

The Thought-Action- Observation Cycle

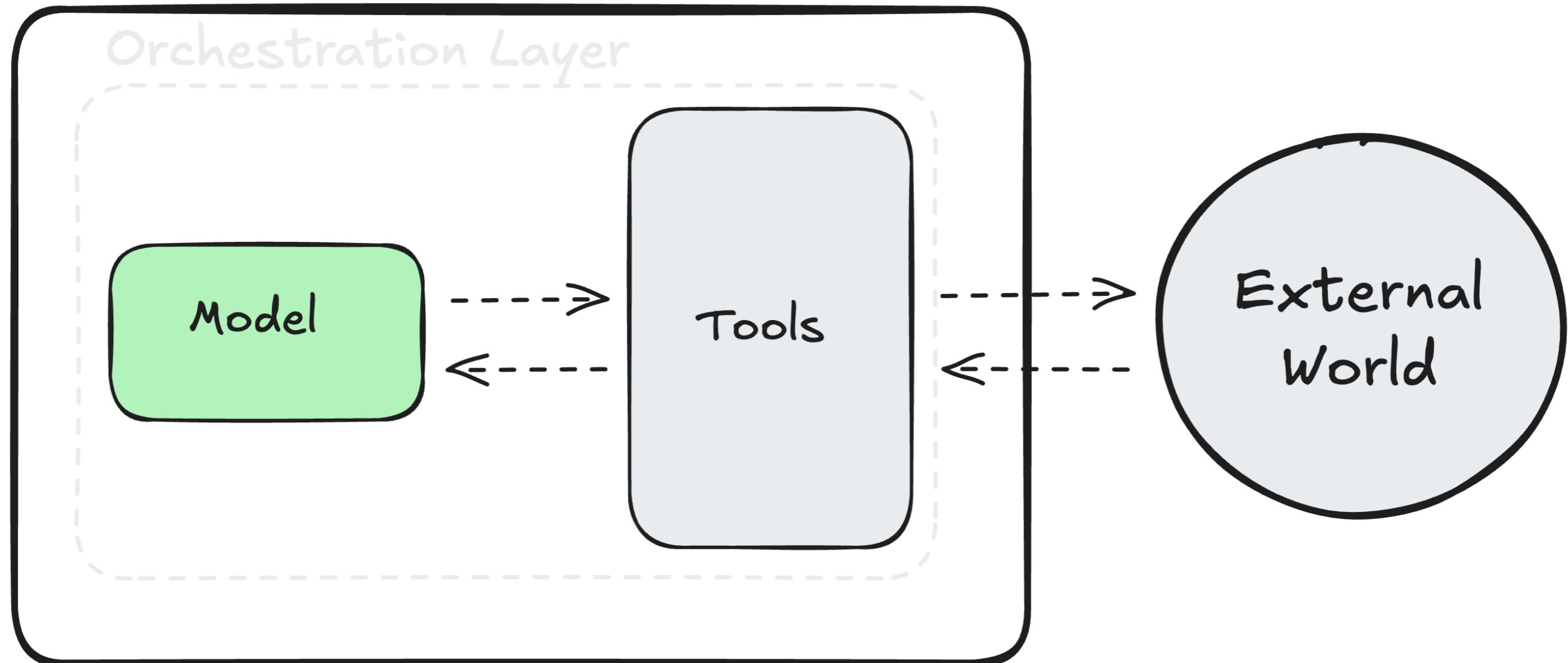
INTRODUCTION TO AI AGENTS



Adel Nehme

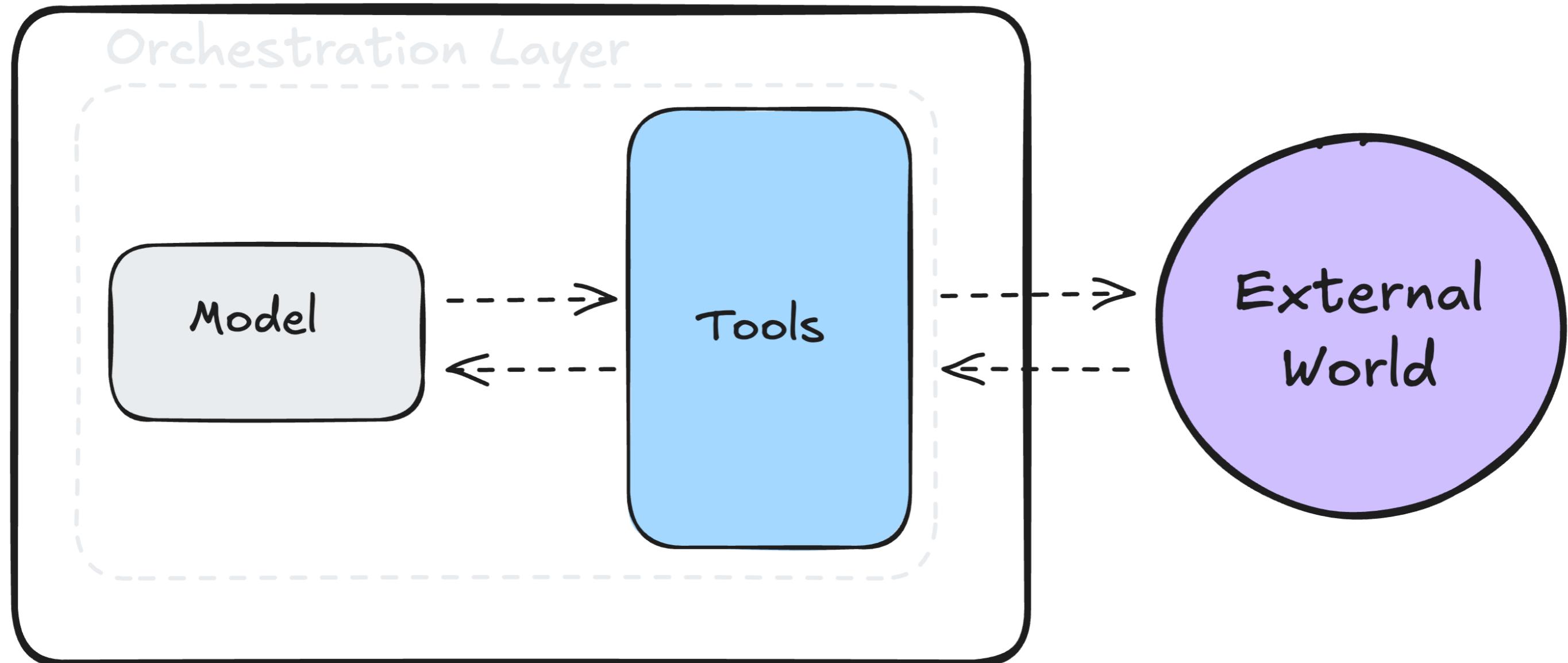
VP of AI Curriculum, DataCamp

The Agentic Trinity: Model, Tools, and Orchestration



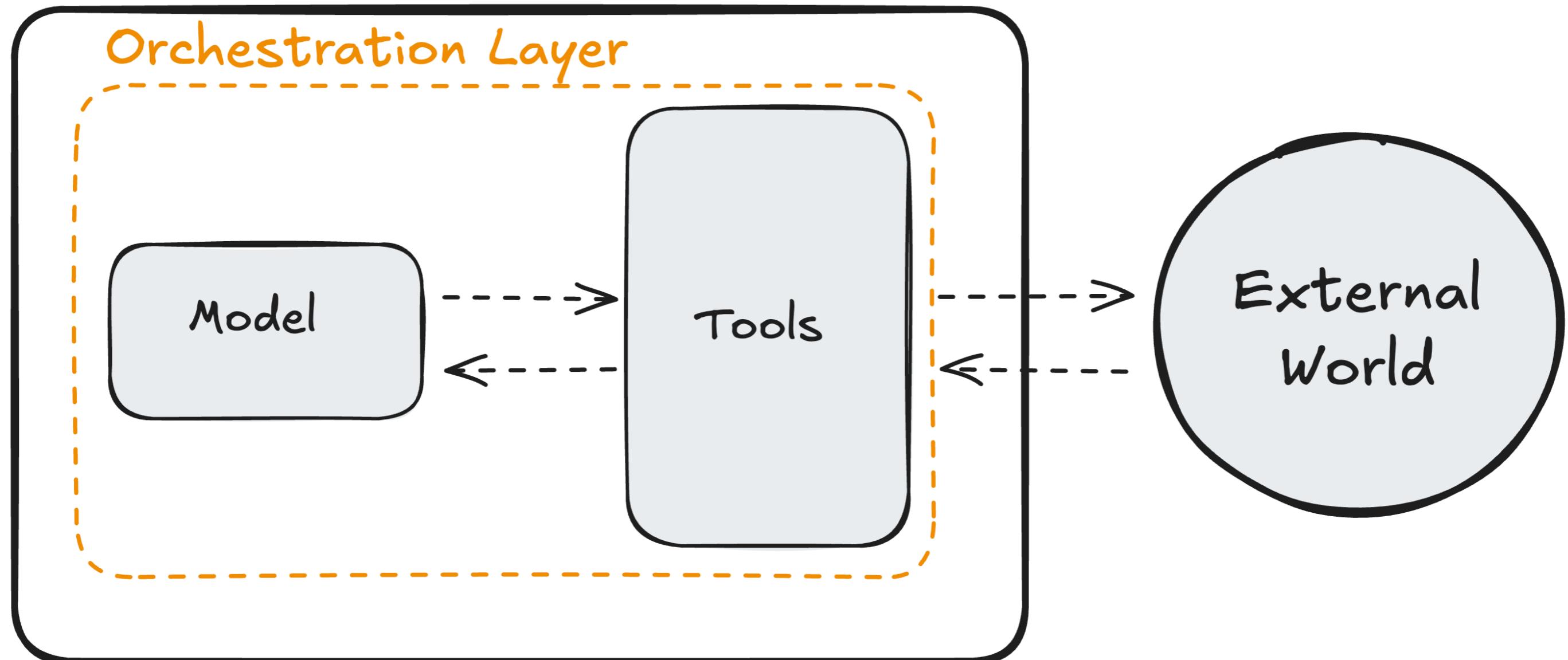
¹ Wiesinger, J., Marlow, P., & Vuskovic, V. (n.d.). Agents.

The Agentic Trinity: Model, Tools, and Orchestration



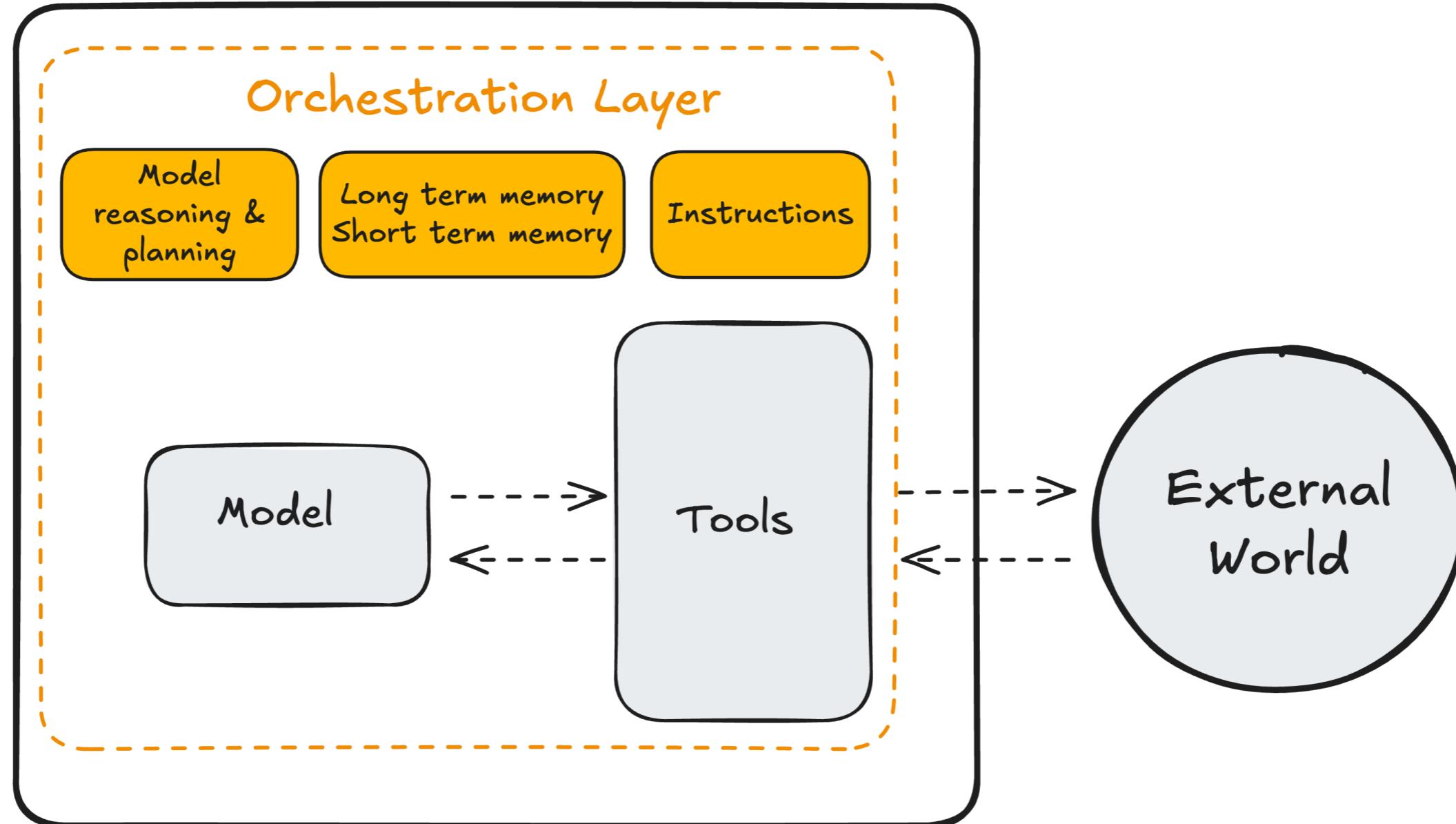
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The Agentic Trinity: Model, Tools, and Orchestration



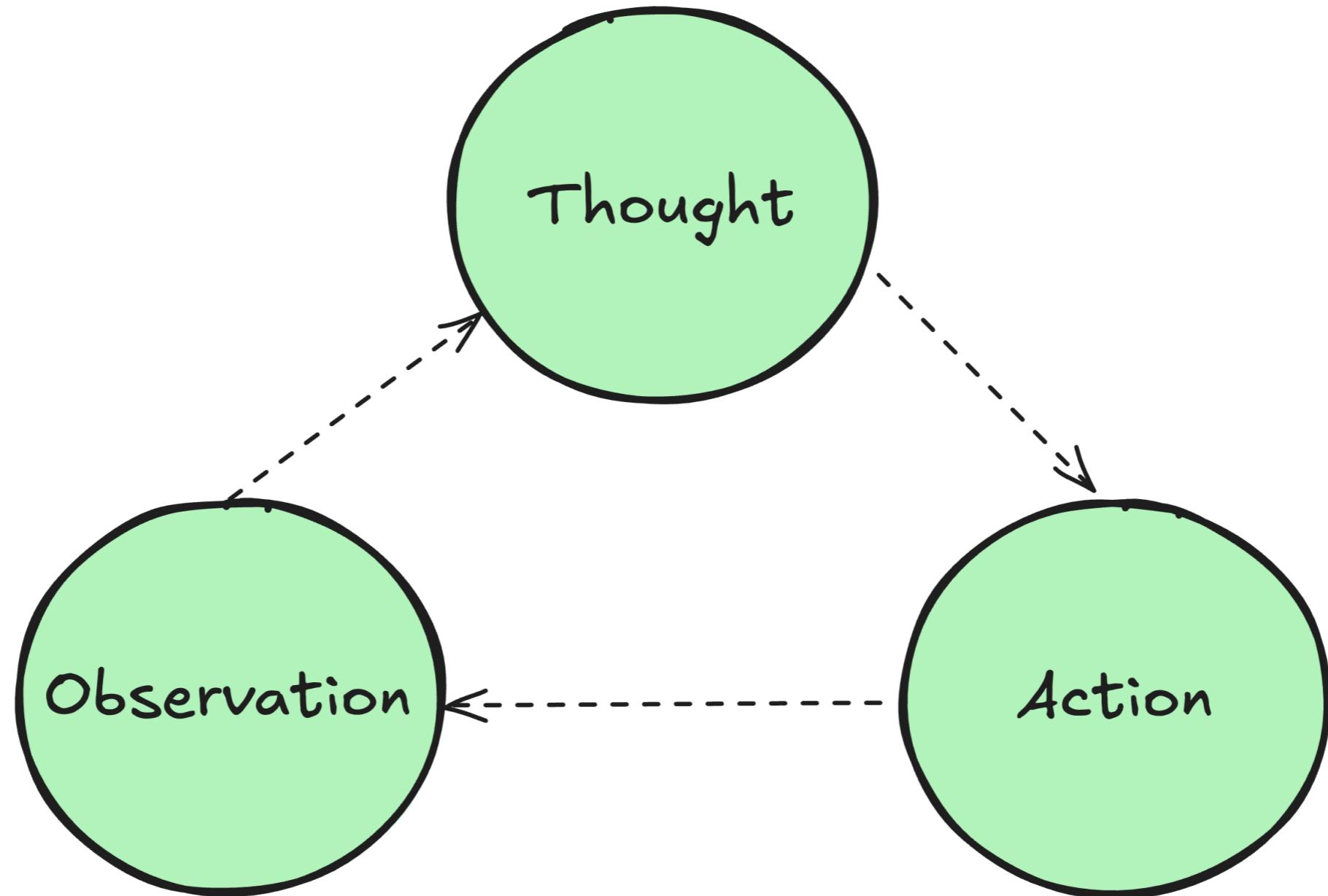
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Maintaining Memory, State, Reasoning, and Planning



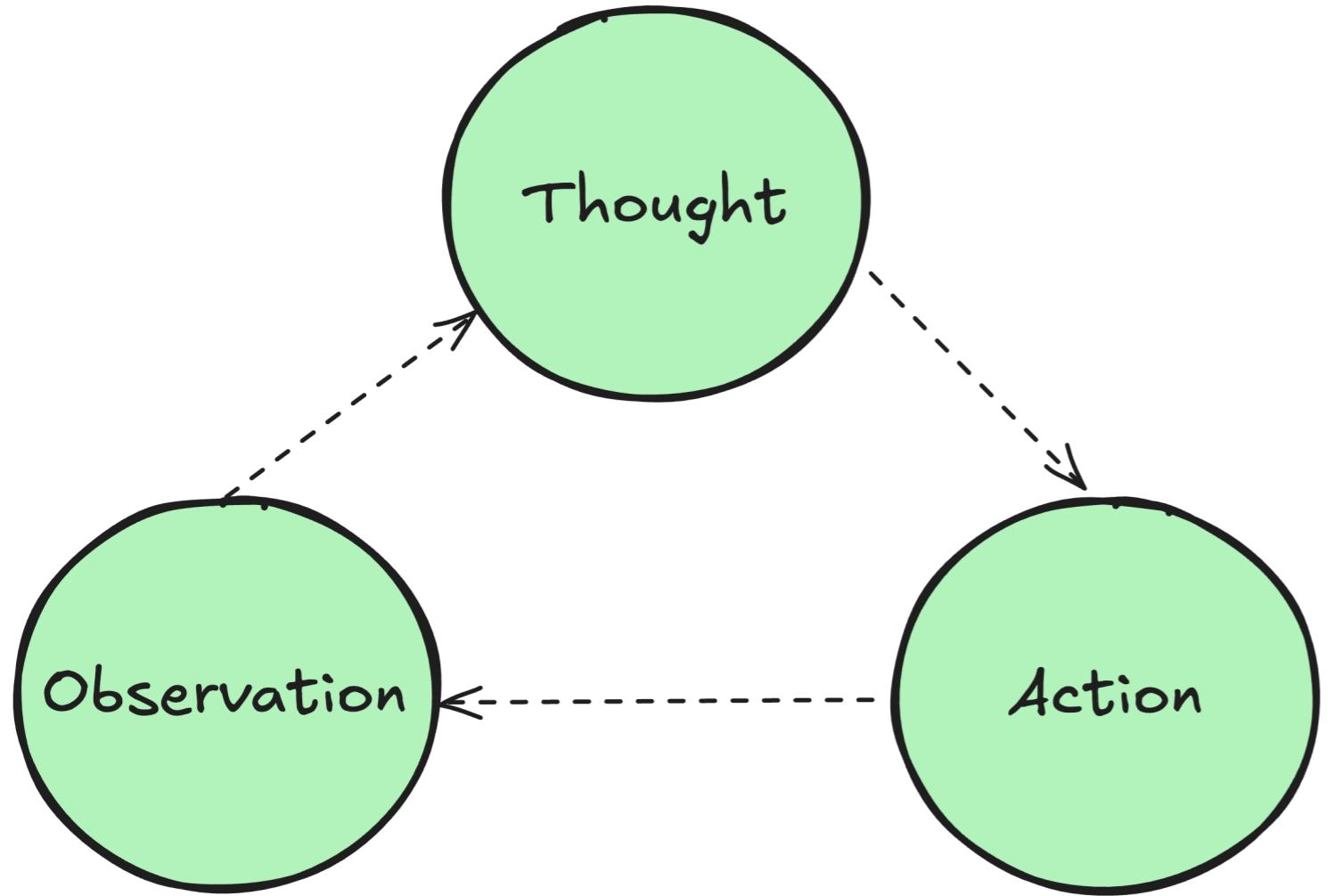
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The Thought-Action-Observation Cycle



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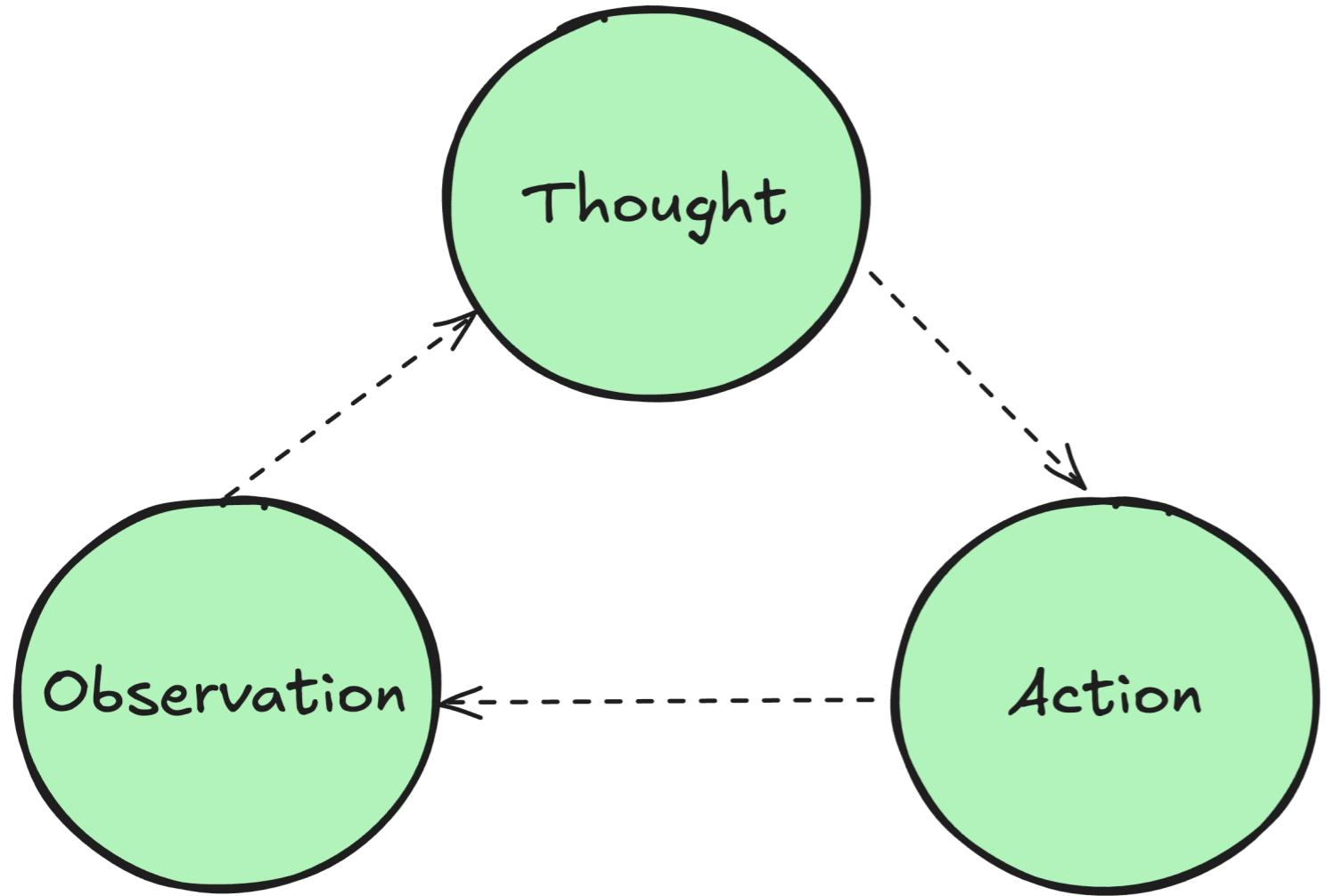
The Thought-Action-Observation Cycle



Thought: The model decides the next step based on the user prompt.

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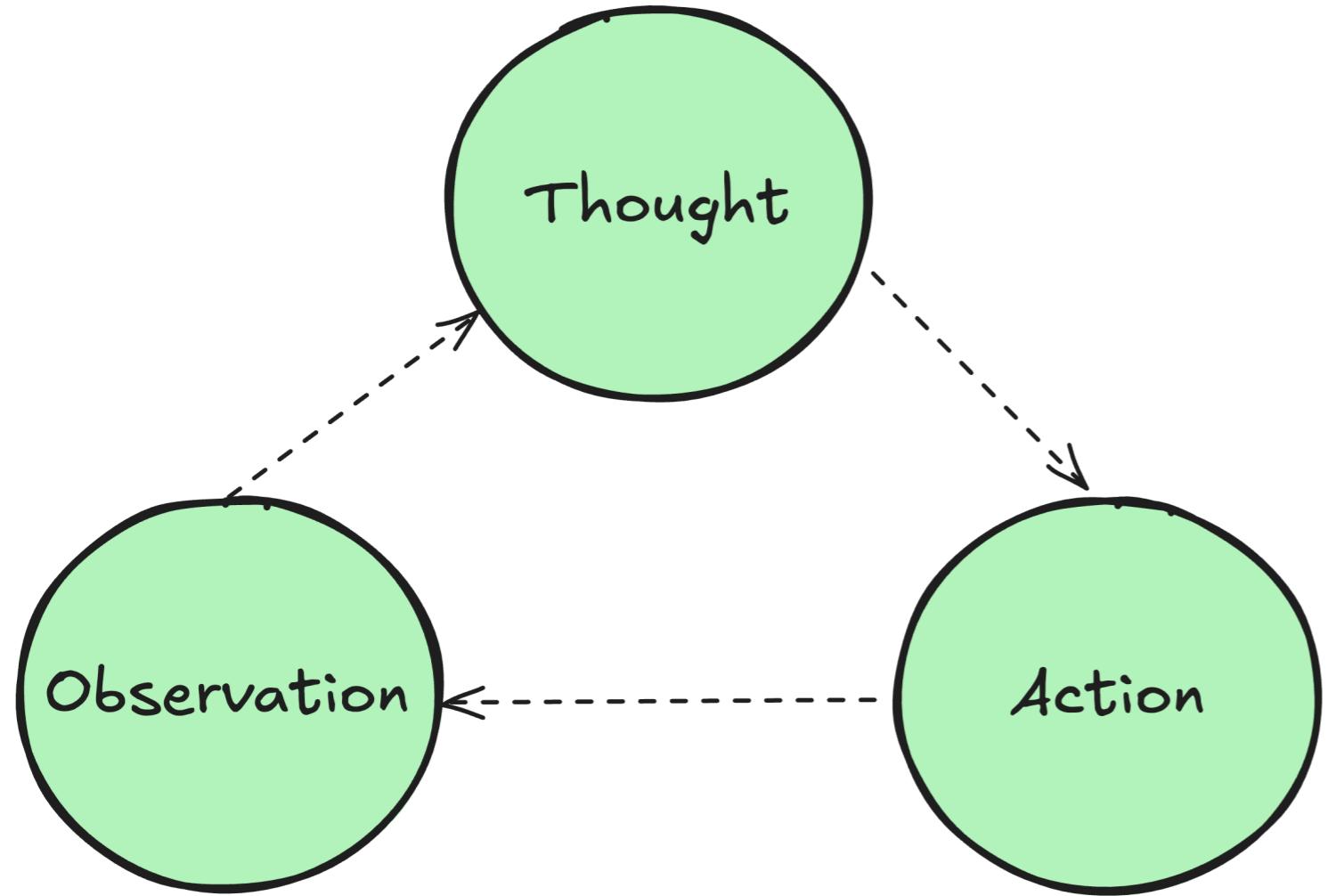
The Thought-Action-Observation Cycle



Action: The agent takes an action, by calling the tools at their disposal.

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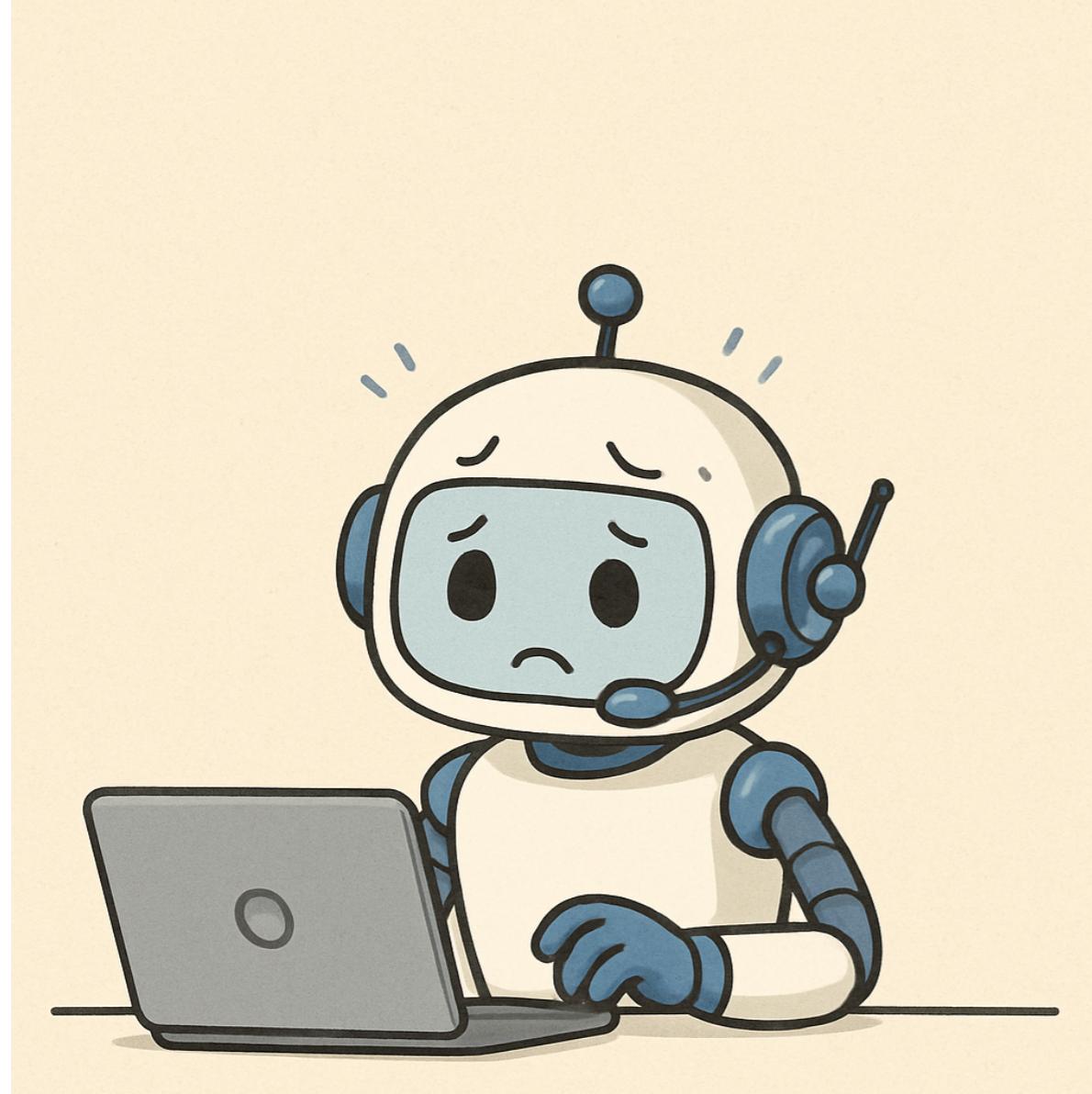
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Observation: The model reflects on the response from the tool. Feeding into the next set of thoughts and actions.

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A Customer Support Agent Example



"I forgot to cancel my subscription and was accidentally billed. Help me get a refund."

¹ Image generated with GPT-4o

The Thought-Action-Observation Cycle

The Thought-Action-Observation Cycle

Cycle	Thought	Action	Observation
1	"I need to understand this customer's situation. Let me check their account details."	Access customer database and retrieve subscription history	Customer has premium plan, renewed 3 days ago for \$99

The Thought-Action-Observation Cycle

Cycle	Thought	Action	Observation
1	"I need to understand this customer's situation. Let me check their account details."	Access customer database and retrieve subscription history	Customer has premium plan, renewed 3 days ago for \$99
2	"The renewal is recent. I should check our refund policy for accidental renewals."	Query company policy database for refund rules	Policy allows full refunds within 7 days for accidental renewals

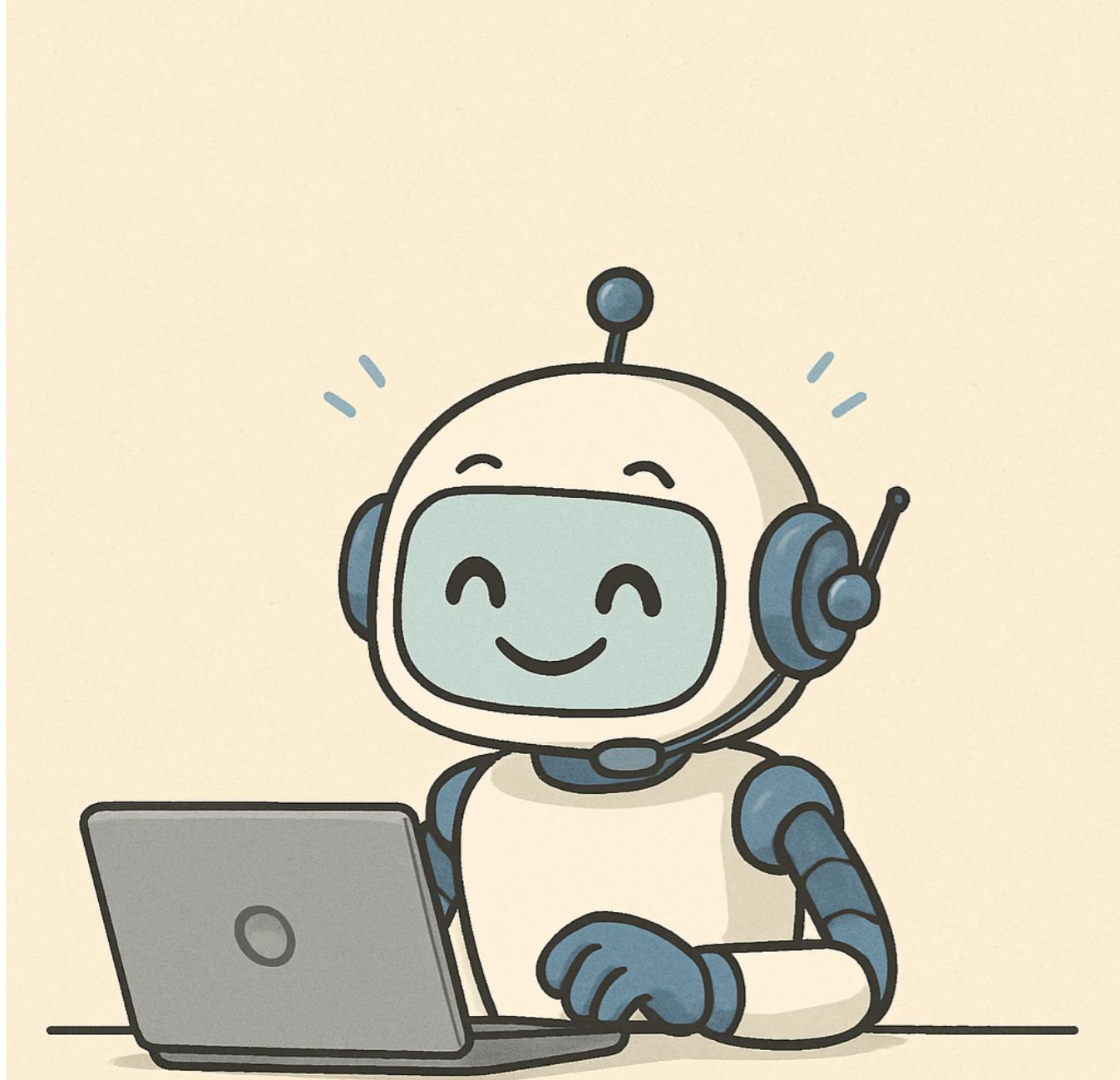
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3	"Great, they qualify! Now I need to process the refund."	Initiate refund transaction through payment system	Refund of \$99 successfully processed

The Thought-Action-Observation Cycle

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3	"Great, they qualify! Now I need to process the refund."	Initiate refund transaction through payment system	Refund of \$99 successfully processed
4	"Refund complete. I should update the customer and cancel their subscription to prevent future charges."	Send confirmation email and update subscription status to 'cancelled'	Email sent, subscription cancelled, ticket can be closed

The Thought-Action-Observation Cycle



Final action: Ticket now can be closed

¹ Image generated with GPT-4o

Let's Practice!

INTRODUCTION TO AI AGENTS

Do Agents Think of Electric Sheep? The ReAct Framework

INTRODUCTION TO AI AGENTS



Adel Nehme

VP of AI Curriculum, DataCamp

The Different Type of Model Thoughts

¹ The Hugging Face Agents Course: <https://github.com/huggingface/agents-course>

The Different Type of Model Thoughts

Thought	Example
Planning	<i>"To help them move apartments, I'll need to find moving companies, compare prices, check availability for their date"</i>

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The Different Type of Model Thoughts

Thought	Example
Planning	<i>"To help them move apartments, I'll need to find moving companies, compare prices, check availability for their date"</i>
Analysis	<i>"Looking at their spending patterns, they're overpaying for subscriptions they rarely use"</i>

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The Different Type of Model Thoughts

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Decision-making	<i>"Since they need it by tomorrow, I should suggest express shipping despite the extra cost"</i>

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Thought	Example
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Analysis	<i>"Looking at their spending patterns, they're overpaying for subscriptions they rarely use"</i>
Decision-making	<i>"Since they need it by tomorrow, I should suggest express shipping despite the extra cost"</i>
Problem-solving	<i>"To optimize this code, I should first profile it to identify bottlenecks"</i>

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The Different Type of Model Thoughts

Thought	Example
Memory integration	<i>"They mentioned being lactose intolerant last week, so I'll exclude dairy from these recipe suggestions"</i>

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The Different Type of Model Thoughts

Thought	Example
Memory integration	<i>"They mentioned being lactose intolerant last week, so I'll exclude dairy from these recipe suggestions"</i>
Self-reflection	<i>"I was too technical in my explanation - let me simplify this using everyday analogies"</i>

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Thought	Example
Memory integration	<i>"They mentioned being lactose intolerant last week, so I'll exclude dairy from these recipe suggestions"</i>
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Goal-setting	<i>"Before planning their workout routine, I need to understand their fitness level and available time"</i>

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Goal-setting	<i>"Before planning their workout routine, I need to understand their fitness level and available time"</i>
Prioritization	<i>"They should book the flights before the hotel, since flight prices increase faster"</i>

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The ReAct Framework: Where Thoughts Come From



¹ Yao, S., Zhao, J., Yu, D., Du, N., Shafran, I., Narasimhan, K., Cao, Y. (2022). ReAct: Synergizing Reasoning and Acting in Language Models. arXiv preprint arXiv:2210.03629.

The ReAct Framework: Reasoning and Acting

Reasoning

Acting

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The ReAct Framework: Reasoning and Acting

Reasoning

Chain of thought prompting

[Prompt...]. Think step by step.

Acting

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The ReAct Framework: Reasoning and Acting

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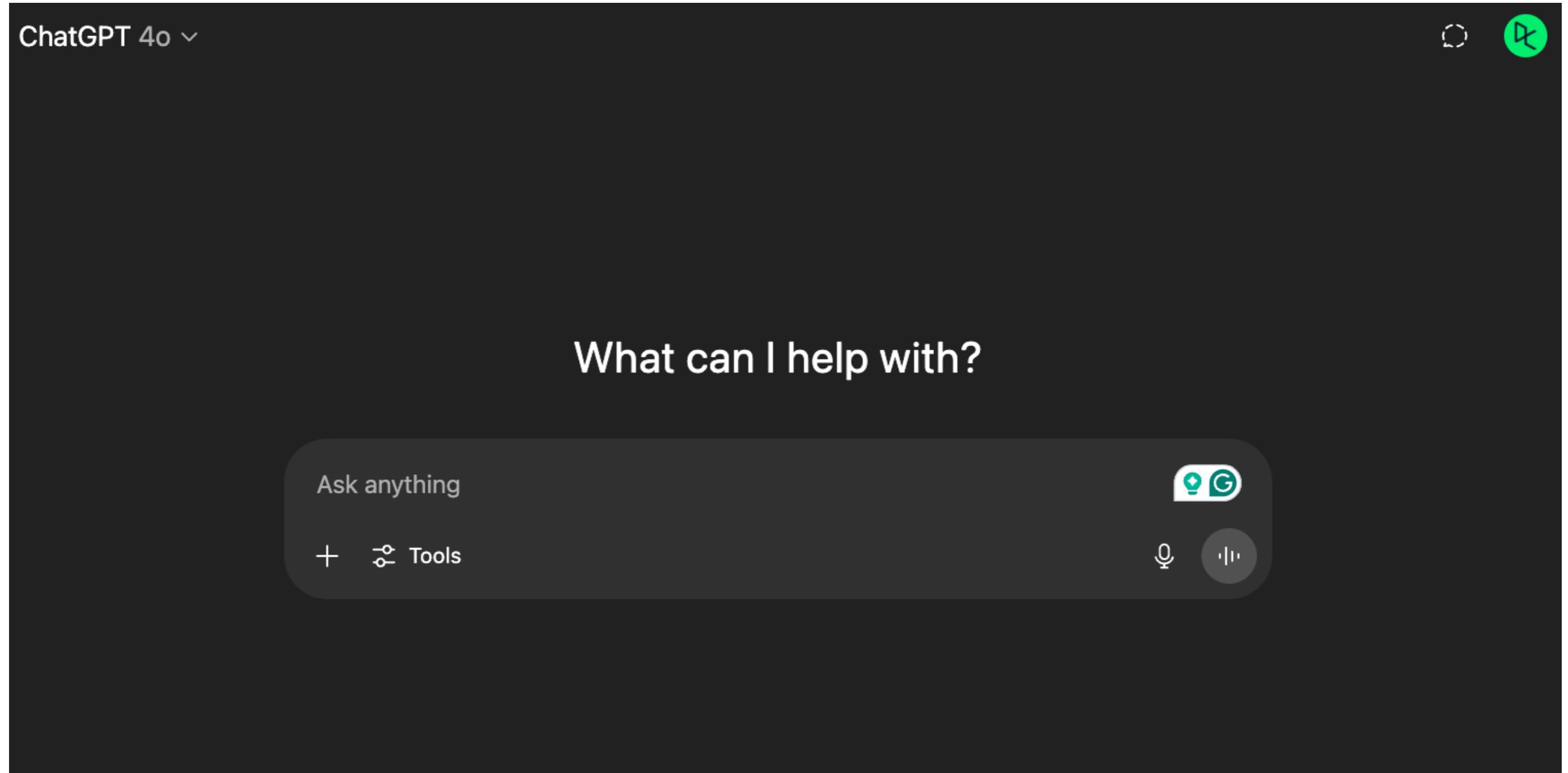
Thought > Action > Observation examples

[Prompt...]. Follow this format:

- Thought: [Think about what to calculate first]
- Action: [Perform calculation]
- Observation: [Result of calculation]
- ...repeat as needed...
- Final Answer: [Complete solution]

¹ Yao, S., Zhao, J., Yu, D., Du, N., Shafran, I., Narasimhan, K., Cao, Y. (2022). ReAct: Synergizing Reasoning and Acting in Language Models. arXiv preprint arXiv:2210.03629.

ReAct in Action: Simple Arithmetic



ReAct in Action: Simple Arithmetic

The question

Calculate the total cost if I buy 3 laptops at \$899 each with a 15% discount and 8% sales tax

The correct answer

\$2475.85

ReAct in Action: Simple Arithmetic

ChatGPT 4o ▾

Share

...

Calculate the total cost if I buy 3 laptops at \$899 each with a 15% discount and 8% sales tax. Only return the answer.

Prompt used

Calculate the total cost if I buy 3 laptops at \$899 each with a 15% discount and 8% sales tax. Only return the answer.

ReAct in Action: Simple Arithmetic

Calculate the total cost if I buy 3 laptops at \$899 each with a 15% discount and 8% sales tax. Think step by step.

Follow this format:

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...repeat as needed...

Final Answer: [Complete solution]

Example:

Thought: Calculate base cost first

Action: $2 \times \$50 = \100

Thought: Apply 10% discount

Action: $\$100 - (\$100 \times 0.10) = \$90$

Final Answer: Total is \$90

Prompt used

Calculate the total cost if I buy 3 laptops at \$899 each with a 15% discount and 8% sales tax. Think step by step.

Follow this format:

Thought: [Think about what to calculate first]

Action: [Perform calculation]

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...repeat as needed...

Final Answer: [Complete solution]

Example:

Thought: Calculate base cost first

Action: $2 \times \$50 = \100

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Final Answer: Total is \$90

Without ReAct Prompting

ChatGPT 4o ▾

Calculate the total cost if I buy 3 laptops at \$899 each with a 15% discount and 8% sales tax. Only return the answer.

\$2,776.63



The correct answer \$2475.85

ChatGPT answer: \$2,776.63

With ReAct Prompting

Sure! Let's go step by step.

Thought: Calculate base cost first

Action: $3 \times \$899 = \$2,697$

Observation: Base cost is \$2,697

Thought: Apply 15% discount

Action: $\$2,697 - (\$2,697 \times 0.15) = \$2,697 - \$404.55 = \$2,292.45$

Observation: Discounted cost is \$2,292.45

Thought: Apply 8% sales tax

Action: $\$2,292.45 + (\$2,292.45 \times 0.08) = \$2,292.45 + \$183.40 = \$2,475.85$

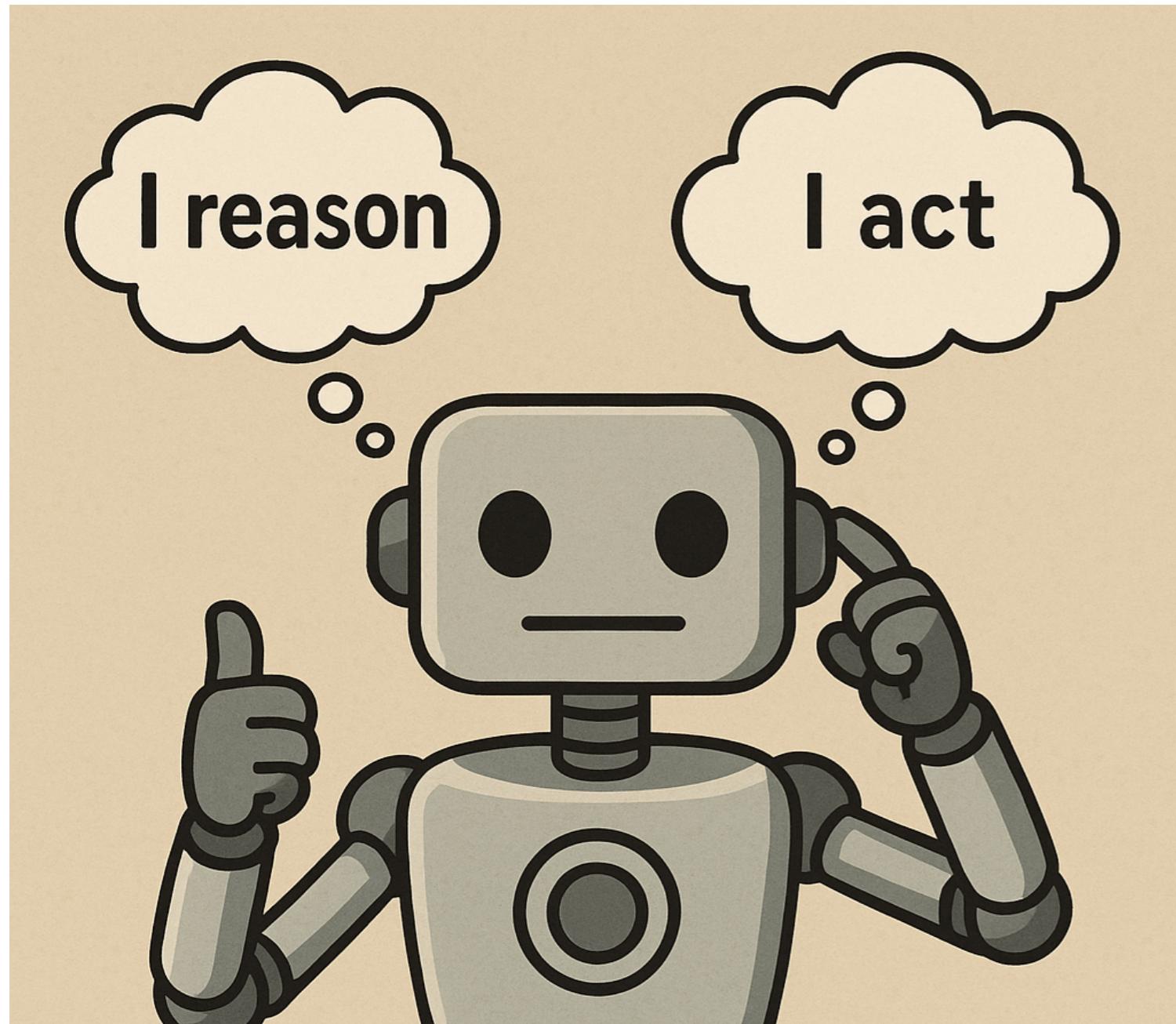
Observation: Final cost after tax is \$2,475.85

Final Answer: Total is \$2,475.85

The correct answer \$2475.85

ChatGPT answer: \$2475.85

ReAct as a Way of Thinking



ReAct is part of the model's system prompt

System prompt are hidden instructions that tell the model how to behave throughout all conversations.

¹ Image generated with GPT-4o

Reasoning Models and ReAct

- ReAct is especially useful on "traditional" language models like the GPT-series of models
- Newer generation reasoning models are explicitly trained to think step by step, and don't need ReAct prompting

Example of reasoning models

- OpenAI o-series of models
- DeepSeek R-series of models
- Gemini thinking models

How to Spot a Reasoning Model

Calculate the total cost if I buy 3 laptops at \$899 each with a 15% discount and 8% sales tax.



Thought for 15 seconds ▾

- When it comes to currency, amounts are typically rounded to two decimal places, like \$2,475.85. Just to double-check, I'll run a quick computation to verify this. I'll make sure the result respects the usual rounding practices, but, yeah, two decimals seem pretty standard.
- To calculate the total for 3 laptops at \$899 each, with a 15% discount and 8% sales tax:
First, the total before the discount is \$2,697. With a 15% discount on that amount, we subtract \$404.55, leaving \$2,292.45. Then, adding 8% sales tax, which is \$183.40, gives a final total of \$2,475.85. For the sake of clarity, I think rounding to the nearest dollar-and-

Let's Practice!

INTRODUCTION TO AI AGENTS

What's in the (Tool) Box?

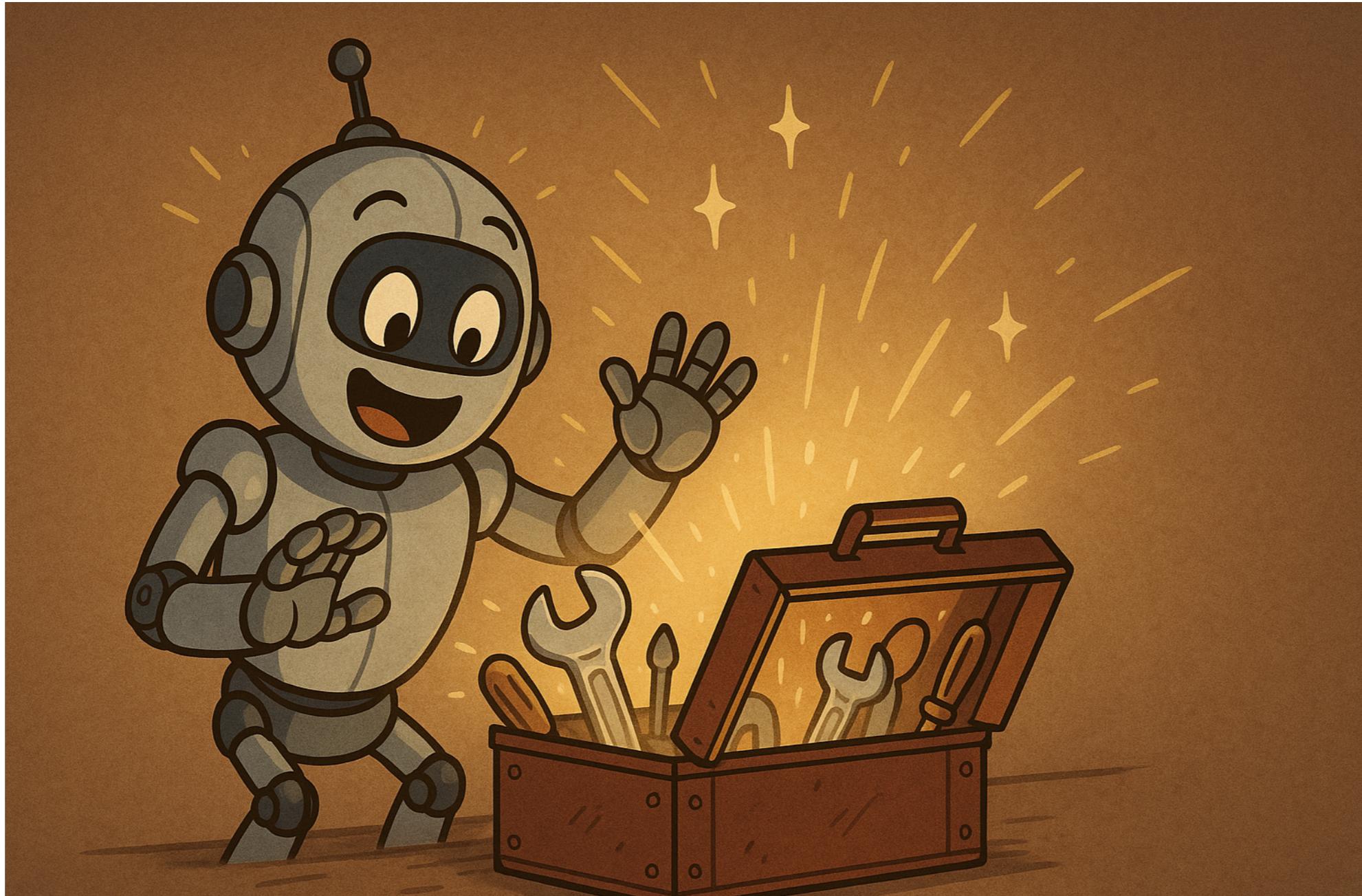
INTRODUCTION TO AI AGENTS



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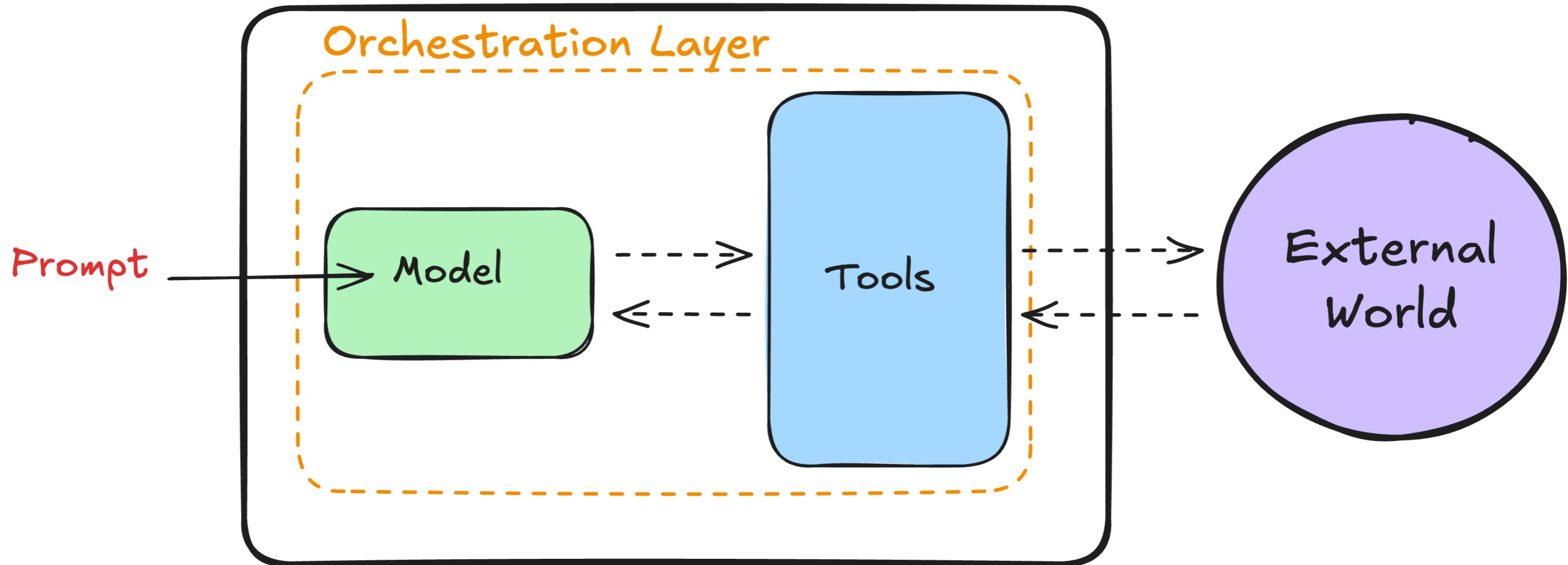
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What's in the (Tool) Box?



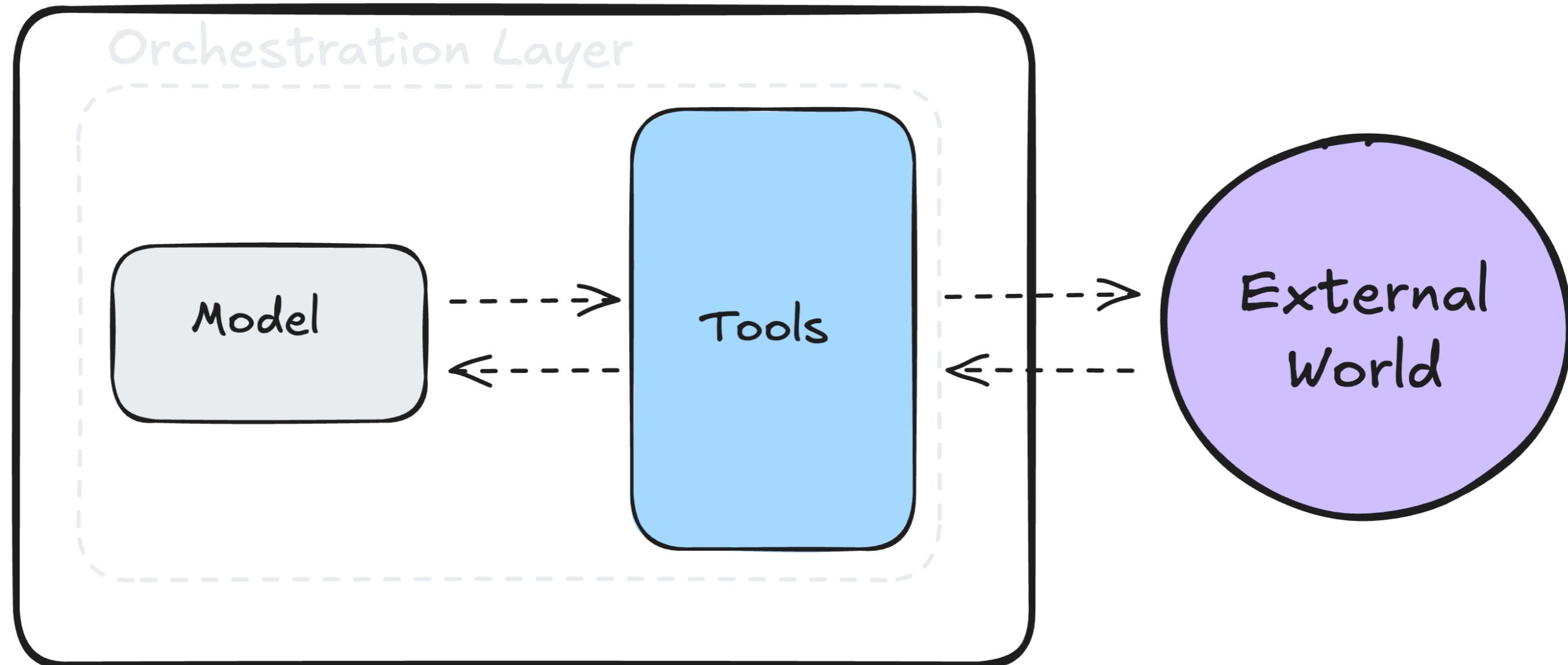
¹ Image generated with GPT-4o

Tool Use: An Essential Component



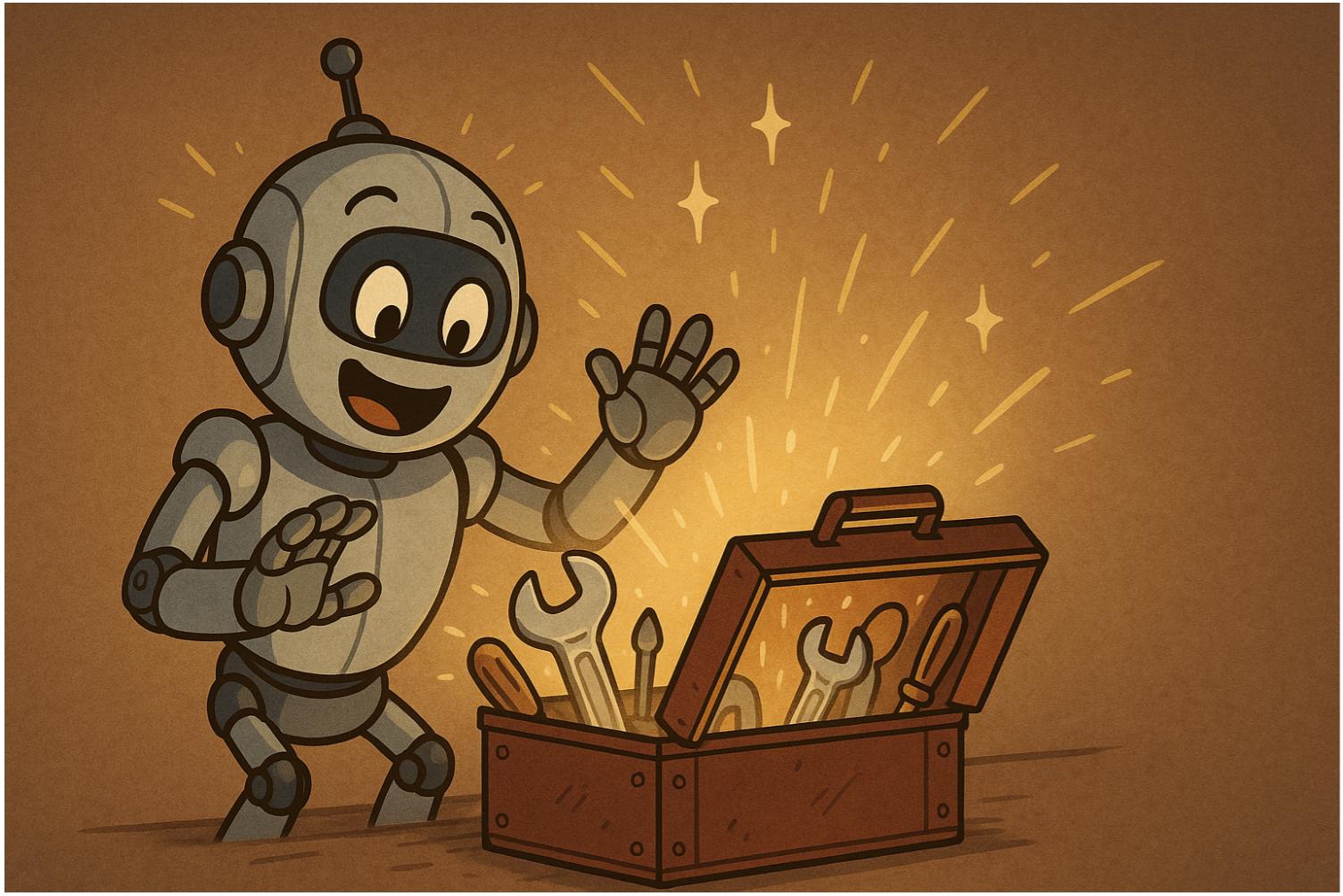
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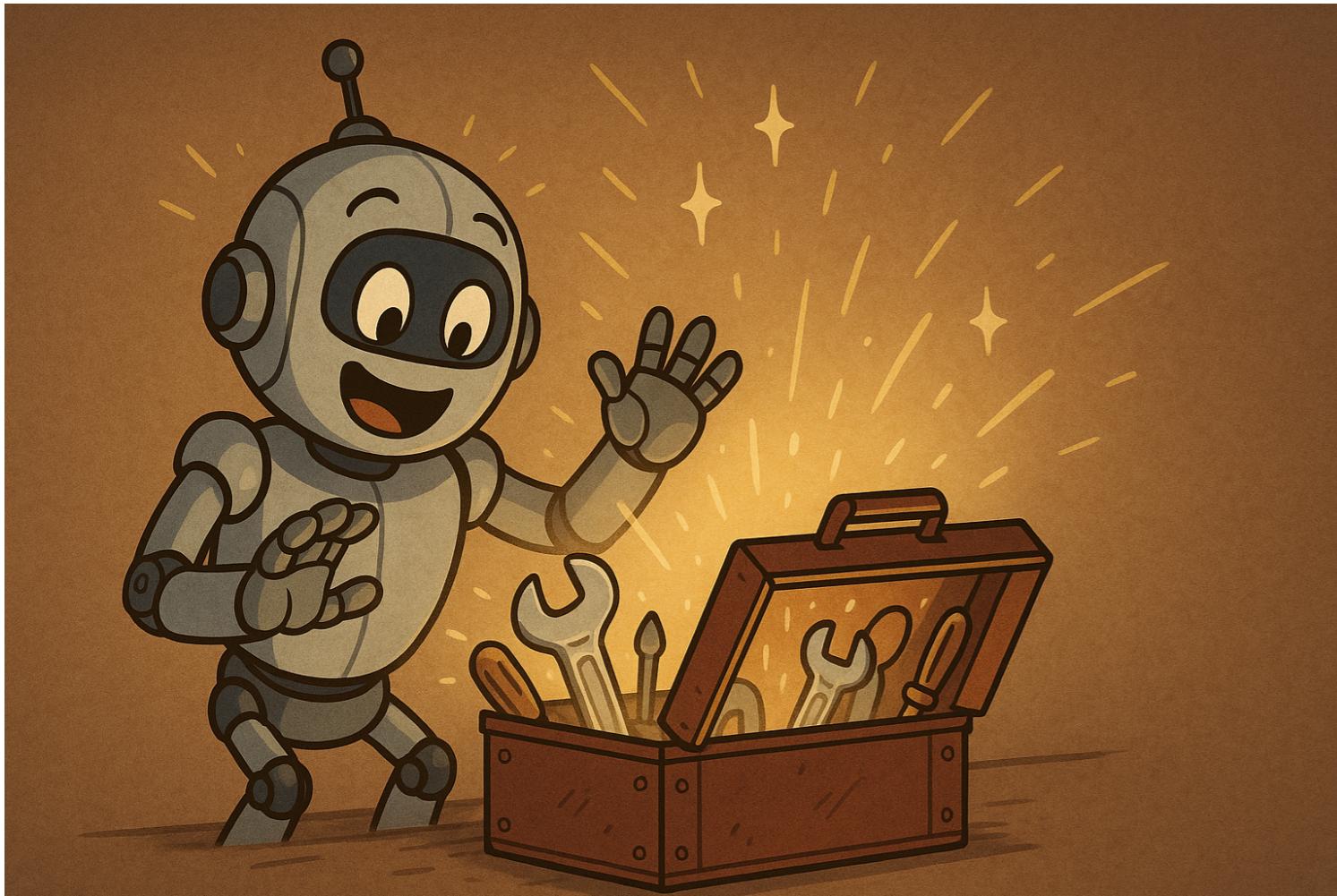
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The Different Type of Tools



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The Different Type of Tools

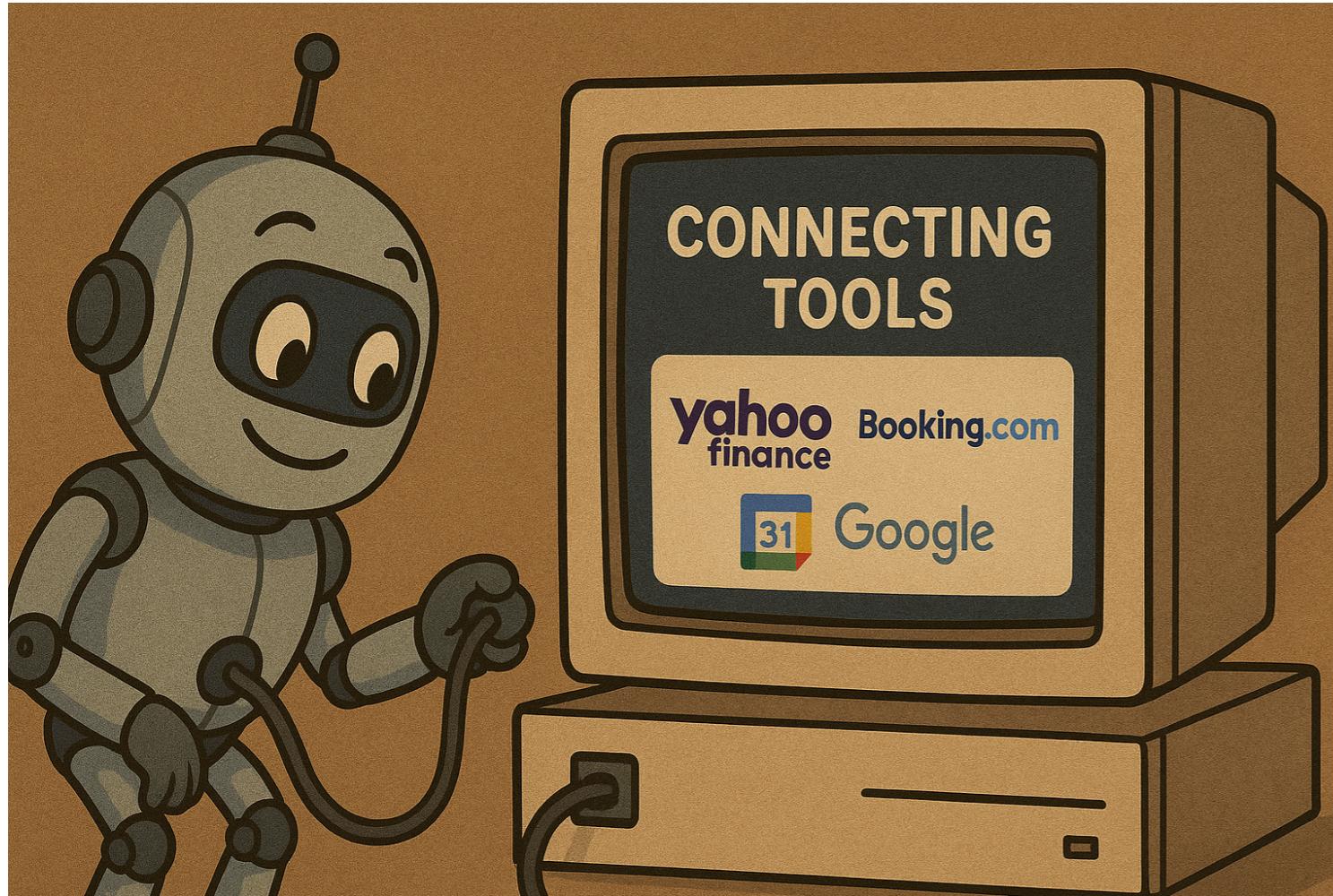


Extensions

Tools that connect agents to the outside world

¹ Wiesinger, J., Marlow, P., & Vuskovic, V. (n.d.). Agents.

Extensions

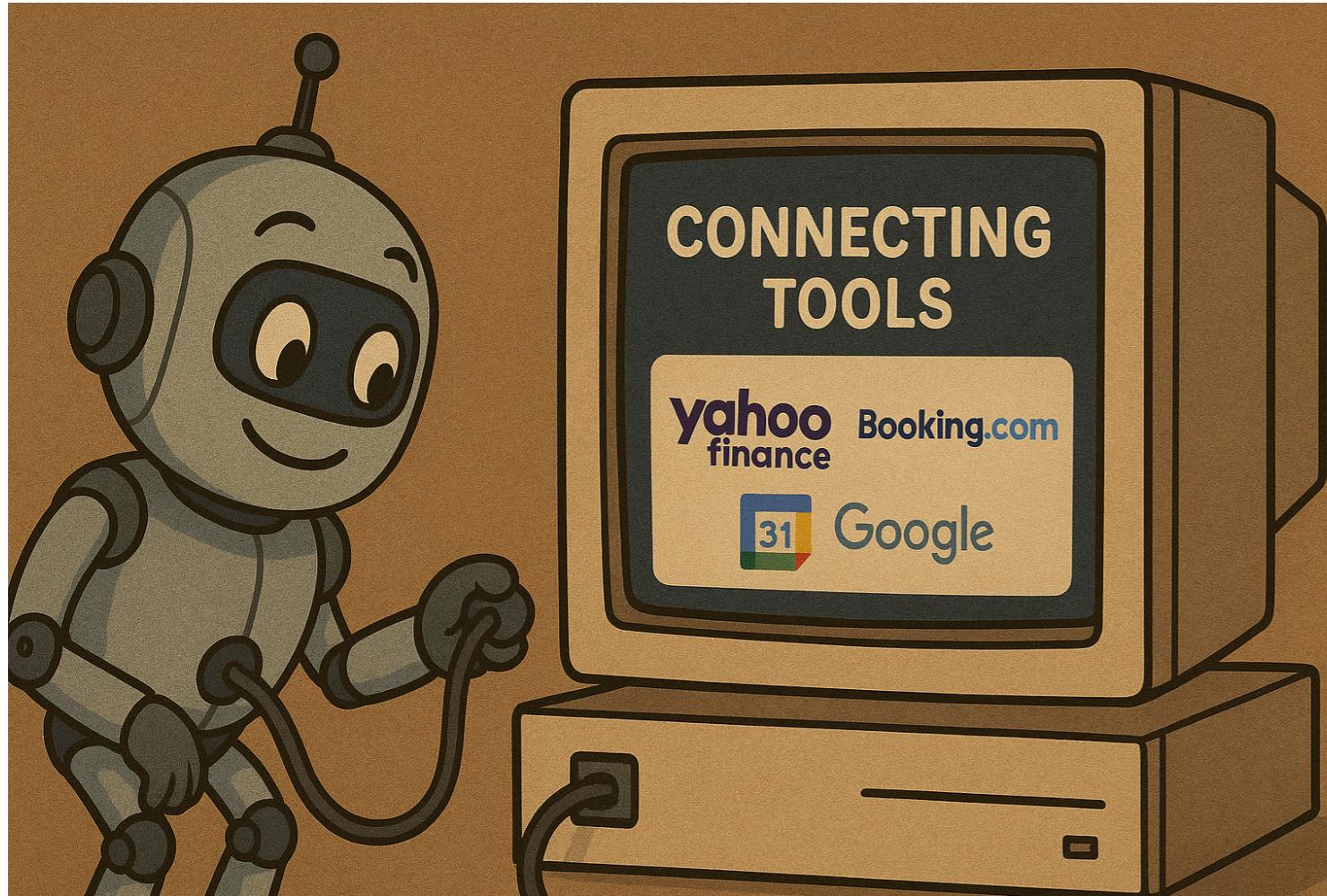


Application Programming Interface

Set of rules that lets different software systems talk to each other and share data or functionality in a structured way

¹ Image generated with GPT-4o

Extensions



Application Programming Interface

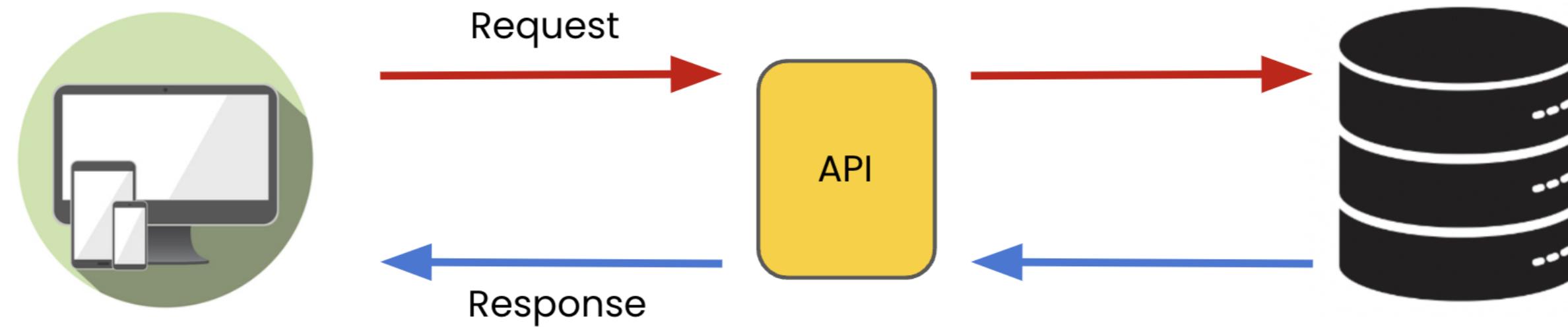
Set of rules that lets different software systems talk to each other and share data or functionality in a structured way

Model Context Protocol

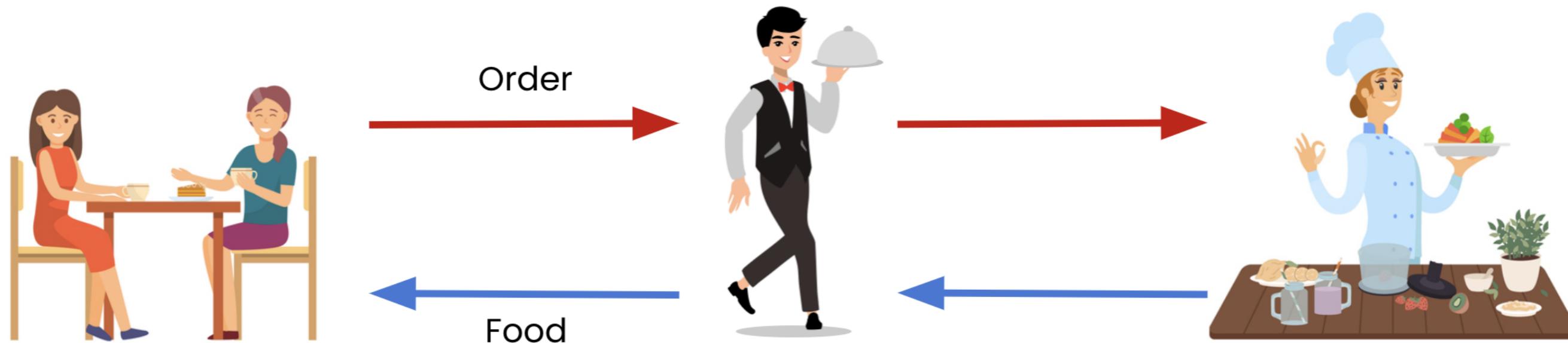
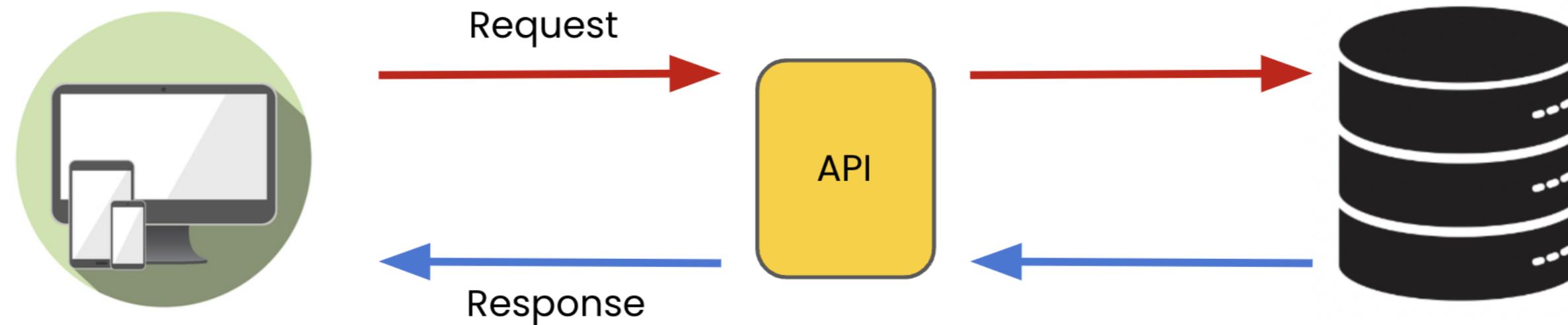
An open standard that lets AI assistants connect to external data sources and tools through a unified interface

¹ Image generated with GPT-4o

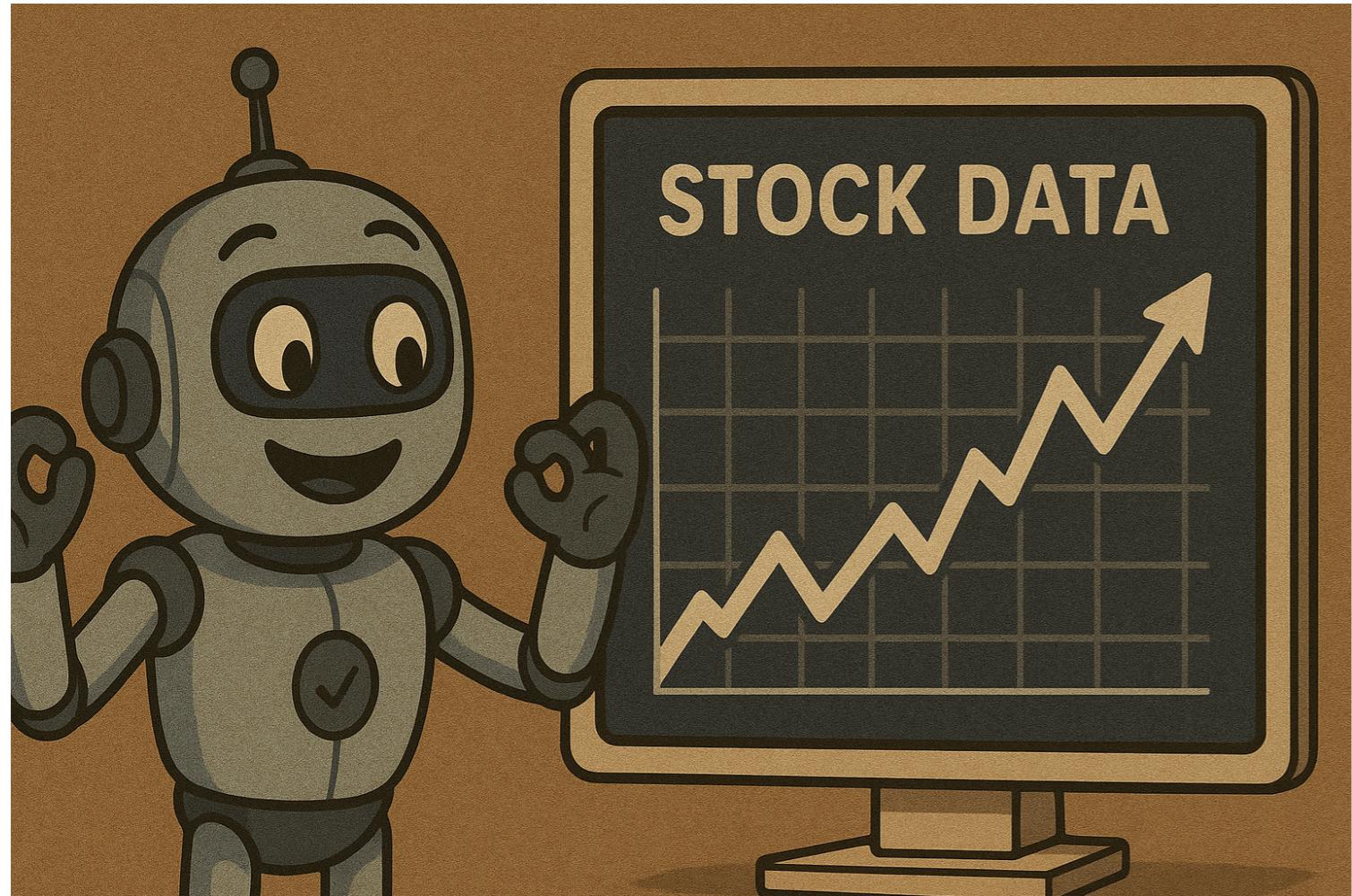
Application Programming Interface (API)



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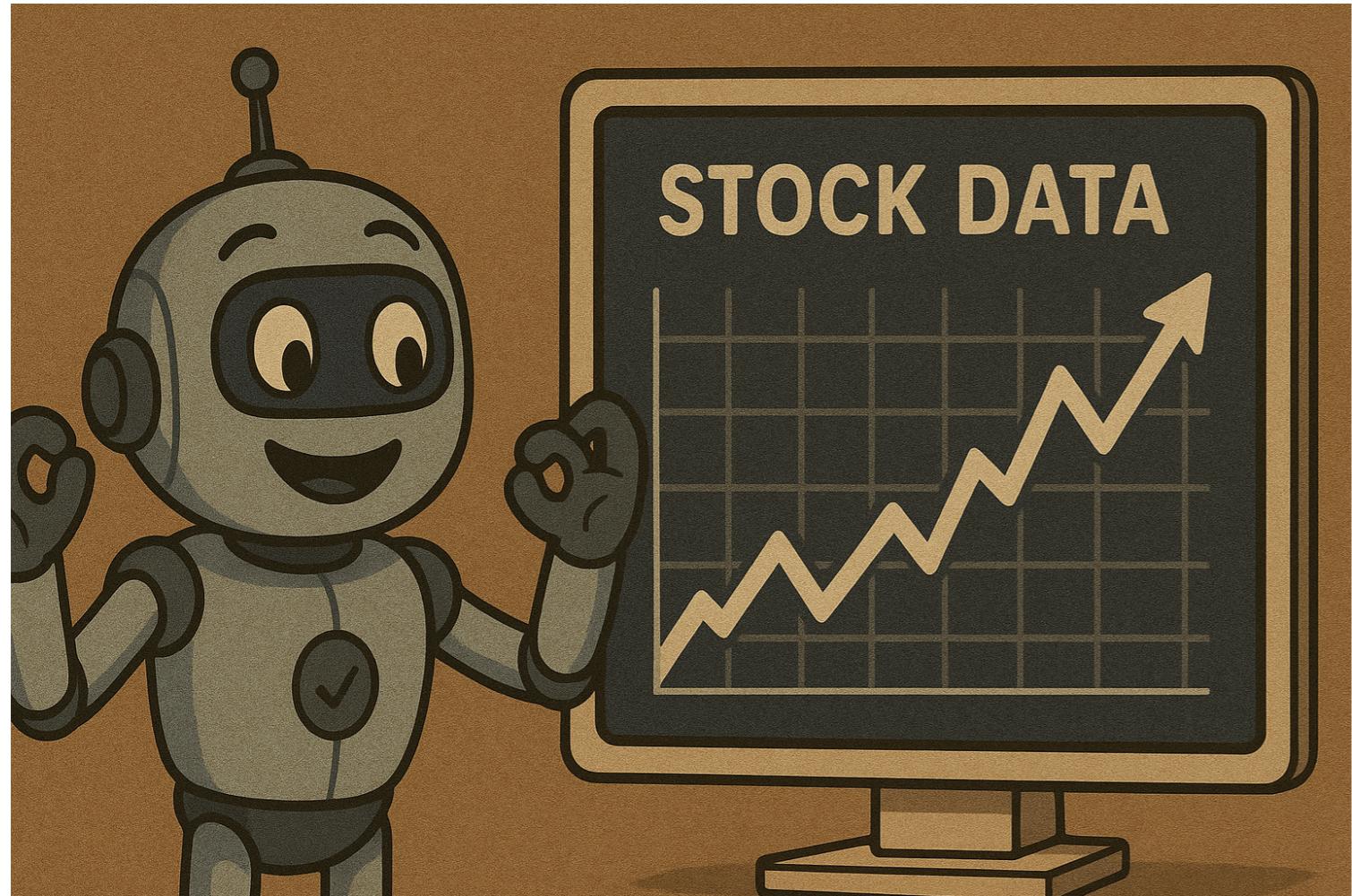


Extending Agent Capabilities with APIs



¹ Image generated with GPT-4o

Extending Agent Capabilities with APIs

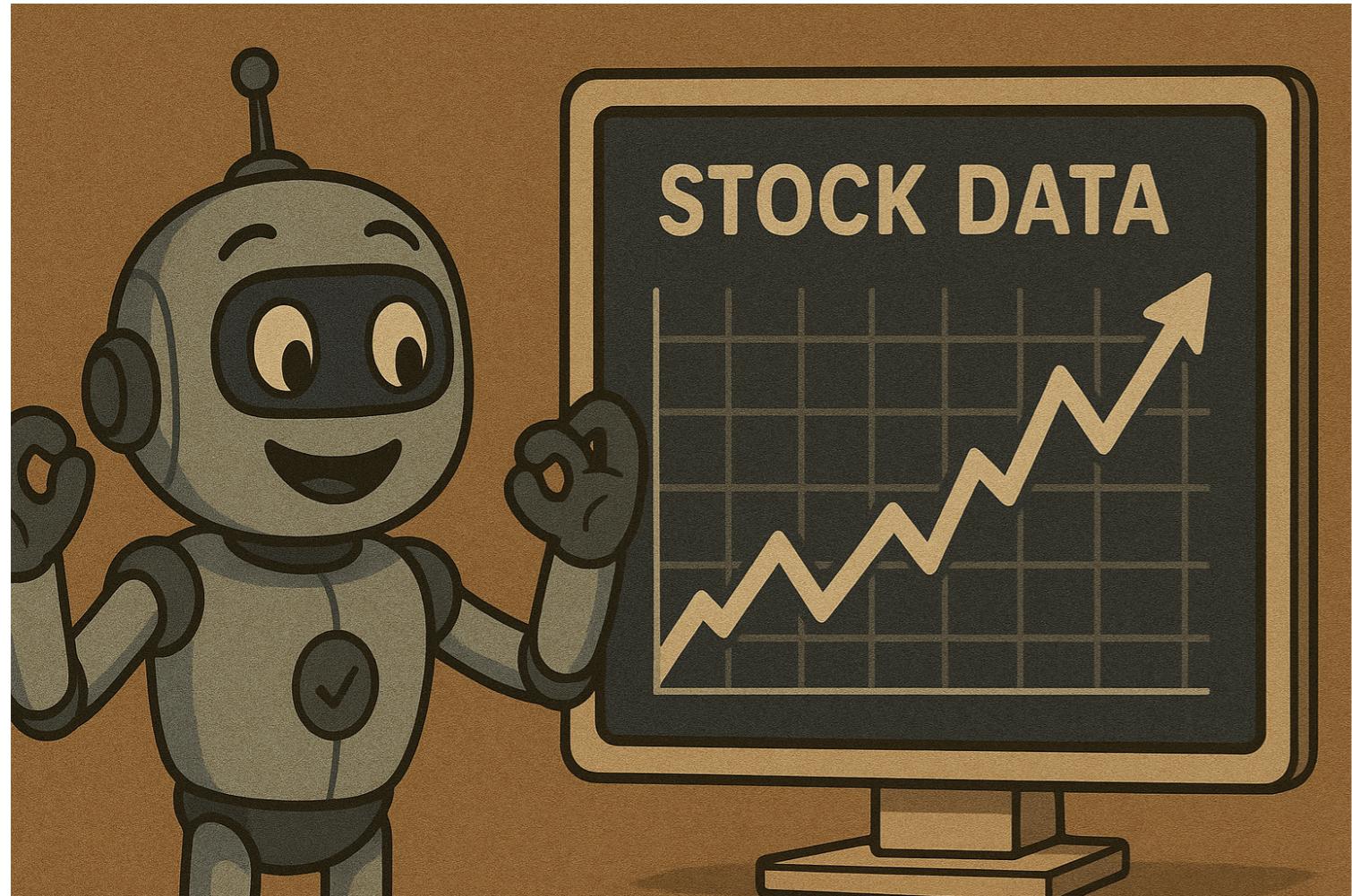


Prompt

What's the stock price of Nvidia today?

¹ Image generated with GPT-4o

Extending Agent Capabilities with APIs



Prompt

What's the stock price of Nvidia today?

Tool use

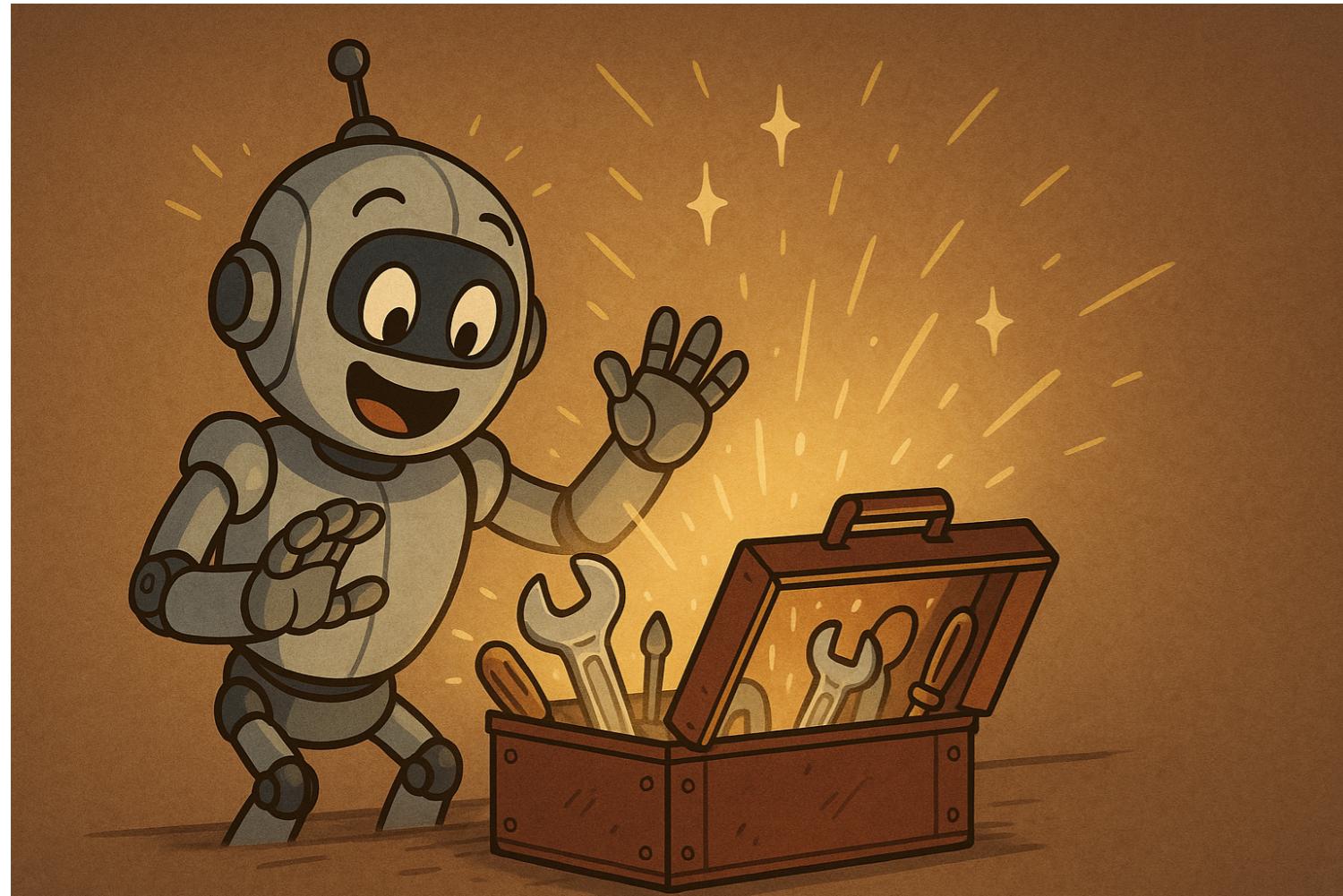
Yahoo Finance API

Response

Nvidia's stock price today is \$141,97

¹ Image generated with GPT-4o

The Different Type of Tools



Extensions

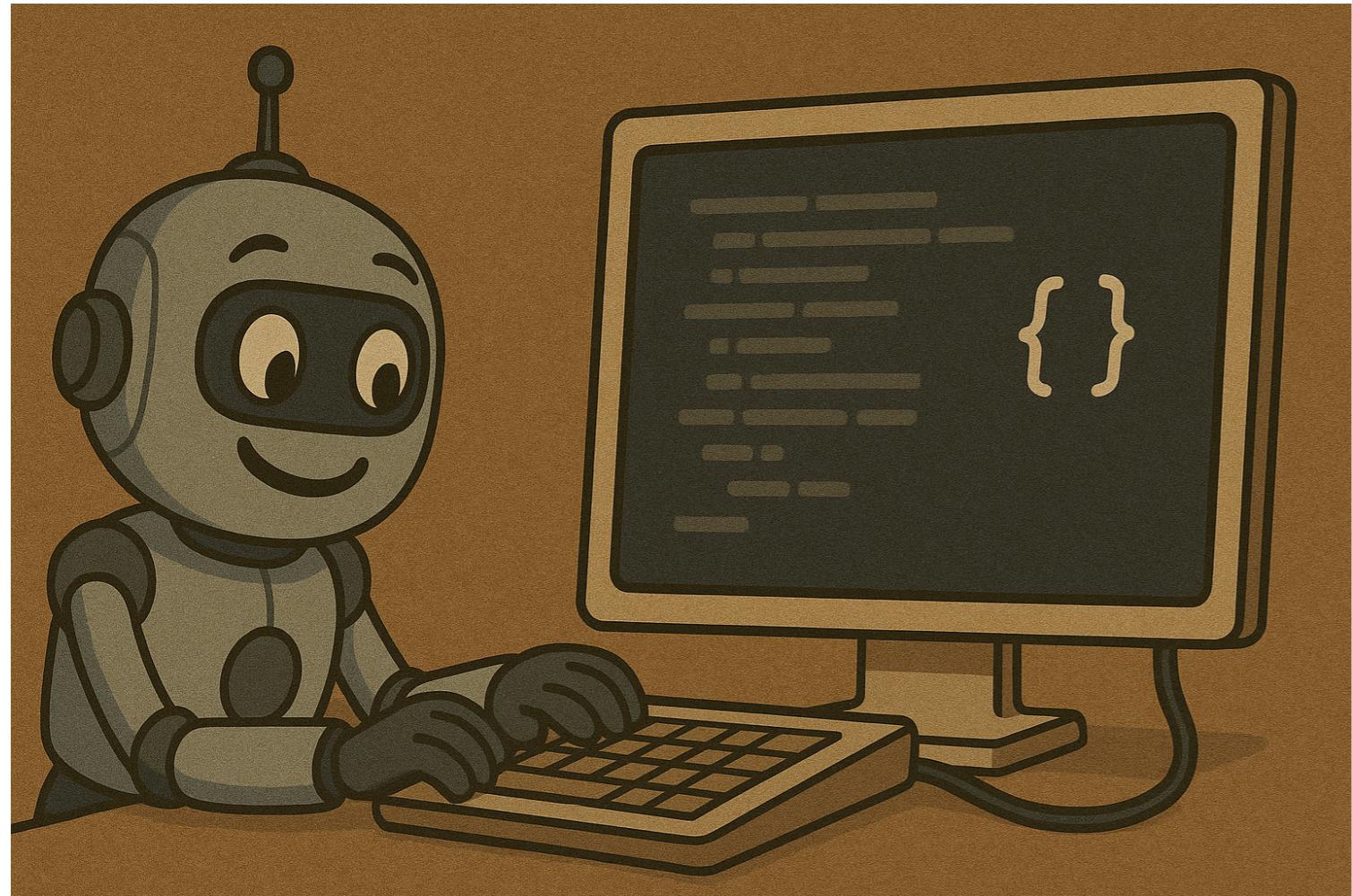
Tools that connect agents to the outside world

Functions

Tools that lets agents execute a specific set of code

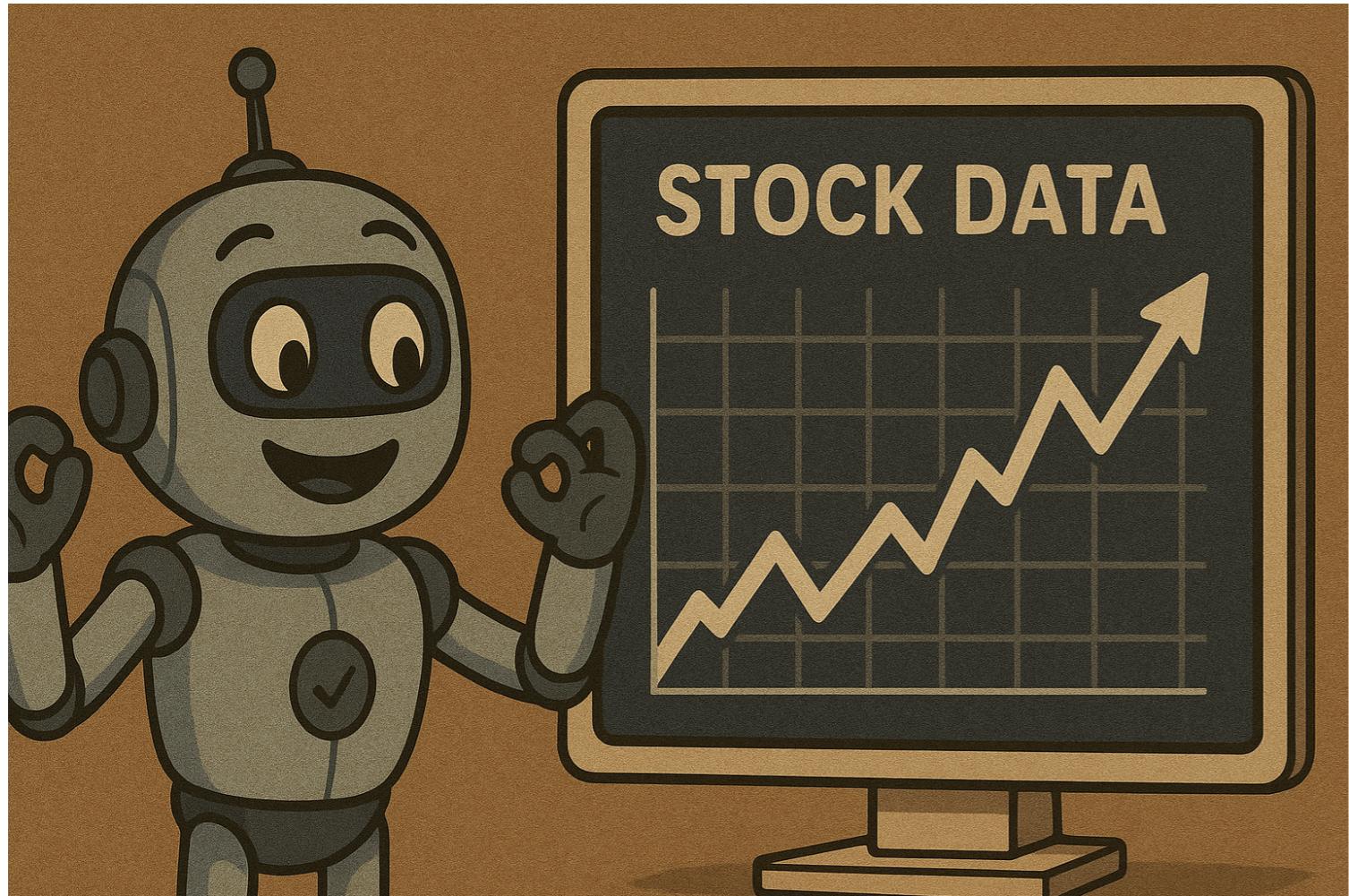
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Functions: Custom Abilities



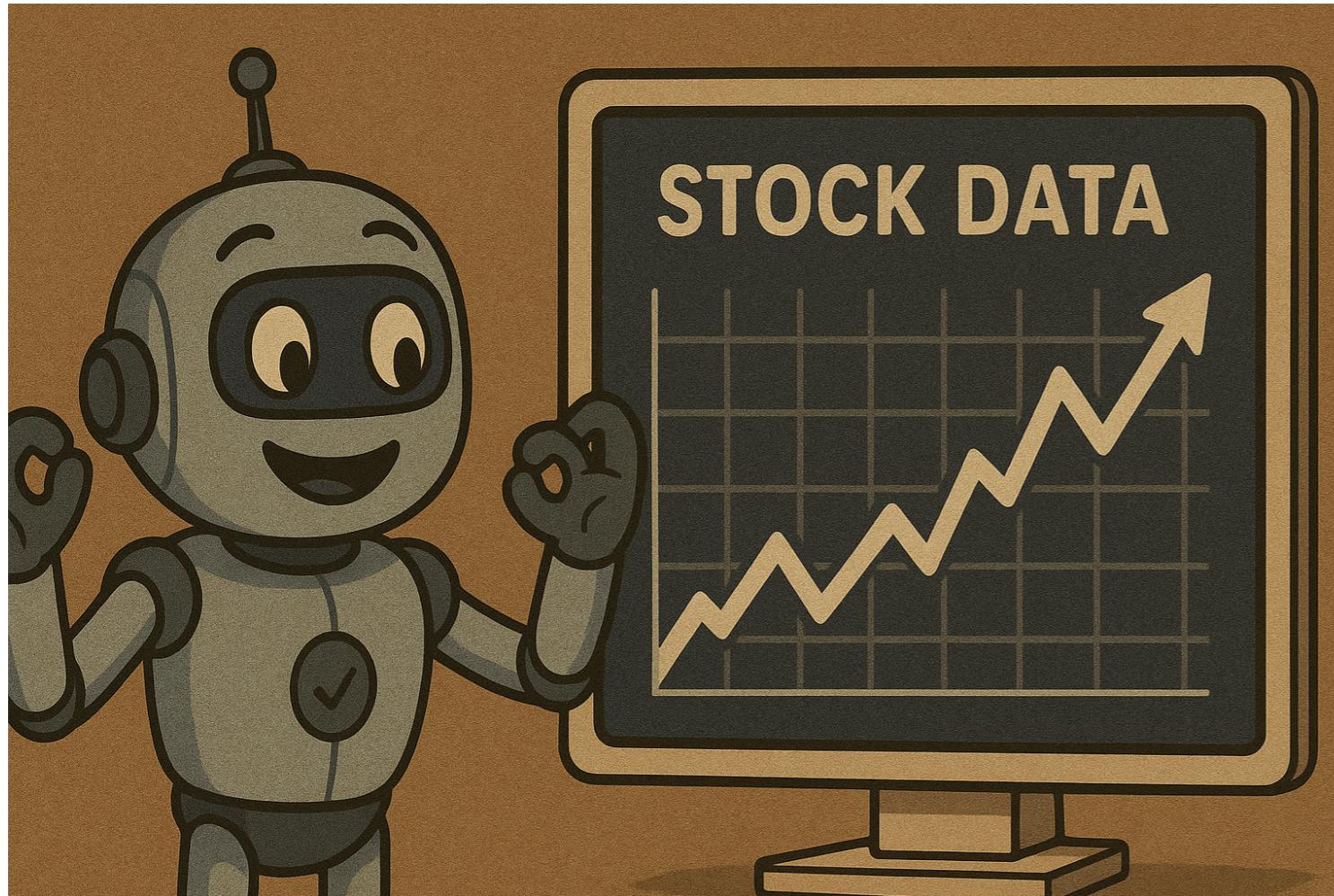
¹ Image generated with GPT-4o

Improving Capabilities with Functions



¹ Image generated with GPT-4o

Improving Capabilities with Functions



Prompt

Analyze Nvidia's stock performance over the last 30 days

Tool use

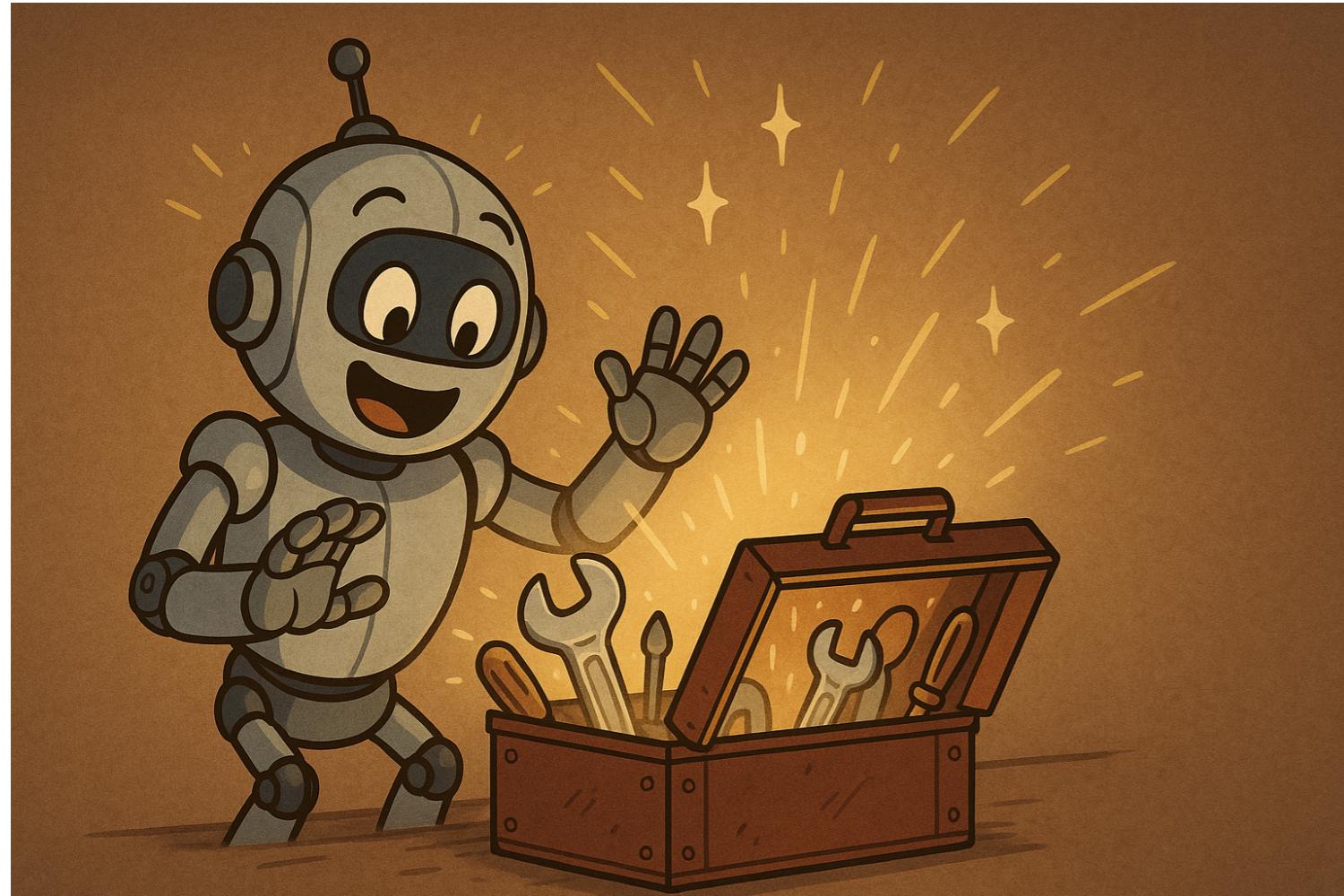
- Yahoo Finance API
- Calculates moving averages function

Response

Nvidia's stock price today is \$141,97. Over the past 30 days, the moving average increased by 10% over the historical average.

¹ Image generated with GPT-4o

The Different Type of Tools



Extensions

Tools that connect agents to the outside world

Functions

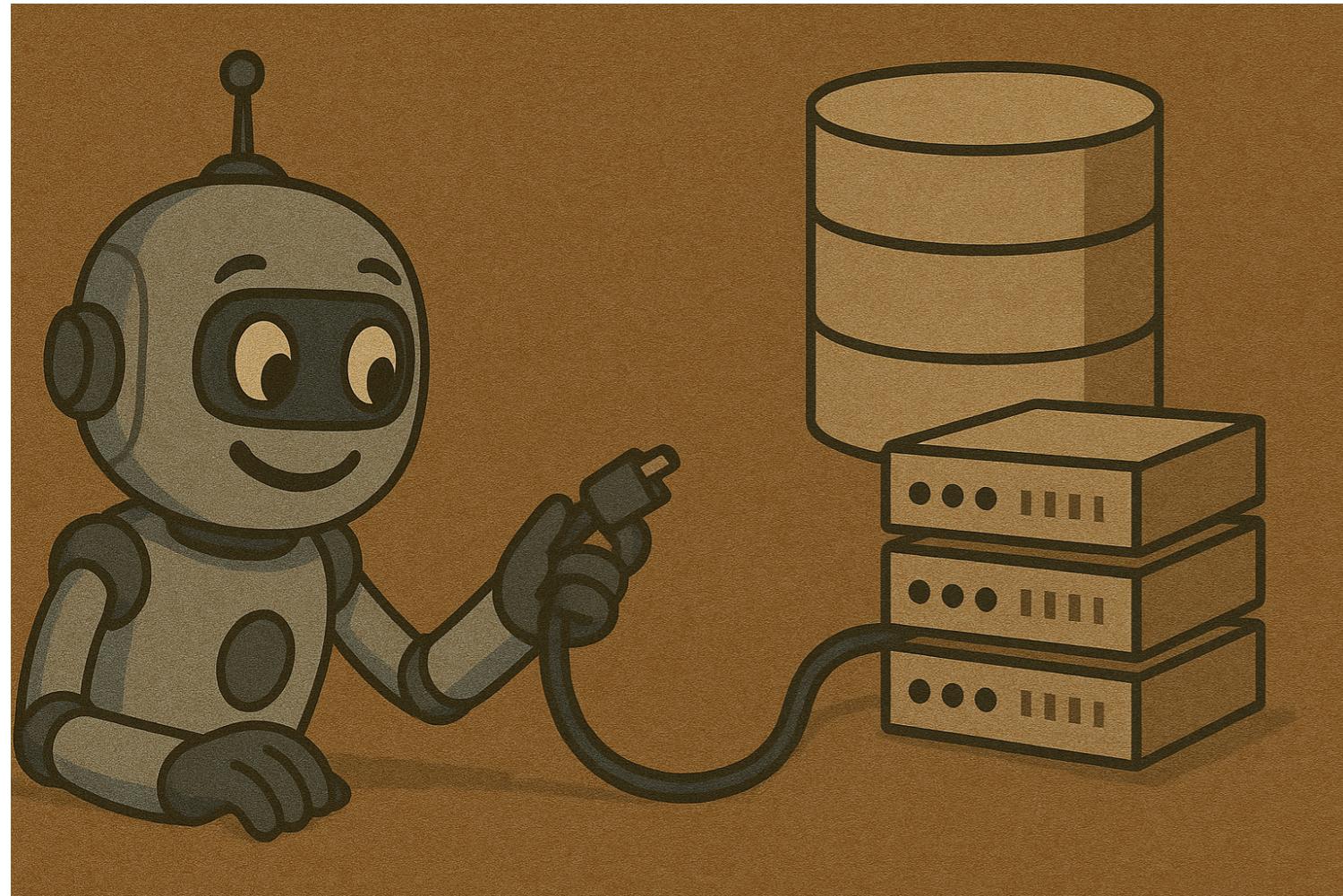
Tools that lets agents execute a specific set of code

Data stores

Tools that lets agents retrieve information from databases and documents

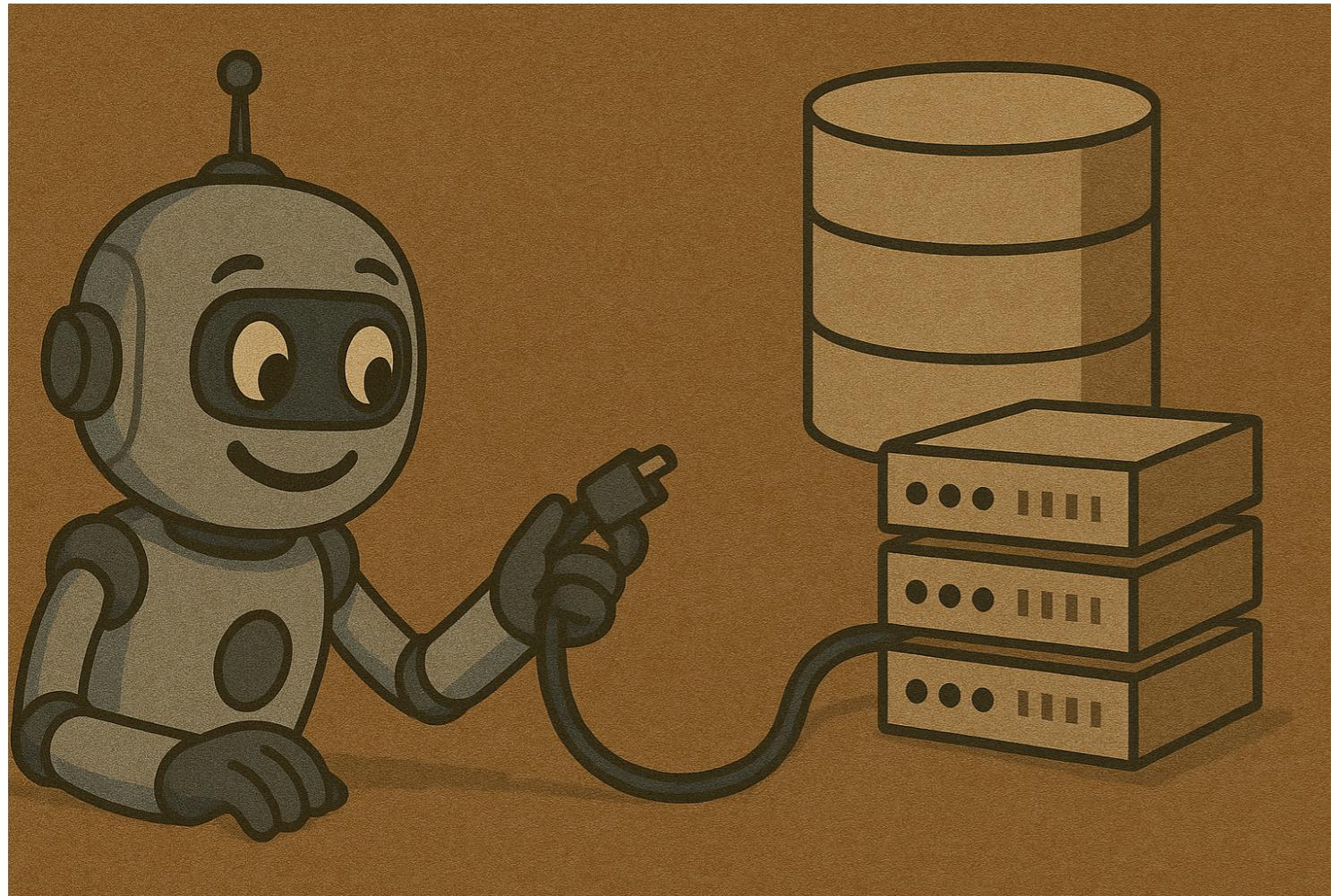
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Data Stores: Retrieving Information



¹ Image generated with GPT-4o

Data Stores: Retrieving Information

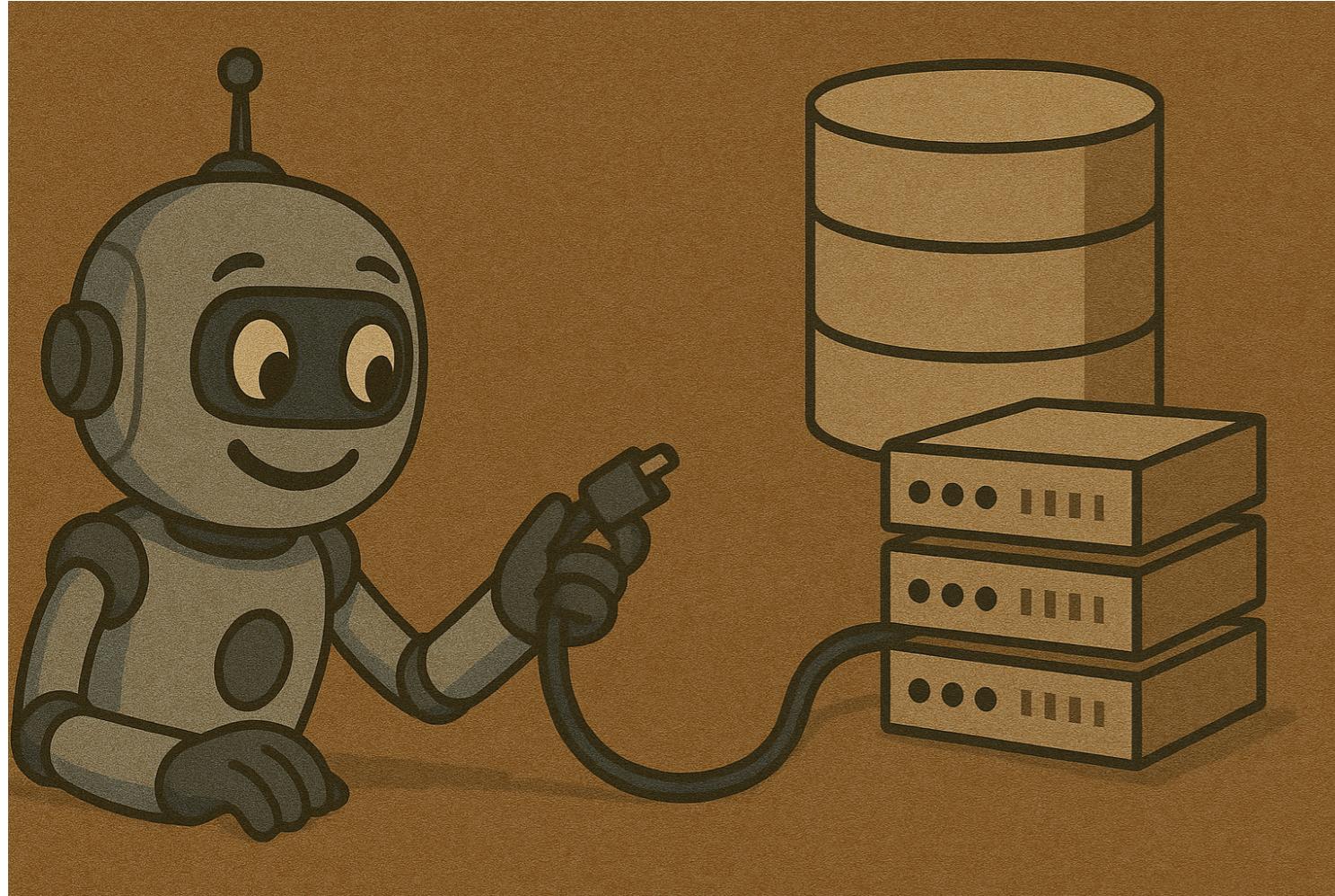


Structured data

- Tabular data
- Databases, Excel Files, Directories, etc...

¹ Image generated with GPT-4o

Data Stores: Retrieving Information



Structured data

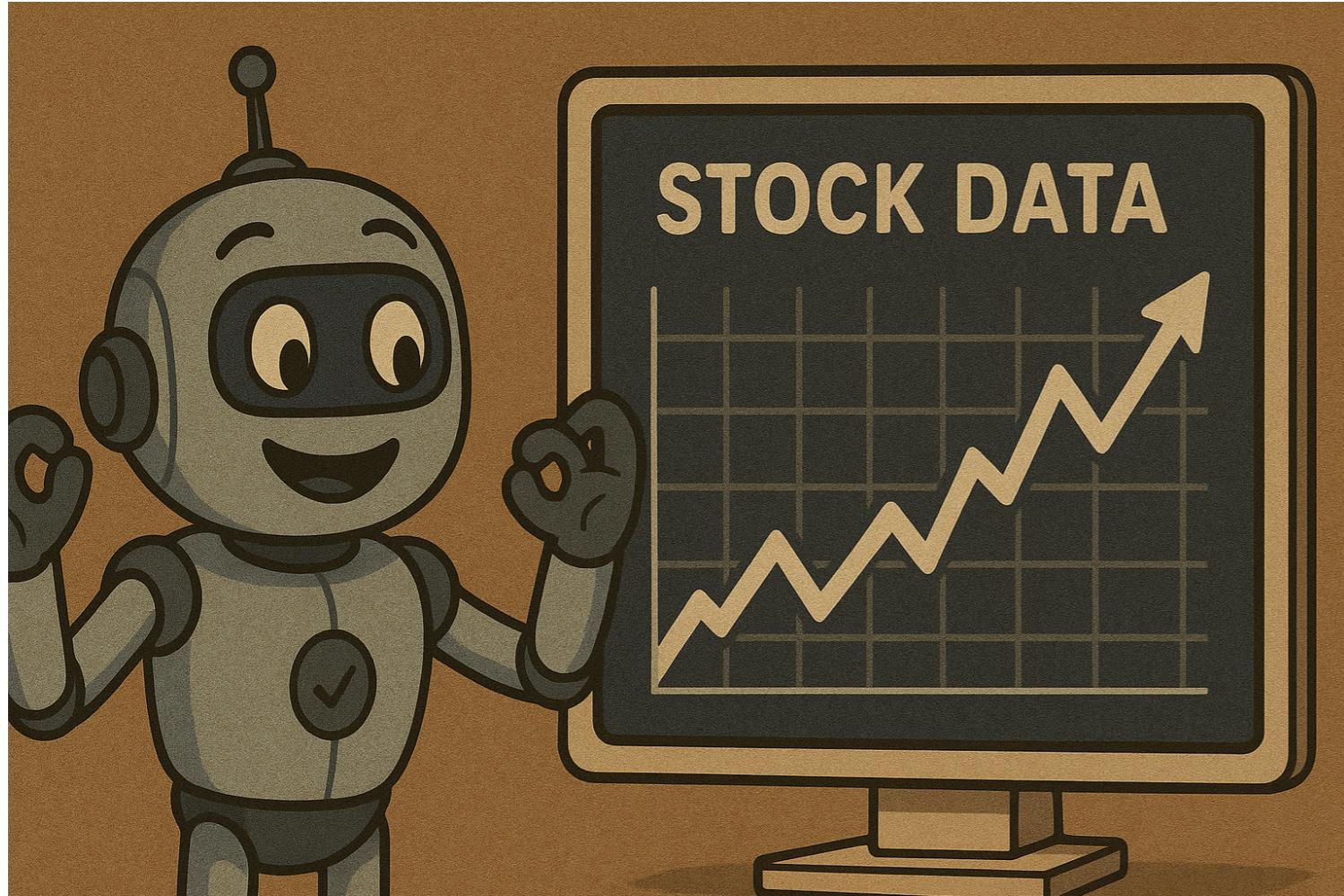
- Tabular data
- Databases, Excel Files, Directories, etc...

Unstructured data

- Text, image, video, audio data
- PDFs, Emails, Company Reports, etc...

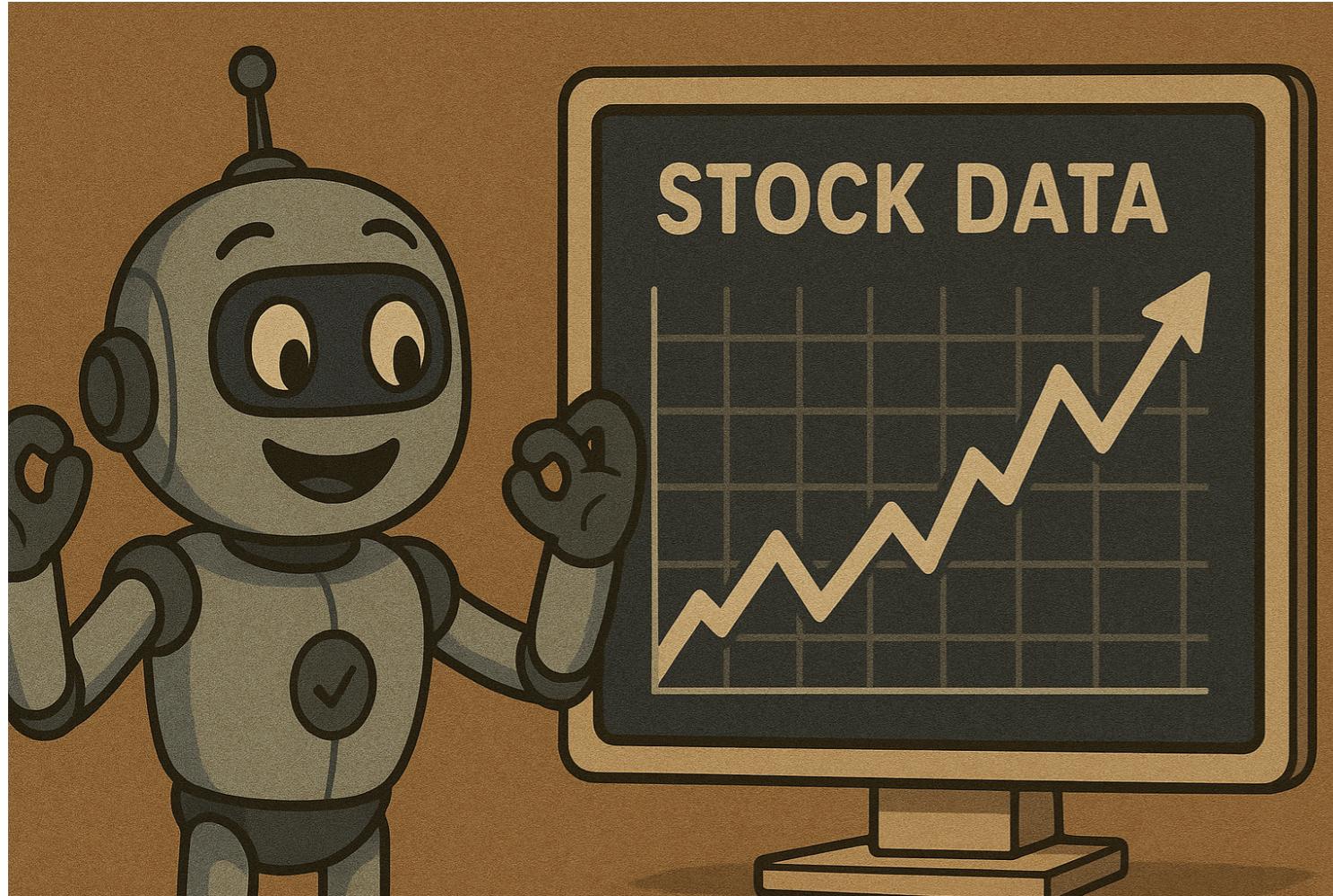
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Improving Capabilities with Data Stores



¹ Image generated with GPT-4o

Improving Capabilities with Data Stores



Prompt

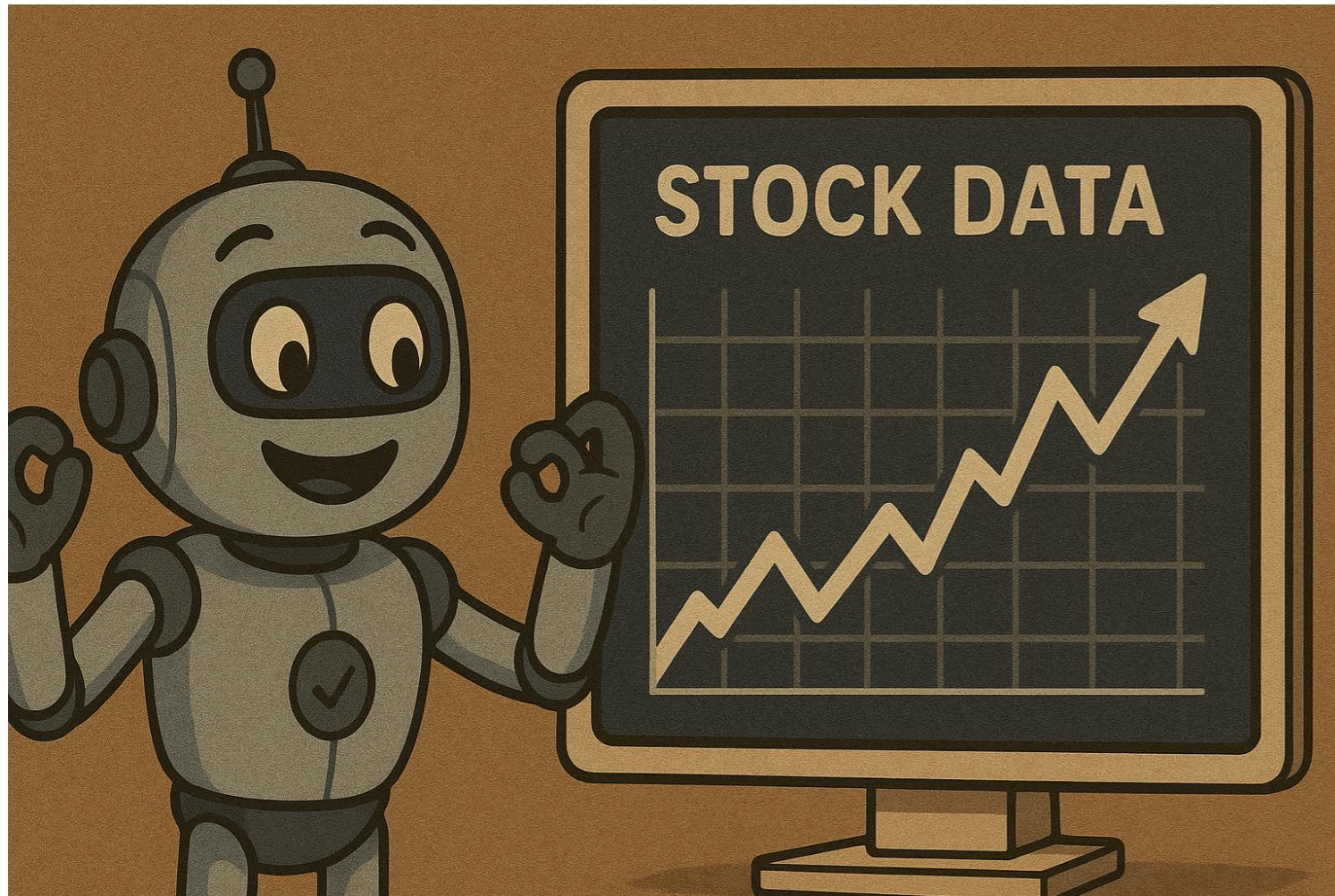
Analyze Nvidia's stock performance over the last 30 days

Tool use

- Yahoo Finance API
- Calculates moving averages function
- Analyst report on the semi-conductor industry

¹ Image generated with GPT-4o

Improving Capabilities with Data Stores



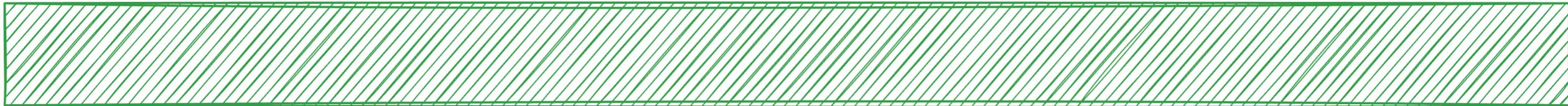
Response

Nvidia's stock price today is \$141,97. Over the past 30 days, the moving average increased by 10% over the historical average. According to analysts, the semiconductor industry is seeing above average growth with exploding demand for GPUs coming from AI labs and increased VC investment in the AI industry.

¹ Image generated with GPT-4o

The Tool Box

Off the shelf tools



Low-code / No-code tools



AI agent frameworks



Let's Practice!

INTRODUCTION TO AI AGENTS

From One to Many: Multi-Agent Systems

INTRODUCTION TO AI AGENTS



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Customer Support in the Real World

Types of customer tickets

- Billing disputes requiring financial knowledge
- Technical issues needing engineering support
- Legal compliance questions demanding regulatory knowledge
- Product recommendations calling for sales acumen

Customer Support in the Real World

Ticket Type	Knowledge Resources	Tools to Access
Billing disputes	Internal finance documentation, payment policy wiki, transaction logs	Secure payment APIs, CRM with billing integration
Technical issues	Engineering runbooks, system architecture docs, incident postmortems	Observability tools (e.g., Datadog), ticketing system, internal dashboards
Legal compliance questions	Legal knowledge base, compliance manuals, GDPR/CCPA documentation	Contract management system, legal Q&A assistant, document retrieval tools
Product recommendations	Product feature matrix, customer personas, sales playbooks	Recommendation engine, CRM with lead tracking, chatbot assistant

The Problem with Single Agents

Increasingly complex logic

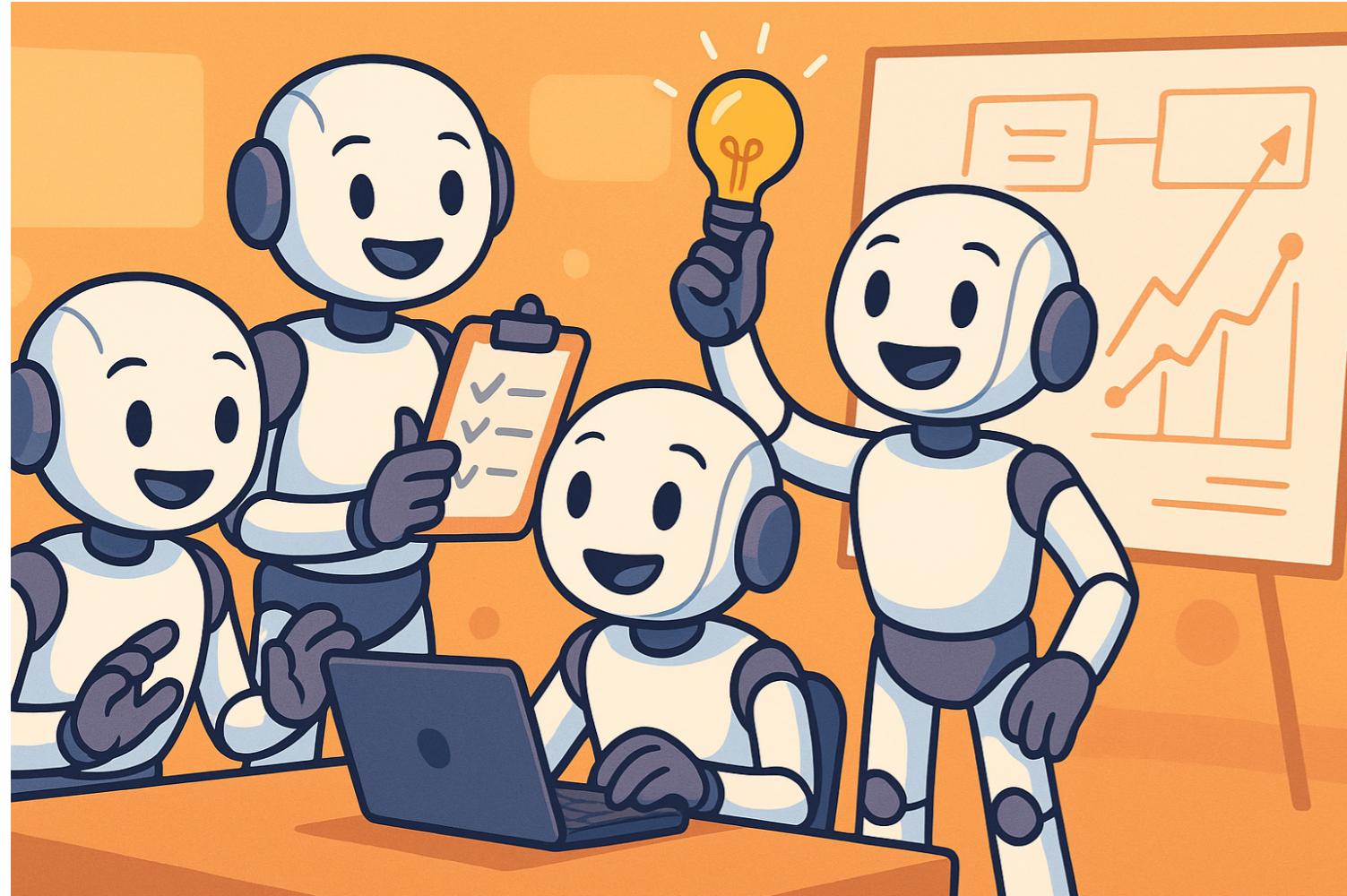
Models using prompts with a high amount of if-else scenarios and edge-cases

Tool overload

Agentic systems where a single model needs to call a wide variety of tools

¹ OpenAI, A Practical Guide to Building Agents, <https://cdn.openai.com/business-guides-and-resources/a-practical-guide-to-building-agents.pdf>

Multi-Agent Systems



Single Agent Systems

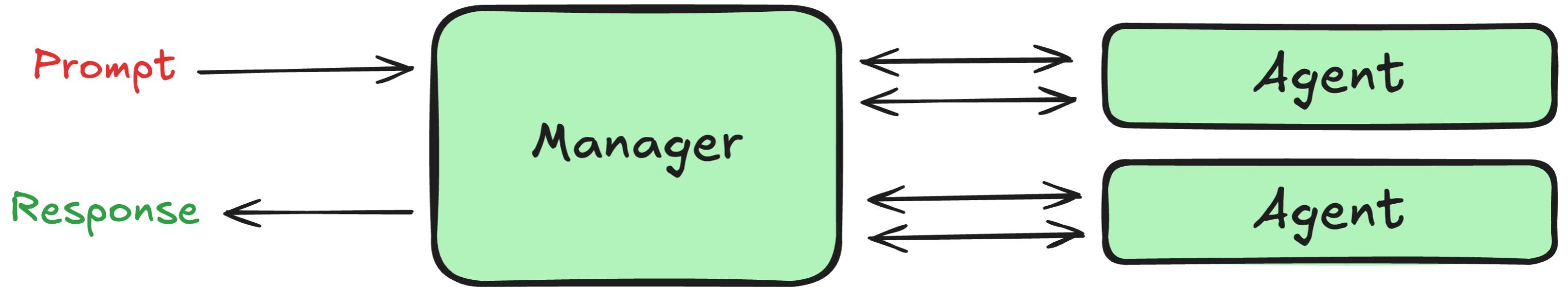
A single model equipped with appropriate tools and instructions executes workflows in a loop

Multi-Agent Systems

Execute workflows across multiple coordinated agents

¹ OpenAI, A Practical Guide to Building Agents, <https://cdn.openai.com/business-guides-and-resources/a-practical-guide-to-building-agents.pdf>

The Manager Pattern



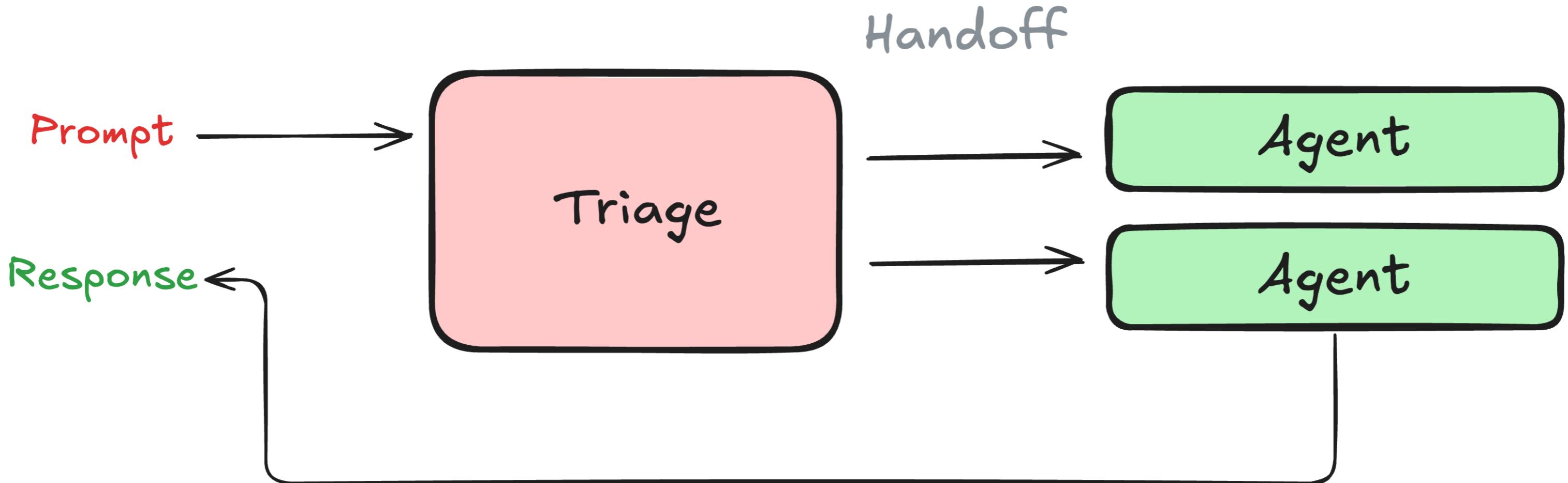
¹ OpenAI, A Practical Guide to Building Agents, <https://cdn.openai.com/business-guides-and-resources/a-practical-guide-to-building-agents.pdf>

The Manager Pattern Applied



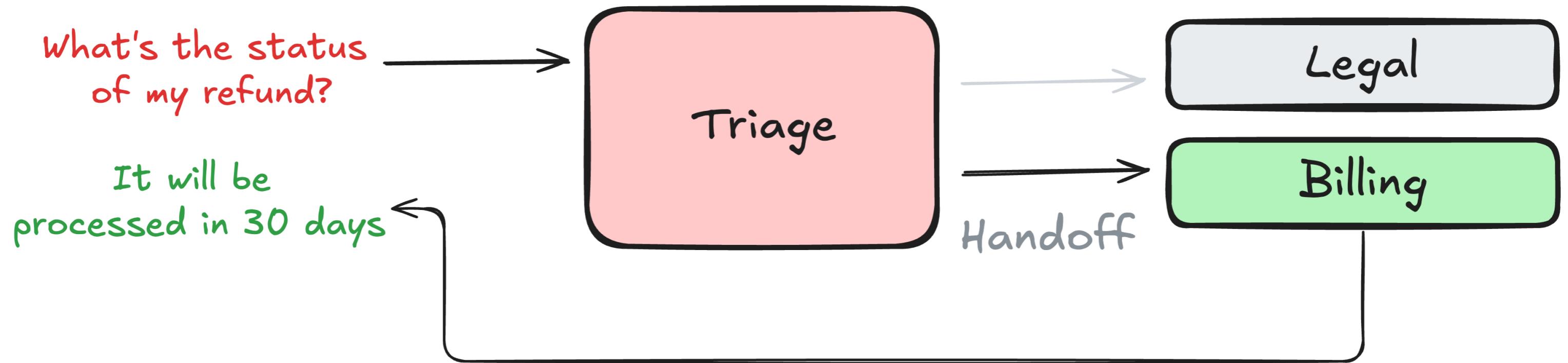
¹ OpenAI, A Practical Guide to Building Agents, <https://cdn.openai.com/business-guides-and-resources/a-practical-guide-to-building-agents.pdf>

The Decentralized Pattern



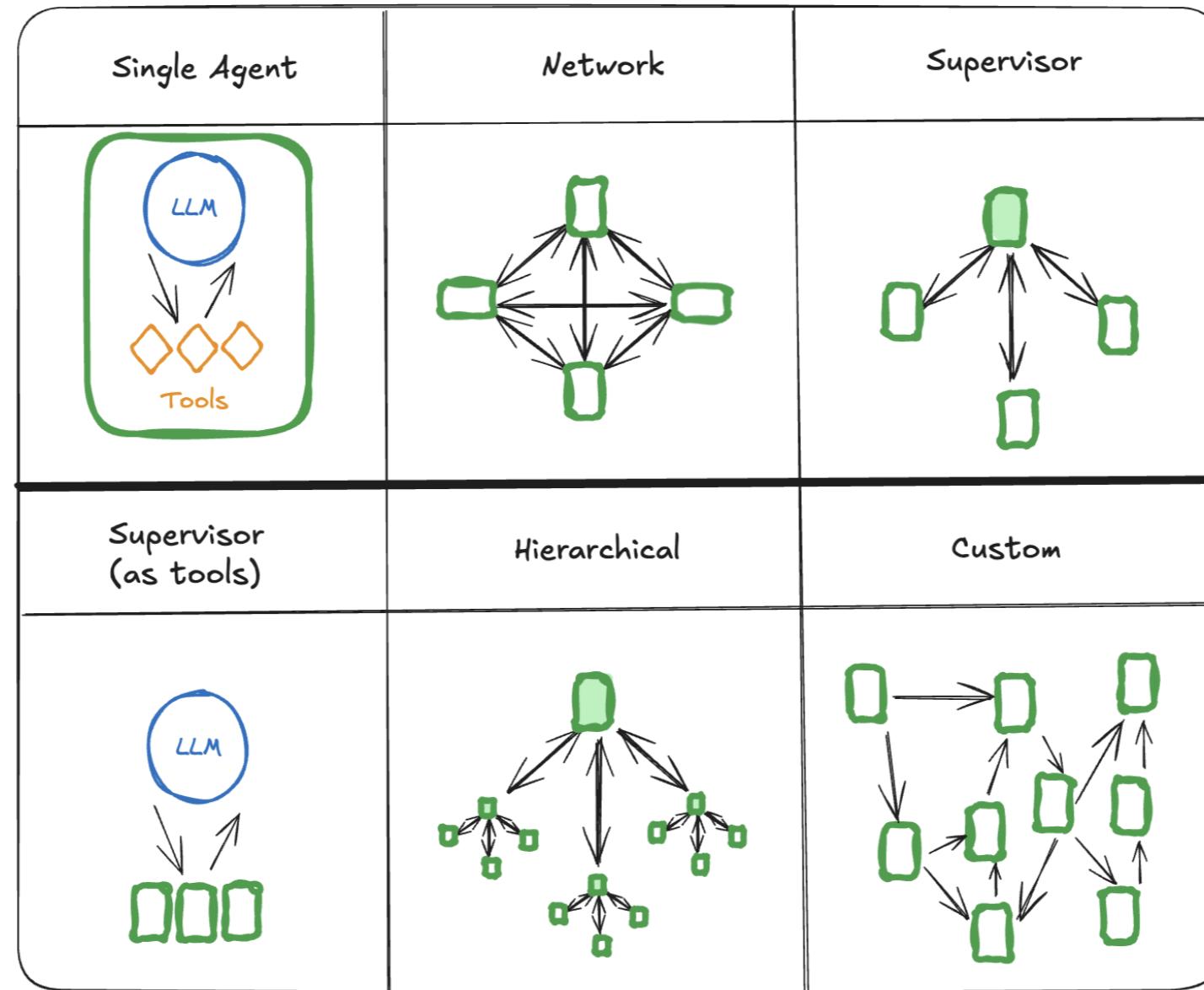
¹ OpenAI, A Practical Guide to Building Agents, <https://cdn.openai.com/business-guides-and-resources/a-practical-guide-to-building-agents.pdf>

The Decentralized Pattern Applied



¹ OpenAI, A Practical Guide to Building Agents, <https://cdn.openai.com/business-guides-and-resources/a-practical-guide-to-building-agents.pdf>

Emerging Agent Architectures



¹ LangGraph Multi Agent Systems, https://langchain-ai.github.io/langgraph/concepts/multi_agent/

From One to Many: Multi-Agent Systems



¹ Image generated with GPT-4o

Let's Practice!

INTRODUCTION TO AI AGENTS