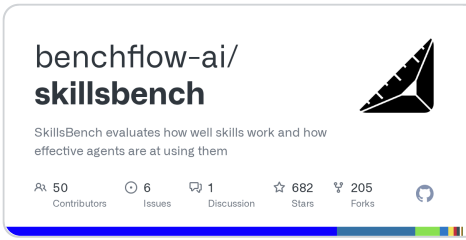
SkillsBench: Benchmarking How Well Agent Skills Work Across Diverse Tasks

https://arxiv.org/pdf/2602.12670



https://github.com/benchflow-ai/skillsbench

GitHub - benchflow-ai/skillsbench: SkillsBench evaluates how well skills work and how effective agen

SkillsBench evaluates how well skills work and how effective agents are at usin···

- 首个系统测评Agent Skills框架，第一个领域专家构建综合Agentic Benchmark
- 涵盖86个任务、11个领域、7种agent配置
- 揭示Agent Skills的insights

Skills介绍：

Problem：Agents need procedural knowledge

Claude Code, Codex提供了强大的通用能力，但是：

- Domain Speific Tasks需要特定的流程知识
- Fine tuning牺牲了通用性
- Token开销

What Skills look like

A Skill directory:

```
anthropic_brand/
    ├ SKILL.md
    ├ docs.md
    ├ slide-decks.md
    └ apply_template.py
```

anthropic/brand_style/SKILL.md

YAML Fontmatter

```
---
name: Anthropic Brand Style Guidelines
description: Applies Anthropic's official brand colors and
typography to PowerPoint presentations
---
```

Metadata

Markdown

```
## Overview

This skill provides Anthropic's official brand identity resources for
PowerPoint presentations. It includes a pre-branded template
and tools to apply Anthropic styling to existing presentations.

## Colors

*Main Colors:*

- Dark: `#141413` - Primary text and dark backgrounds
- Light: `#faf9f5` - Light backgrounds and text on dark
- Light Gray: `#e8e6dc` - Subtle backgrounds

### Typography

- *Headings*: Poppins (with Arial fallback)
- *Body Text*: Lora (with Georgia fallback)
```

Freeform Content

Progressive Disclosure

Initially, Claude sees just the metadata (from the YAML frontmatter of SKILL.md) from the available Skills.

Name: Excel Files
description: Comprehensive Microsoft Excel (.xlsx) document creation, editing, and analysis with support for formulas, formatting, analysis, and visualization. Use when:
(1) Creating new spreadsheets with formulas & formatting
(2) Reading and analyzing data,
(3) Modifying spreadsheets while preserving formulas
(4) Data analysis and visualization
(5) Recalculating formulas

Name: PowerPoint Files
description: Microsoft PowerPoint (.pptx) presentation creation, editing, and analysis.
1. Creating or modifying presentations
2. Reading and analyzing existing content
3. Analyzing comments or speaker notes

name: Anthropic Brand Style Guidelines
description: Applies Anthropic's official brand colors & typography to PowerPoint presentations and other professional docs.

name: Anthropic BigQuery Schemas
description: Strategic data analysis using Google BigQuery for the Finance & Strategy team. Provides access to revenue metrics, product usage analytics, sales/CRM data, and analytics via MCP integration.

Progressive Disclosure

If Claude thinks the Skill is relevant to the current task, it loads the full SKILL.md file into context.

anthropic/brand_style/SKILL.md

YAML Fontmatter

```
---
name: Anthropic Brand Style Guidelines
description: Applies Anthropic's official brand colors and
typography to PowerPoint presentations
---
```

Markdown

```
## Overview

This skill provides Anthropic's official brand identity resources for
PowerPoint presentations. It includes a pre-branded template
and tools to apply Anthropic styling to existing presentations.

## Colors

*Main Colors:*

- Dark: `#141413` - Primary text and dark backgrounds
- Light: `#faf9f5` - Light backgrounds and text on dark
- Light Gray: `#e8e6dc` - Subtle backgrounds

### Typography

- *Headings*: Poppins (with Arial fallback)
- *Body Text*: Lora (with Georgia fallback)
```

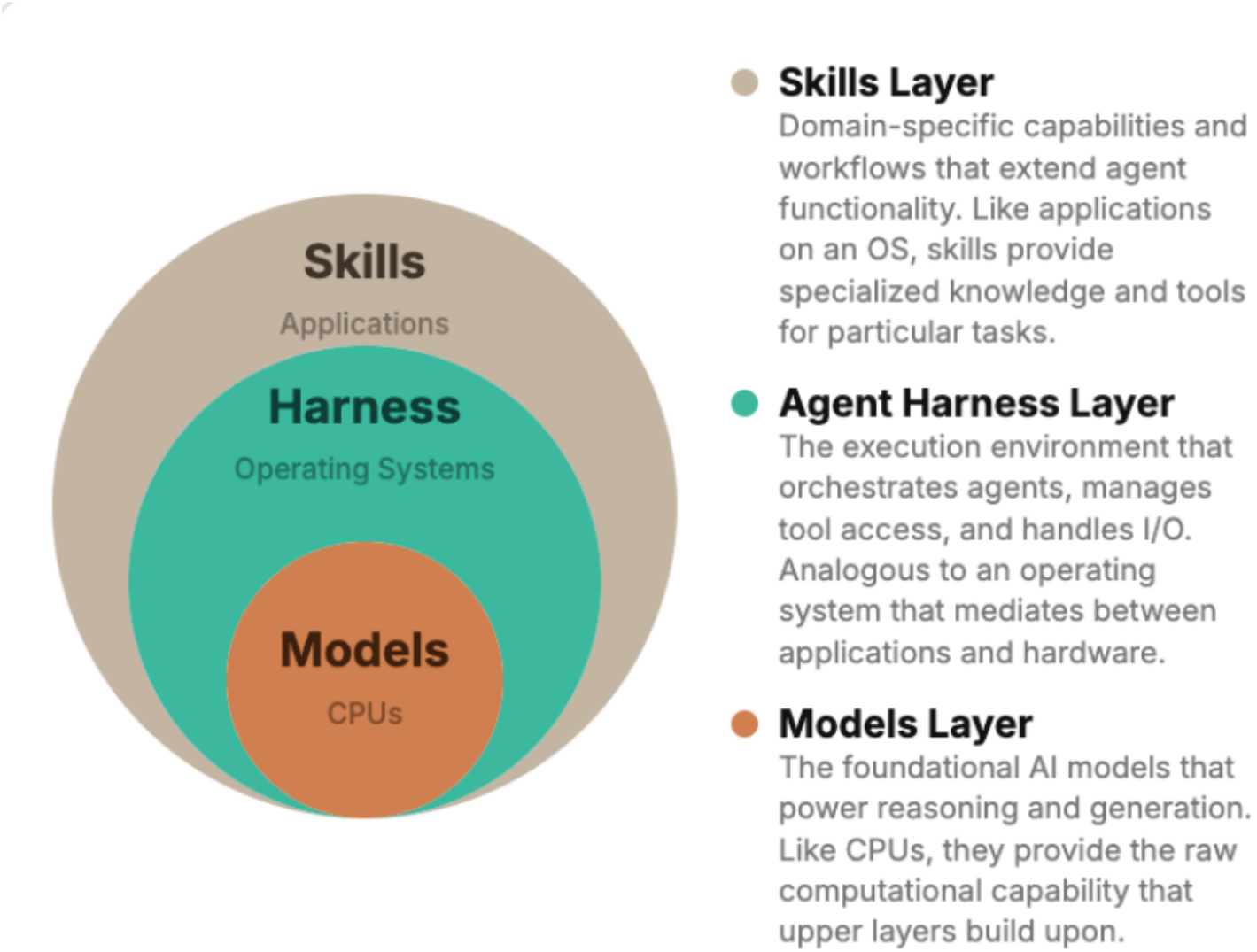
Level	File	Context Window	# Tokens
1	SKILL.md Metadata (YAML)	Always loaded	~100
2	SKILL.md Body (Markdown)	Loaded when Skill triggers	<5k
3+	Bundled files (text files, scripts, data)	Loaded as-needed by Claude	unlimited*

Approach	**Token Cost**	**Performance**
Manual instructions	5,000-10,000 tokens/request	Variable quality
Skills (metadata only)	Minimal (just name/description)	Expert-level
Skills (full load)	~5,000 tokens when skill is used	Expert-level

Skills对比其他runtime augmentation范式：

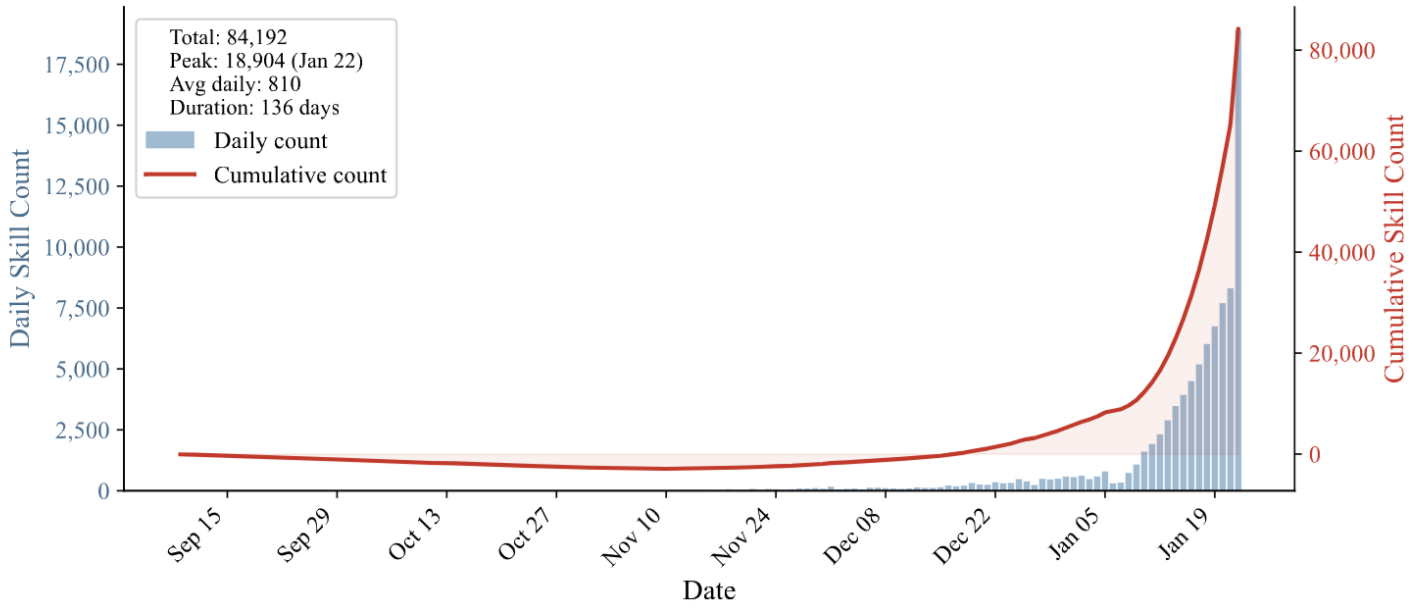
	Prompts	RAG	Tools	Skills
Modular/reusable	×	✓	✓	✓
Procedural guidance	Limited	×	×	✓
Executable resources	×	×	✓	✓
Cross-model portable	✓	✓	✓	✓

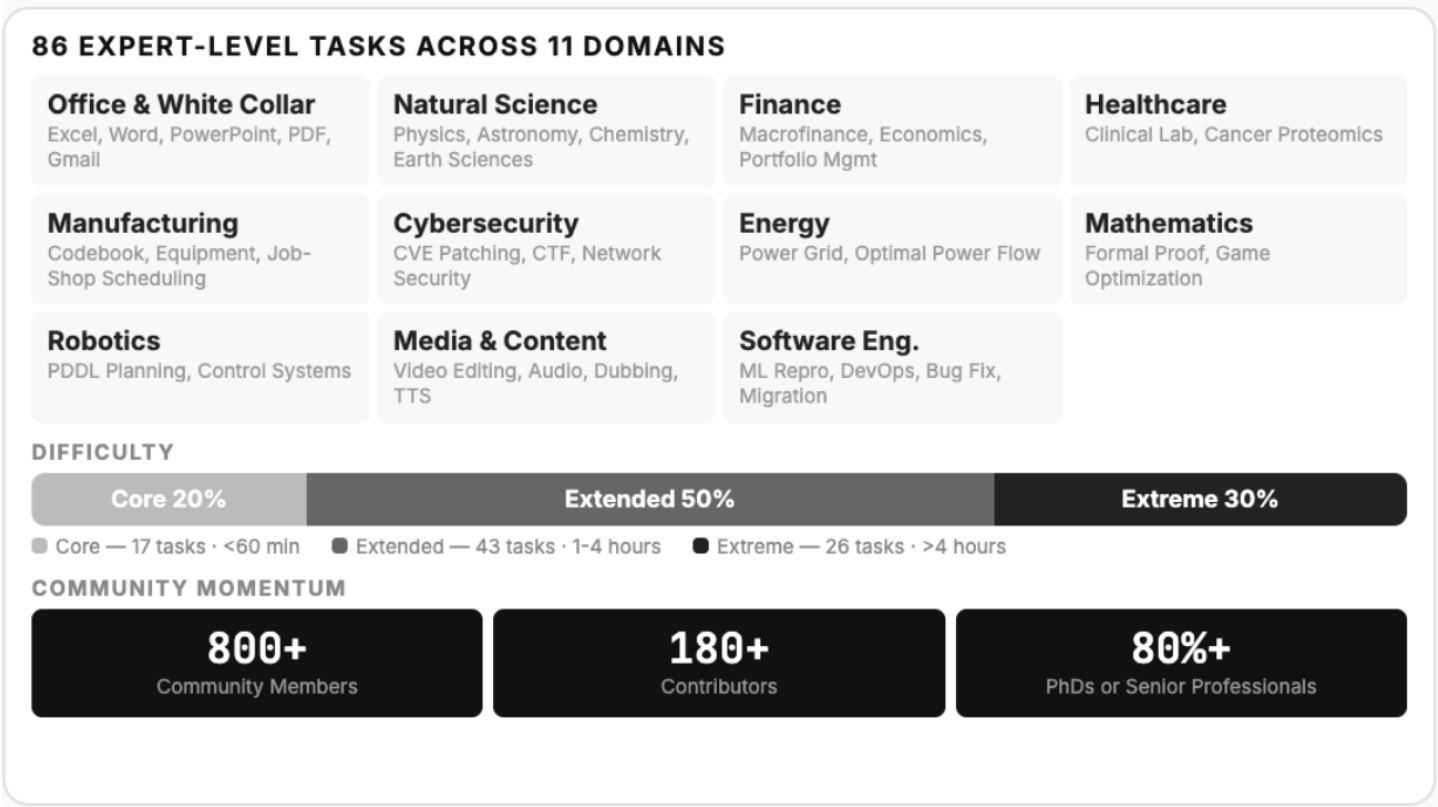
Skills的逻辑关系：



Benchmark概览：

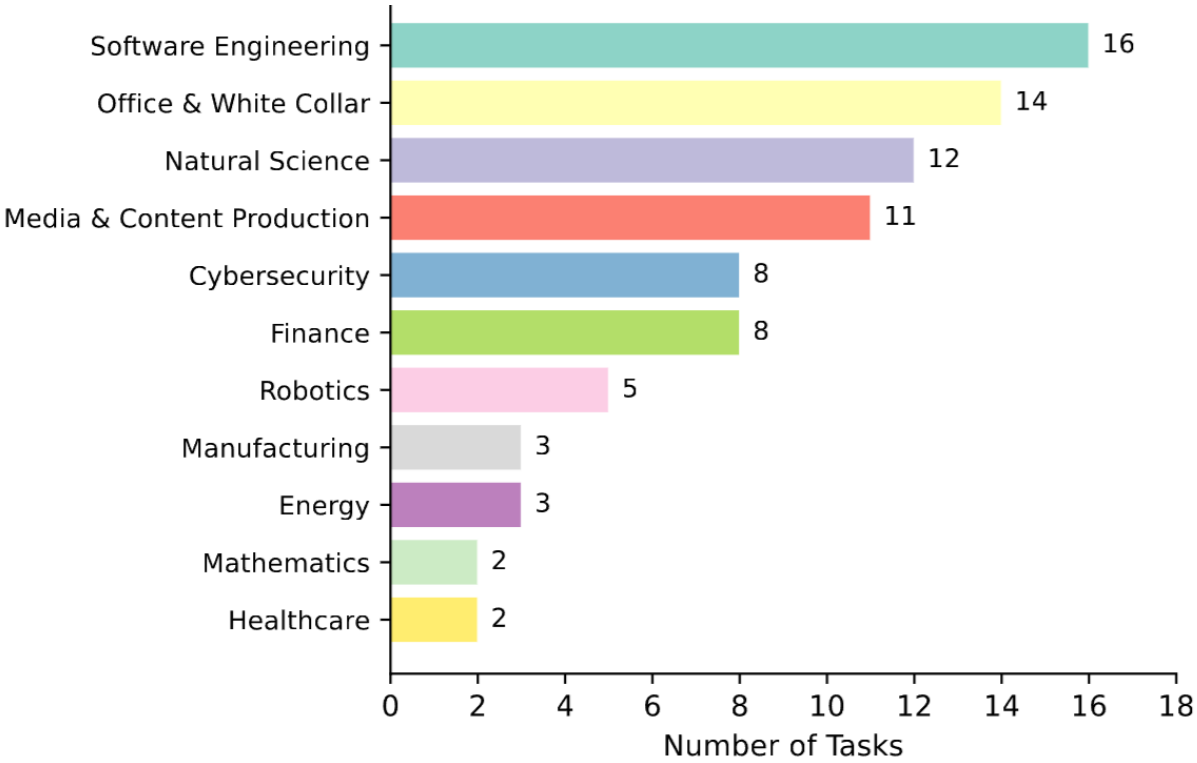
开源社区提供越来越多的skills，但是缺乏对Skills如何/何时提高Agent性能的评估



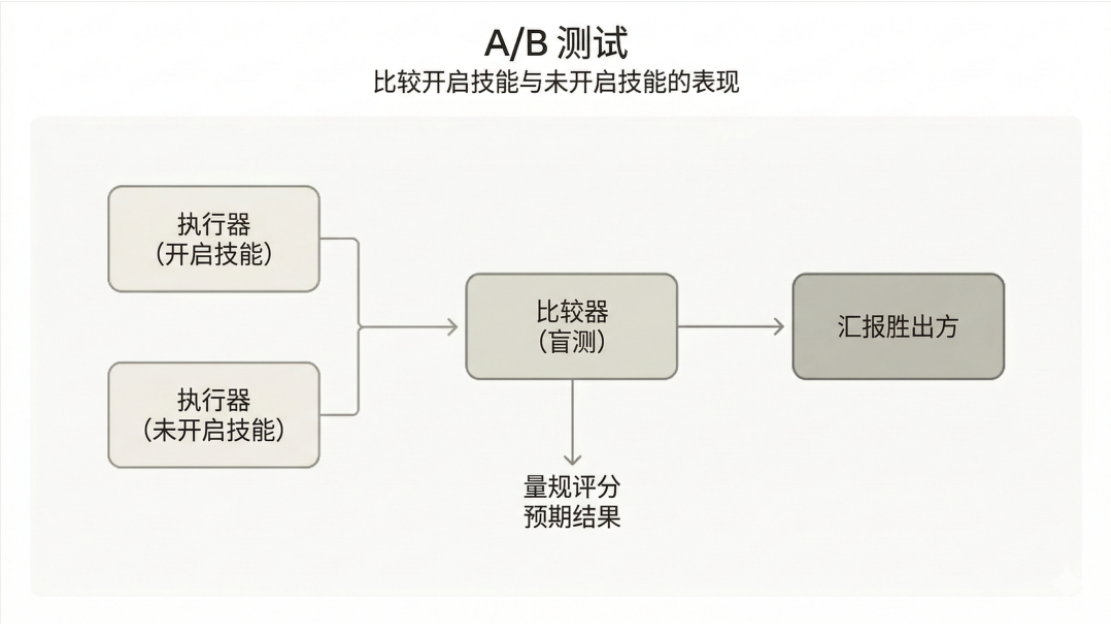


Configuration划分：

Difficulty	Tasks	Human Time
Core	17 (20%)	< 60 min
Extended	42 (49%)	1-4 hours
Extreme	26 (31%)	> 4 hours



- With Skills
- Without Skills
- Self-generated Skills：排除LLM内部已有的知识



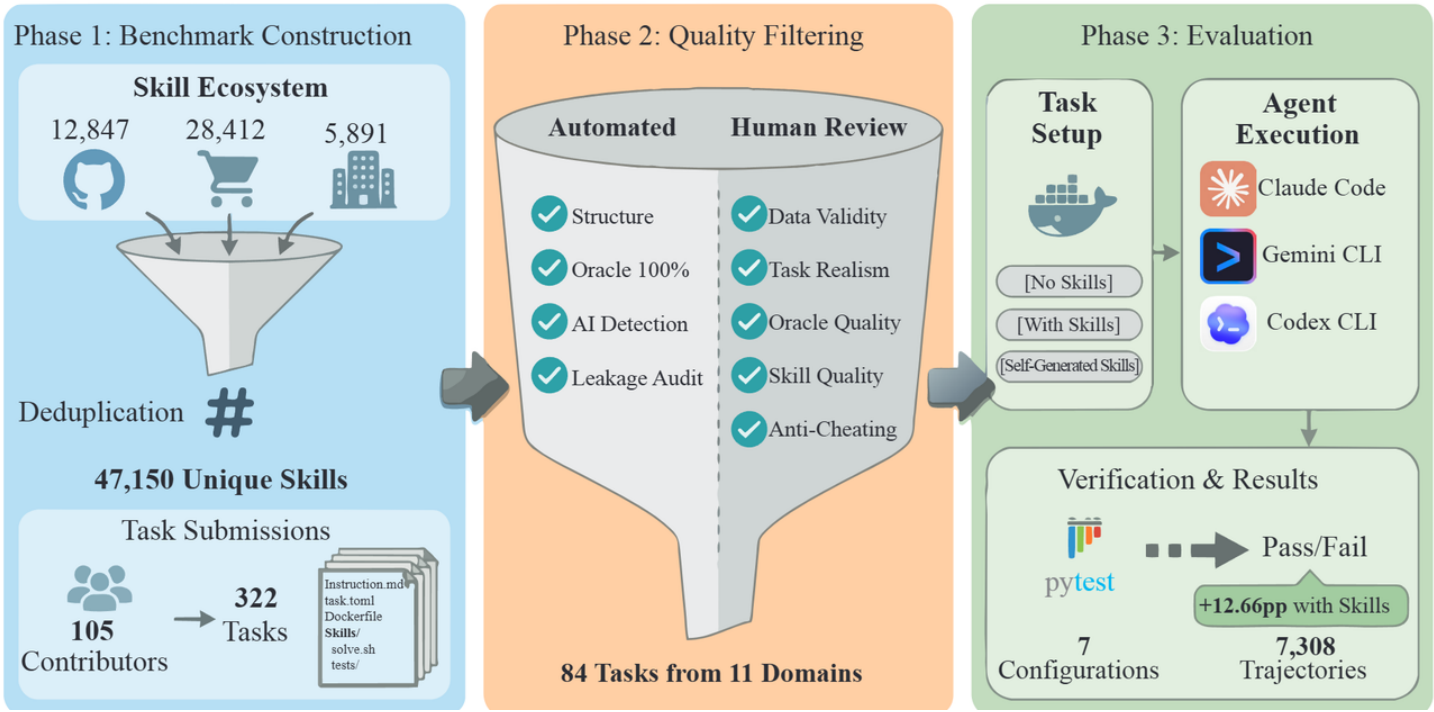
指标：

Pass Rate: the binary reward across 5 trials

Normalized Gain:

$$g = \frac{\text{pass}_{\text{skill}} - \text{pass}_{\text{vanilla}}}{1 - \text{pass}_{\text{vanilla}}}$$

Benchmark构建：



- **Instructions** written by humans (verified via human review and GPTZero)
- **Deterministic verifiers** with programmatic assertions - no LLM-as-judge variance
- **Leakage prevention** via CI-based audits ensuring Skills provide guidance, not solutions
- **Oracle solutions** demonstrating resolvability

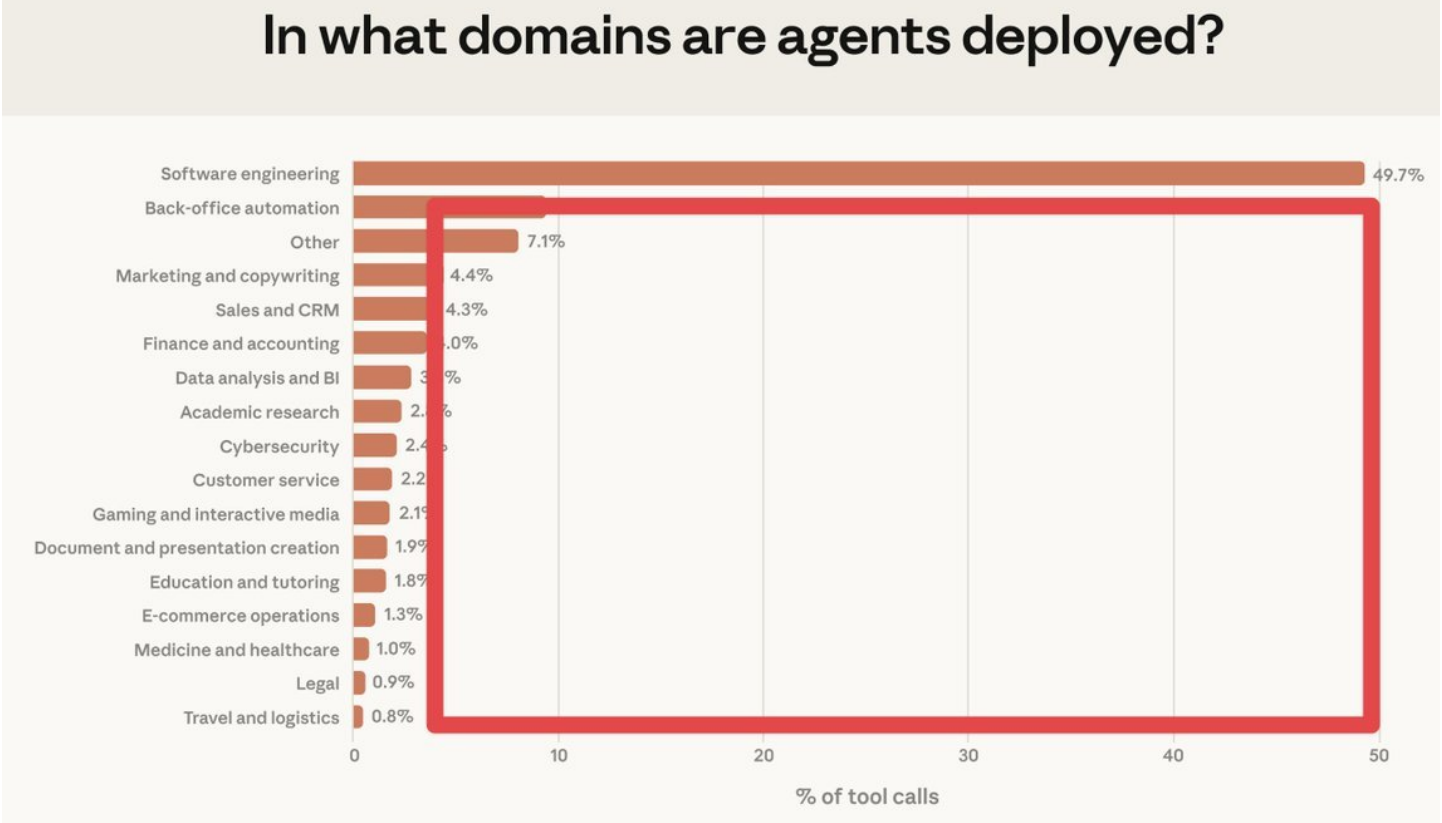
Key Findings:

Skills提供了显著的增益，Claude Code的收益最大：

Agent + Model	No Skills	With Skills	Uplift
Gemini CLI (Gemini 3 Flash)	31.3	48.7	+17.4
Claude Code (Opus 4.5)	22.0	45.3	+23.3
Codex (GPT-5.2)	30.6	44.7	+14.1
Claude Code (Opus 4.6)	30.6	44.5	+13.9
Gemini CLI (Gemini 3 Pro)	27.6	41.2	+13.6
Claude Code (Sonnet 4.5)	17.3	31.8	+14.5
Claude Code (Haiku 4.5)	11.0	27.7	+16.7

不同的domain下，skills带来的收益差别非常明显：

Domain	With Skills	No Skills	Δ_{abs}
Healthcare	86.1%	34.2%	+51.9
Manufacturing	42.9%	1.0%	+41.9
Cybersecurity	44.0%	20.8%	+23.2
Natural Science	44.9%	23.1%	+21.9
Energy	47.5%	29.5%	+17.9
Office & White Collar	42.5%	24.7%	+17.8
Finance	27.6%	12.5%	+15.1
Media & Content Production	37.6%	23.8%	+13.9
Robotics	27.0%	20.0%	+7.0
Mathematics	47.3%	41.3%	+6.0
Software Engineering	38.9%	34.4%	+4.5



Skills的数量与复杂度对性能的影响：

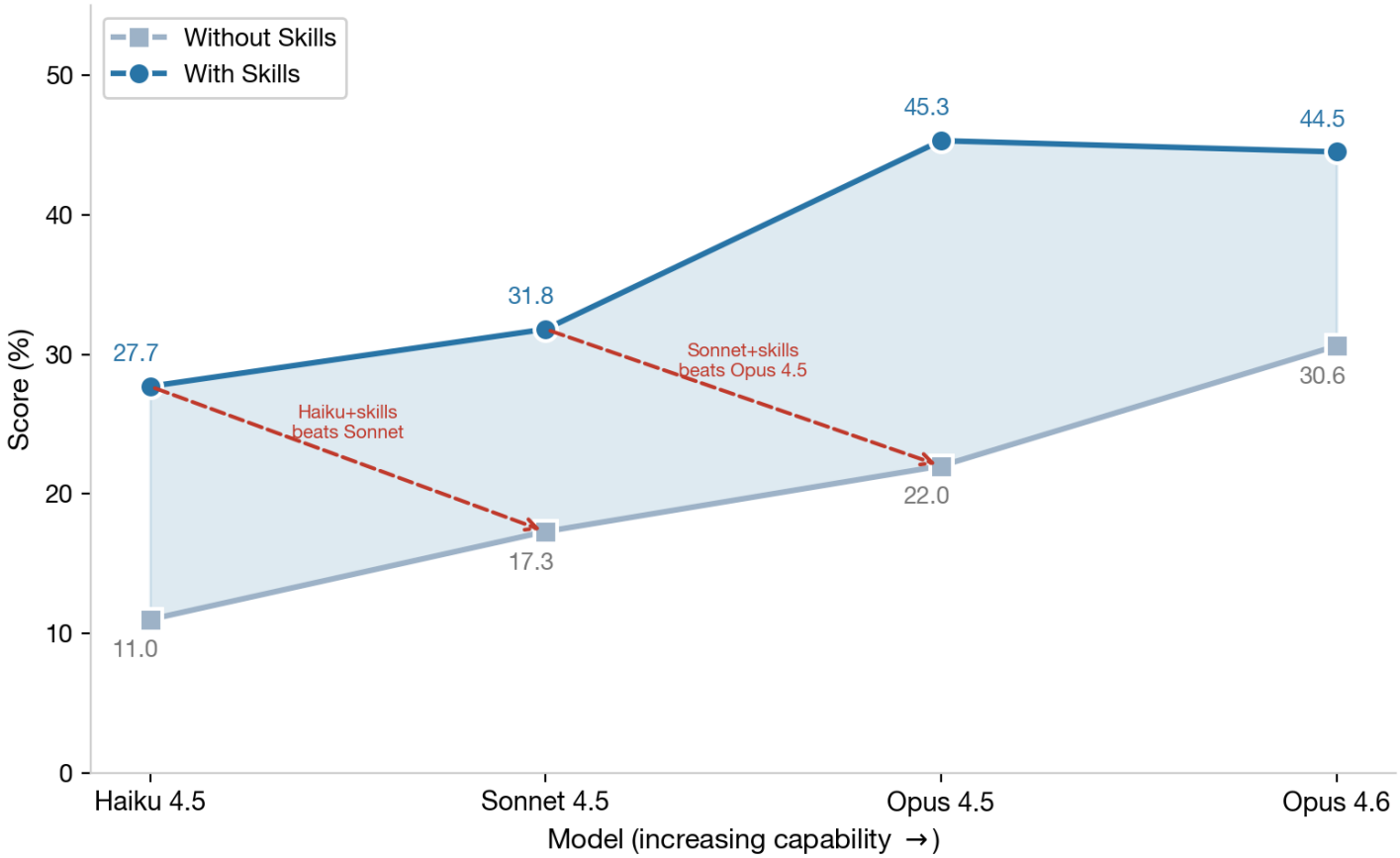
Skills Count	With Skills	No Skills	Δ_{abs}
1 skill	42.2%	24.4%	+17.8
2–3 skills	**42.0%**	**23.4%**	**+18.6**
4+ skills	32.7%	26.9%	+5.9

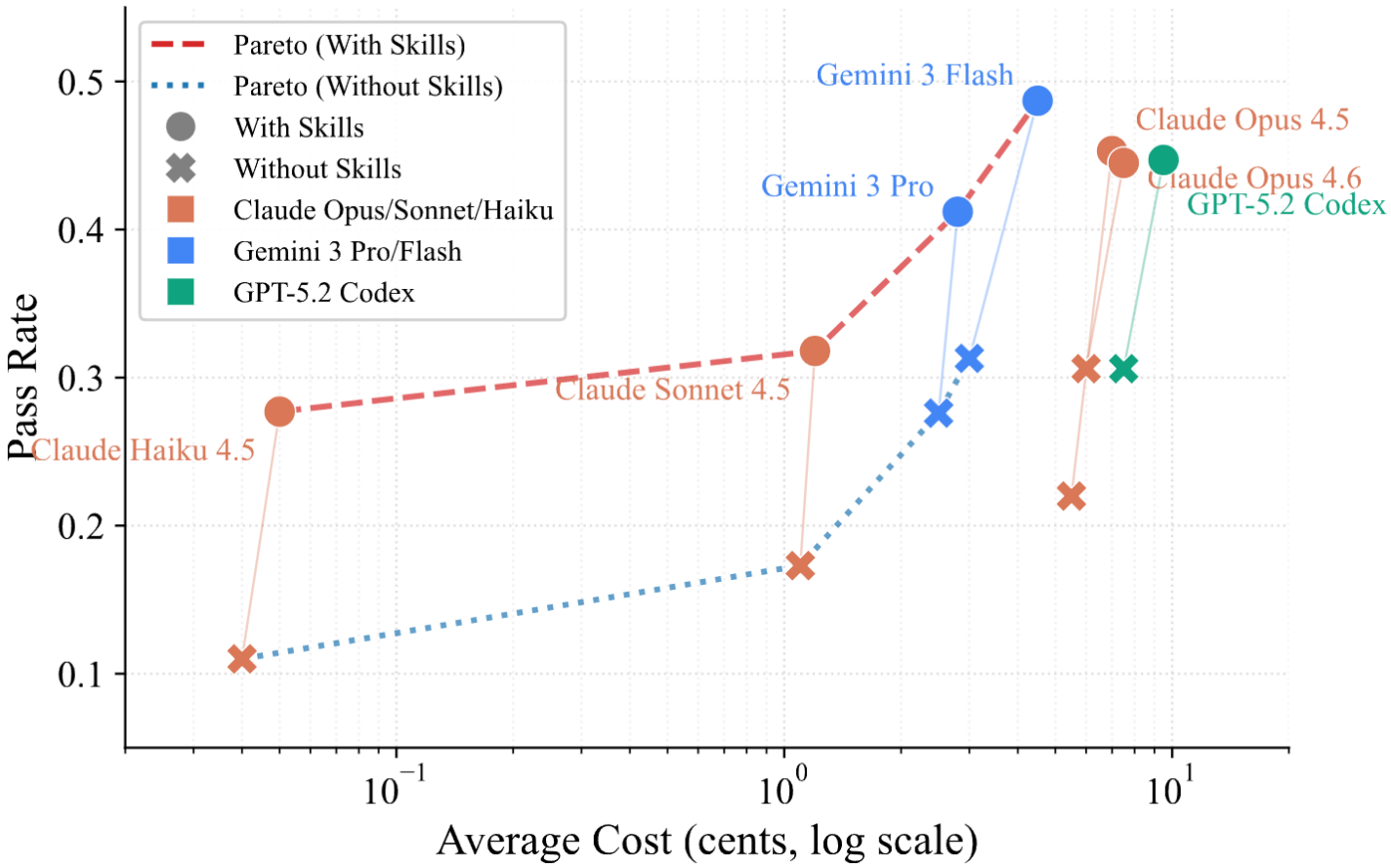
Self-generated Skills基本没有作用：

Case study分析出两种失败模式：procedure不准确；缺乏领域知识

Harness	Model	No Skills	Curated Skills		Self-Generated	
			Pass Rate	g (%)	Pass Rate	g (%)
Gemini CLI	Gemini 3 Flash	31.3	48.7	25.3	–	–
Claude Code	Opus 4.5	22.0	45.3	29.9	21.6	–0.5
Codex	GPT-5.2	30.6	44.7	20.3	25.0	–8.1
Claude Code	Opus 4.6	30.6	44.5	20.0	32.0	+2.0
Gemini CLI	Gemini 3 Pro	27.6	41.2	18.8	–	–
Claude Code	Sonnet 4.5	17.3	31.8	17.5	15.2	–2.5
Claude Code	Haiku 4.5	11.0	27.7	18.8	11.0	0.0
Mean		24.3	40.6	21.5	21.0	–1.8

Skills可以弥补model scale的不足：





Future Work：

- Self-generated Skills：外部反馈 & Self-evlove，例如AutoSkill, SkillRL, **SkillsCreator**(https://mp.weixin.qq.com/s/vjMG8i7DwQ7R2B1C4AVQdA)等

- Domain Skills