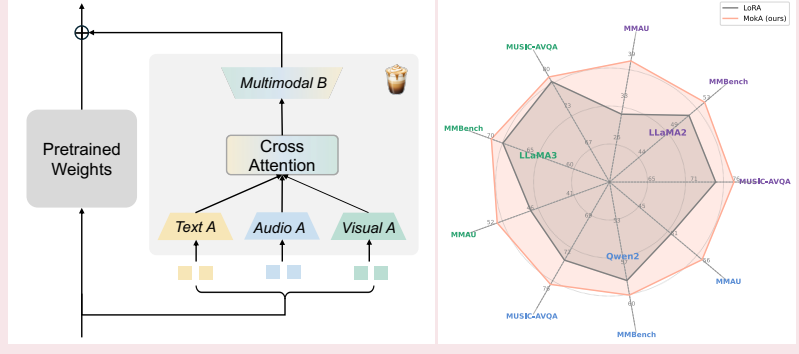
## 代表性成果一

### 小模型中的模态信息平衡利用



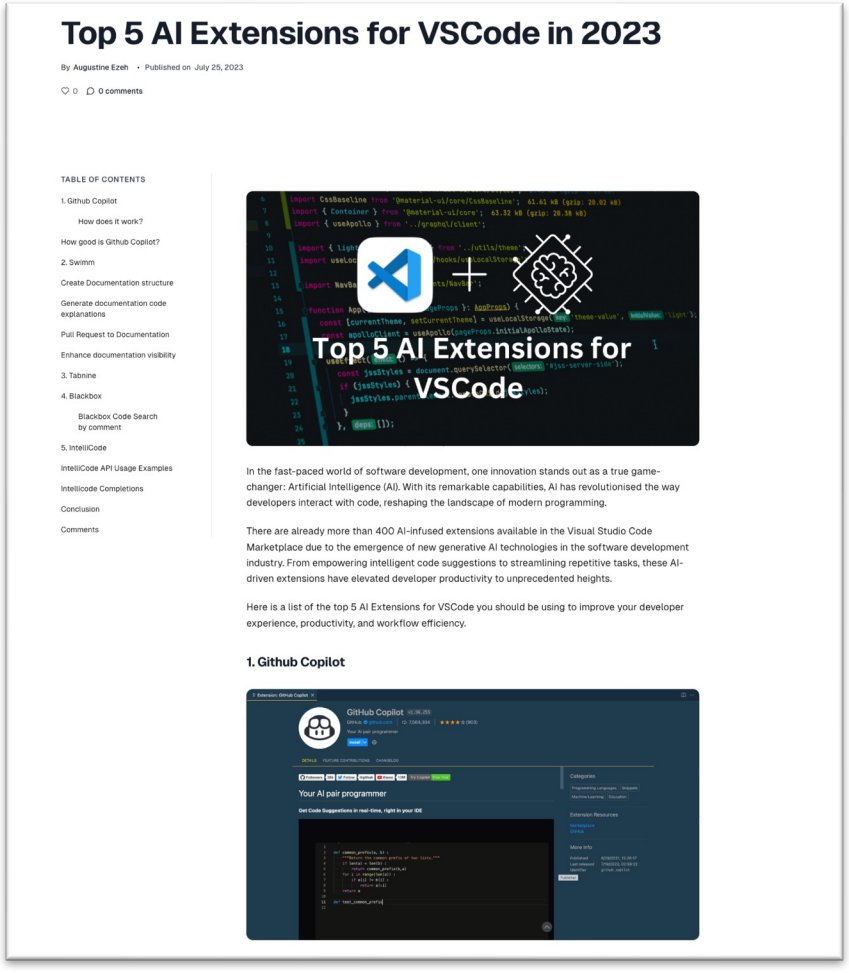

## 代表性成果二

### 多模态大模型中的模态高效协同



# 第一阶段：Autocomplete

GitHub Copilot



Top 5 AI Extensions for VSCode in 2023

By Augustine Ezeh • Published on July 25, 2023

0 0 comments

TABLE OF CONTENTS

1. Github Copilot
   How does it work?
How good is Github Copilot?
2. Swimm
Create Documentation structure
Generate documentation code explanations
Pull Request to Documentation
Enhance documentation visibility
3. Tabnine
4. Blackbox
   Blackbox Code Search by comment
5. IntelliCode
IntelliCode API Usage Examples
Intellicode Completions
Conclusion
Comments




In the fast-paced world of software development, one innovation stands out as a true game-changer: Artificial Intelligence (AI). With its remarkable capabilities, AI has revolutionised the way developers interact with code, reshaping the landscape of modern programming.

There are already more than 400 AI-infused extensions available in the Visual Studio Code Marketplace due to the emergence of new generative AI technologies in the software development industry. From empowering intelligent code suggestions to streamlining repetitive tasks, these AI-driven extensions have elevated developer productivity to unprecedented heights.

Here is a list of the top 5 AI Extensions for VSCode you should be using to improve your developer experience, productivity, and workflow efficiency.

**1. Github Copilot**




2021年开始测试，正式上线于2022年

- 自动补全工具
- 根据注释提示可以补全函数

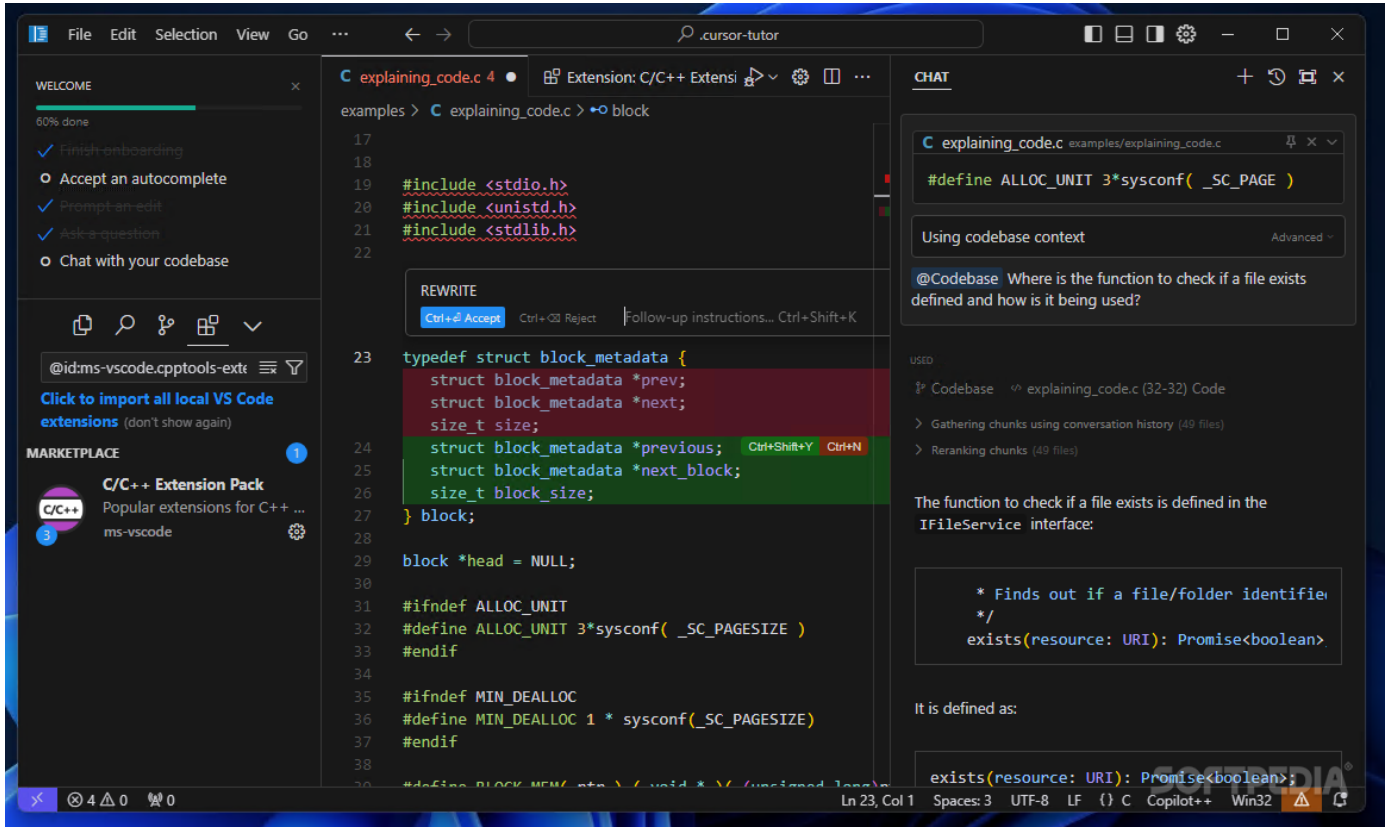
useRowActions.js

```
28      },
29      {
30        label: 'Modify rate/allocation',
31        selected: false,
32        onClick: (e, row) => {
33          const id = row[0]?.value;
34          const record = { ...getRecordById(id) };
35          setRowModal(<ModifyModal booking={record} onClose={e => setRowMod
36        },
37      },
38      {
39        label: 'Delete',
40        selected: false,
41        onClick: (e, row) => {
42          const id = row[0]?.value;
43          const booking = { ...getRecordById(id) };
44          setRowModal(<DeleteModal booking={booking} refreshParent={refresh
45        },
46      },
47    ];
48    return rowActions;
49  };
50
51  export default useRowActions;
52
```

# 第二阶段：IDE Agent

发布于2023年

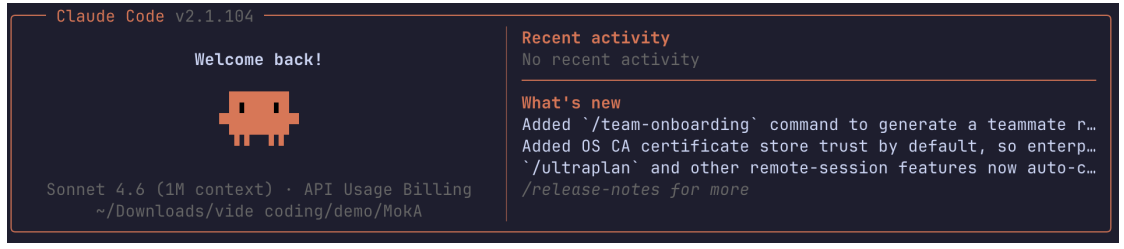
- 大模型Agent内置在IDE中
- Human-agent协作
- 自然语言编程，prompt-repsonse方式驱动，只需要校验修改
- 可以直接针对整个项目进行更改
- 配置多个主流大模型



# 第三阶段：CLI Agent

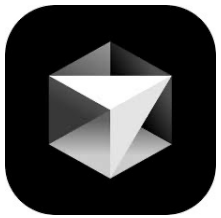
Claude Code发布于2025年7月

- Command Line Agent
- AI从“副驾驶”到“主驾驶”
- 只关心输出，不关心difference
- Human只关注如何定义任务，放手让AI全部执行，主动性更强
- 部署更自由，有terminal的地方就有agent
- **Beyond coding**




# 从Autocomplete到CLI Agent


2021年开始测试，正式上线于2022年
AI代码补全工具，可生成函数级代码



发布于2023年
AI原生IDE
以prompt-response的方式完成任务

Claude Code发布于2025年7月
Command Line Agent
AI独立完成任务

# Vibe Coding

QuickStart
快速上手

Rules
永久上下文

Memory
项目内部上下文

Permissions
命令执行权限

Hooks
状态触发事件件

Skills
预置SOP

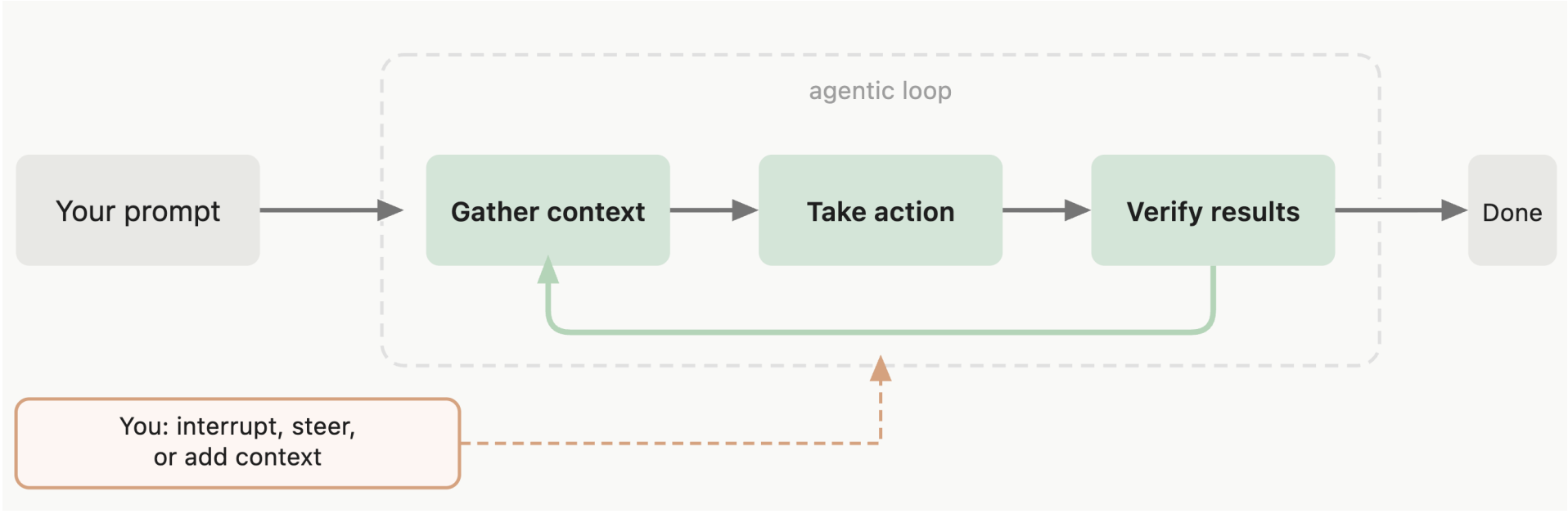
SubAgent
各自执行

AgentTeam
多Agent合作

Sandbox
隔离的运行环境

Harness Engineering
更好驾驭Agent

# 基本使用


agentic loop
Your prompt
Gather context
Take action
Verify results
Done
You: interrupt, steer,
or add context

# QuickStart

以我们的NeurIPS论文MokA的项目代码为例，如何快速上手并进行修改和拓展


如何快速了解一个新项目？

/init

总结当前codebase的基本结构.

然后继续提问从high-level到specific：

- *give me an overview of this codebase*
- *explain the main architecture patterns used here*
- *what are the model backbone?*

# QuickStart

以我们的NeurIPS论文MokA的项目代码为例，如何快速上手并进行修改和拓展

```
→ MokA claude
  Claude Code v2.1.91
  Sonnet 4.6 · API Usage Billing
  ~/Downloads/demo/MokA

❯ 修改modified_peft，修改原本设计中的cross-attention模块，改为使用文本question作为query
进行跨模态attention

● Explore(Explore modified_peft directory)
  └ Bash(ls -la /Users/ykw/Downloads/demo/MokA/models/ | head -30)
    Bash(grep -r "projector\|QFormer" /Users/ykw/Downloads/demo/MokA/models/*.py
        2>/dev/null | grep -i "class\|def" | head -20)
    Search(pattern: "class.*Projector|class.*QFormer", path: "models")
    +11 more tool uses (ctrl+o to expand)
  └ Interrupted · What should Claude do instead?

❯ 查看当前LoRA的实现

  Searched for 1 pattern, read 1 file (ctrl+o to expand)

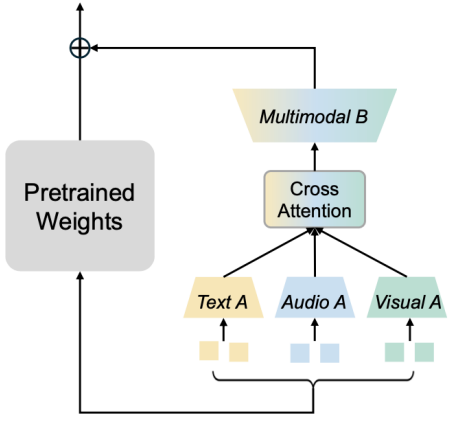
● 现在我理解了当前设计：image token 作为 query，question token 作为 key/value。

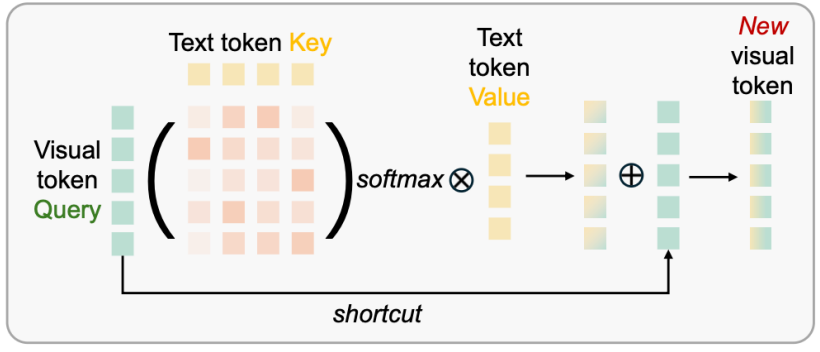
  要改为 question token 作为 query，image token 作为 key/value，只需修改 Linear.forward
  中的 cross-attention 块（第 627-653 行）：

● Update(modified_peft/tuners/lora/layer.py)

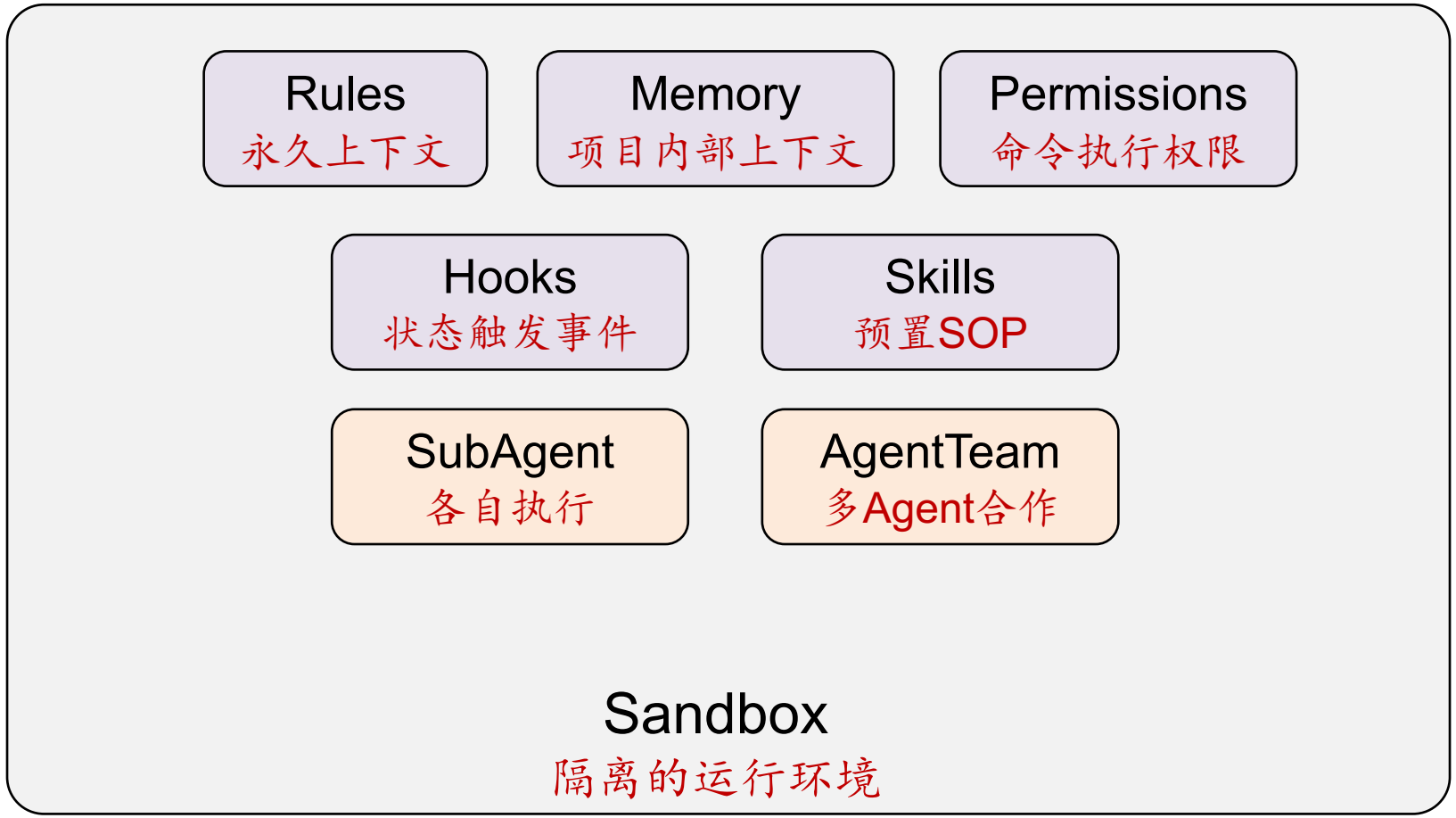
Edit file
modified_peft/tuners/lora/layer.py
623                     # Step 2: reshape 回 batch 维度，进行 cross attention
624                     lora_A_output = lora_A_output_flat.reshape(batch, seq_len, 1)
625
626 -                   # 如果有 question_mask，对 image token 和 question token 做 cross
    -attention
626 +                   # 如果有 question_mask，对 question token 和 image token 做 cross
    +attention
627                     if (image_mask_flat == 1).any():
628                         for i in range(batch):
629 -                           # 获取当前样本的 image token 索引
630 -                           image_indices = torch.where(my_image_mask[i] == 1)[0]
631 -                           if len(image_indices) == 0:
632 -                               continue
633 -
```

如何基于该项目进行拓展？此时以MokA中的交互模块设计为示例。



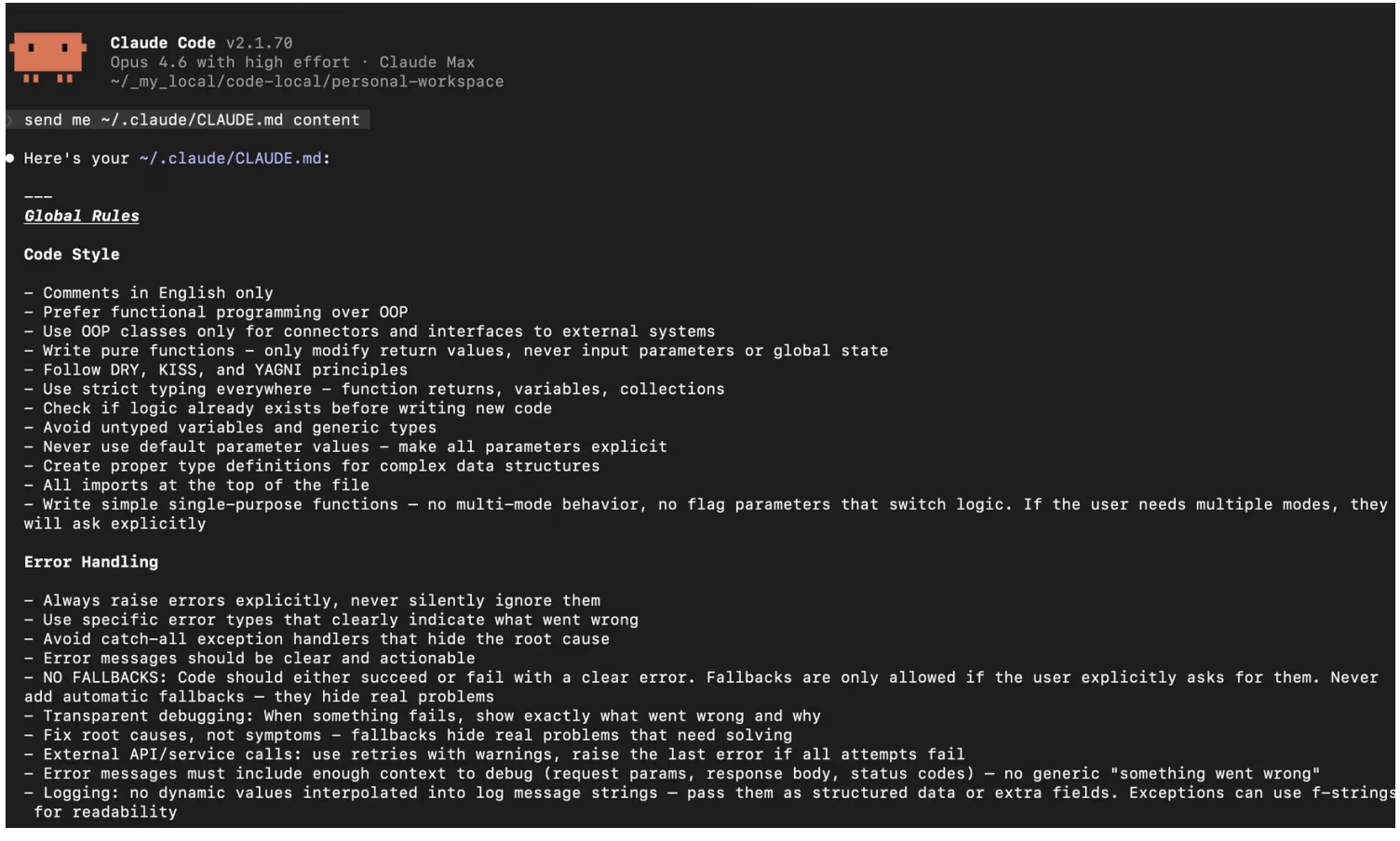
# 基础要点


Rules
永久上下文
Memory
项目内部上下文
Permissions
命令执行权限
Hooks
状态触发事件
Skills
预置SOP
SubAgent
各自执行
AgentTeam
多Agent合作
Sandbox
隔离的运行环境

# Rules-全局上下文

## Rules：~/.claude/CLAUDE.md

永久上下文，每次新session都会载入，显式制定规则，例如coding style，错误处理等等。
不建议太长， 如有需求可以拆解为多个markdown，按需载入




```
.claude/rules/
├── code-style.md
├── testing.md
├── api-conventions.md
└── security.md
```

# Memory-项目内上下文

**Memory：~/.claude/projects/<project>/memory/**

Claude code会为每个项目维护memory目录，MEMORY.md为入口文件，在整个会话期间，Claude 会读取和写入此目录中的文件。

记录当前项目的debug信息，以及当前项目需要遵循的要求等等。

```
~/.claude/projects/<project>/memory/
├── MEMORY.md          # Concise index, loaded into every session
├── debugging.md       # Detailed notes on debugging patterns
├── api-conventions.md # API design decisions
└── ...                # Any other topic files Claude creates
```

# Permissions-可执行边界

## Permissions：/permissions

如何防止cli agent删库？

Allow，Ask，Deny

| Tool type | Example | Approval required | ”Yes, don’t ask again” behavior |
|---|---|---|---|
| Read-only | File reads, Grep | No | N/A |
| Bash commands | Shell execution | Yes | Permanently per project directory and command |
| File modification | Edit/write files | Yes | Until session end |

```
/permissions

Permissions:  Recently denied   Allow   Ask   Deny   Workspace

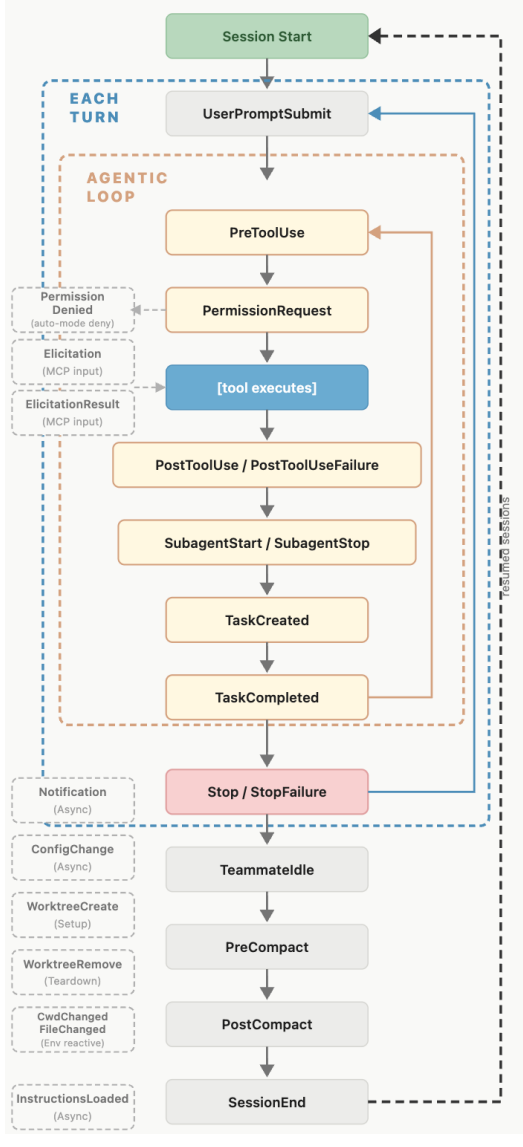
Claude Code can read files in the workspace, and make edits when auto-accept edits
is on.

  -  /Users/ykw/Downloads/demo/MokA (Original working directory)
  1. Add directory…
```

# Hooks-自动化

## Why Hooks?

- 自定义的shell命令，执行确定性脚本，在session的生命周期的特定环节触发。
- Event-driven automations.
- 需要指定：什么时候触发、针对什么操作、运行什么脚本




一个session的生命周期

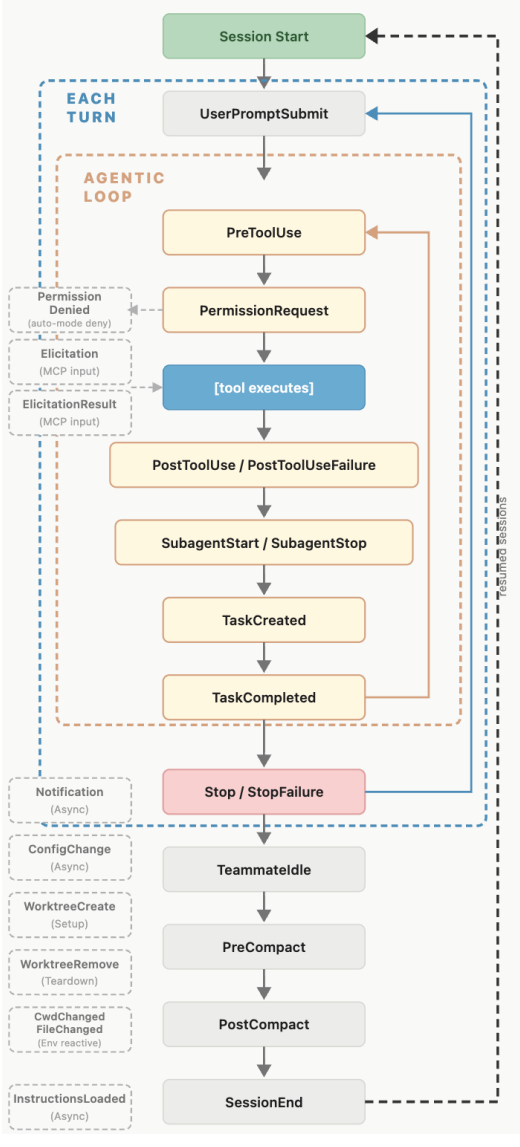
# Hooks-自动化

```
{
  "hooks": {
    "CwdChanged": [
      {
        "hooks": [
          {
            "type": "command",
            "command": "direnv export bash >> \"$CLAUDE_ENV_FILE\""
          }
        ]
      }
    ]
  }
}
```

在文件切换时切换不同的环境变量

```
{
  "hooks": {
    "PostToolUse": [
      {
        "matcher": "Edit|Write",
        "hooks": [
          {
            "type": "command",
            "command": "jq -r '.tool_input.file_path' | xargs npx prettier --write"
          }
        ]
      }
    ]
  }
}
```

编辑后自动格式化代码




一个session的生命周期

# Skills-标准化

## Why Skills?

- 大模型的SOP，抽象和复用能力，把流程标准化，避免反复说明，模型反复进行思考消耗。
- 可以是需要注入的domain knowledge，可以是对某类型文件的多种操作，可以是任一固定流程
- 包含背景信息、工具使用说明、参考范式/格式规范等等
  - 处理pdf，xlsx等各种格式文件
  - 抓取并总结当日hugging face daily paper，保存到Notion页面
  - 在指定的标准benchmark评测模型
  - 等等

# Skills-标准化

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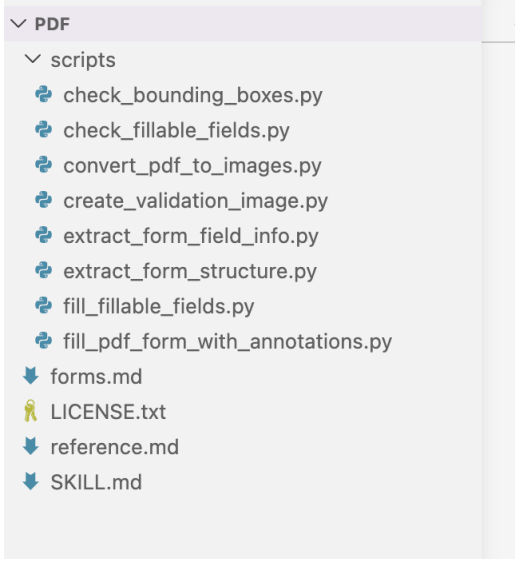
- 渐进式披露




```
---
name: pdf
description: Use this skill whenever the user wants to do anything with PDF files. This includes reading or extracting text/tables from PDFs, combining or merging multiple PDFs into one, splitting PDFs apart, rotating pages, adding watermarks, creating new PDFs, filling PDF forms, encrypting/decrypting PDFs, extracting images, and OCR on scanned PDFs to make them searchable. If the user mentions a .pdf file or asks to produce one, use this skill.
license: Proprietary. LICENSE.txt has complete terms
---

# PDF Processing Guide

## Overview

This guide covers essential PDF processing operations using Python libraries and command-line tools. For advanced features, JavaScript libraries, and detailed examples, see REFERENCE.md. If you need to fill out a PDF form, read FORMS.md and follow its instructions.

## Quick Start

```python
from pypdf import PdfReader, PdfWriter

# Read a PDF
reader = PdfReader("document.pdf")
print(f"Pages: {len(reader.pages)}")

# Extract text
text = ""
for page in reader.pages:
    text += page.extract_text()
```
```

```
## Python Libraries

### pypdf - Basic Operations

#### Merge PDFs
```python
from pypdf import PdfWriter, PdfReader

writer = PdfWriter()
for pdf_file in ["doc1.pdf", "doc2.pdf", "doc3.pdf"]:
    reader = PdfReader(pdf_file)
    for page in reader.pages:
        writer.add_page(page)

with open("merged.pdf", "wb") as output:
    writer.write(output)
```

#### Split PDF
```python
reader = PdfReader("input.pdf")
for i, page in enumerate(reader.pages):
    writer = PdfWriter()
    writer.add_page(page)
    with open(f"page_{i+1}.pdf", "wb") as output:
        writer.write(output)
```
```

SKILL.md

# Skills-标准化

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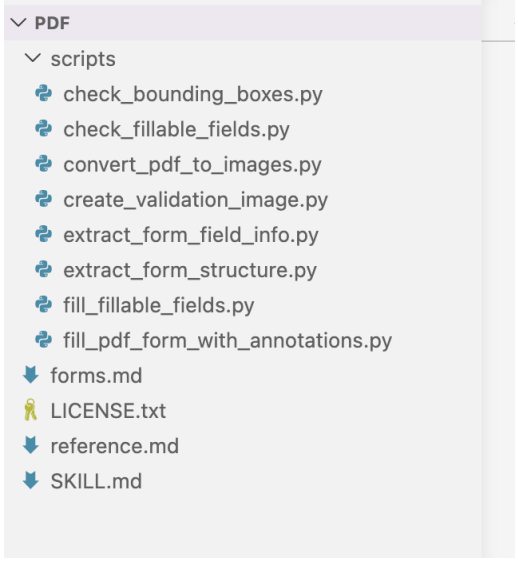
- 渐进式披露

**Skill姓名及描述：始终加载（~100 token）**




```
---
name: pdf
description: Use this skill whenever the user wants to do anything with PDF
files. This includes reading or extracting text/tables from PDFs, combining
or merging multiple PDFs into one, splitting PDFs apart, rotating pages,
adding watermarks, creating new PDFs, filling PDF forms, encrypting/
decrypting PDFs, extracting images, and OCR on scanned PDFs to make them
searchable. If the user mentions a .pdf file or asks to produce one, use
this skill.
license: Proprietary. LICENSE.txt has complete terms
---

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    for page in reader.pages:
        writer.add_page(page)

with open("merged.pdf", "wb") as output:
    writer.write(output)
```

#### Split PDF
```python
reader = PdfReader("input.pdf")
for i, page in enumerate(reader.pages):
    writer = PdfWriter()
    writer.add_page(page)
    with open(f"page_{i+1}.pdf", "wb") as output:
        writer.write(output)
```
```

**SKILL.md**

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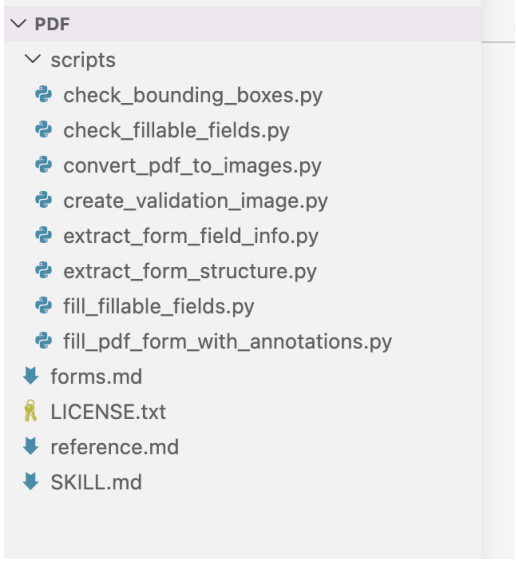


Skill姓名及描述：始终加载（~100 token）

```
---
name: pdf
description: Use this skill whenever the user wants to do anything with PDF files. This includes reading or extracting text/tables from PDFs, combining or merging multiple PDFs into one, splitting PDFs apart, rotating pages, adding watermarks, creating new PDFs, filling PDF forms, encrypting/decrypting PDFs, extracting images, and OCR on scanned PDFs to make them searchable. If the user mentions a .pdf file or asks to produce one, use this skill.
license: Proprietary. LICENSE.txt has complete terms
---

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```
```

具体的事件描述及处理方式

```
## Python Libraries

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        writer.add_page(page)

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    writer.write(output)
```

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    writer = PdfWriter()
    writer.add_page(page)
    with open(f"page_{i+1}.pdf", "wb") as output:
        writer.write(output)
```
```

可能涉及对python脚本，shell命令的执行

SKILL.md

# Skills-标准化

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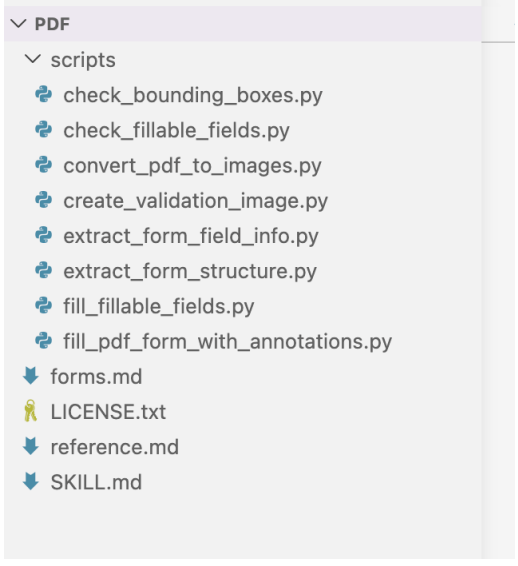
- 包含背景信息、工具使用说明、参考范式/格式规范等等
- 渐进式披露

SKILL.md中的其他内容：触发时加载（<5k token）

两种触发方式：

1. 模型生成过程中若判定需求与该skill匹配，则读取
2. 用户主动在prompt中斜杠调用




文件夹中的其他内容：按需加载（长度不限）

执行该skill过程中若需要则加载，SKILL.md中可能链接到文件夹中的其他资源

Skill姓名及描述：始终加载（~100 token）

```
---
name: pdf
description: Use this skill whenever the user wants to do anything with PDF files. This includes reading or extracting text/tables from PDFs, combining or merging multiple PDFs into one, splitting PDFs apart, rotating pages, adding watermarks, creating new PDFs, filling PDF forms, encrypting/decrypting PDFs, extracting images, and OCR on scanned PDFs to make them searchable. If the user mentions a .pdf file or asks to produce one, use this skill.
license: Proprietary. LICENSE.txt has complete terms
---

# PDF Processing Guide

## Overview

This guide covers essential PDF processing operations using Python libraries and command-line tools. For advanced features, JavaScript libraries, and detailed examples, see REFERENCE.md. If you need to fill out a PDF form, read FORMS.md and follow its instructions.

## Quick Start

```python
from pypdf import PdfReader, PdfWriter

# Read a PDF
reader = PdfReader("document.pdf")
print(f"Pages: {len(reader.pages)}")

# Extract text
text = ""
for page in reader.pages:
    text += page.extract_text()
```
```

具体的事件描述及处理方式

SKILL.md

```
## Python Libraries

### pypdf - Basic Operations

#### Merge PDFs
```python
from pypdf import PdfWriter, PdfReader

writer = PdfWriter()
for pdf_file in ["doc1.pdf", "doc2.pdf", "doc3.pdf"]:
    reader = PdfReader(pdf_file)
    for page in reader.pages:
        writer.add_page(page)

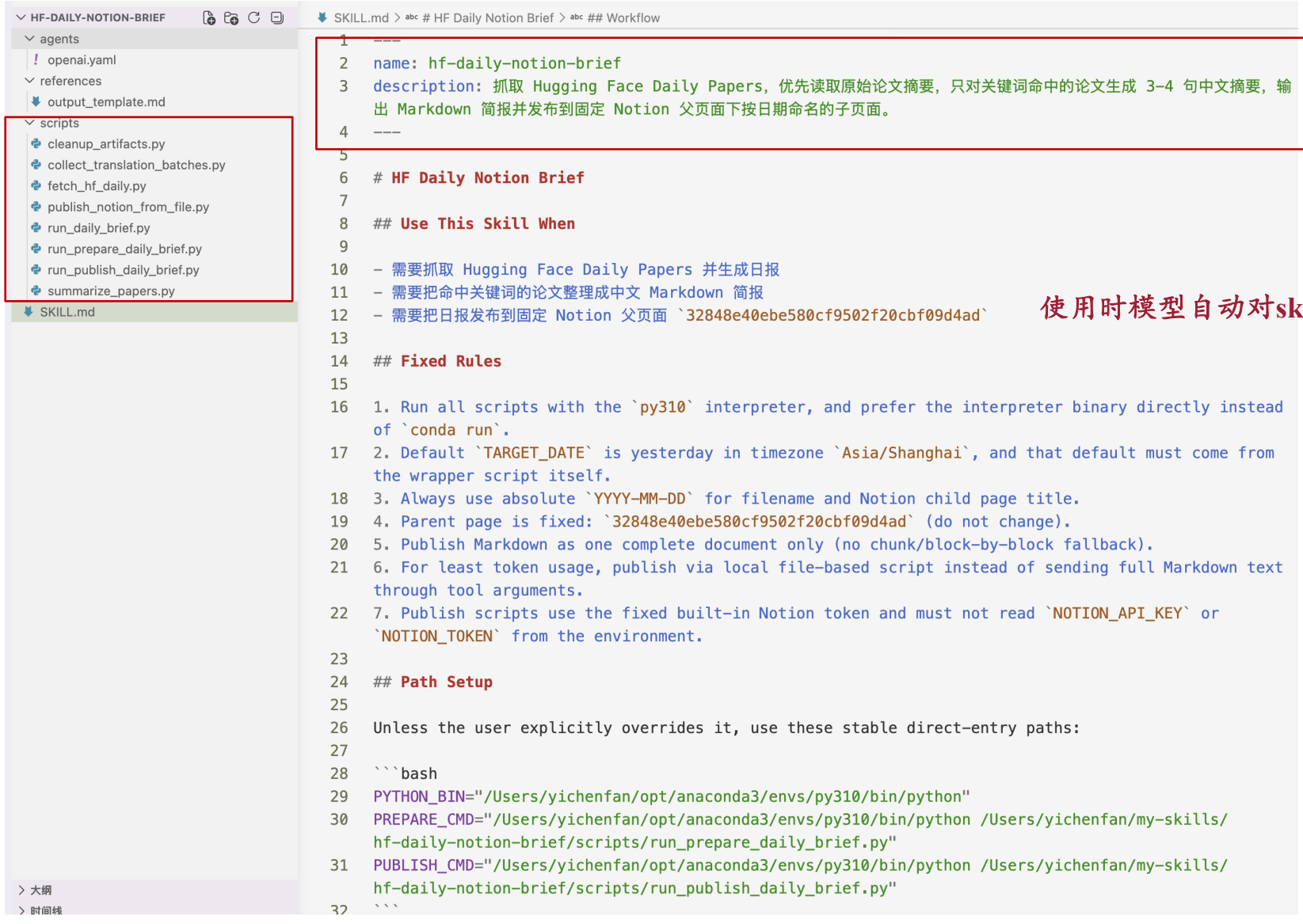
with open("merged.pdf", "wb") as output:
    writer.write(output)
```

#### Split PDF
```python
reader = PdfReader("input.pdf")
for i, page in enumerate(reader.pages):
    writer = PdfWriter()
    writer.add_page(page)
    with open(f"page_{i+1}.pdf", "wb") as output:
        writer.write(output)
```
```

可能设计对python脚本，shell命令的执行

# Skills-标准化

一个抓取每日论文的skill例子




使用时模型自动对skill具体内容进行改进

# Skills-标准化

**Why Skills?**

- 大模型的SOP，抽象和复用能力，把流程标准化，避免反复说明，模型反复进行思考消耗。
- 可以是需要注入的domain knowledge，可以是对某类型文件的多种操作，可以是任一固定流程
- 包含背景信息、工具使用说明、参考范式/格式规范等等
  - 处理pdf，xlsx等各种格式文件
  - 抓取并总结当日hugging face daily paper，保存到Notion页面
  - 在指定的标准benchmark评测模型
  - 等等

- 不建议载入过多skills。占用过多context长度，且尤其在session窗口context已经比较长的情况下，模型无法回溯到注入的skills信息。
- 在输入的指令圈定可能使用的skills范围，减少模型的大范围搜索

# Sandbox-受限环境安全运行

## Why Sandbox?

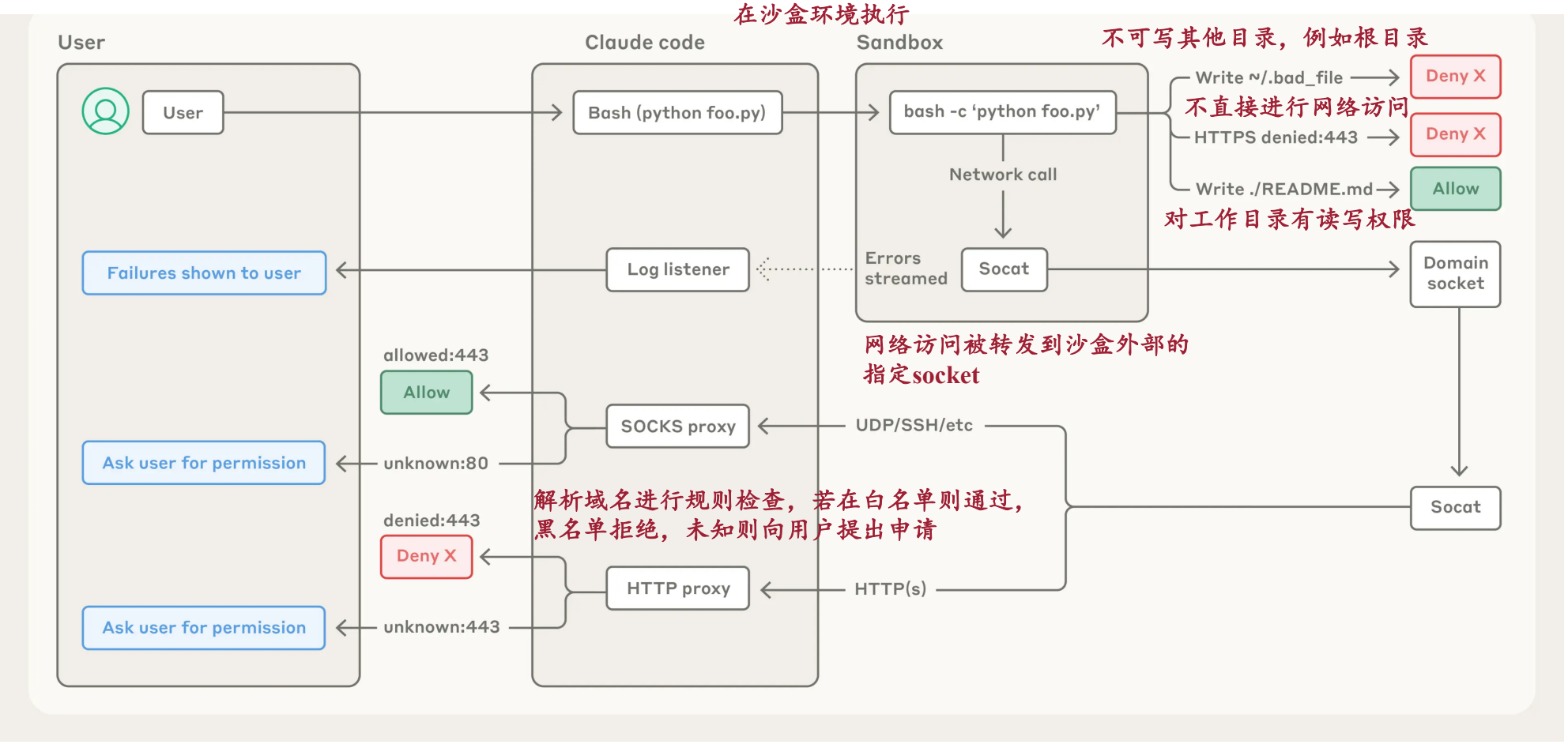
- 多次审批造成疲劳感
- 影响生产力，减慢开发流程
- 干扰模型自主性

## How?

- 明确权限范围
- 减少审批提示
- 增强自主性

# Sandbox-受限环境安全运行

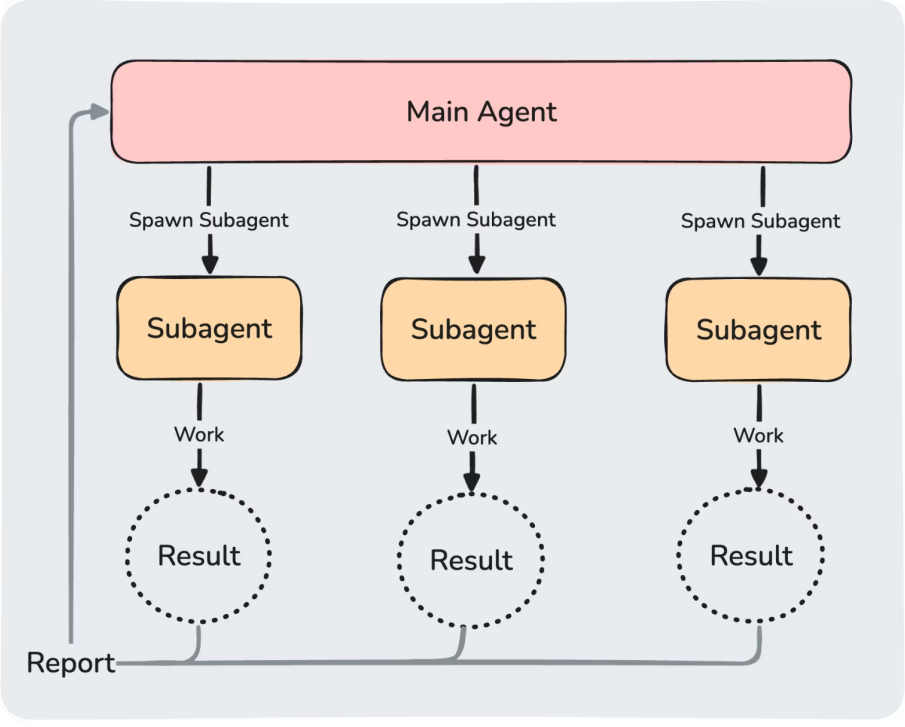
Claude Code沙盒设计：文件系统隔离&网络隔离



# 应对复杂任务：Subagents与Agent Team

## Why Subagent?

- 执行特定任务，在隔离的session中完成任务，节省/避免污染主session的context
- 对于特定任务，可以在隔离的session中给出更精准的instruction，避免主session的context影响特定任务
- 将明确、固定的特定任务交给成本更低的模型，节省成本。例如，主session用opus，subagent用haiku
- 跨项目复用subagent
- Main agent调用或用户触发



# 应对复杂任务：Subagents与Agent Team

还是抓取每日论文的skill例子，对于中文摘要总结采用单独的子程序处理，隔离context，并行加速

```
## Translation Prompt Template

When running subagents on the exported translation jobs, use a prompt with these
constraints:

- Read one JSON item at a time or a small batch of items from the local jobs
file.
- For each item, write `summary_zh` as 3-4 Chinese sentences.
- Stay faithful to the full English abstract.
- Preserve model names, dataset names, benchmark names, metrics, percentages,
and technical terms.
- Do not add commentary like `这篇文章主要讲了`.
- Output strict JSON only.
```

```
Recommended per-item prompt shape:

```text
你在处理机器学习论文摘要。请基于给定的完整英文摘要，写 3-4 句忠实、紧凑的中文摘要。
要求：
1. 保留方法、任务、数据集、指标、结果等关键信息。
2. 不要编造原文没有的信息。
3. 不要输出解释、前言或 Markdown。
4. 只输出一个 JSON 对象，格式为 {"index":<int>,"summary_zh":"..."}。
```

Expected translation job item shape:

```json
{
  "index": 0,
  "title": "Paper title",
  "topics": ["LLM", "Multimodal"],
  "summary": "Full English abstract..."
}
```
```

SKILL.md

共有 22 个待翻译条目，所以这轮按规则起 6 个子代理，批次会是 `4/4/4/4/3/3` 。我先把每批 jobs 写到独立的临时文件，再并行分发。

后台终端已完成以及 /Users/yichenfan/opt/anaconda3/envs/py310/bin/python - <<'PY' import json from pathlib impor...

已生成6 个智能体

已根据以下指令创建 Mendel (worker)：Translate the ML paper abstracts in /tmp/hf_batch_jobs_0.json into Chinese su...
已根据以下指令创建 Huygens (worker)：Translate the ML paper abstracts in /tmp/hf_batch_jobs_1.json into Chinese su...
已根据以下指令创建 Popper (worker)：Translate the ML paper abstracts in /tmp/hf_batch_jobs_2.json into Chinese su...
已根据以下指令创建 Kierkegaard (worker)：Translate the ML paper abstracts in /tmp/hf_batch_jobs_3.json into Chines...
已根据以下指令创建 Kepler (worker)：Translate the ML paper abstracts in /tmp/hf_batch_jobs_4.json into Chinese sum...
已根据以下指令创建 Meitner (worker)：Translate the ML paper abstracts in /tmp/hf_batch_jobs_5.json into Chinese su...

6 个翻译子代理已经分发出去了，每个只负责自己的 batch 文件，不会互相覆盖。我现在等第一轮全部落盘，然后按技能要求一次性 merge，再走 publish wrapper。

# 应对复杂任务：Subagents与Agent Team

## Why Agent team?

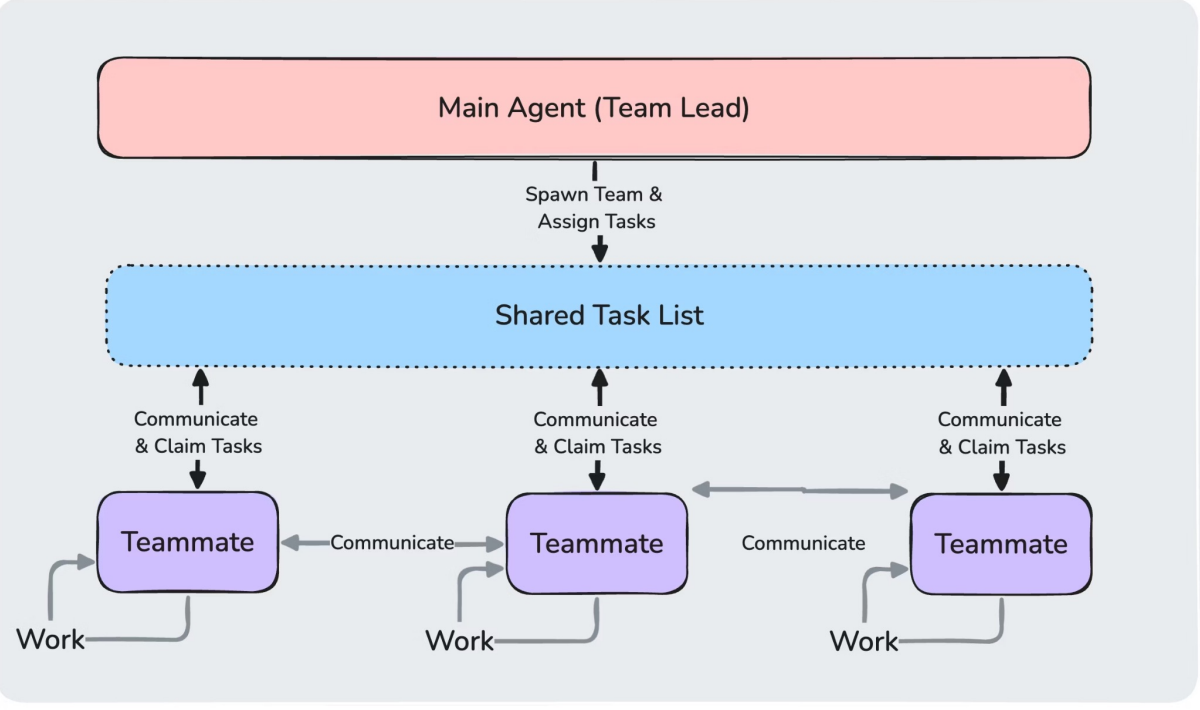
- Agent之间需要交流
- 需要多方面review正确性
- 并行处理讨论，更快收敛到正确答案

**分别针对不同方面进行code review**

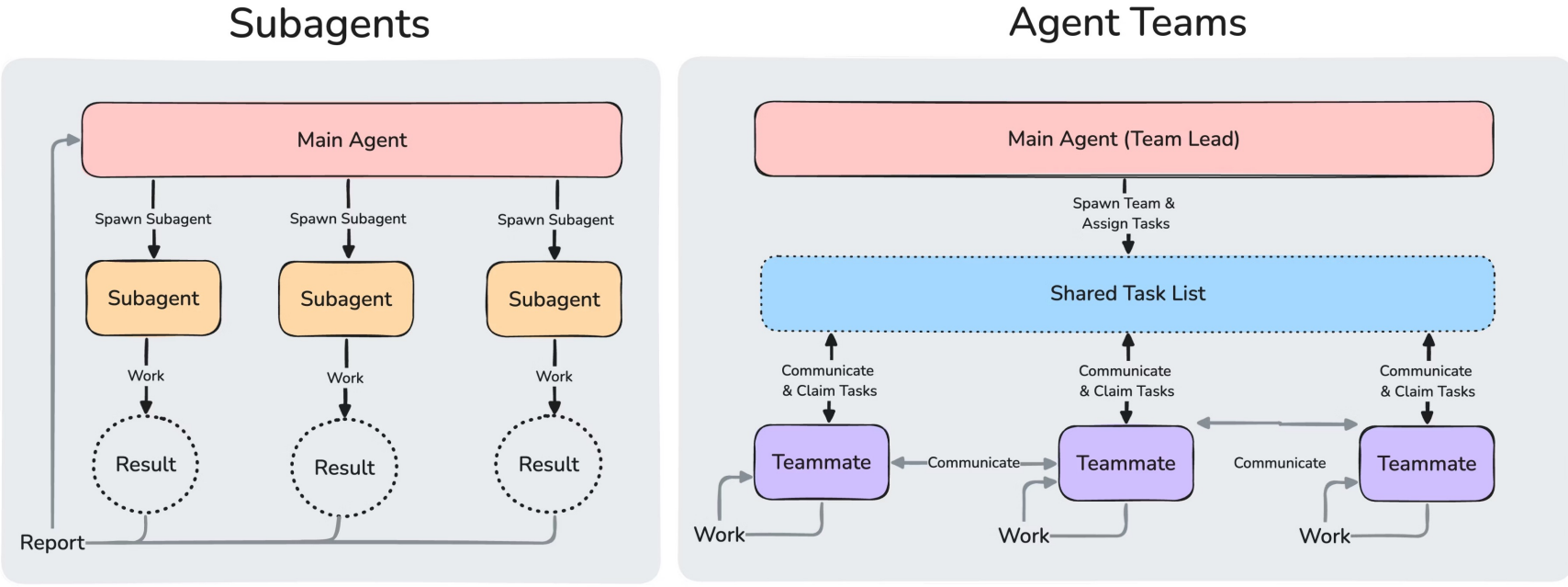
```
Create an agent team to review PR #142. Spawn three reviewers:
- One focused on security implications
- One checking performance impact
- One validating test coverage
Have them each review and report findings.
```

**对于code issue，并行开展检查，并且进行debate**

```
Users report the app exits after one message instead of staying connected.
Spawn 5 agent teammates to investigate different hypotheses. Have them talk to
each other to try to disprove each other's theories, like a scientific
debate. Update the findings doc with whatever consensus emerges.
```



# 应对复杂任务： Subagents与Agent Team

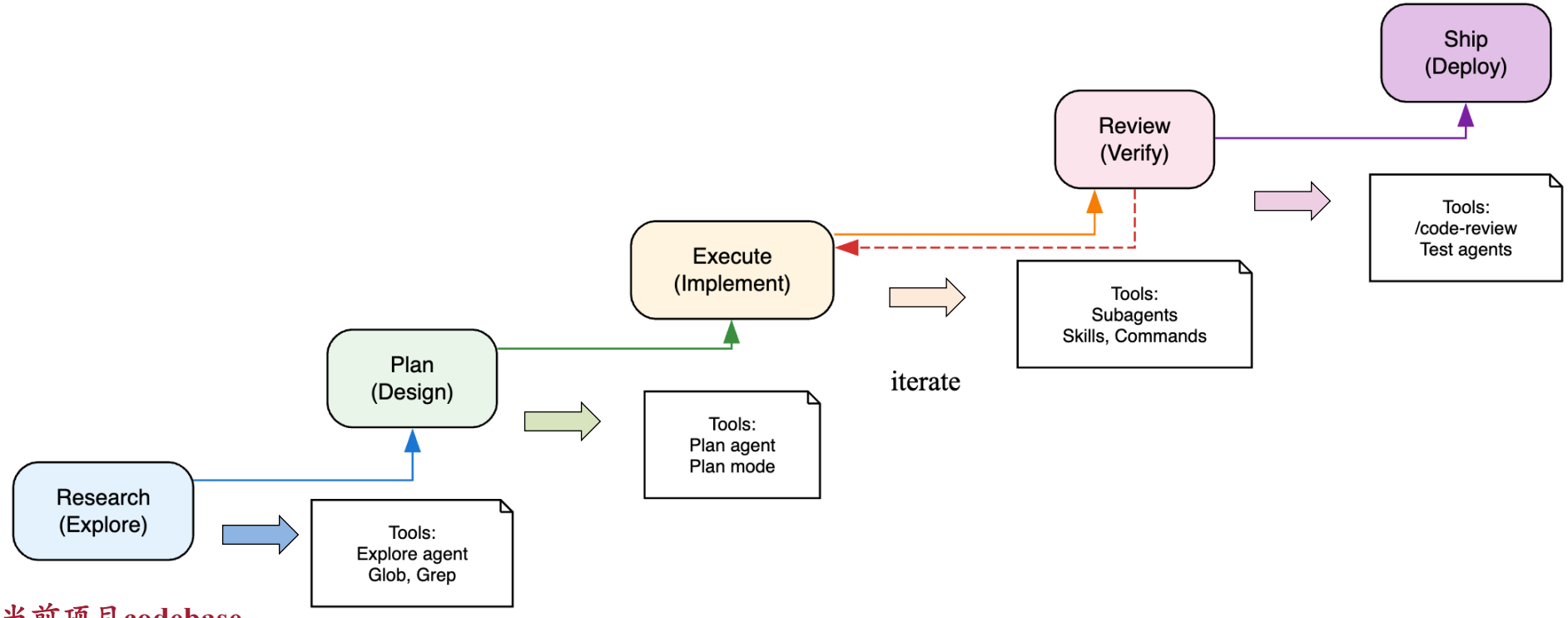



| | Subagents | Agent teams |
|---|---|---|
| **Context** | Own context window; results return to the caller | Own context window; fully independent |
| **Communication** | Report results back to the main agent only | Teammates message each other directly |
| **Coordination** | Main agent manages all work | Shared task list with self-coordination |
| **Best for** | Focused tasks where only the result matters | Complex work requiring discussion and collaboration |
| **Token cost** | Lower: results summarized back to main context | Higher: each teammate is a separate Claude instance |

是否需要agent之间交流　　仅执行　　需要讨论合作

# 工作实践：Explore、Plan、Execute、Review

- 先探索规划，再执行，同时review迭代
- 其中任意步骤之后都可以插入review，不仅是code review，也可以插入plan review
- 打磨 plan比修改bad code效率更高
- 使用markdown作为媒介，作为human-agent/agent-agent interface




探索当前项目codebase

充分了解背景信息以及需求

# 工作实践：Explore、Plan、Execute、Review

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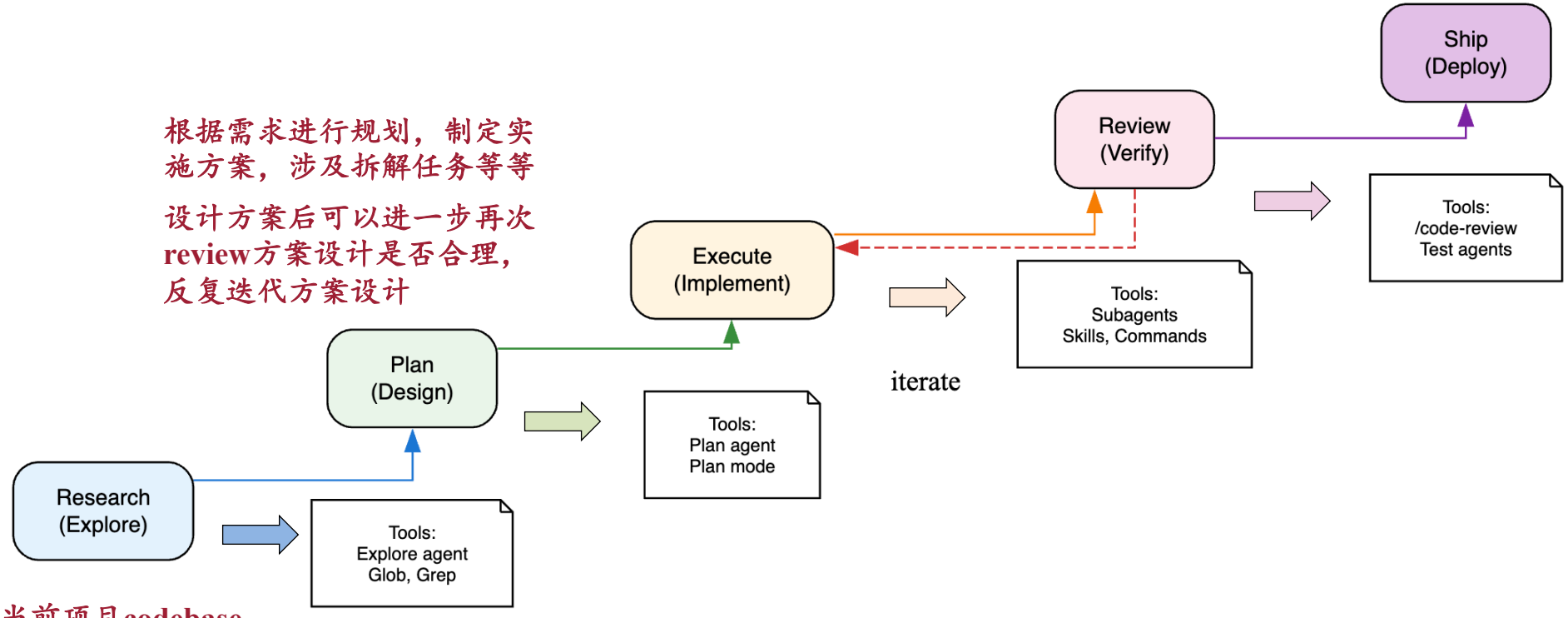

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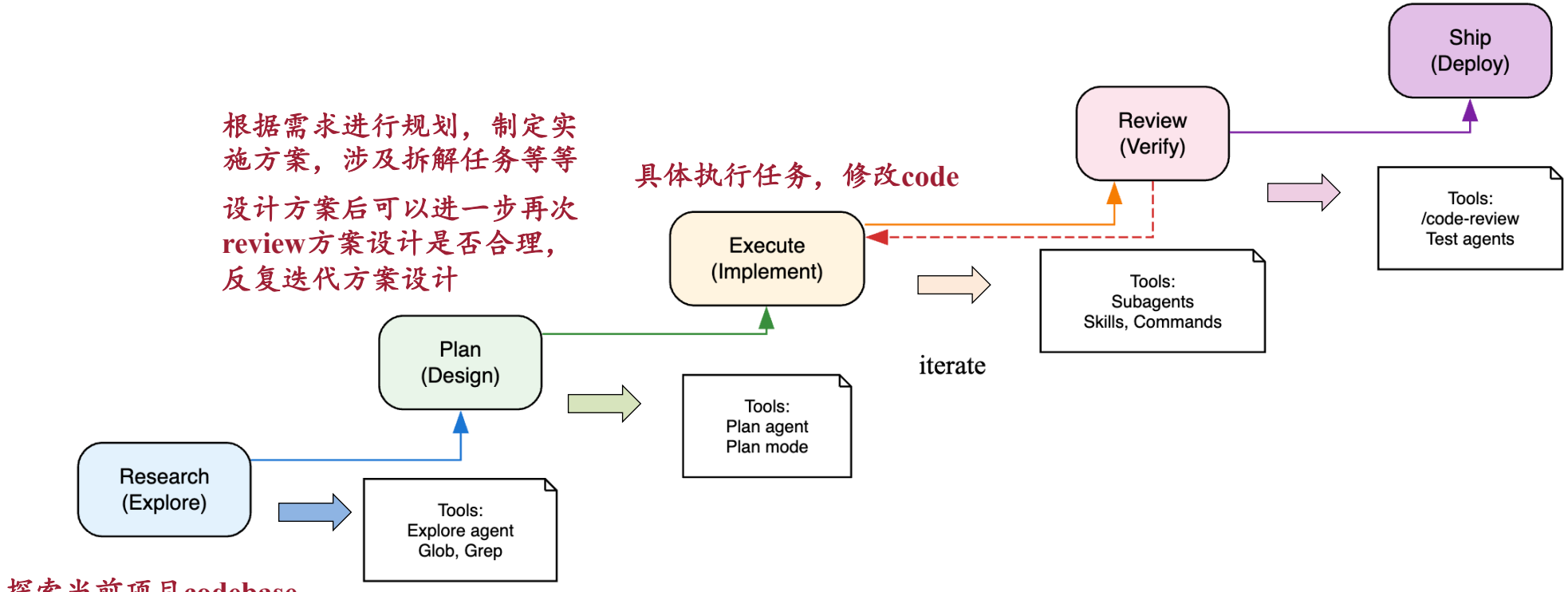

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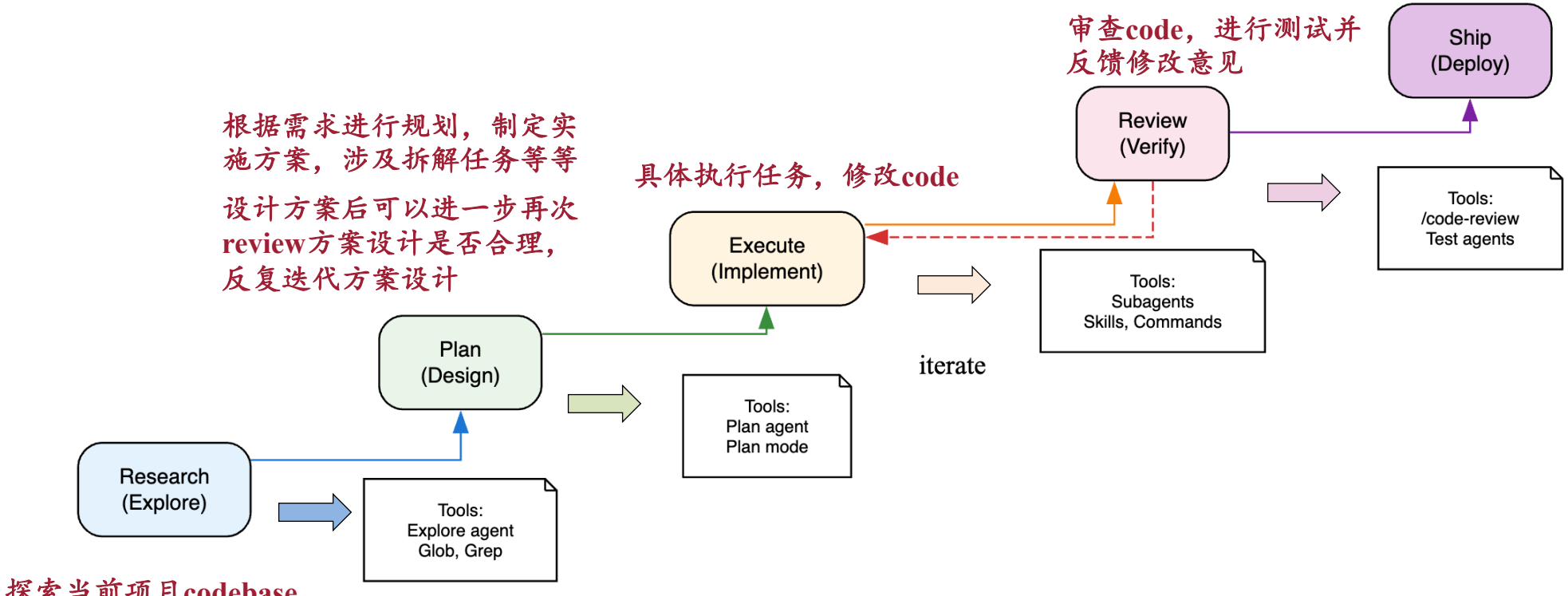
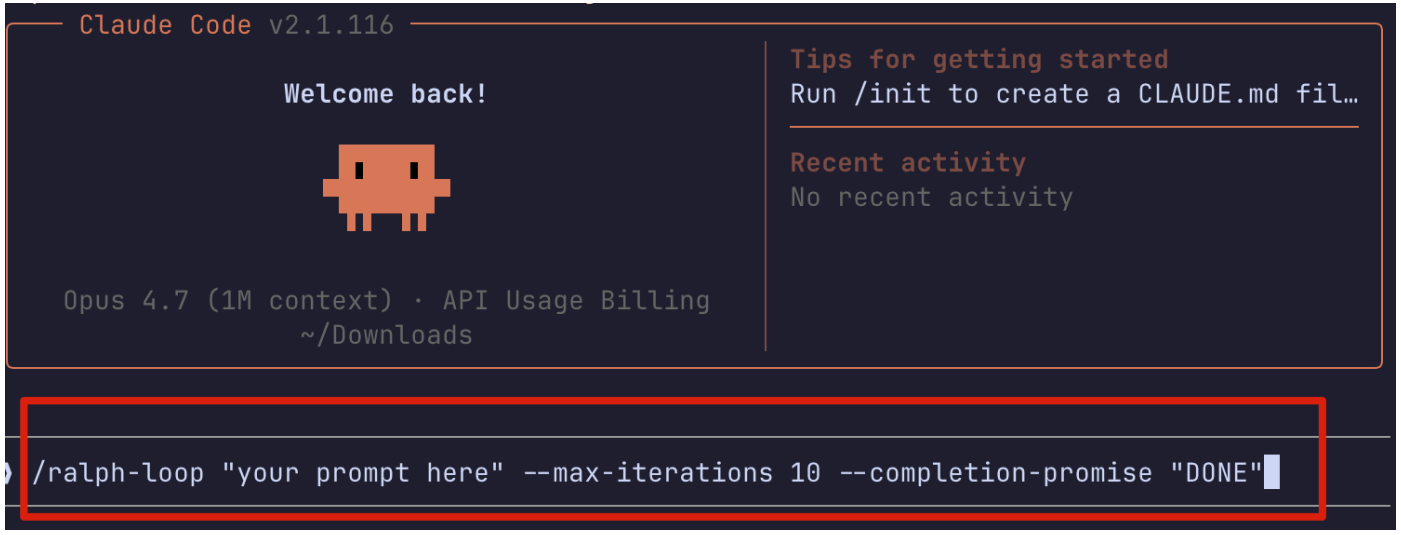
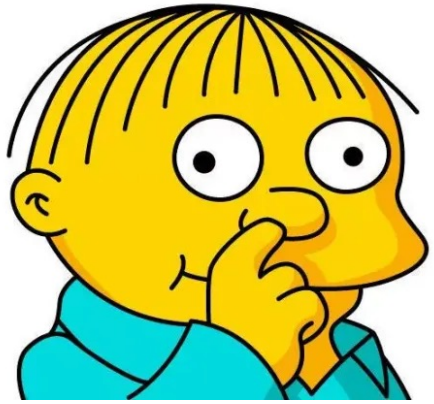


# 常用插件：Ralph Loop

- 自主迭代循环机制。给出一个任务和完成条件后，Agent开始执行该任务；
- 当模型在某次迭代中尝试结束时，一个 **Stop Hook** 会拦截试图退出的动作，并**重新注入原始任务提示**，从而创建一个自我参照的反馈循环。
- 在这个循环中，模型可以读取上一次迭代改动过的文件、测试结果和 git 历史，并据此**逐步修正自己的输出直到达到完成条件或达到设定的迭代上限**。

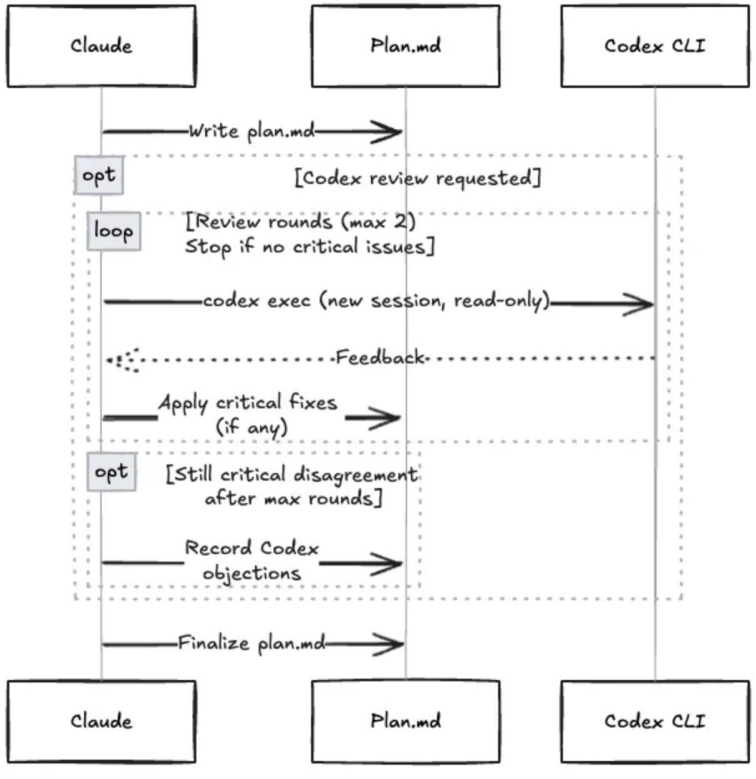


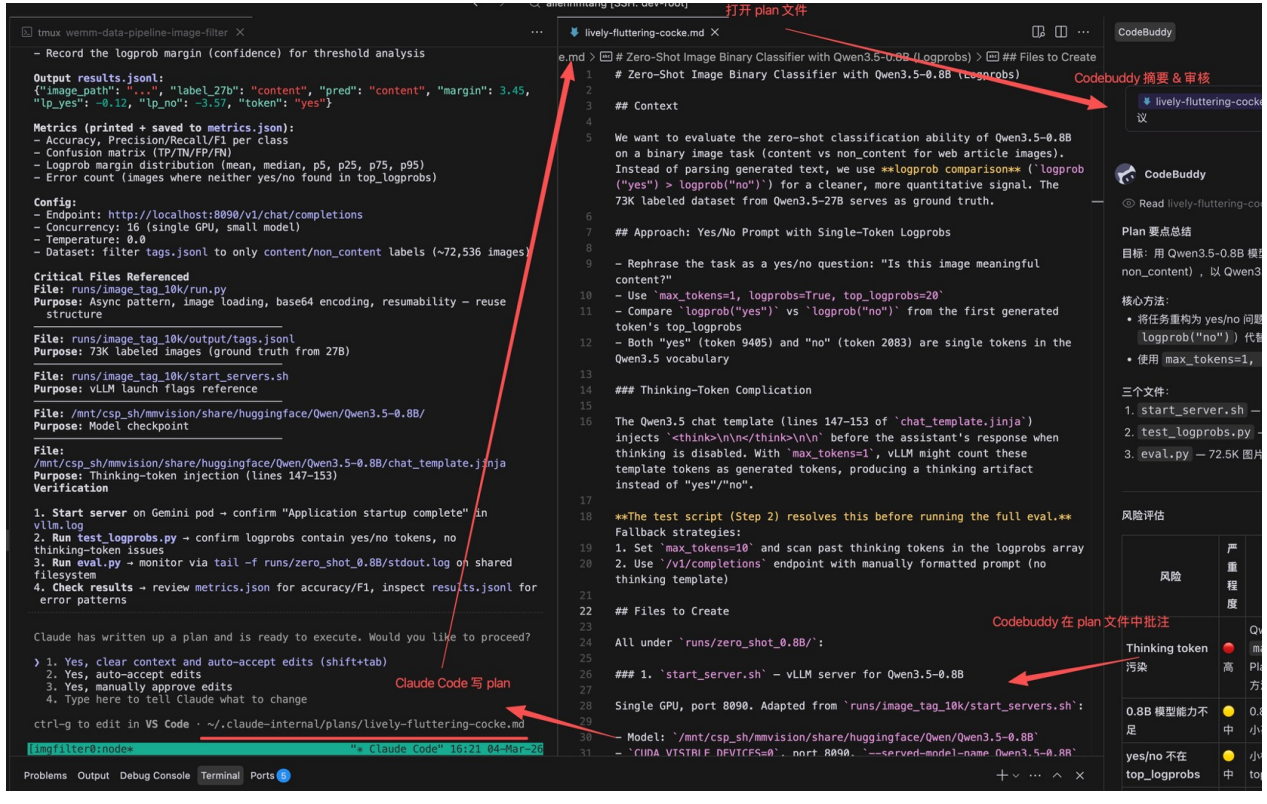



**Ralph Wiggum**
**《辛普森一家人》**

# 工作实践：多家模型协同

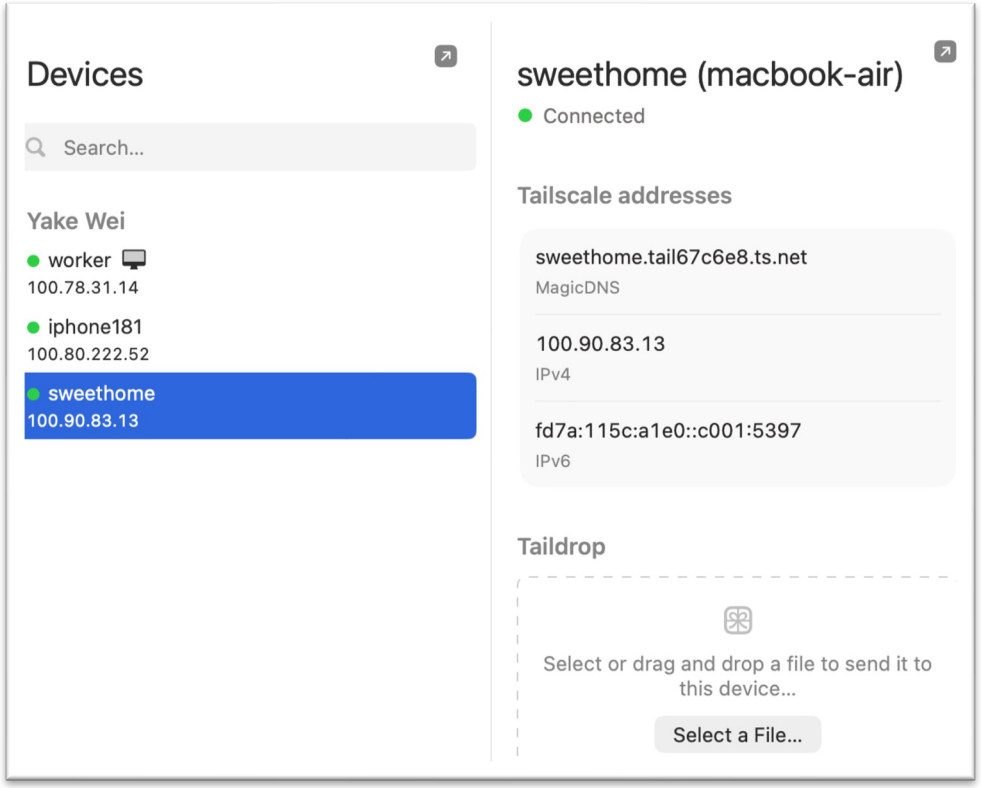
- Single-Model Blindness：使用一家模型，plan、execute、review是同一个， 既当运动员又当裁判，难以发现自身问题
- Claude Code已支持 /codex-review，在Claude Code中调用Codex中的gpt-5.5等模型进行review
- 或者可以直接基于markdown作为媒介，查阅批注plan，或者review代码



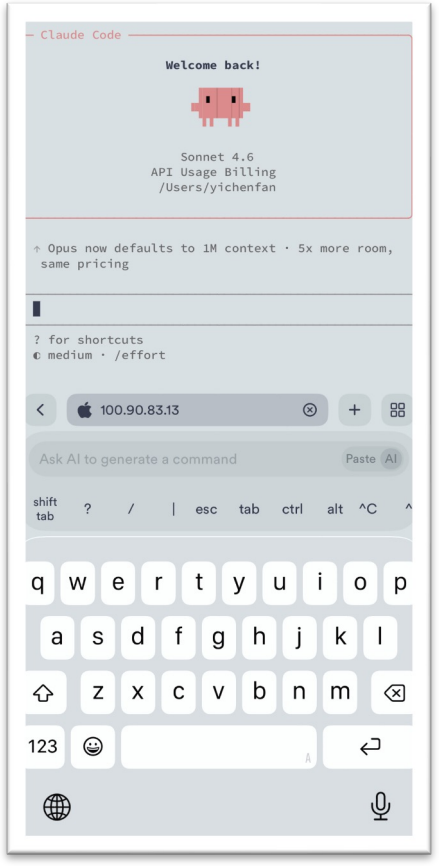
# 多端协作：tailscale+termius

- 哪里有命令行哪里就有agent




Tailscale组网，实现网络内设备互相访问

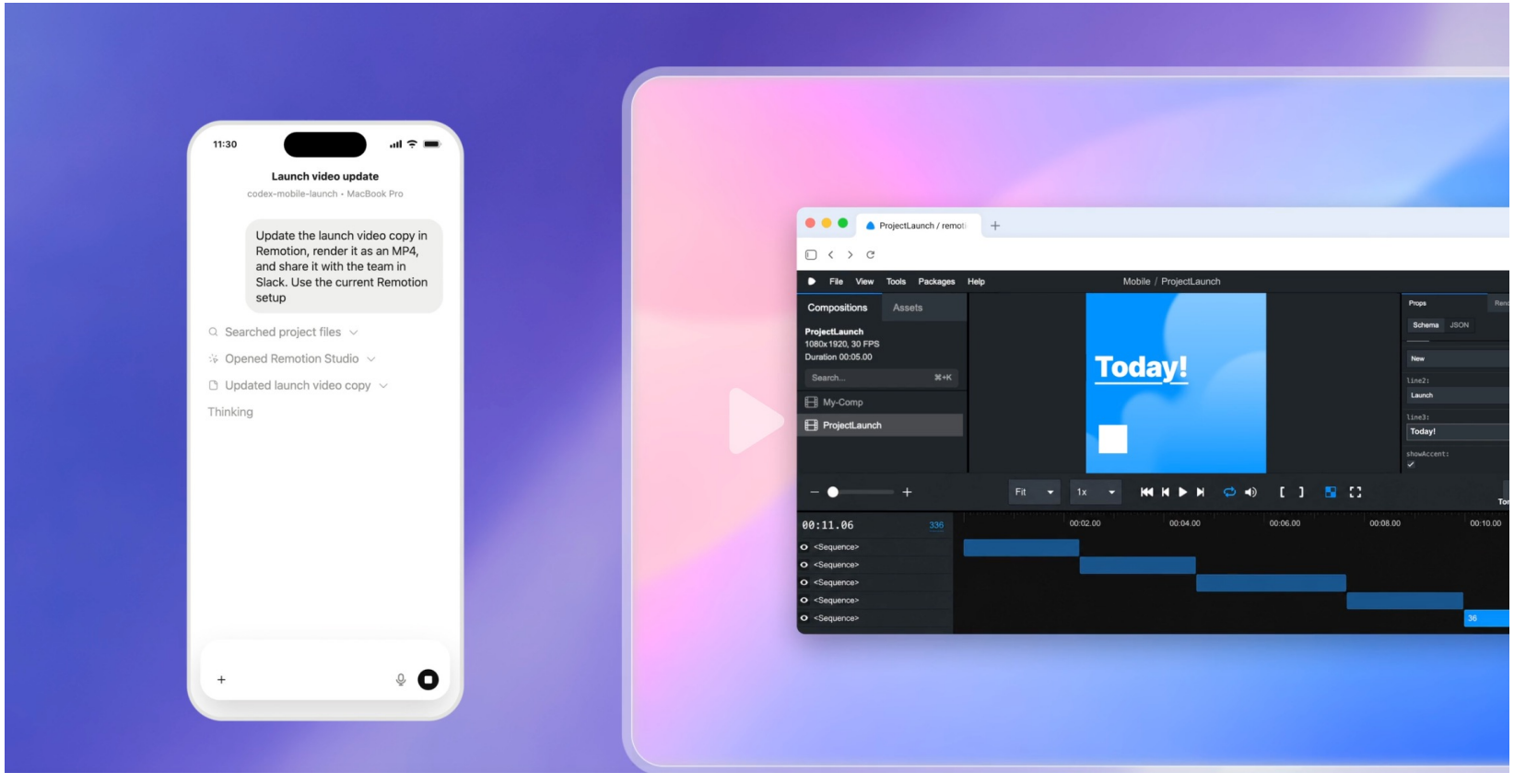
其中一台设备保持全天候运行，用于处理定时任务或长时任务



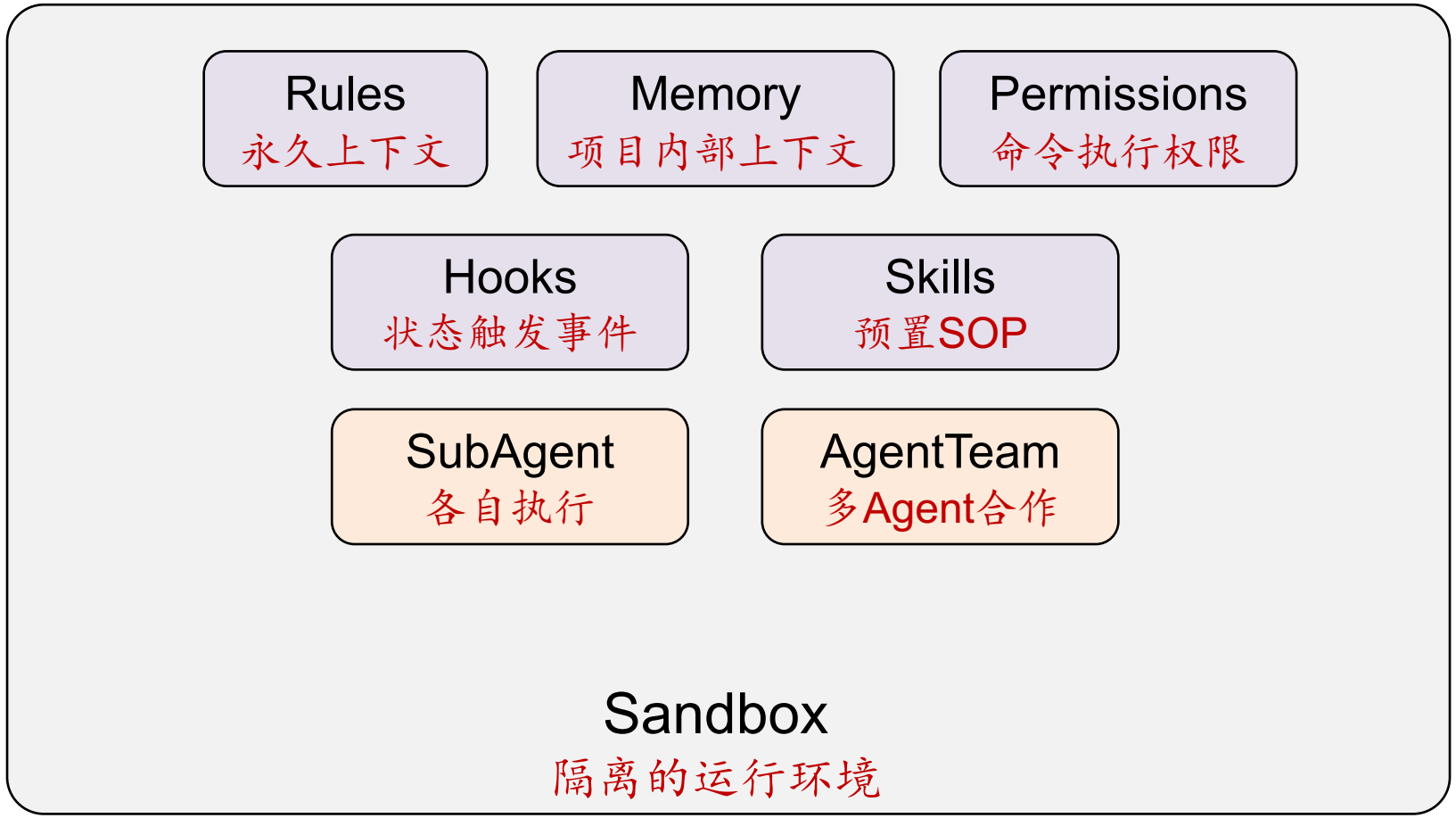

移动端同样可通过termius访问

# 多端协作：tailscale+termius

- Codex已支持多端协同（iOS+MacOS）
- 支持通过iPhone ChatGPT APP直接访问服务器



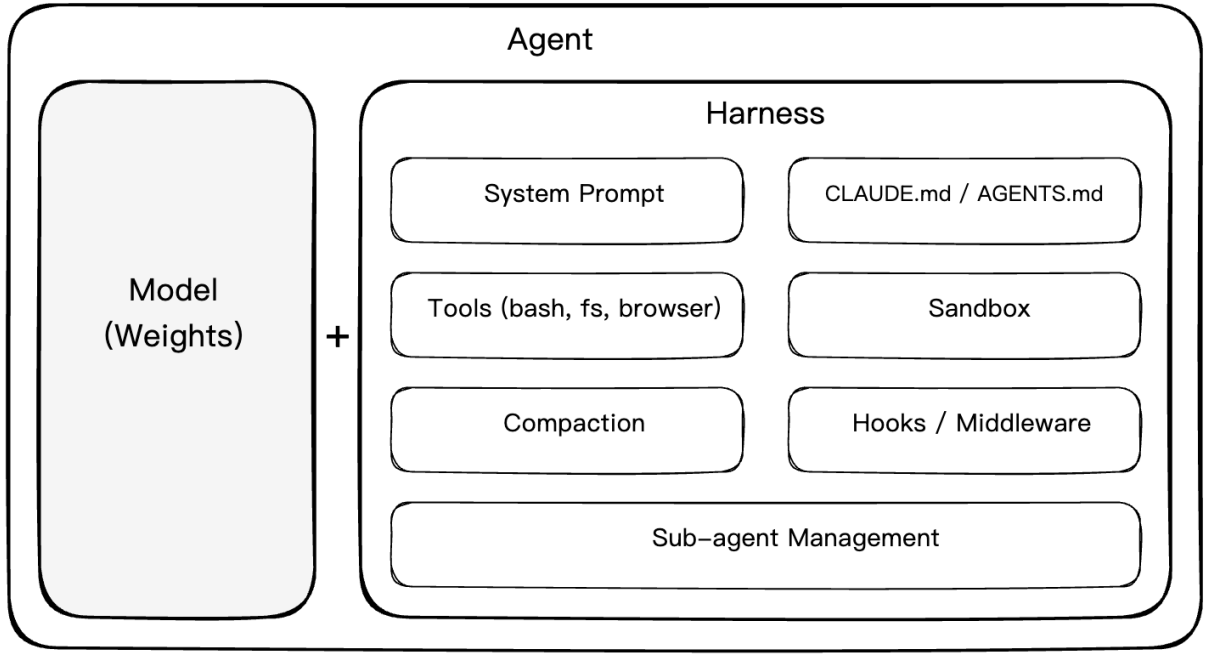
# 要点回顾


Rules
永久上下文
Memory
项目内部上下文
Permissions
命令执行权限
Hooks
状态触发事件
Skills
预置SOP
SubAgent
各自执行
AgentTeam
多Agent合作
Sandbox
隔离的运行环境

# Harness Engineering

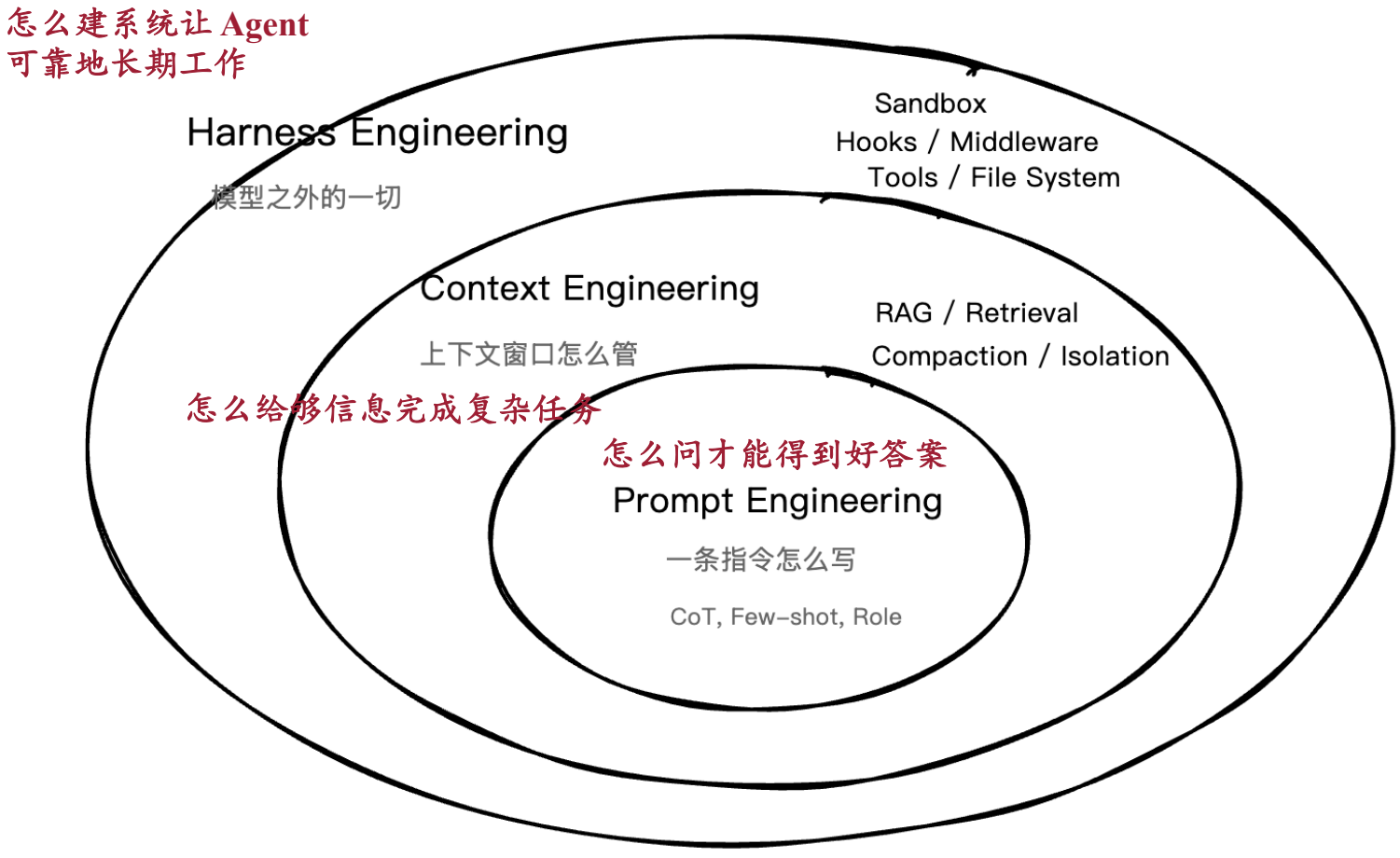
- 源于Mitchell Hashimoto的一篇博文和OpenAI的文章
- 从日常使用技巧，走到更系统化的方法论
- Harness：除了模型权重以外的一切

Agent = Model + Harness



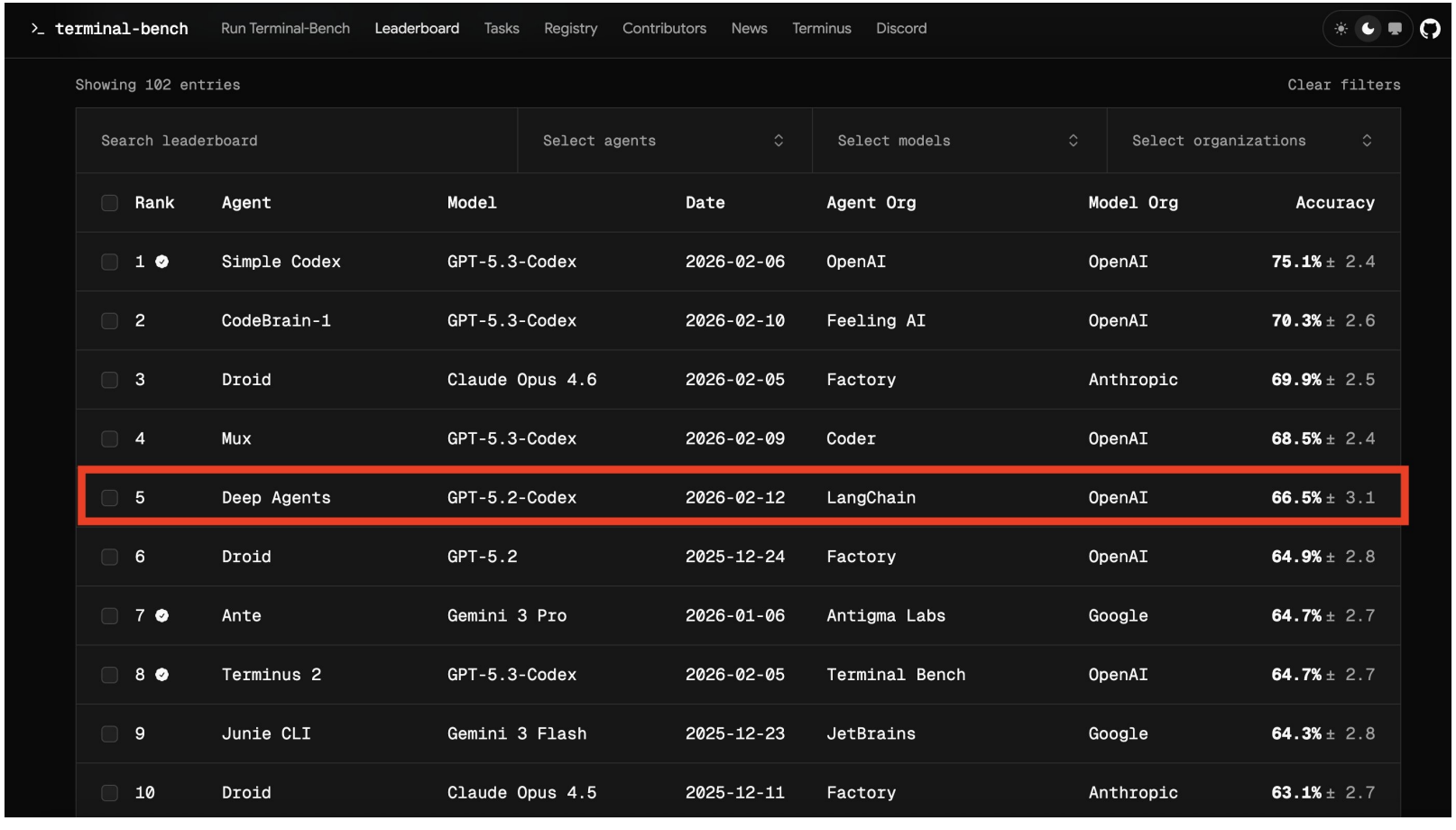
# Harness Engineering

- Prompt Engineering，Context Engineering与Harness Engineering



# 一个Harness Engineering案例

- LongChain团队的实验，仅通过Harness Engineering，在保持模型不变的情况下， 在Terminal Bench 2.0上的得分从52.8 提高到66.5，提高了13.7分。



terminal-bench | Run Terminal-Bench | Leaderboard | Tasks | Registry | Contributors | News | Terminus | Discord

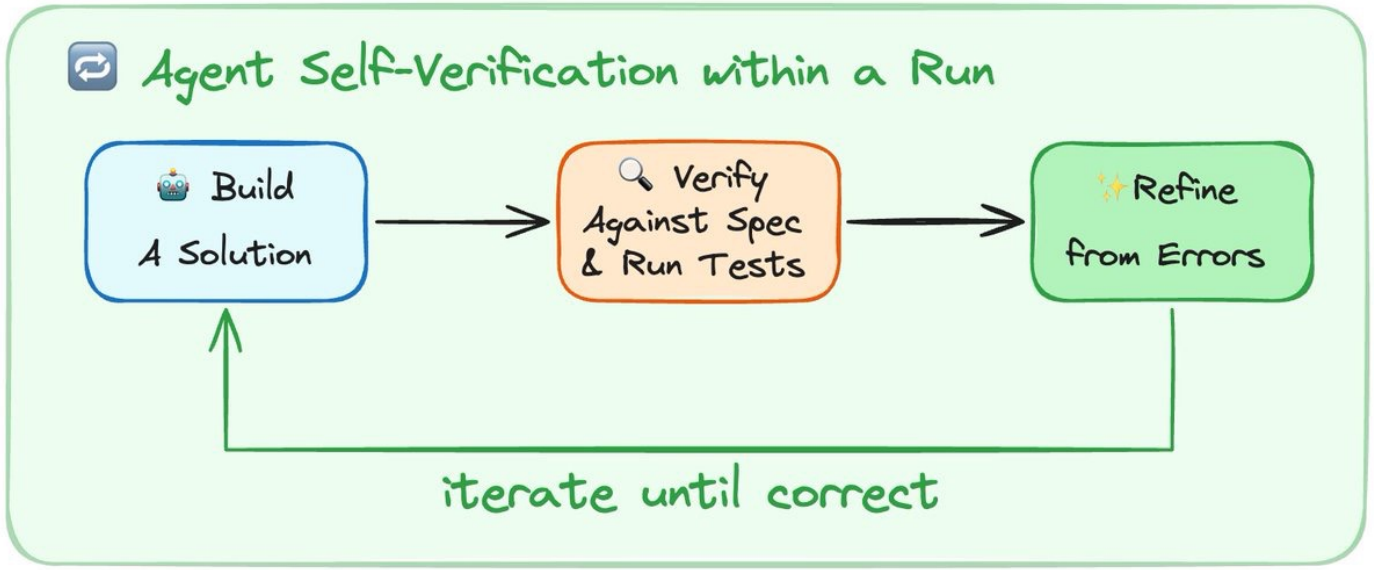
Showing 102 entries | Clear filters

Search leaderboard | Select agents | Select models | Select organizations

| Rank | Agent | Model | Date | Agent Org | Model Org | Accuracy |
|---|---|---|---|---|---|---|
| 1 | Simple Codex | GPT-5.3-Codex | 2026-02-06 | OpenAI | OpenAI | 75.1% ± 2.4 |
| 2 | CodeBrain-1 | GPT-5.3-Codex | 2026-02-10 | Feeling AI | OpenAI | 70.3% ± 2.6 |
| 3 | Droid | Claude Opus 4.6 | 2026-02-05 | Factory | Anthropic | 69.9% ± 2.5 |
| 4 | Mux | GPT-5.3-Codex | 2026-02-09 | Coder | OpenAI | 68.5% ± 2.4 |
| 5 | Deep Agents | GPT-5.2-Codex | 2026-02-12 | LangChain | OpenAI | 66.5% ± 3.1 |
| 6 | Droid | GPT-5.2 | 2025-12-24 | Factory | OpenAI | 64.9% ± 2.8 |
| 7 | Ante | Gemini 3 Pro | 2026-01-06 | Antigma Labs | Google | 64.7% ± 2.7 |
| 8 | Terminus 2 | GPT-5.3-Codex | 2026-02-05 | Terminal Bench | OpenAI | 64.7% ± 2.7 |
| 9 | Junie CLI | Gemini 3 Flash | 2025-12-23 | JetBrains | Google | 64.3% ± 2.8 |
| 10 | Droid | Claude Opus 4.5 | 2025-12-11 | Factory | Anthropic | 63.1% ± 2.7 |

# 一个Harness Engineering案例

- **修改 1：退出前强制自检，用到了hook**
  - 在 Agent 试图退出时拦截，通过hook强制注入一个 checklist 让它对照任务说明验证。

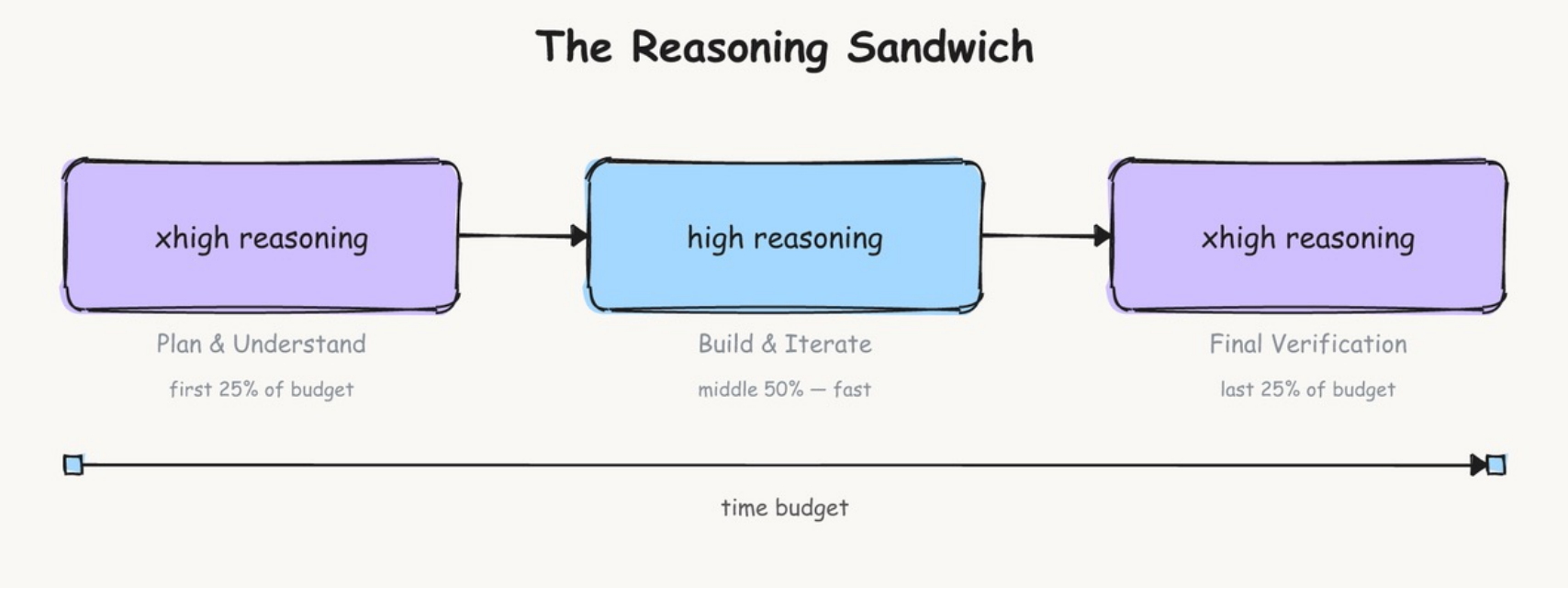



- **修改 2：启动时注入环境信息**
  - Agent 在陌生环境中会浪费大量时间探索目录结构、找Python环境。他们在Agent启动时自动跑一些bash命令扫描环境，把结果注入上下文。

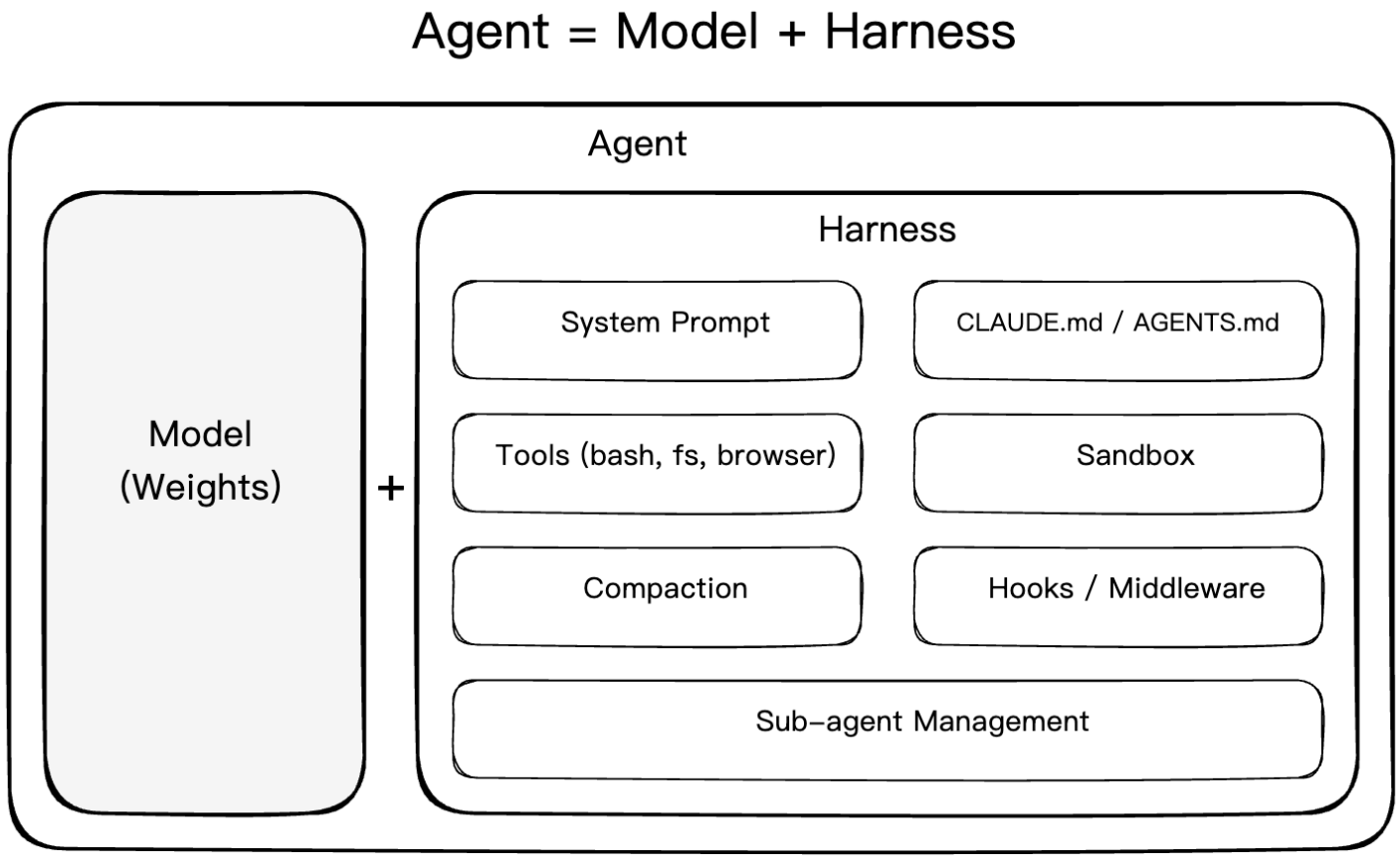
- **修改 3：死循环检测**
  - Agent有时候会在同一个文件上反复做小修改，10+ 次还在原地打转。他们通过hook追踪每个文件的编辑次数，超过阈值就注入"考虑换个方案"的提示。

# 一个Harness Engineering案例

- **修改 4：Reasoning Sandwich**
  - GPT-5.2-Codex 有 4 档推理强度（low/medium/high/xhigh），全程 xhigh 反而得分低（53.9%），因为耗时过久。最终他们用 xhigh → high → xhigh 的“三明治”策略——规划和验证用高推理，执行阶段用中等推理。



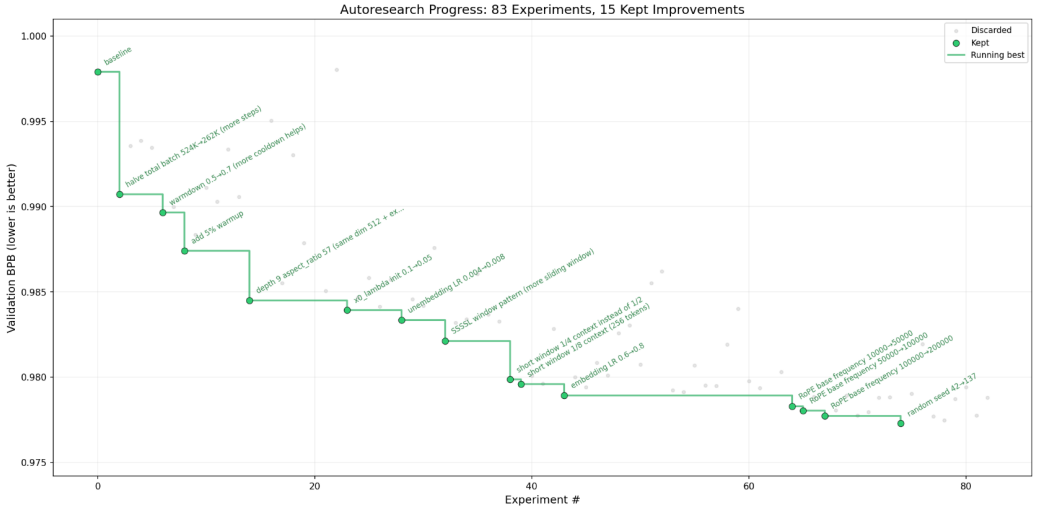
# 从何处入手Harness Engineering



# Vibe Research

- 开放心态：AI承担了科研中的dirty work，并加速了idea验证的过程（学习codebase、源码修改、实验、写作润色），每个人都有了自己“实习生”。
- 个人认为比较可行的loop：AI deep research + 人类思想 + AI coding + AI analysis + 人类监督并纠偏

autoresearch




Andrej Karpathy的Autoresearch工具


Analemma公司的实践：417 hours产出166 papers

# Thanks for Listening!

**卫雅珂**

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参考来源：

- https://code.claude.com/docs
- https://pyshine.com/Claude-Code-Best-Practices
- https://martinfowler.com/articles/harness-engineering.html
- https://www.philschmid.de/agent-harness-2026
- https://yuanchaofa.com/post/harness-engineering-for-ai-agents
- https://x.com/Vtrivedy10/status/2023805578561060992?s=20&ref=blog.langchain.com