BUILDING AND DEPLOYING AI AGENTS

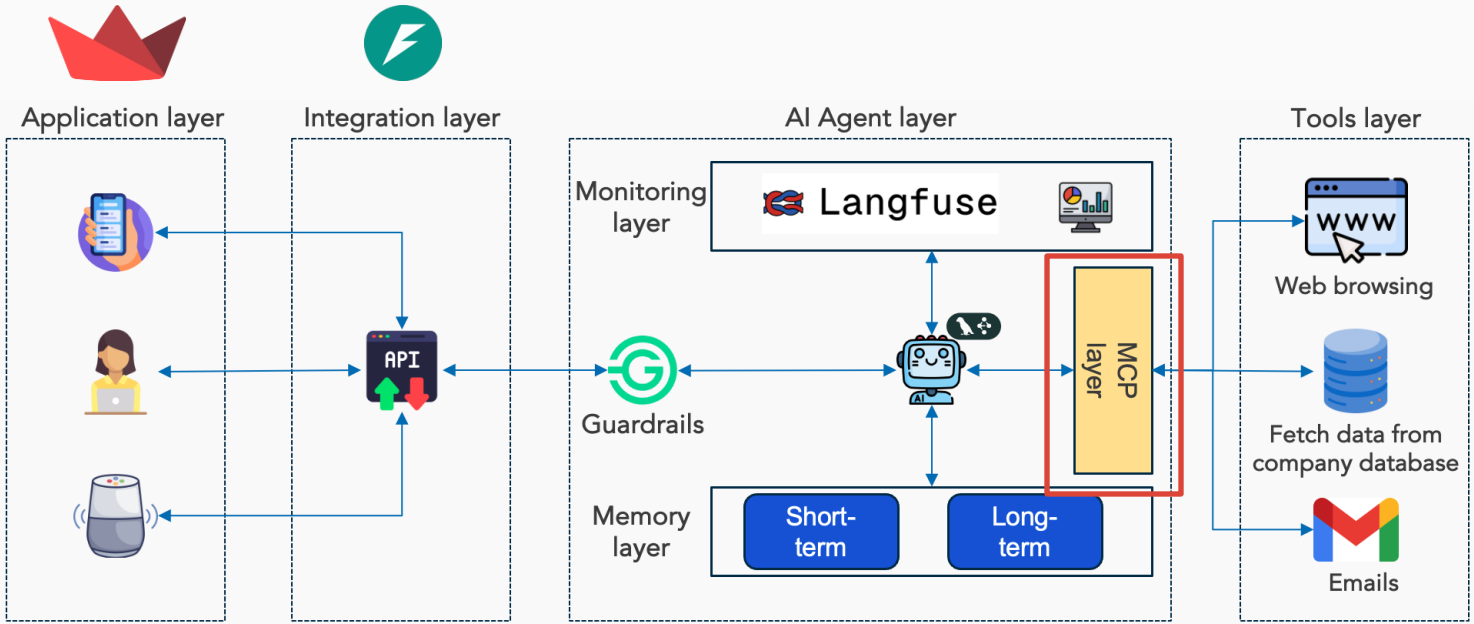
Class 7 - AI Standard Protocols & real-world AI Agent

Today's Roadmap

1. **Introducing MCP protocol –** deep dive into the most popular AI standard protocol
2. **Demo –** Building your first MCP and adding it into an Agent
3. **AI Agents use cases –** Overview
4. **Real-world use case experience –** Deep dive into a real AI Agent
5. **Lessons learned –** Sharing real experience
6. **Demo –** Capturing everything you learned and develop a Travel Agent
7. **Reflection -** Connecting the dots of what we learned today.
8. **M6 assignment** – What is the challenge?
9. **Wrap up -** Next steps

Connecting all dots

Today we will look at the last piece of the puzzle

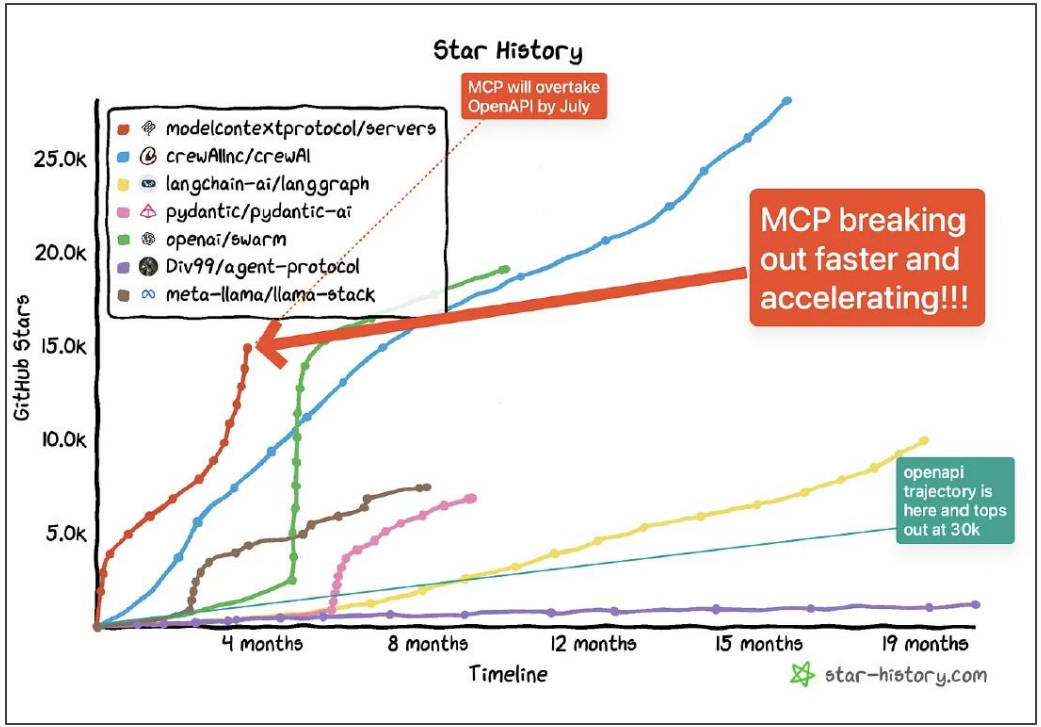


The HTTP moment of AI?

Source: https://www.anthropic.com/news/model-context-protocol

MCP is Growing Super Fast

All major players have already adopted it



Source: https://medium.com/@manuktiwary/the-model-context-protocol-mcp-a-complete-guide-84ecb9cbaf03

What is MCP?

MCP is an open protocol that enables seamless integration between **AI apps & agents** and your **tools & data sources**.

APIs

Standardize how **web applications** interact with the **backend**:

- Servers
- Databases
- Services

LSP

Standardizes how **IDEs** interact with **language-specific tools**:

- Code navigation
- Code analysis
- Code intelligence

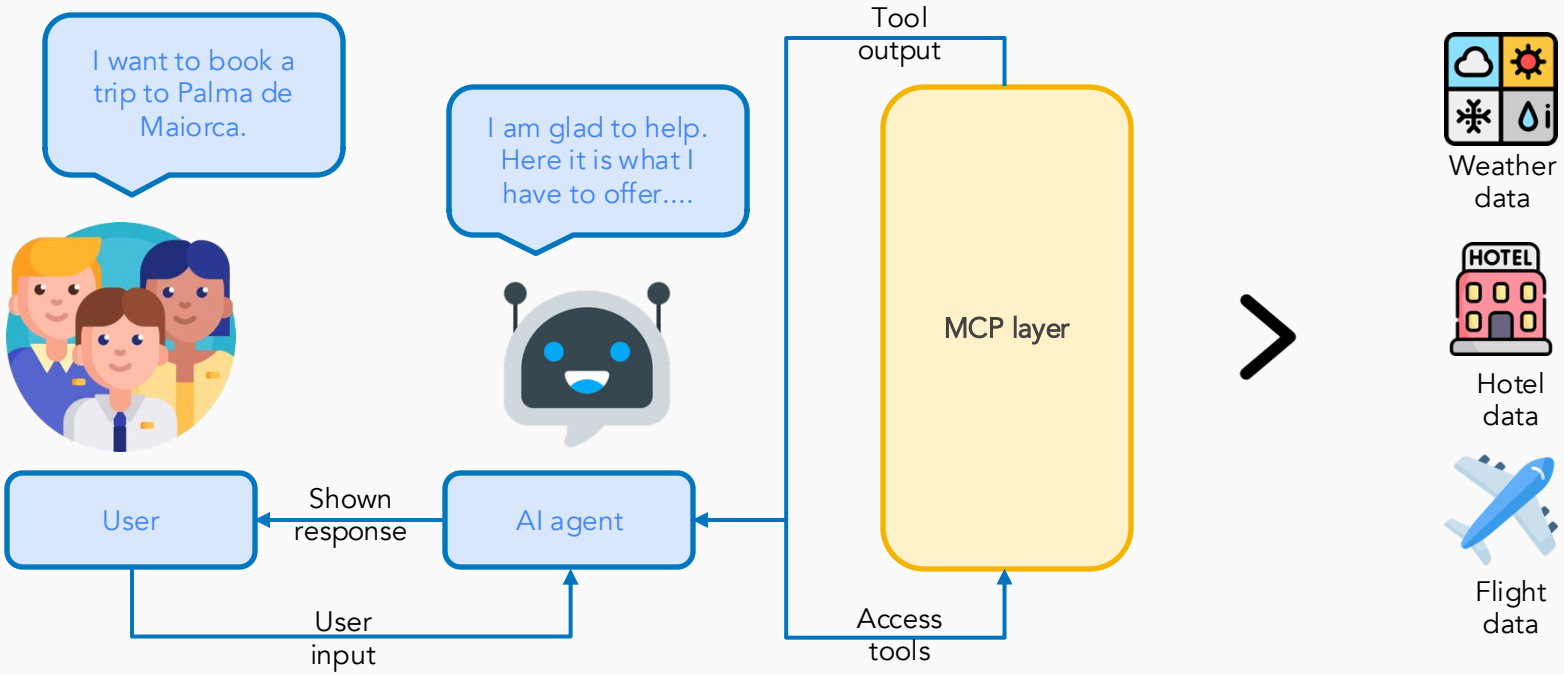
MCP

Standardizes how **AI applications** interact with **external systems**:

- Prompts
- Tools
- Resources

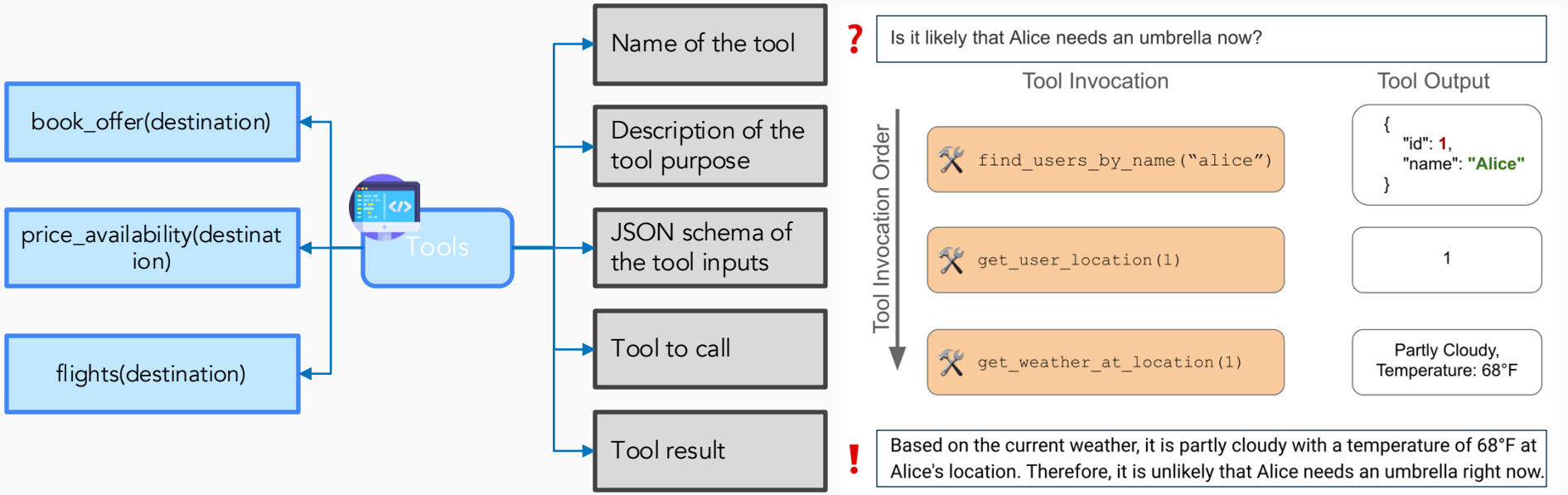
The problem MCP solves

Let's say you're building a chat interface where users can ask a travel assistant about their next trip. A user might ask, "I want to book a trip to Palma de Maiorca?" To handle this, the Agent needs tools to access API's.



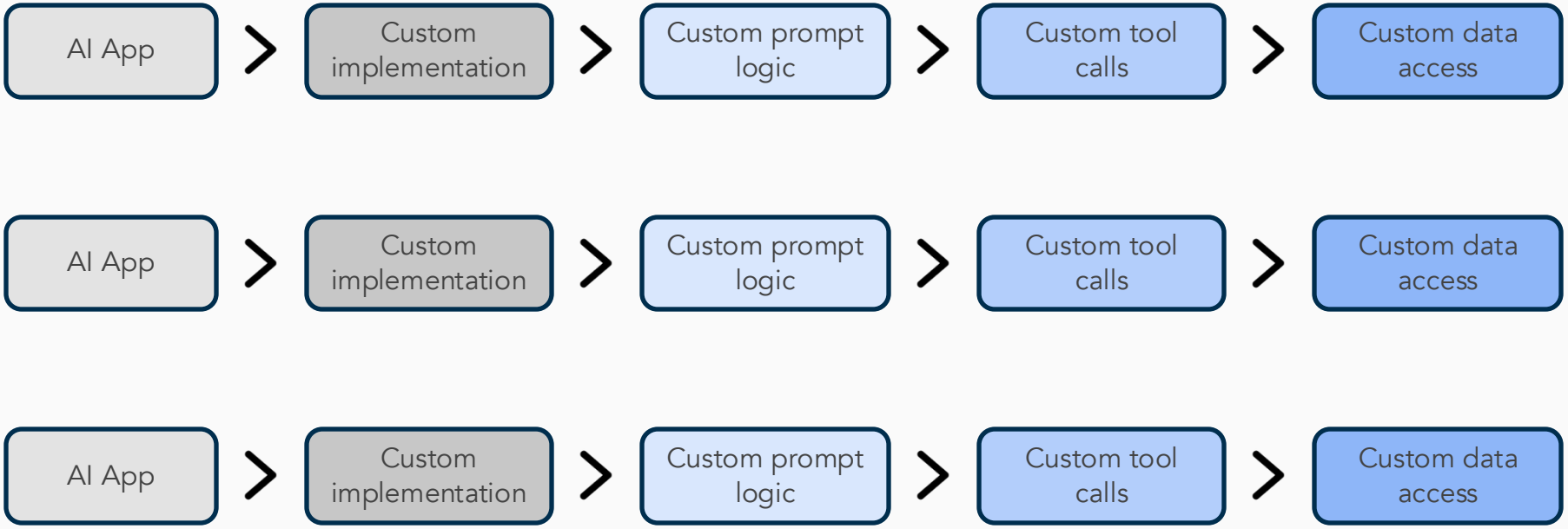
The problem MCP solves

API's have multiple purposes like search accommodations, check price and availability, book and tons more. Without MCP, you'd need to create an incredible number of tool schemas and functions to handle all of API's features.



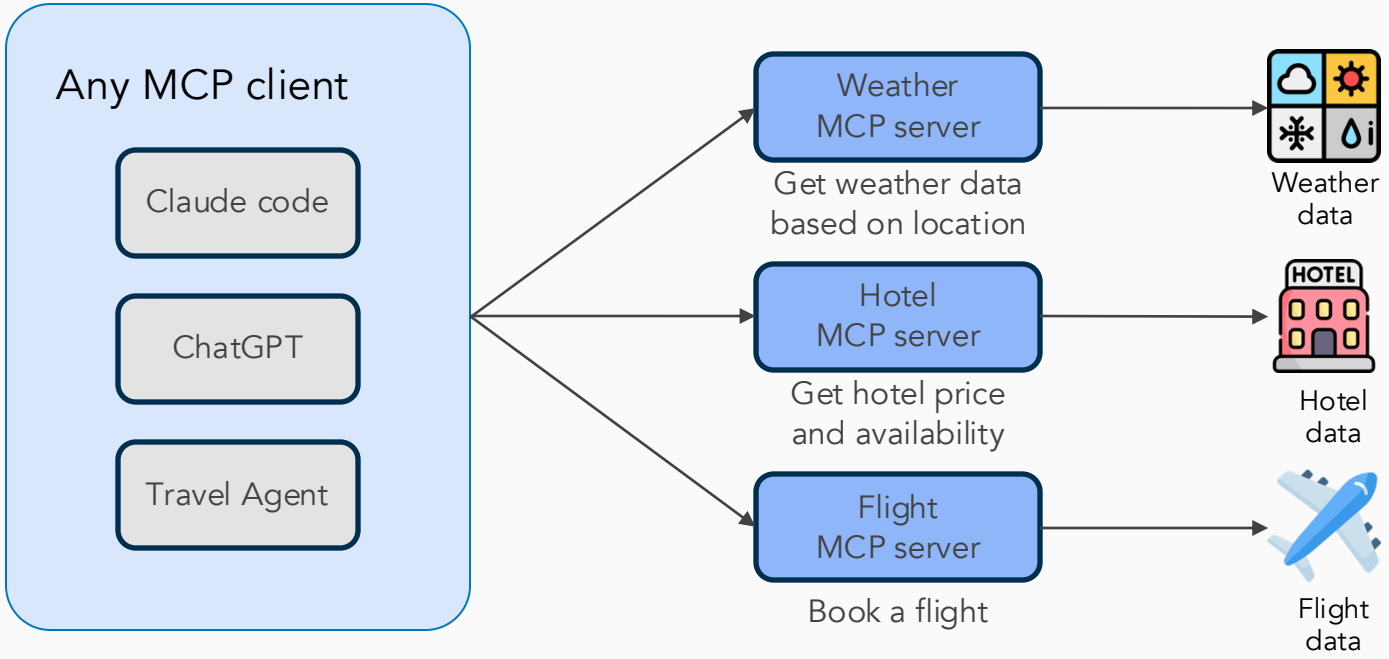
Without MCP

Fragmented AI development



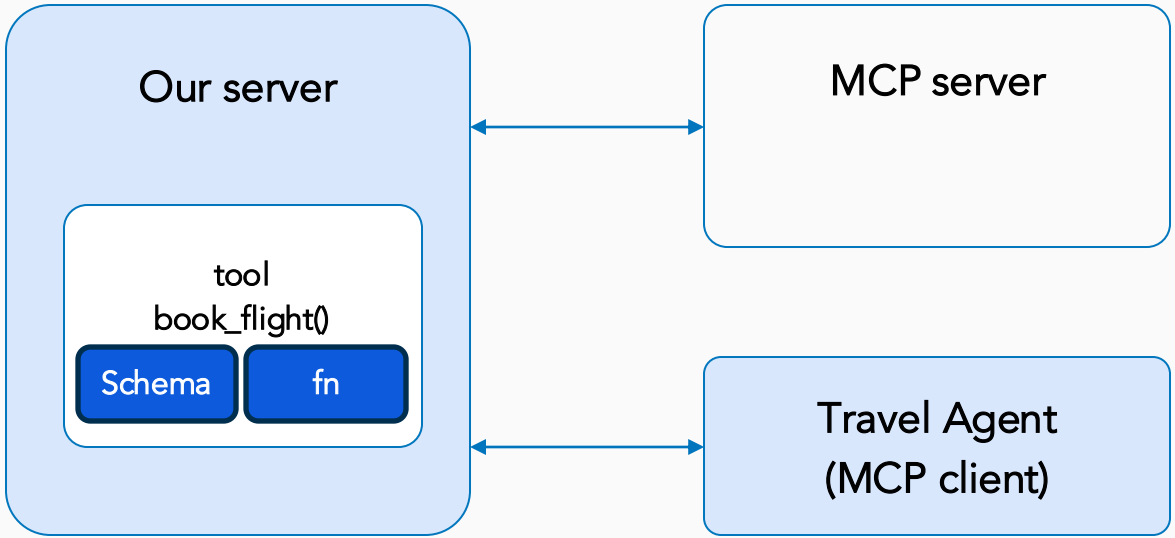
With MCP

Standardised AI development



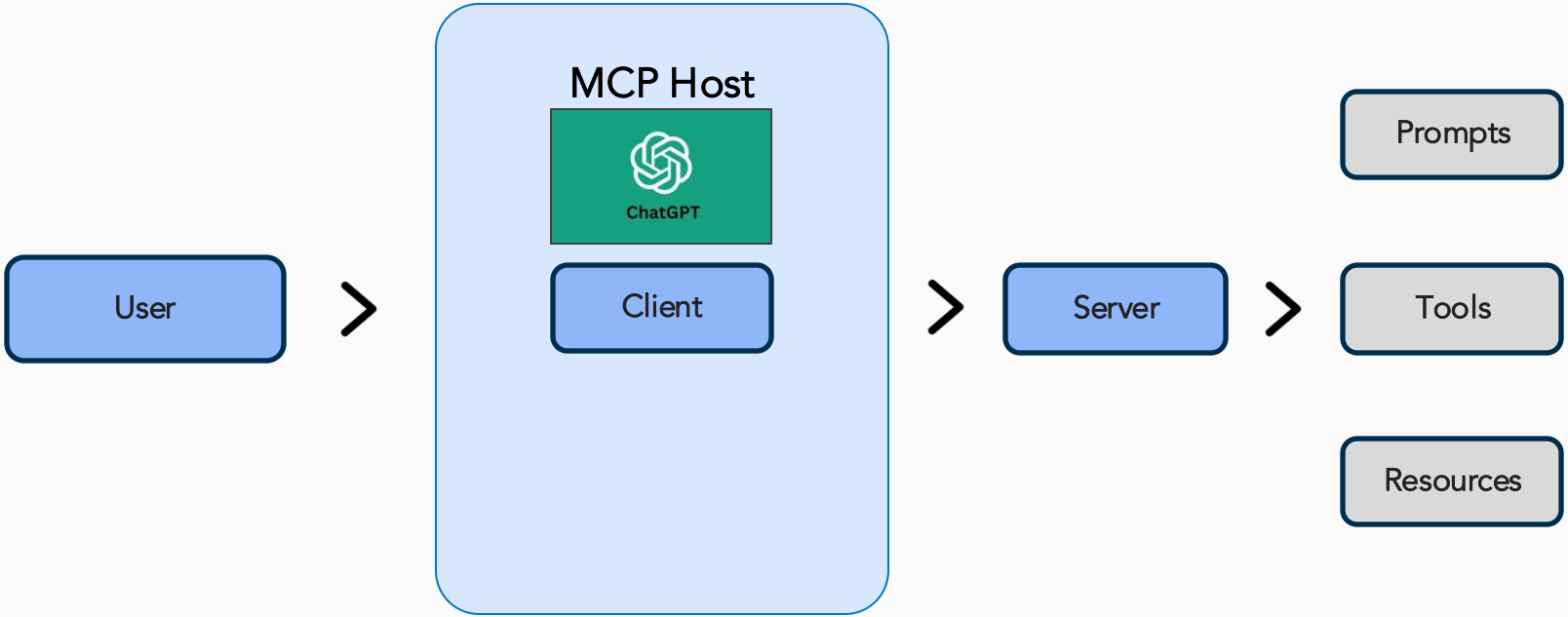
How does MCP work?

MCP alleviates this burden by transferring tool definitions and execution from your server to dedicated MCP servers. Instead of creating all tools yourself, a dedicated MCP server will manage specific flows, such as search.



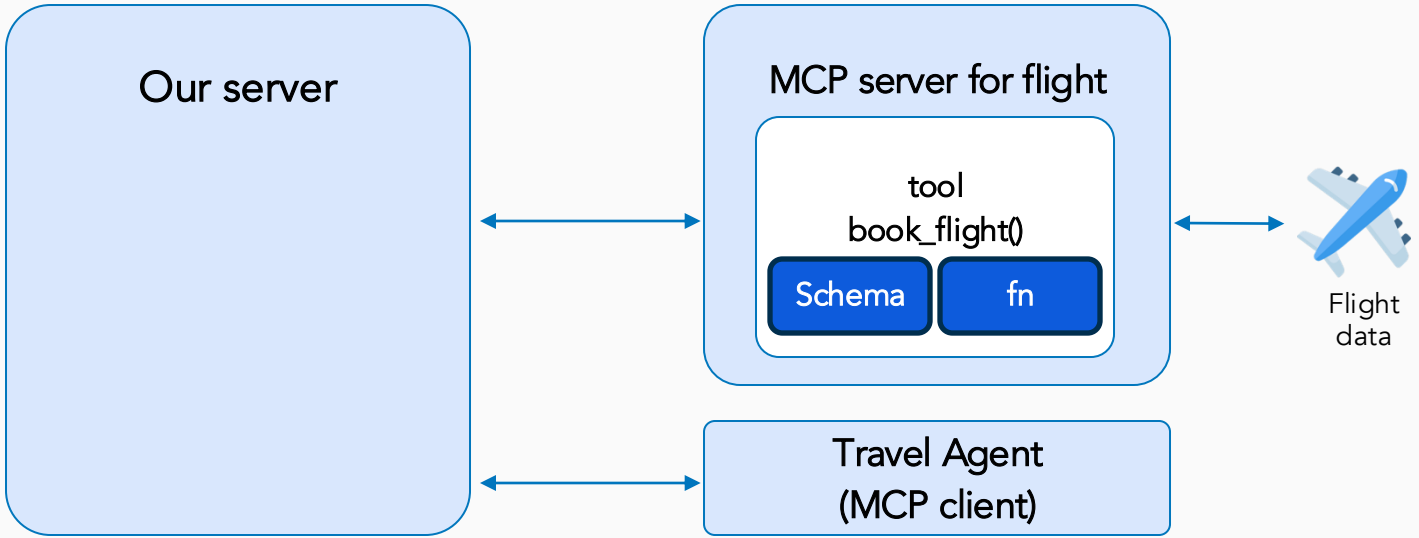
MCP server core components

MCP is what makes AI useful for real apps



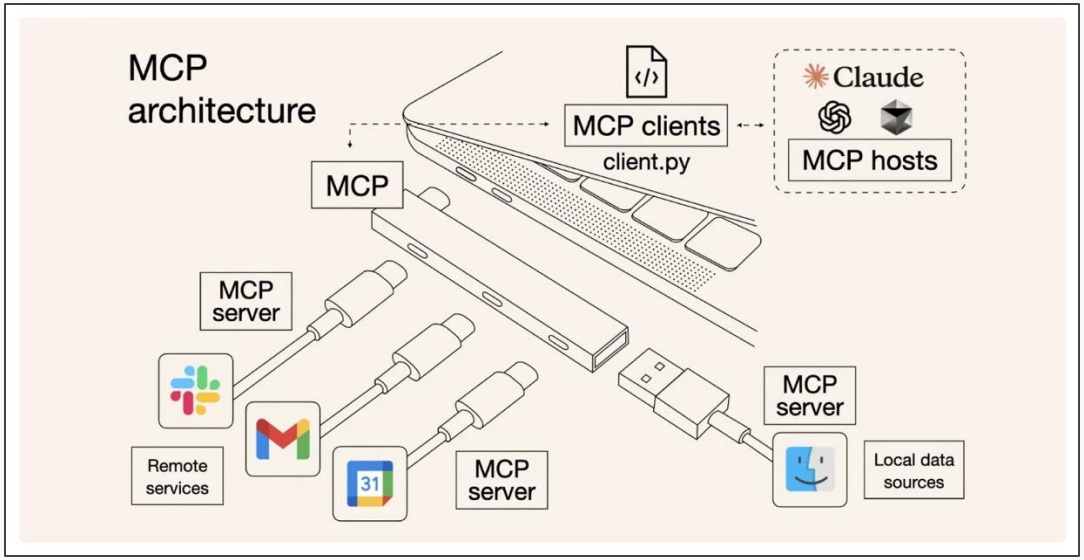
MCP server explained

MCP Servers provide access to data or functionality implemented by outside services. They act as specialised interfaces that standardise the exposure of tools, prompts, and resources.



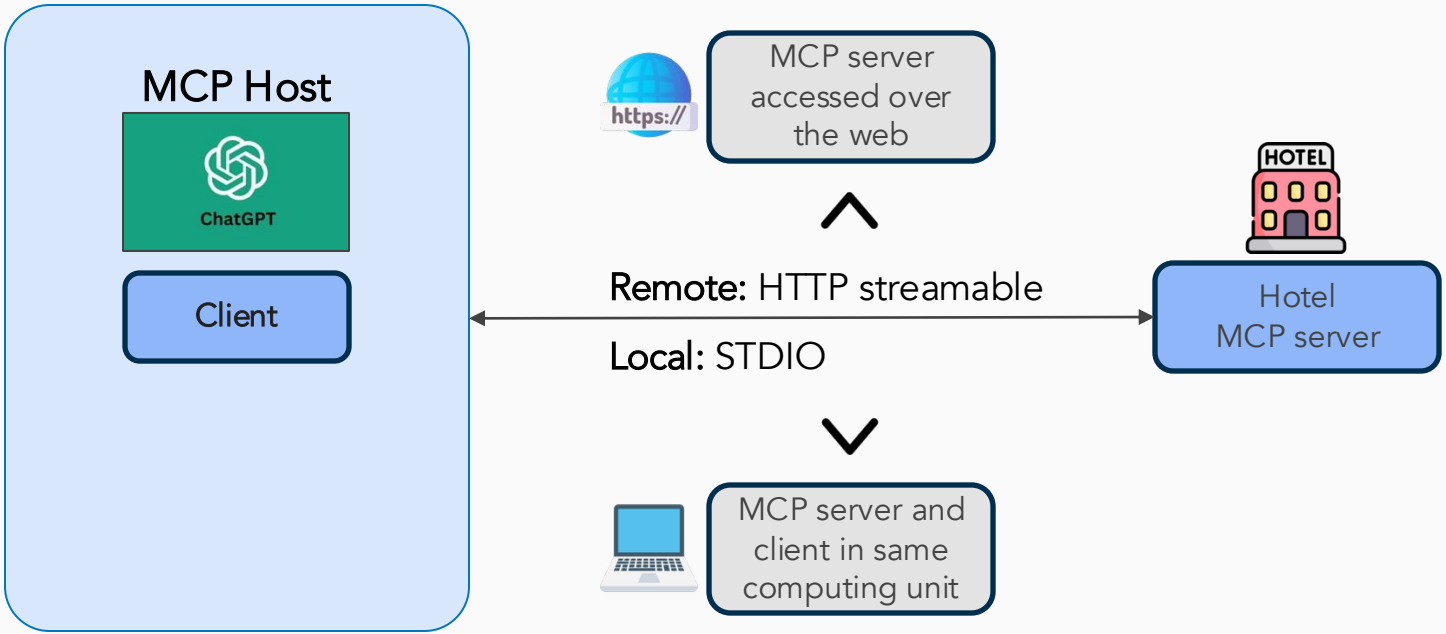
MCP client

The MCP client serves as the communication bridge between your server and MCP servers. It's your access point to all the tools that an MCP server provides, handling the message exchange and protocol details so your application doesn't have to.



Transport Agnostic communication

One of MCP's key strengths is being transport agnostic, a fancy way of saying the client and server can communicate over different protocols



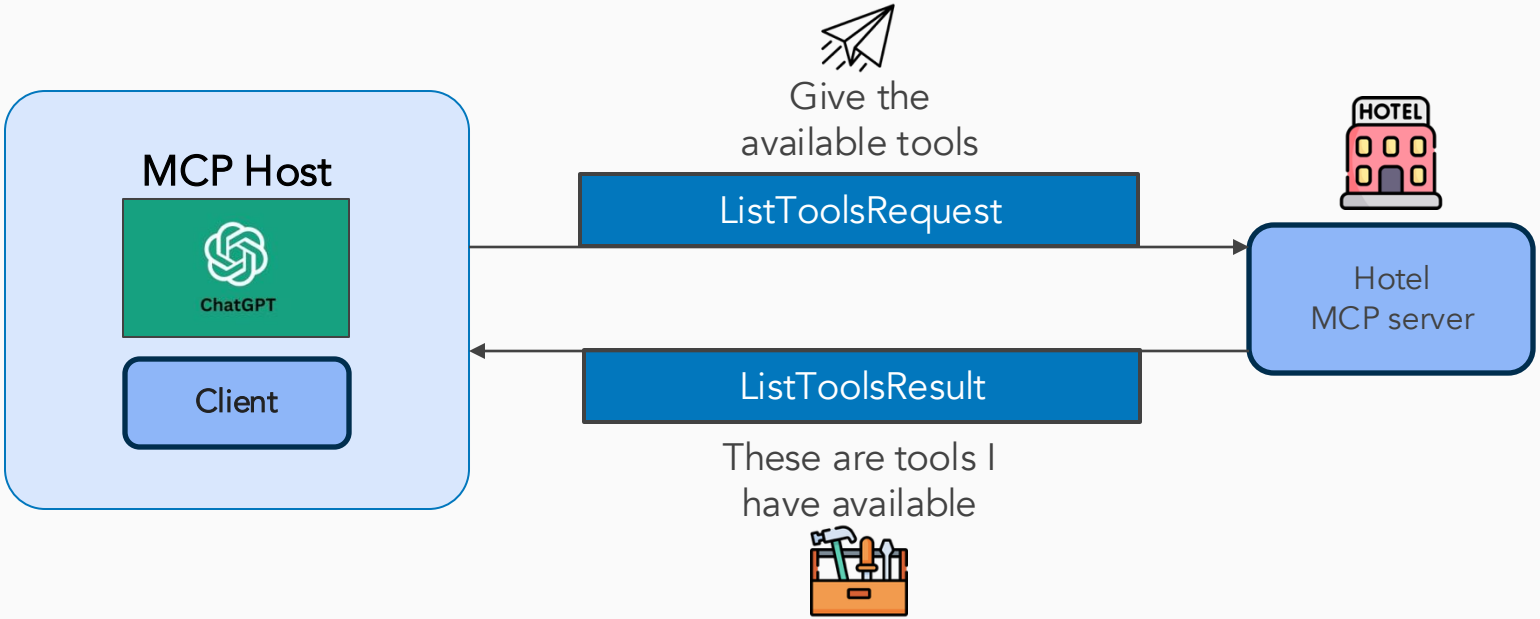
MCP Message Types

Once connected, the client and server exchange specific message types defined in the MCP specification. The main ones you'll work with are:

- **ListToolsRequest/ListToolsResult:** The client asks the server, "What tools do you provide?" and gets back a list of available tools.
- **CallToolRequest/CallToolResult:** The client asks the server to run a specific tool with given arguments, then receives the results.

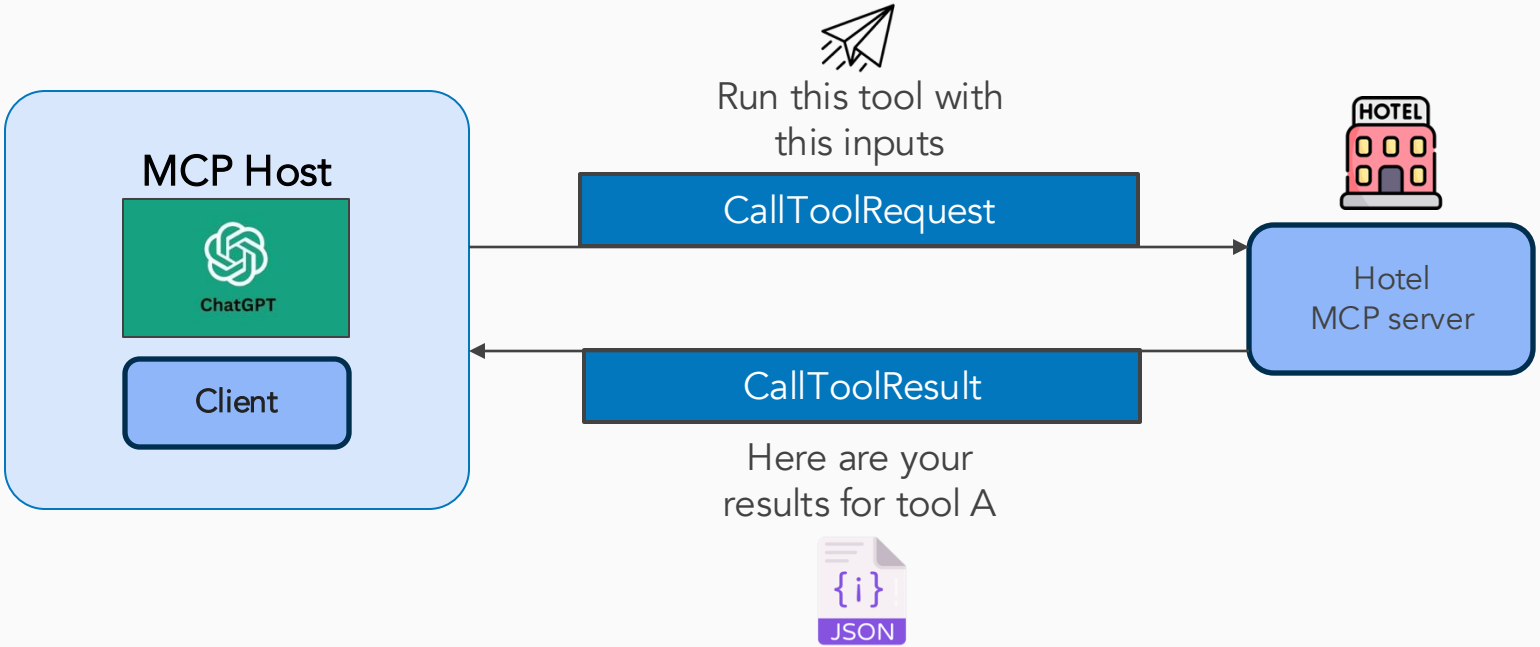
ListToolsRequest/ListToolsResult

The client can initiate the MCP server connection by requesting the tools and the server responds back with the available tools.



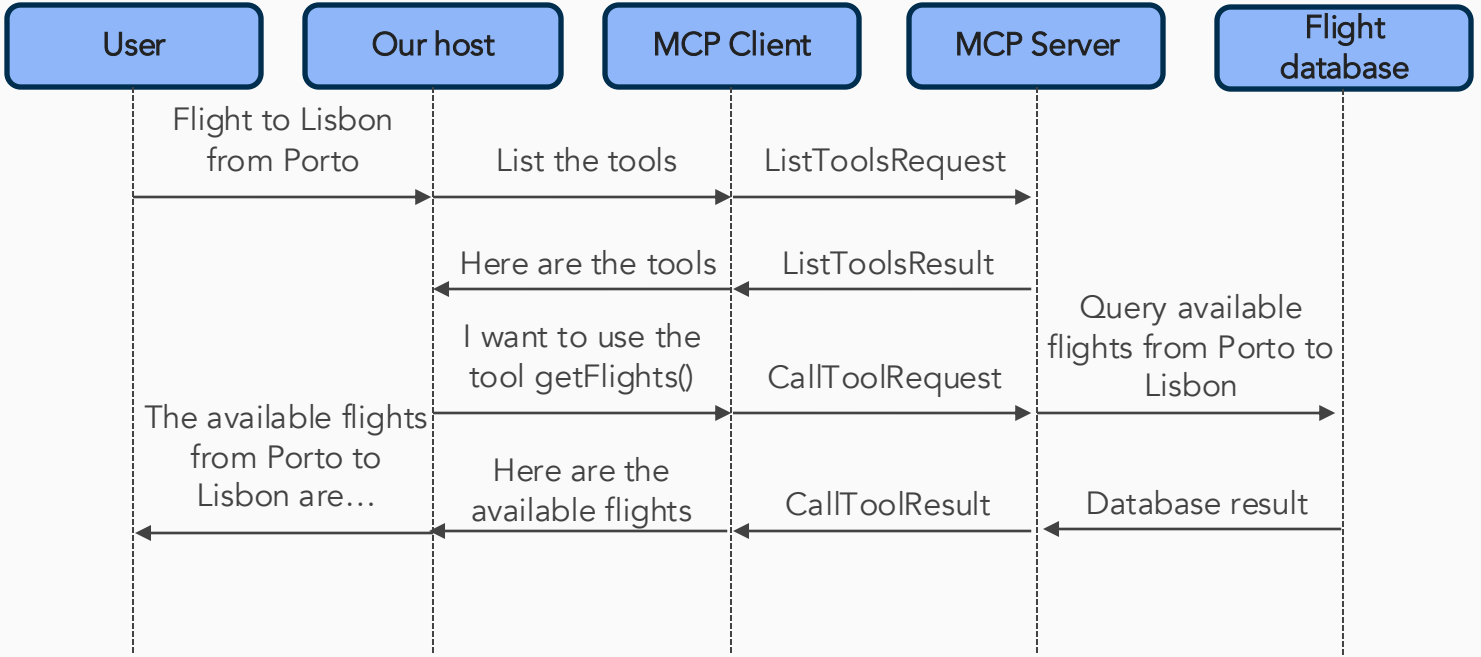
CallToolRequest/CallToolResult

The client can also request to trigger a given tool and receive back it's result from the server.



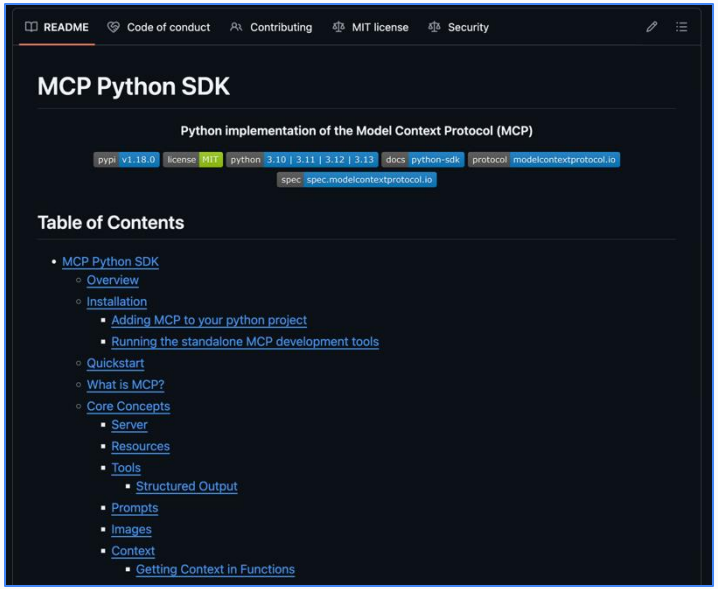
Communication flow

The MCP client abstracts away the complexity of server communication, letting you focus on your application logic while still getting access to powerful external tools.



Defining tools with MCP

Building an MCP server becomes much simpler when you use the official Python SDK. Instead of writing complex JSON schemas by hand, you can define tools with decorators and let the SDK handle the heavy lifting.

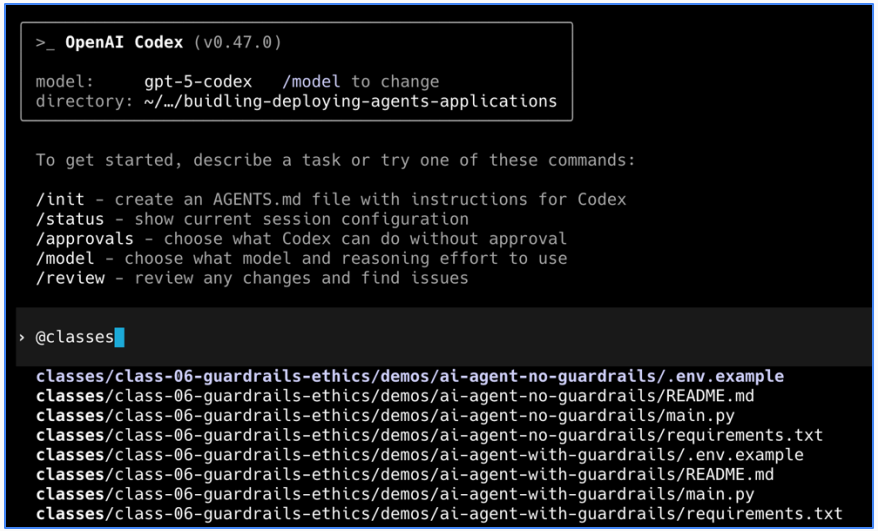


Source: https://github.com/modelcontextprotocol/python-sdk

Defining resources with MCP

Let's say you want to build a document mention feature where users can type @document_name to reference file. This requires two operations:

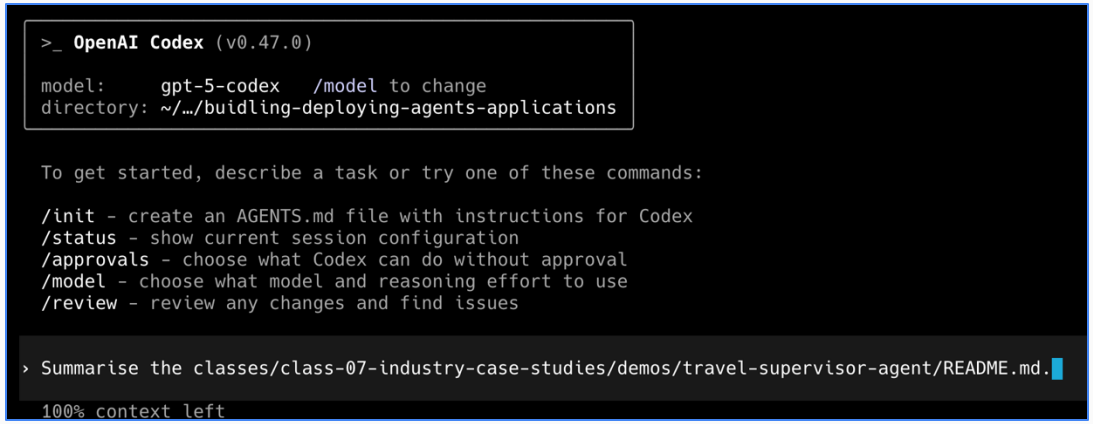
- Getting a list of all available documents (for autocomplete)
- Fetching the contents of a specific document (when mentioned)



Codex usage example of the decorator @

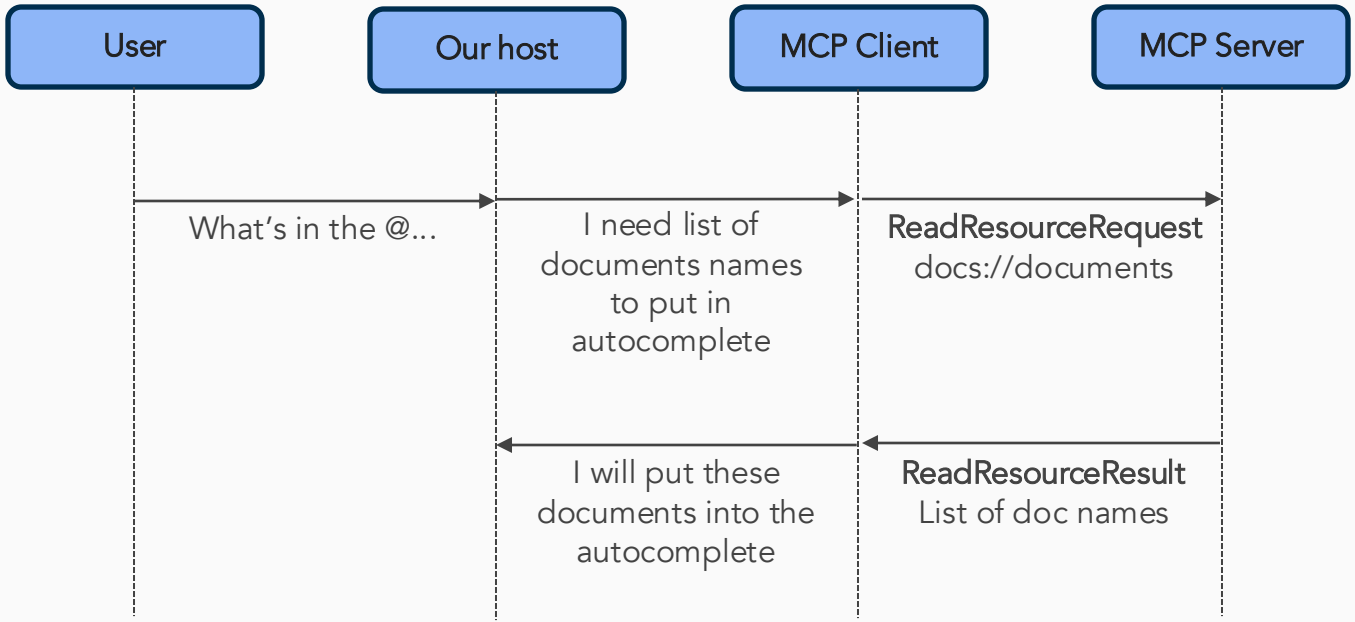
Defining resources with MCP

When a user mentions a document, your system automatically injects the document's contents into the prompt sent to the Client, eliminating the need for the Client to use tools to fetch the information.



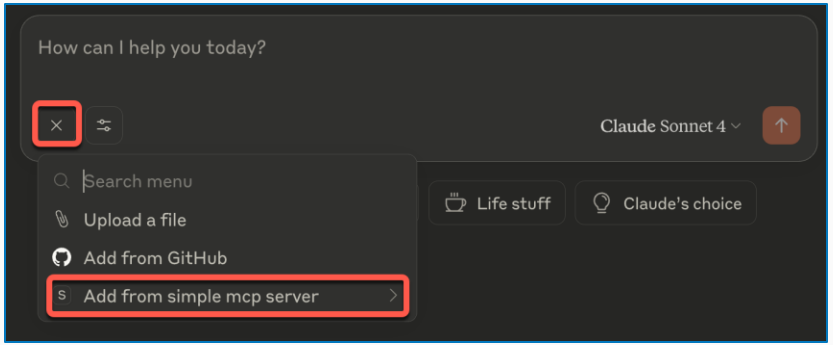
How resources work?

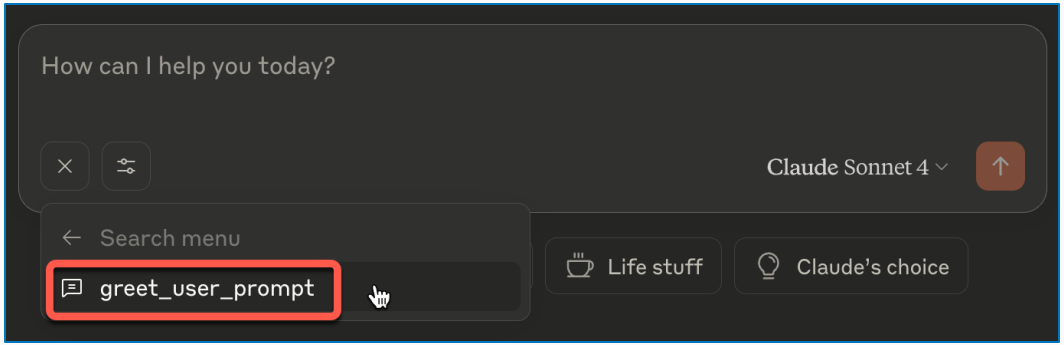
Resources follow a request-response pattern. When your client needs data, it sends a ReadResourceRequest with a URI to identify which resource it wants. The MCP server processes this request and returns the data in a ReadResourceResult.



Prompts in MCP servers

Prompts in MCP servers let you define pre-built, high-quality instructions that clients can use instead of writing their own prompts from scratch. Think of them as carefully crafted templates that give better results than what users might come up with on their own.





Source: https://medium.com/@laurentkubaski/mcp-prompts-explained-including-how-to-actually-use-them-9db13d69d7e2

Why use Prompts in MCP servers?

As the MCP server author, you can spend time crafting, testing, and evaluating prompts that work consistently across different scenarios. Users benefit from this expertise without having to become prompt engineering experts themselves.

Let's use codex as an example without prompt templates

Create a README.md for the Travel Agent.

With this prompt Codex will make a lot of assumptions for the README.md structure and content.

Use prompt templates If we want a particular style for our README.md

Please analyze the following project files and create a comprehensive README.md file that includes:

1. Project Title and Description: A clear, concise overview of what the project does
2. Features: Key functionality and capabilities
3. Installation: Step-by-step setup instructions
4. Usage: Examples of how to use the project
5. Configuration: Any environment variables or config files needed
6. Dependencies: Required libraries, frameworks, or tools
7. Project Structure: Brief overview of the codebase organization

Please make the README professional, well-formatted with proper markdown, and suitable for a public repository.

Setting up the MCP server

The Python FastMCP SDK makes server creation straightforward. You can initialise a server with just one line.

example.py

```python
from datetime import datetime
from mcp.server.fastmcp import FastMCP
import logging

mcp = FastMCP("basic-demo")

@mcp.tool()
def get_current_time() -> str:
 return datetime.now().isoformat()

if __name__ == "__main__":
 logging.info("🚀 Basic MCP (stdio)")
 mcp.run(transport="stdio")
```

Tool, prompts and resources definitions with decorators

The SDK uses decorators to define tools. Instead of writing JSON schemas manually, you can use Python type hints and field descriptions. The SDK automatically generates the proper schema that Claude can understand.

example.py

```python
@mcp.tool(
  name="read_doc_contents",
  description="Read the contents of a document and return it as a string."
)
def read_document(
doc_id: str = Field(description="Id of the document to read")
):
  if doc_id not in docs:
    raise ValueError(f"Doc with id {doc_id} not found")
  return docs[doc_id]
```

Resources definition

For resources we use the @mcp.resource decorator either for direct resources or templated resources.

example.py

```python
@mcp.resource("docs://documents.txt")
def get_docs() -> str:
  with open("./documents.txt", "r") as f:
    return f.read()

@mcp.resource("docs://documents/{doc_id}")
def fetch_doc(doc_id: str) -> str:
  if doc_id not in docs:
    raise ValueError(f"Doc with id {doc_id} not found")
  return docs[doc_id]
```

Prompt definition

Prompts use a similar decorator pattern to tools and resources:

example.py

```
@mcp.prompt(
name="format",
description="Rewrites the contents of the document in Markdown
format."
)
def format_document():
  prompt = f"""
Your goal is to reformat a document to be written with markdown
syntax.
"""
  return prompt
```

Key benefits of the MCP SDK

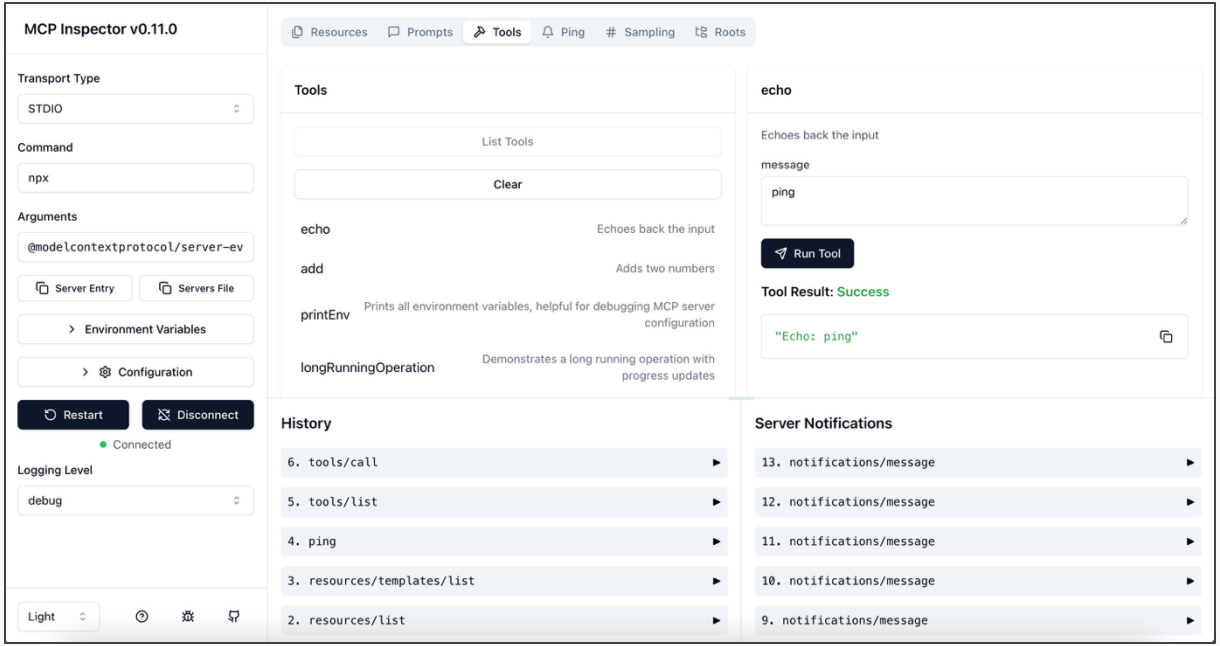
- No manual JSON schema writing required
- Type hints provide automatic validation
- Clear parameter descriptions help Claude understand tool usage
- Error handling integrates naturally with Python exceptions
- Tool registration happens automatically through decorators
- The MCP Python SDK transforms tool creation from a complex schema-writing exercise into simple Python function definitions. This approach makes it much easier to build and maintain MCP servers while ensuring Claude receives properly formatted tool specifications.

Demo – Let’s build a simple MCP

And inspect it 

Building our first MCP server

We will also use our first MCP client



- Install npm using the following link first https://nodejs.org/en/download
- Install and open the MCP inspector with the following command:

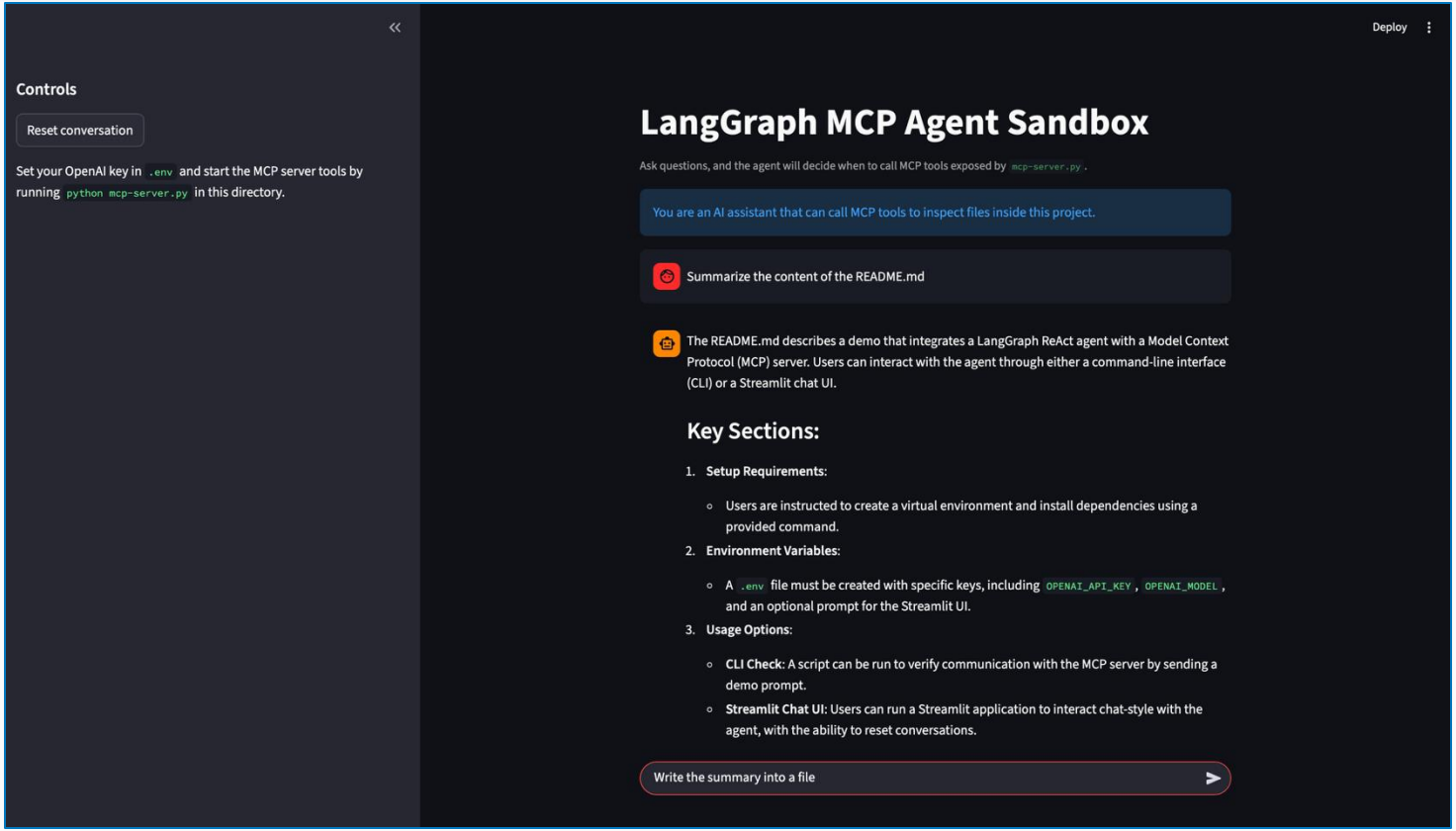
```
npx @modelcontextprotocol/inspector
```

- For more info check https://github.com/modelcontextprotocol/inspector

Source: https://github.com/diaxz12/BUILDING-AND-DEPLOYING-AI-AGENTS---Part-2/tree/main/classes/class-07-mcp-protocol/demos/intro-mcp-walkthrough

Demo – Adding MCP to LangGraph Agent

Demo overview

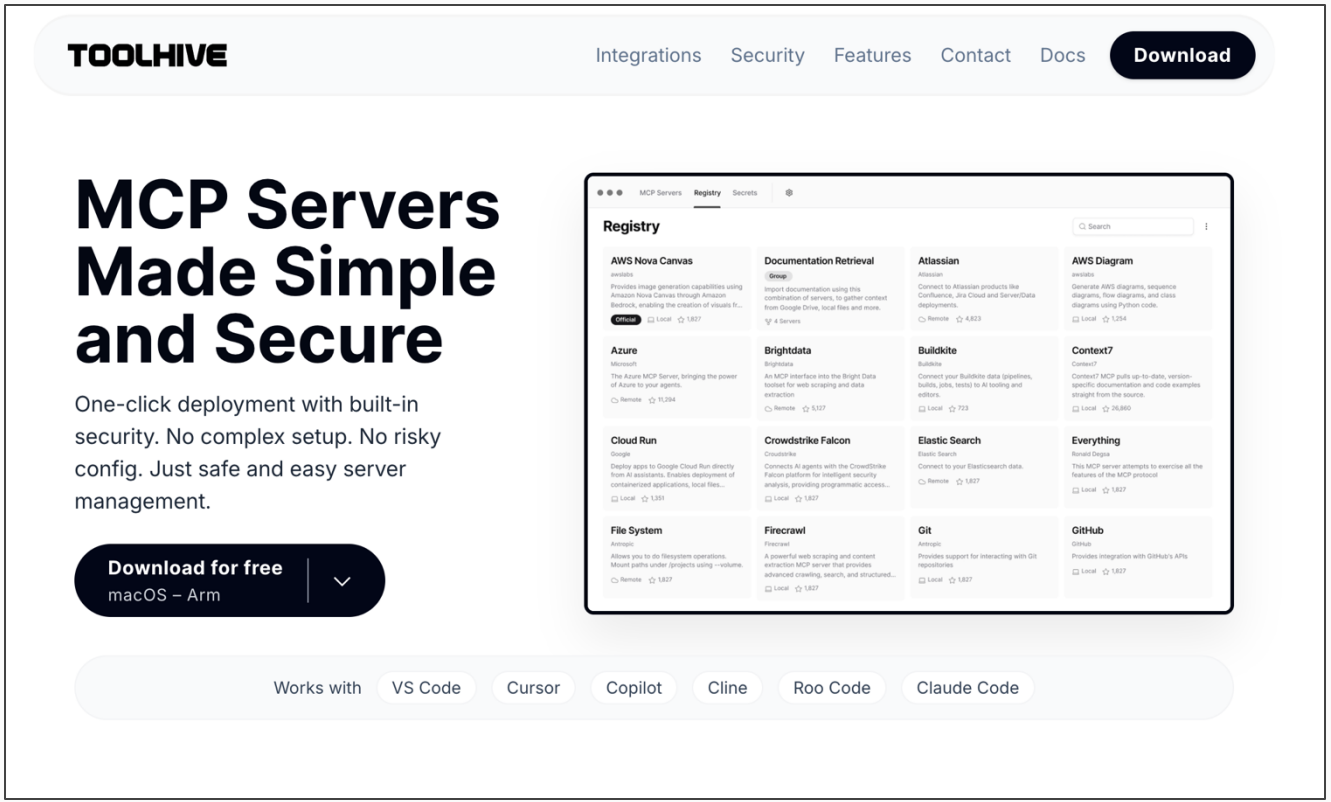


Source: https://github.com/diaxz12/BUILDING-AND-DEPLOYING-AI-AGENTS---Part-2/tree/main/classes/class-07-mcp-protocol/demos/langgraph-agent-with-mcp

Demo – Leveraging the MCP community

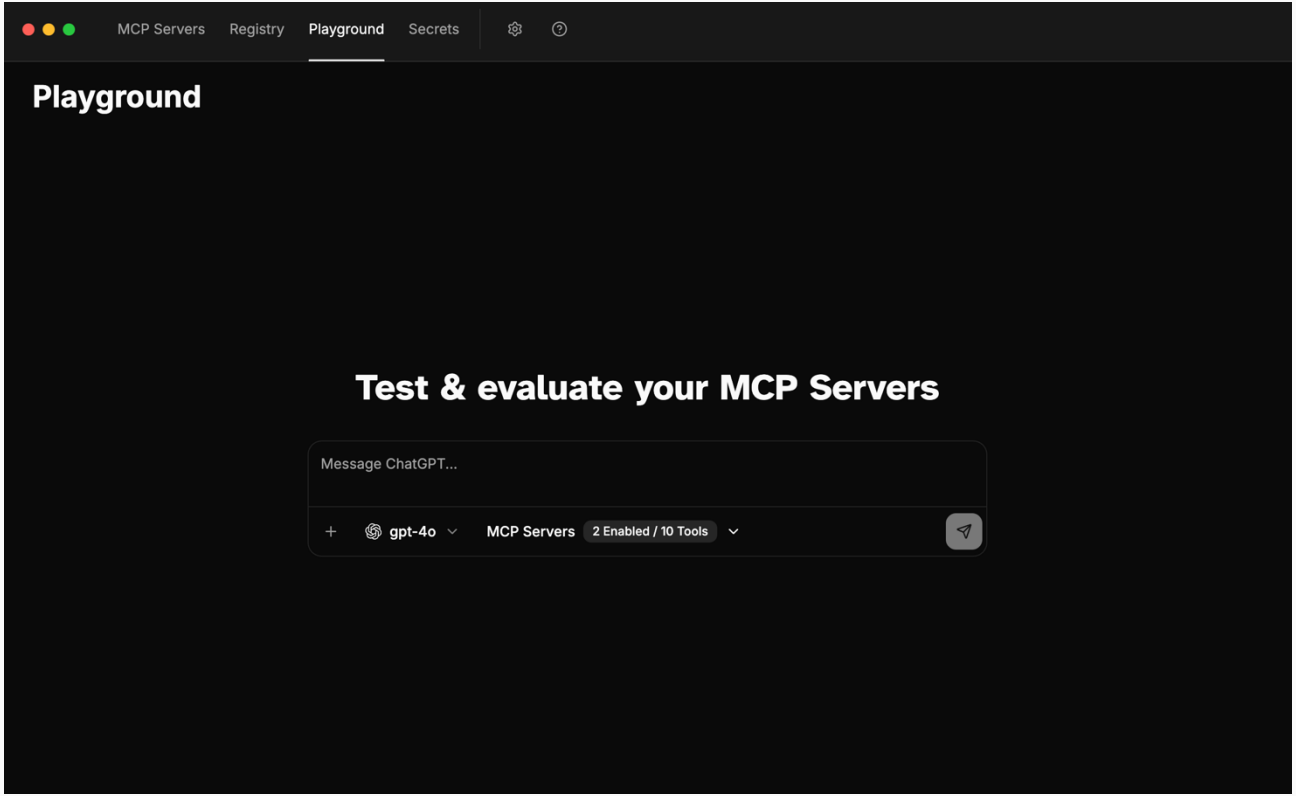
Sharing is caring

Introducing ToolHive



ToolHive is a great tool to install, configure and use MCP servers with different clients

We can even quickly test the MCP server through a ChatUI



Using the ChatUI is a great way to assess if the MCP server will be relevant for the AI Agent we are developing. Build fast, fail fast!

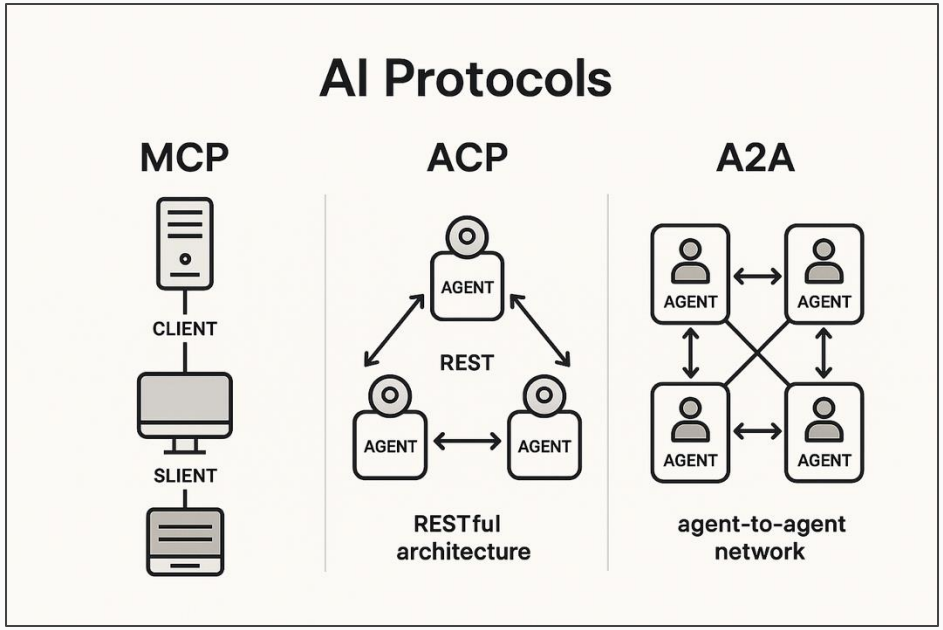
The protocol wars

What other AI protocols already exist?

Three Major Players Competing/Complimenting?

- MCP (Anthropic): AI-to-tool communication and data access
- A2A (Google): Agent-to-agent system communication, secure collaboration
- ACP (IBM Research): Agent Communication Protocol, focuses on practical adoption first

The Stakes: Who becomes the "HTTP" of AI agent communication?



AI Agents in the Real World

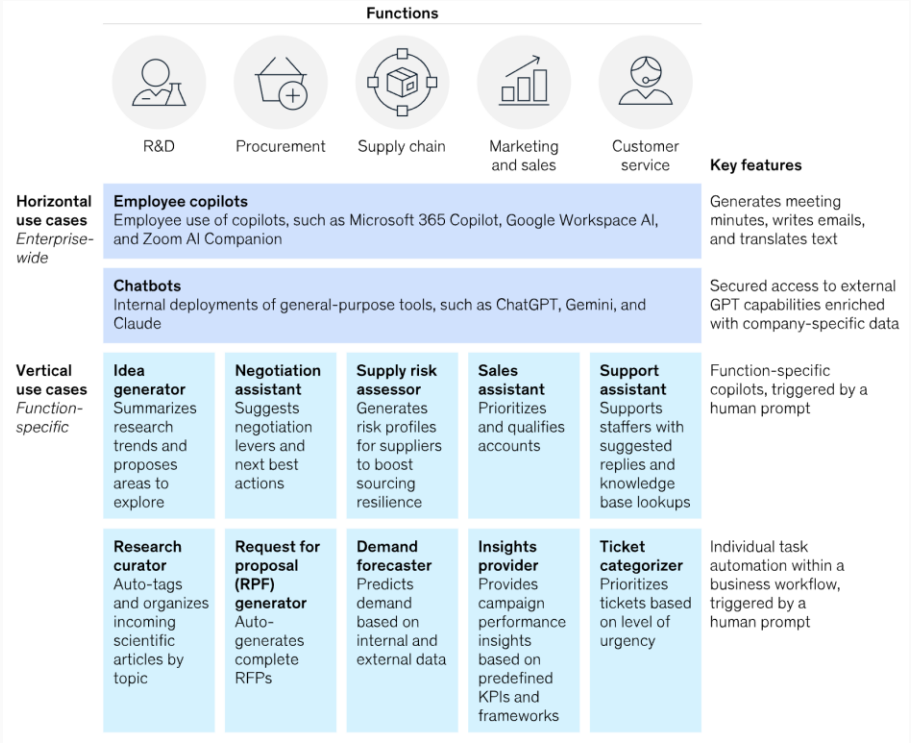
Where Agents Are Making an Impact

"We believe that, in 2025, we may see the first AI agents 'join the workforce' and materially change the output of companies."

Industry	AI Agent	Key Outcomes
1. Customer Service	H&M's Virtual Shopping Assistant	40% reduction in cart abandonment, **3x boost in conversion**
2. IT Operations	IBM Watson AIOps	60% faster incident resolution, **80% drop in false alerts**
3. Cybersecurity	Darktrace Autonomous Response	Real-time threat neutralization, **92% breach reduction**
4. Healthcare	Mass General Brigham AI Copilot	**60% less documentation time**, improved patient engagement
5. Drug Discovery	Insilico Medicine AI Agents	Reduced R&D costs by **70%, accelerated molecule discovery**
6. Manufacturing	Siemens Industrial Edge Agents	**30% downtime reduction**, predictive maintenance
7. Inventory	Ocado Smart Fulfillment Agent	**99.9% order accuracy**, real-time stock updates
8. Supply Chain	DHL Resilience360 AI Agents	**35% fewer delays**, improved supplier communication
9. Finance	Bank of America's "Erica"	1B+ interactions, **98% issue resolution rate**
10. Government	Singapore's "Ask Jamie"	50% call deflection, **15M+ questions answered**, improved citizen satisfaction

You can find more use cases here: https://tinyurl.com/learning-tutai

Exploring using cases across your company



Source: https://www.mckinsey.com/capabilities/quantumblack/our-insights/seizing-the-agentic-ai-advantage

Luis this is nice but seems to high level!

Case Study: TUI Travel Assistant

I will share my experience with one of TUI's Agent in production

Case Study: TUI Travel Assistant

- **Problem:** Scale personalized travel advise across markets
- **Solution:** Bedrock + Guardrails + Internals APIs + Smartphone Uk App
- **Outcome:** Assisting the customer on booking his next holiday with TUI

🎯 Live Demo

I will walk you through a real implementation and then show you a simplified version built using what we learned on this module. Pay attention to the architecture decisions and trade-offs made during development.

TUI Travel Assistant

Real-world application

TUI Group overview

Global group - headquartered in Germany

Cruise ships	Hotels	Aircraft	Travel Agencies
16	~400	~130	~1200

Revenue 2024:
23.2 bn €

Underlying EBIT 2024:
1.3 bn €

TUI CARE FOUNDATION

TUI Care Foundation, initiated by TUI, promotes the positive effects of tourism in **25 countries**

140 million API calls per day
5356 TB data traffic per month
10 billion lambda calls per month
Serving **20+ million customers**

Over **7 million** TUI Collection excursions have been sold since the launch

Motivation

As a TUI App user

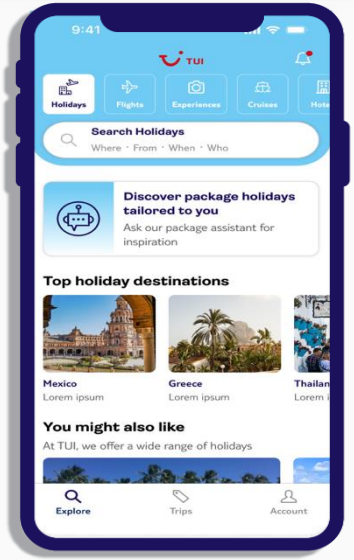
I want assistance when trying to find my next holiday

So that I can figure out when and where to go

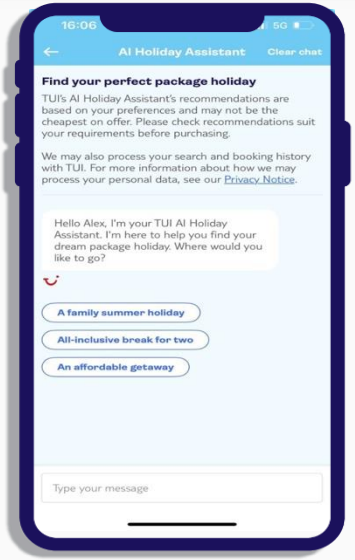
Customer goal: Replicate the retail experience in your pocket. Perfect for those struggling to decide where or when to go, let TUI support you through the difficult decision-making process and find you the perfect holiday.

Business goal: Improve breadth of data and knowledge on customers, enhancing personalisation models. Better understand the issues customers face when finding products to enhance experience in the future.

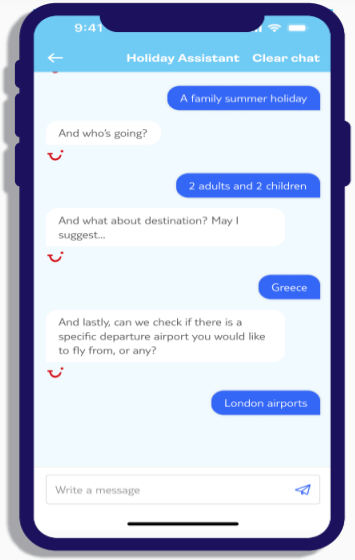
AI Conversational search



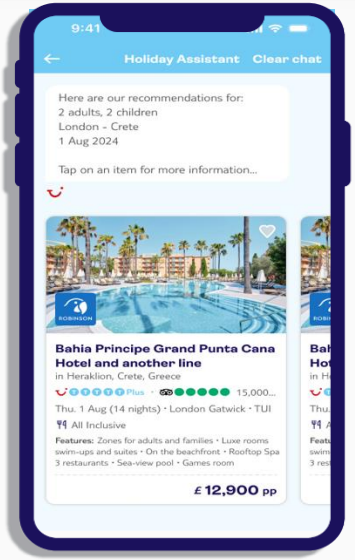
Entry Point 🌐
A TUI customer opens & logs into the app, ready to plan their next holiday. The customer spots the Holiday Assistant homecard, intrigued, and clicks to navigate into the feature.



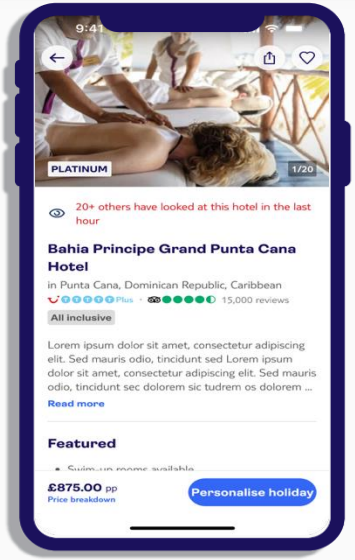
Chat Interface 🔒
The chat pops up, asking, "Hi Joe, let us help you find your next holiday!" The chat then asks Joe what he's looking for with, with either pre-populated suggestion that he can pick from, or he input text in the field below.



Q&A 🤖
Joe then clicks on a family summer holiday, and the chat starts to ask Joe for more details, including how many guests, where to depart from and any country or cities he had in mind.



Tailored Suggestions 🌟
The agent processes this and suggests actual package holidays based on Joe's input. The results are shown in a card carousel which Joe can scroll and compare with the summary shown on the card, including the price.

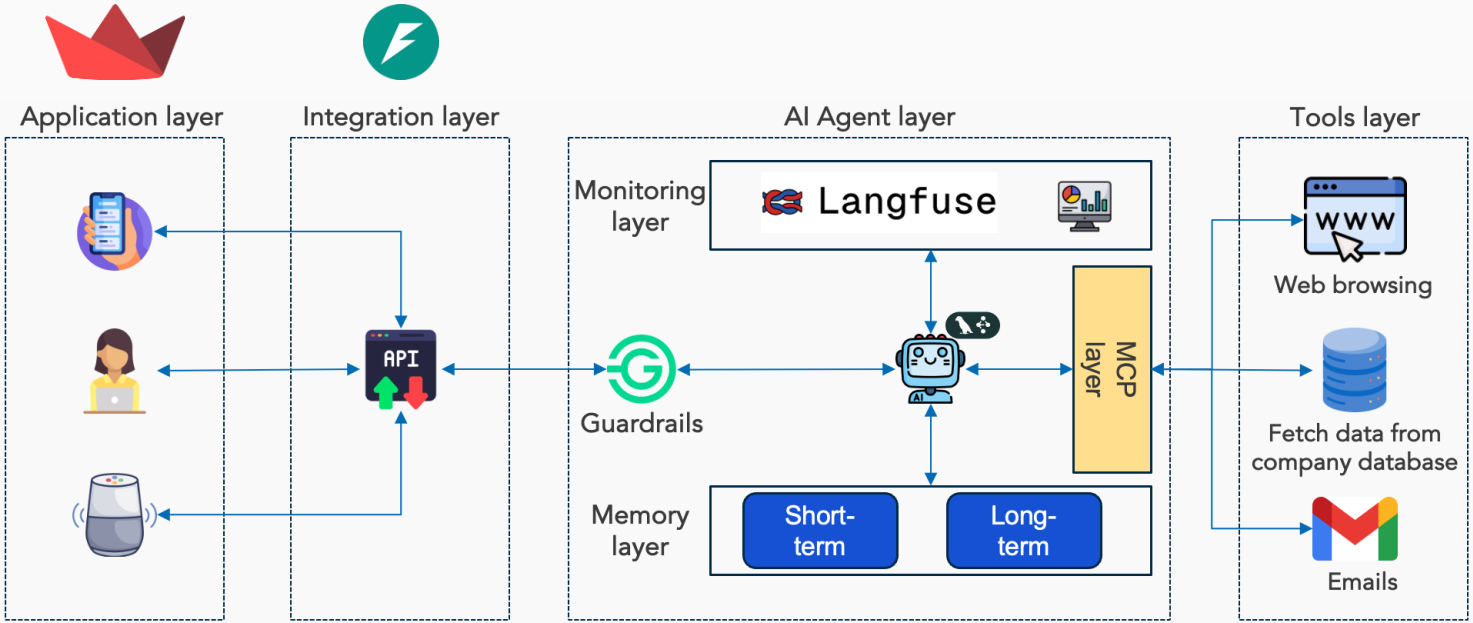


Holiday Details 🌟
Joe is then interested in one of the suggested holiday packages, he clicks on the card and lands on the native holiday details page. From there, he can proceed with configuration or go back to the chat.

TUTAI Travel Agent Live Demo

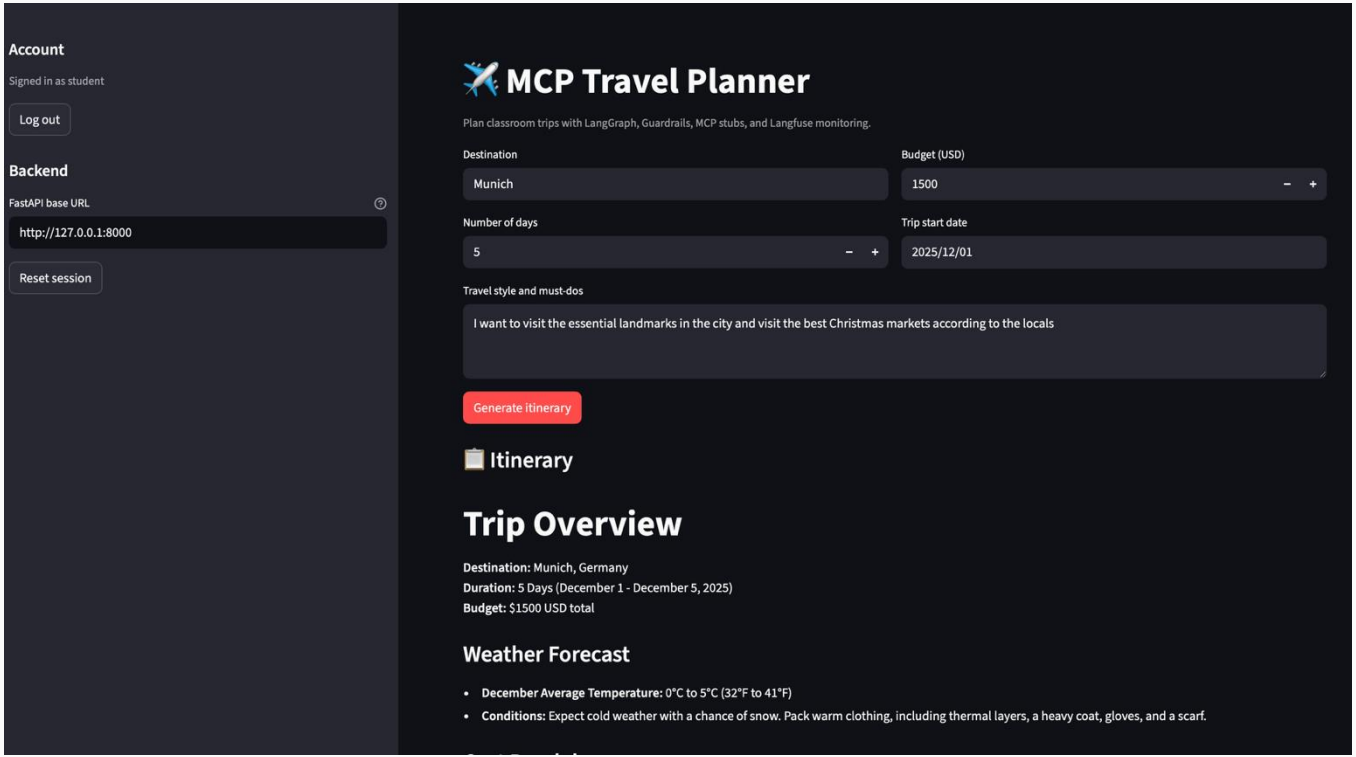
Let's connect all the dots and build an AI Agent Application end to end

This demo will leverage all you have learned in this module



Source: https://github.com/diaxz12/BUILDING-AND-DEPLOYING-AI-AGENTS---Part-2/tree/main/classes/class-07-mcp-protocol/demos/ai-agent-application

A travel planner that builds the perfect itinerary



You can access the travel app here: https://diaz-travel-app.streamlit.app/

Reflection

Reflection Questions

- How are you planning to leverage MCP for your capstone project?
- What aspects of the **TUI Travel Assistant** architecture could you reuse in your capstone project?
- How will you define success metrics (KPIs) for your agent? Which ones matter most?
- What were the main architectural lessons learned from the TUI case study (e.g., memory, tools, supervision pattern)?
- How can scalability and latency challenges be mitigated in your own design?

M6 assignment

M6 Assignment Instructions

Focusing on the technical side of the capstone project

1. Build your **LangGraph-based AI Agent** using the class examples as a starting point.
2. Integrate **at least one MCP server** and **one additional tool** of your choice.
3. **Deploy** the agent API on **Render** and connect it to a **Streamlit Community Cloud UI**.
4. Add **Guardrails AI** to enforce safety (e.g., input validation or output moderation).
5. Set up **Langfuse** for monitoring and evaluation (track latency, tool calls, quality).
6. Reflect on design trade-offs and summarize lessons learned.
7. Submit by email including:
    - GitHub repo (source code + README)
    - Render API & Streamlit app links
    - Langfuse dashboard or screenshots
    - PDF report (≤10 pages: architecture, deployment, evaluation, guardrails, reflection)

📅 **Deadline:** December 20, 2025 (aligned with Capstone Delivery Date)

Wrap-up

Wrap-Up & Next Steps

Developing an AI Agent goes beyond building it

- Your AI Agent should deliver reliable, measurable, and safe outputs.
- It must be observable, and aligned with real user needs.
- From day one, you should be able to track its success.

Next:

- Begin defining your **Capstone use case** and the real-world problem your Agent will address.
- Start planning your **technical implementation** for M6, which will focus on evaluating the Agent you build.
- (Optional) Assign **one Technical Lead per team.** This person will coordinate the technical work (LangGraph, MCP, Render, Streamlit, Langfuse, Guardrails AI).
- **Remember** that your Capstone story and your M6 Agent evaluation are **two sides of the same project**.

In short: Your capstone project defines the "why" and M6 demonstrates the how

Questions?

luis.f.s.m.dias@gmail.com
https://www.linkedin.com/in/luisfilipedias/