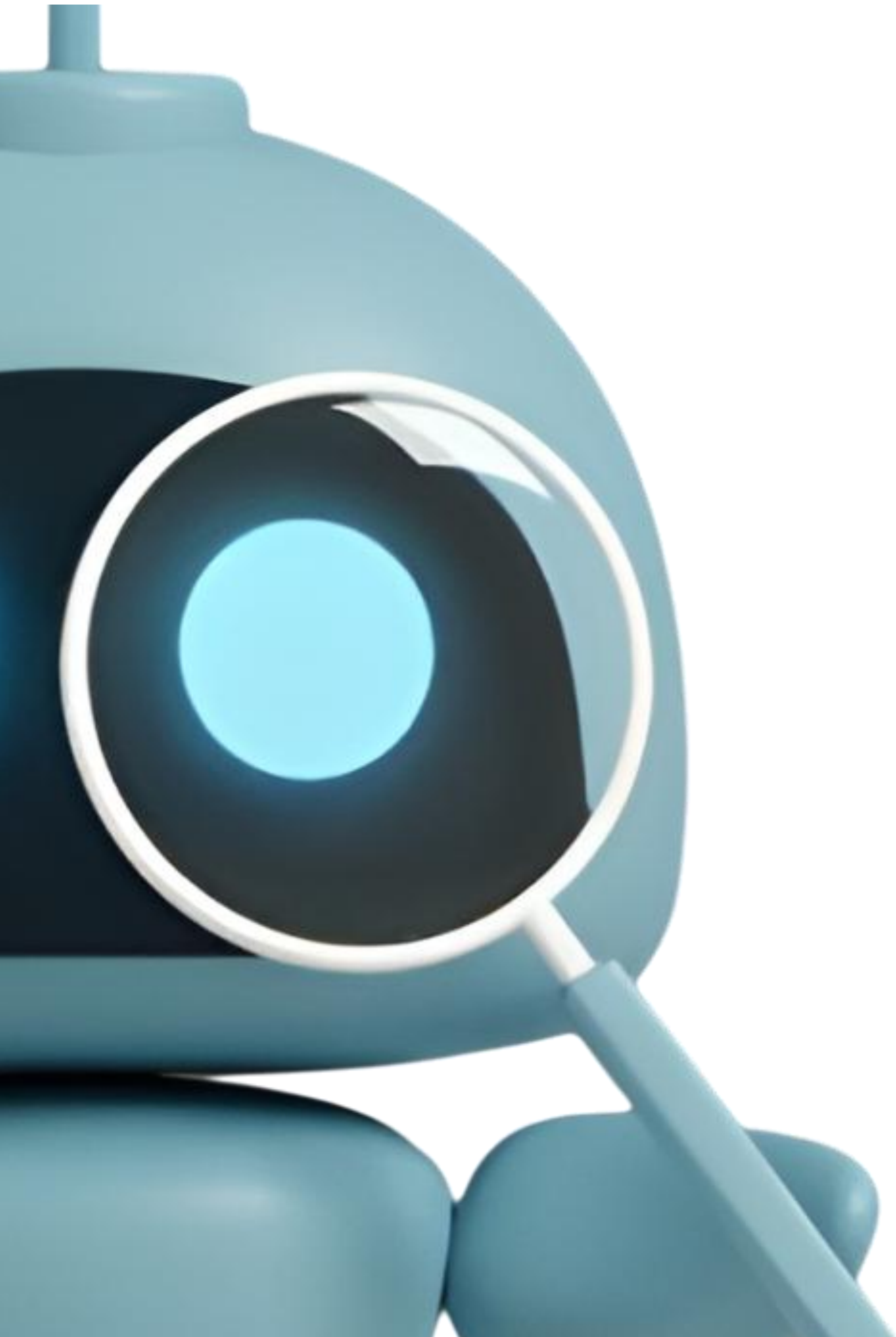
December 11th, 2024



AI Assistants

From Click-Deploy to Production

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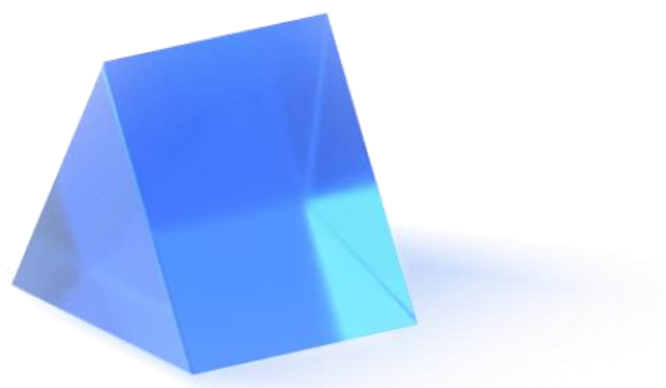
AI Assistants



What are AI Assistants?

AI-driven tools that engage with users via natural language to provide **intelligent, adaptive support**

Why AI Assistants?

- **Domain Expertise**
- 24/7 Available
- **Consistent** and **Adaptable**
- Boost efficiency
- Scalable

How Assistants Work

Retrieval Augmented Generation (RAG) is a combination of an information system retrieval with LLM skills to create contextually grounded responses

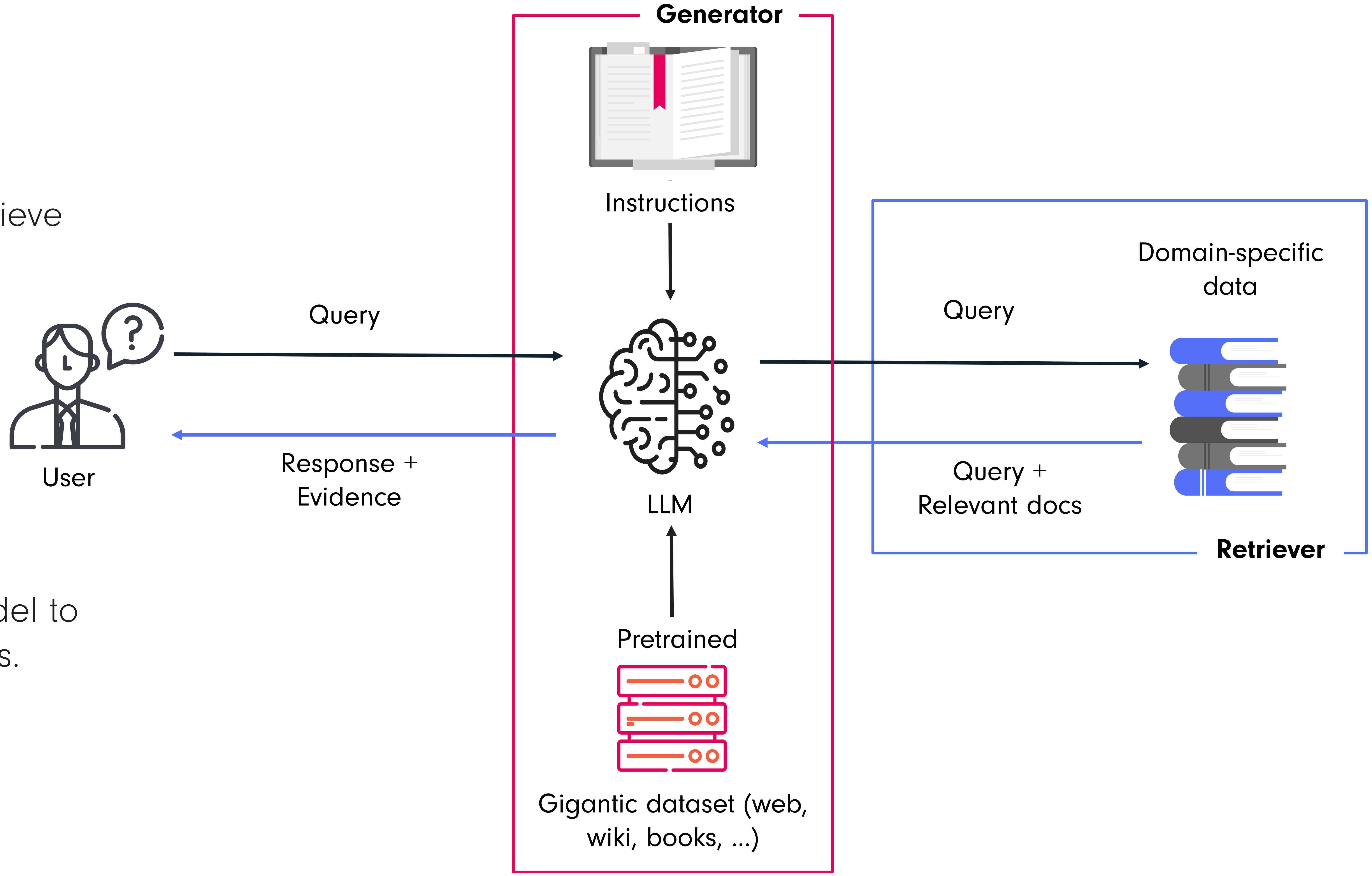
How does RAG work?

1. Retrieval

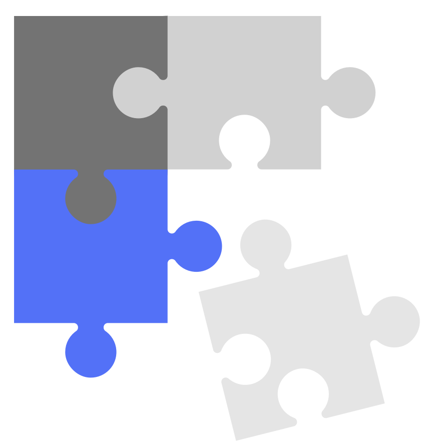
The solution queries a vast database to retrieve the most relevant documents to user input.

2. Augmentation

This content is served to the generative model to generate accurate, context-aware responses.

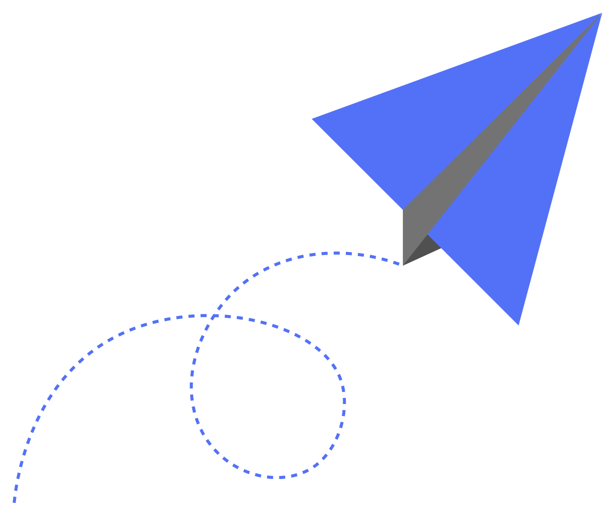


Why RAG over Fine-Tuning?



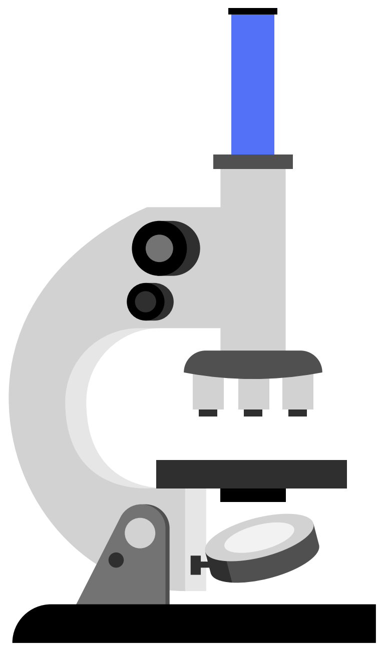
Always Up-to-Date

- Replies are always up-to-date
- **Adapts to changes** in your data, making it flexible for evolving business needs



Cost-Effective & Scalable

- No need for retraining
- **Scales efficiently**, adapting to user needs



Trustworthy & Transparent

- Verifiable response
- Tracing answers back to the original content for deep-dive

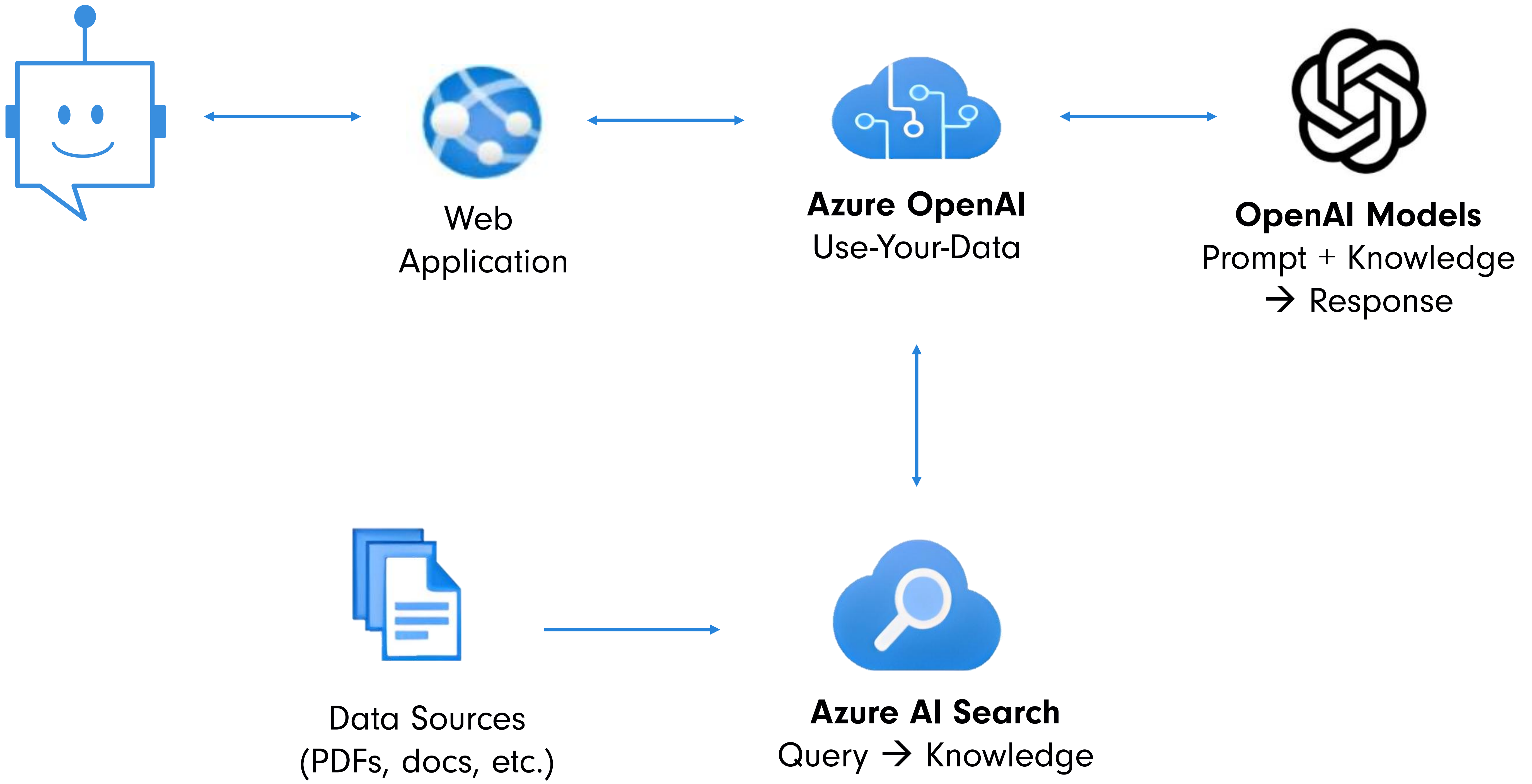
Exploration Phase

Azure OpenAI Services

Azure OpenAI Service integrates OpenAI's generative AI models with Azure's enterprise-grade cloud, offering **secure**, scalable access via REST APIs.

Chat with your data enables the Assistant to craft **system prompts** and integrate the LLM with your data.

Azure AI Search is the RAG **retrieval system** indexing data with relevance tuning, security, and global reach.



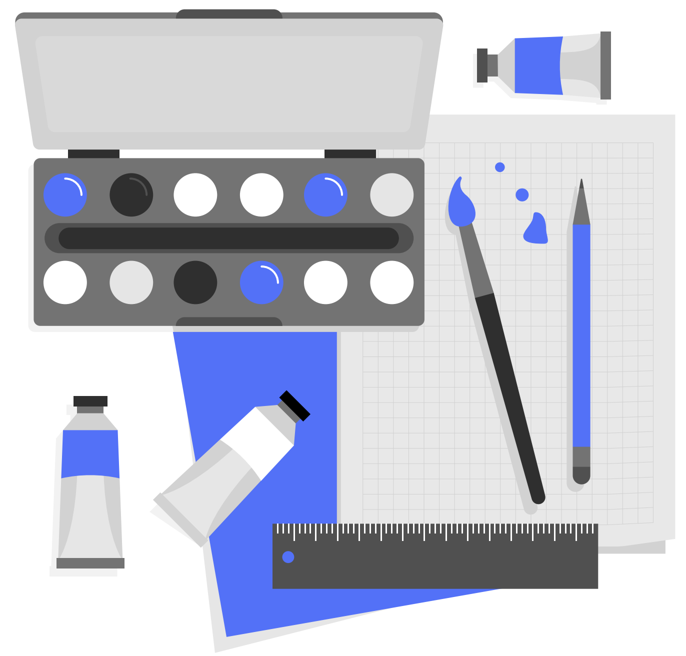
Azure AI Search Retrieval Methods

Vector Search

- **Vector-embedded space**
- Measures **similarity** between queries and documents
- Identifies **conceptually related** content

Keyword Search

- Match **exact** terms
- **Traditional search** needs
- Combines with Vector Search to form Hybrid Search



Semantic Search

- Understand the **query intent** ranking results by contextual relevance and meaning.
- Human-like understanding and deeper insights

Azure AI Search Core Components

Index

It’s the Assistant's **knowledge base** storing processed content and associated metadata. It is **highly customizable**, allowing the configuration of metadata attributes like titles, paths, and vectors for retrieval, filtering, or sorting

Skillset

Defines **cognitive skills** for preparing and enriching data, including chunking, embedding, field mapping, and custom enrichments for AI processing.

Indexer

Handles **connecting**, **populating**, and **updating** the index with data from the source based on skillset instructions

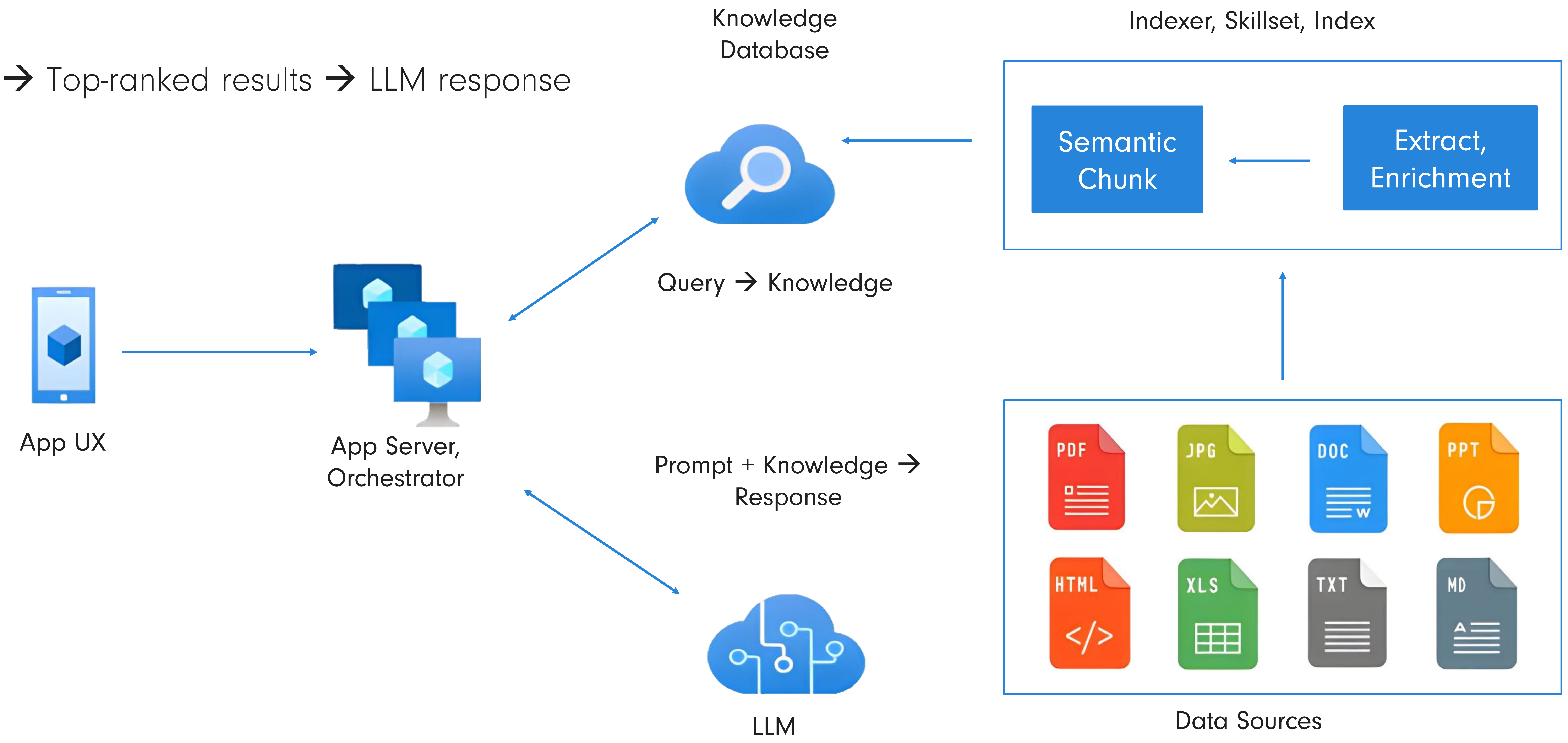
Data Source

Connects to **original data sources**, storing raw data before enrichment and indexing.

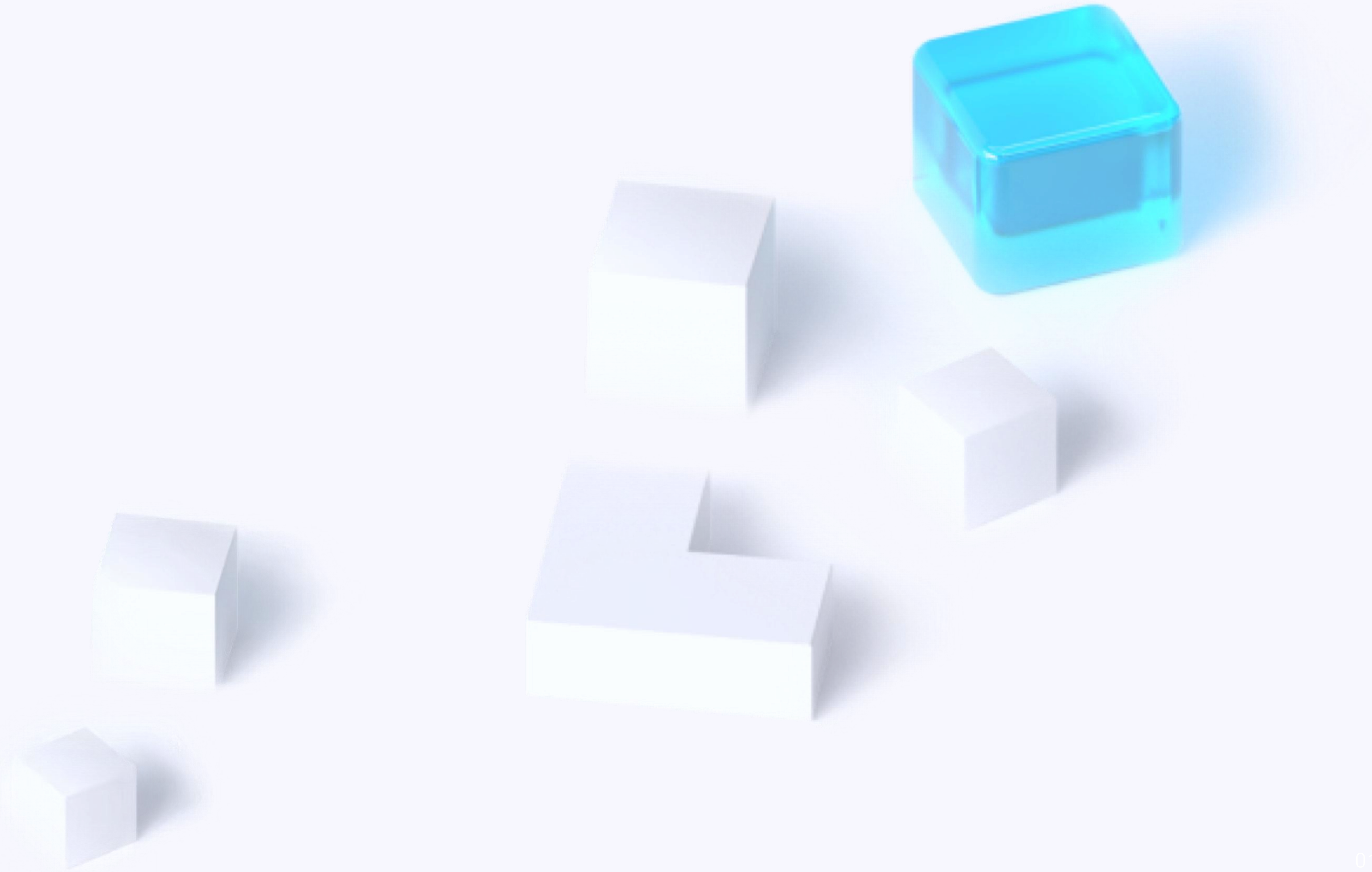
PoC Architecture

RAG Pattern

User query → Search → Top-ranked results → LLM response

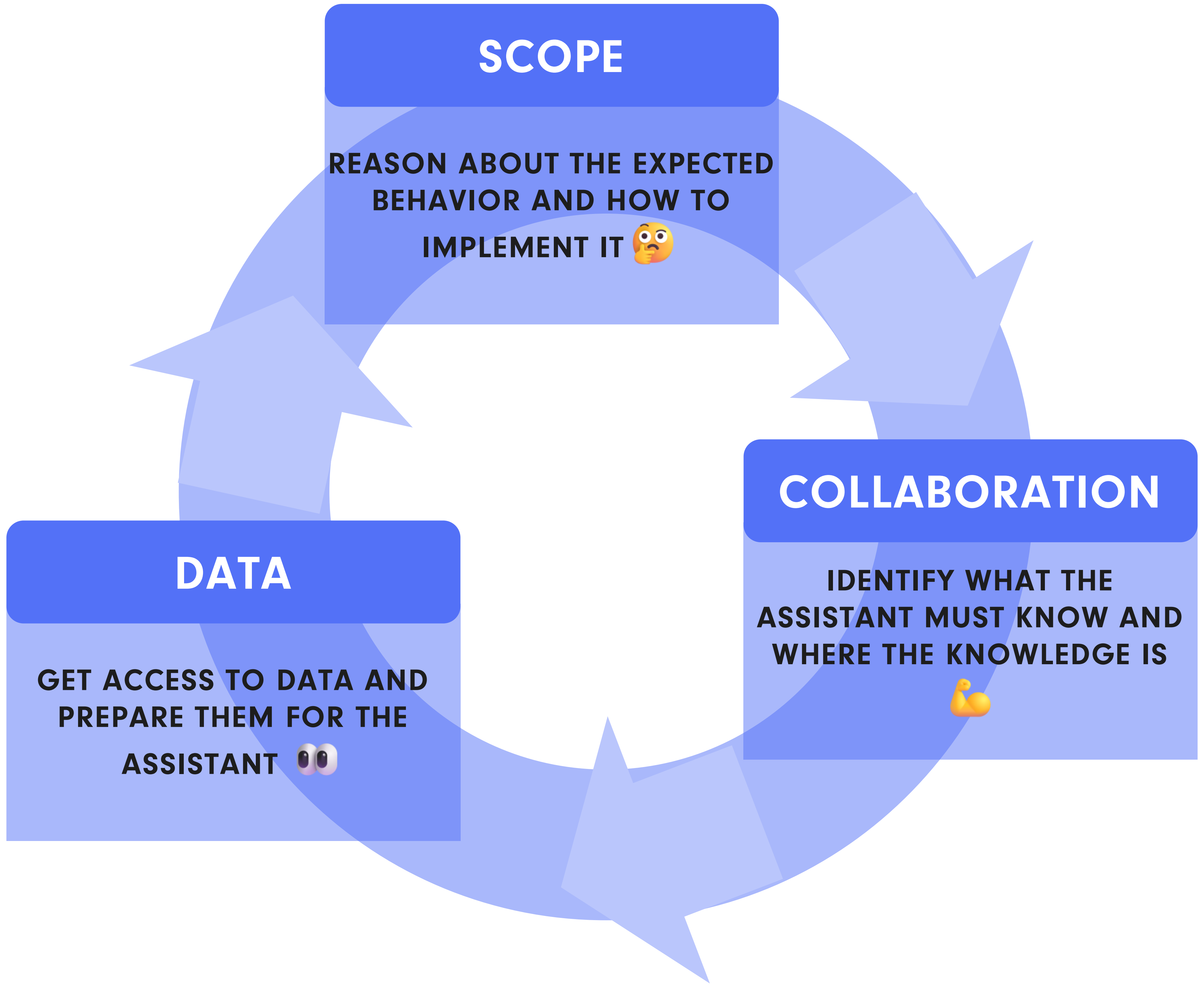


Demo



Identify Relevant Data Sources

An effective AI Assistant strictly depends on **high-quality data source identification.**



Inputs

- The relevance of data sources depends on the **Assistant's scope**
- Early **collaboration with end users** accelerates behavior shaping and offers insights into key **information's *location***, format, and accessibility

Knowledge Sources

- **Internal Sources**: Confluence, GitHub (specs, guidelines), Teams threads, and training materials (video transcriptions, diagrams)
- **External Sources**: Public content (blogs, websites) and secure third-party partner documentation

Knowledge Mining

To ensure Azure AI Search works **effectively**, data must be optimized for indexing and retrieval.

Data Preparation
Python pipelines to collect, clean, and manipulate data

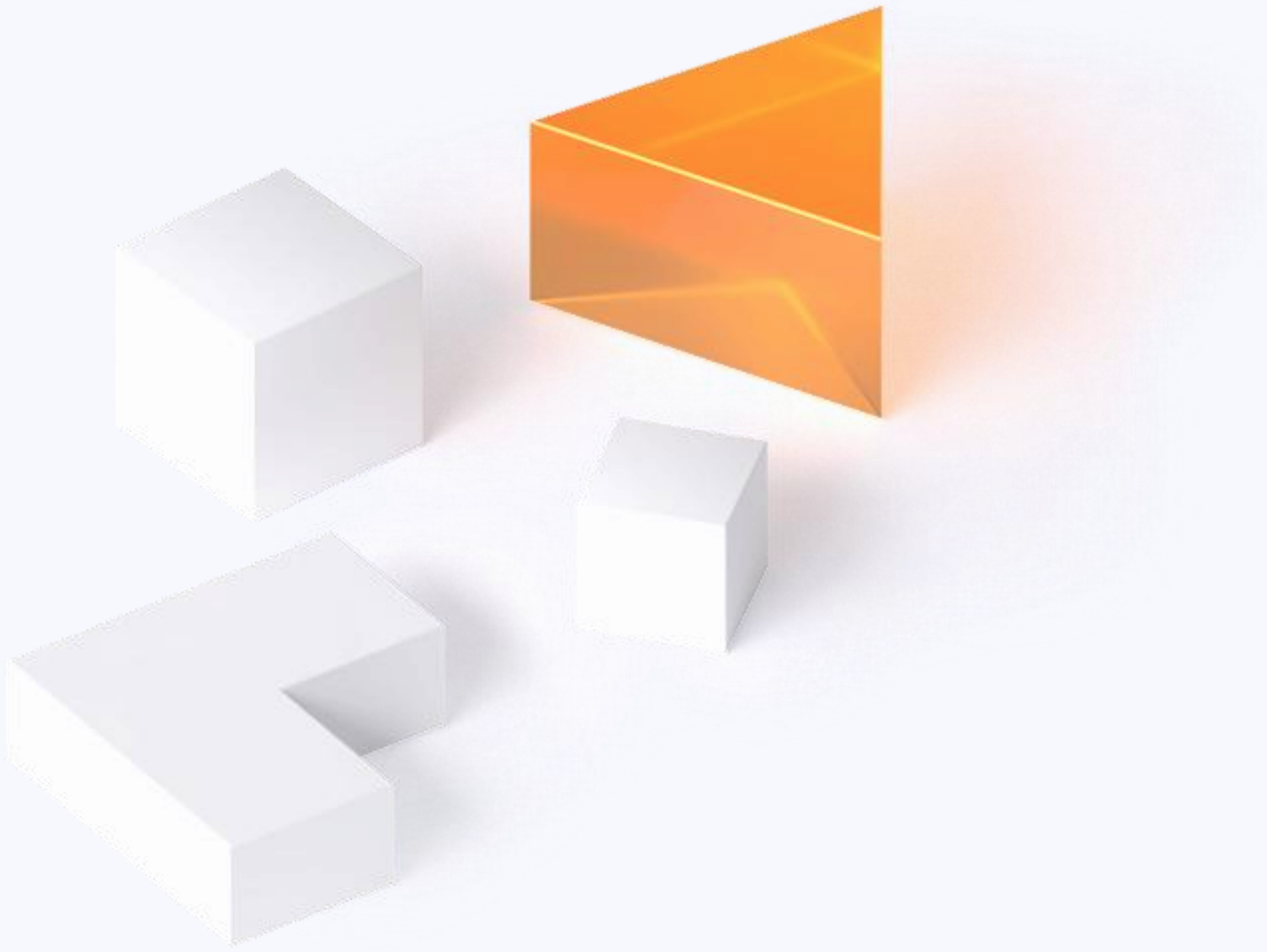
PDFs
Format for easy indexing

Diagrams
Use Mermaid syntax for better usability

LLM-Assisted Transformations
Convert informal content (chats, transcripts) into structured, informative documents

```
CHAT_SUPPORT_TO_DOCs = """
You are a sophisticated processing tool tasked with
analyzing and structuring technical support dialogues.

Your main objectives include:

- Identifying the main issue from the dialogue's title.
- Summarizing the core problem from the main text.
- Extracting and listing solutions and steps from the
responses.

Operating guidelines:

- Output should be organized in a predefined format,
focusing on clarity and relevance.
- Strictly use the data provided in the structured input
without adding assumptions.
- Maintain professionalism and ensure privacy by omitting
personal details.
"""
```

Transition to Production

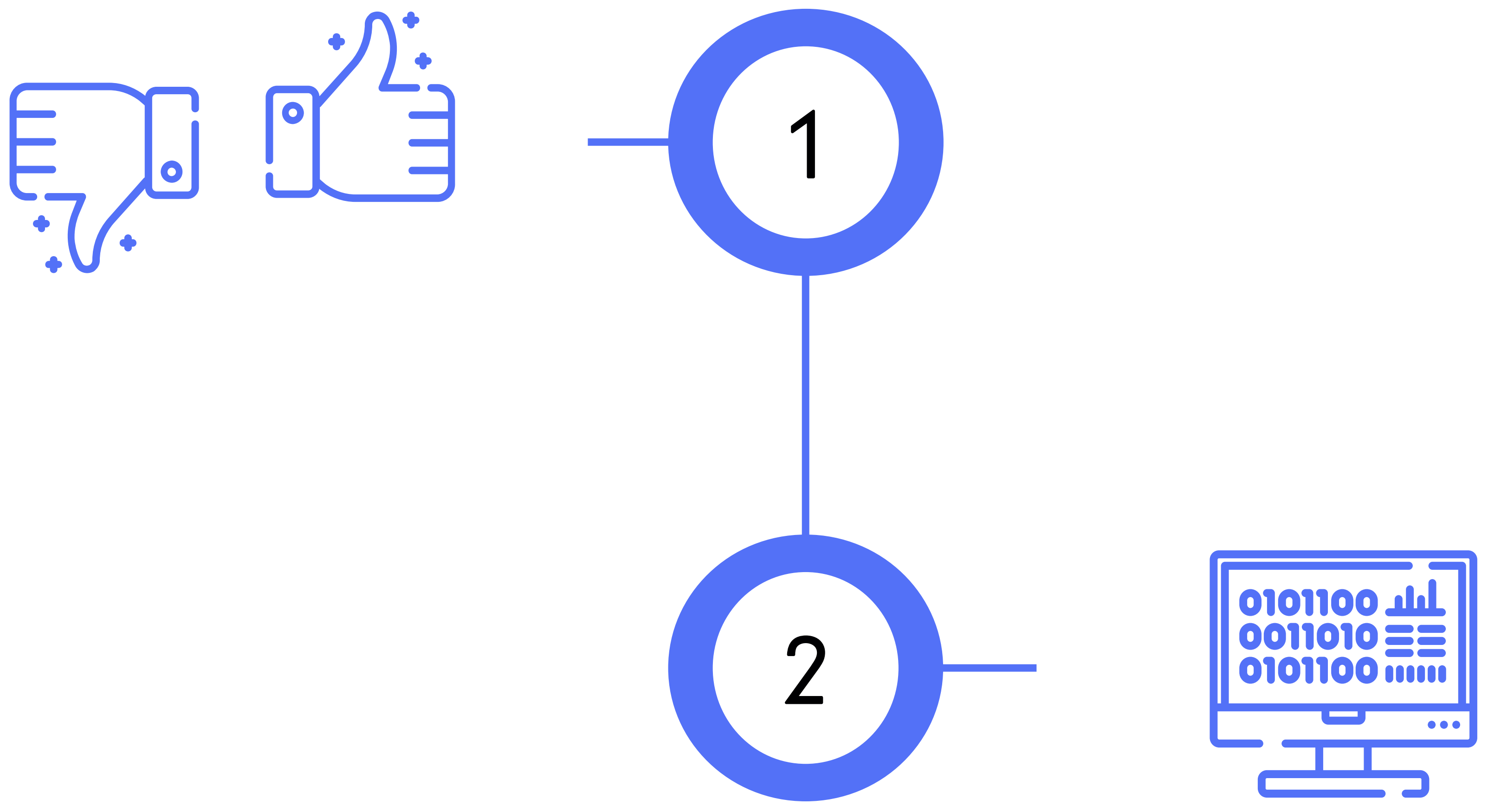


Evaluation & Feedback

Actively using and monitoring the Assistant's impact is the **compass for identifying improvement areas**.
Note. Guidelines and best practices were provided to users to maximize the Assistant's effectiveness

Human Feedback

- **In-Interface Thumbs Up/Down**: Evaluation of single messages
- **Dedicated Surveys**: assessing the Assistant's impact – usage, satisfaction, and time saved.



Automatic Evaluation

Objectively assess user intent understanding and response quality

- **Ground truth based**
- **Only exploiting LLMs**

LLM-as-a-Judge

Context Relevance

Check if the response *fits* the query and stays aligned with the **prior messages**

What are popular attractions in Paris?

- ☺: The Eiffel Tower and Notre-Dame Cathedral.
- ☹ The Eiffel Tower is amazing. Do you like French food?

Answer Relevance

Assess if the Assistant’s response is **relevant and exhaustive**.

What is the best time to visit Paris?

☺: April to June or October for mild weather.

☹: Paris is a major European city.

Groundedness

Measurement of **knowledge base usage**, and the answer **faithfulness**.

How many people visit the Eiffel Tower each year?

☺: About 7 million annually.

☹: Around 20 million people annually (incorrect data).

Answer Relevance

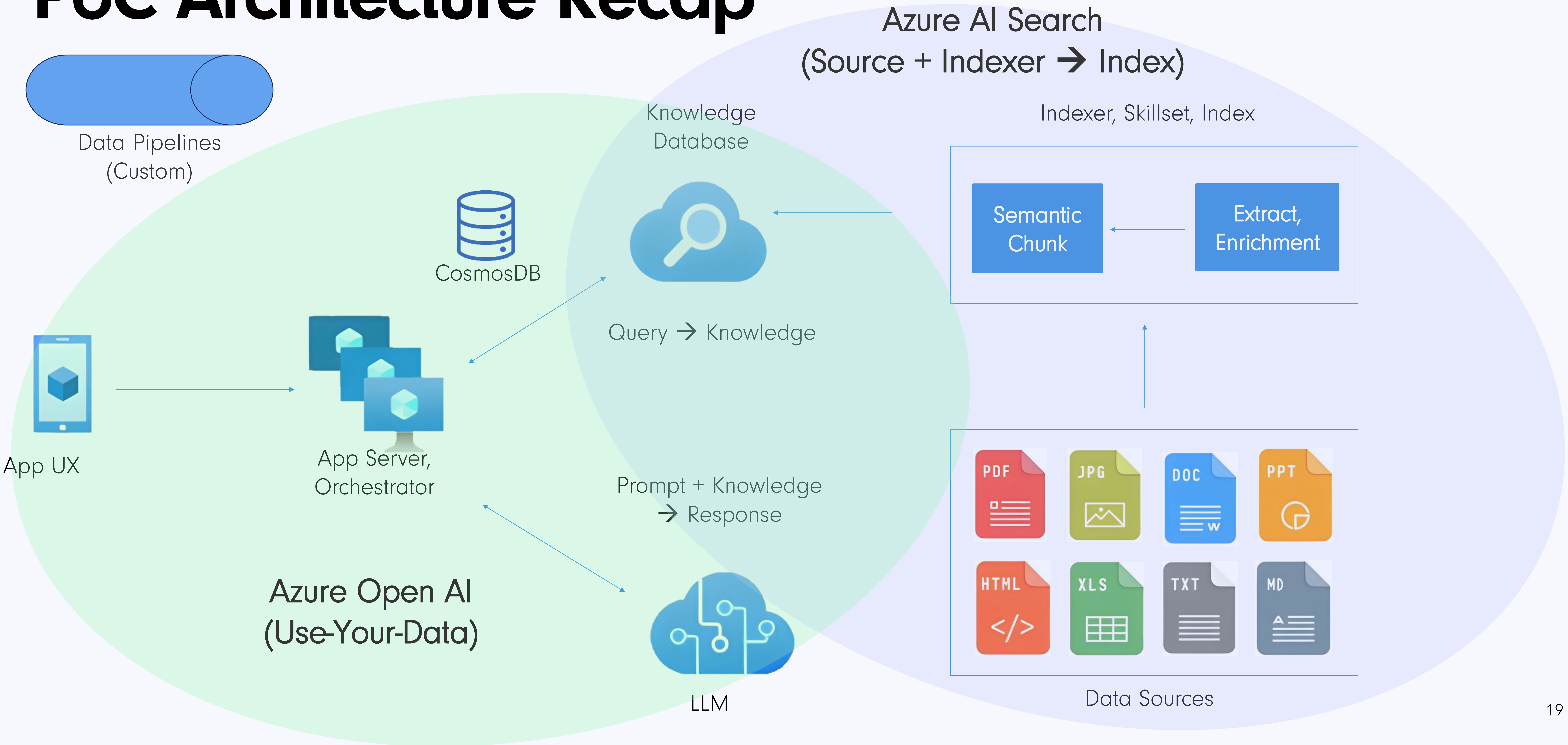
```
ANSWER_RELEVANCE_TRULENS = """You are a RELEVANCE grader; providing the relevance of the given RESPONSE to the given PROMPT.
Respond only as a number from 0 to 10 where 0 is the least relevant and 10 is the most relevant.

A few additional scoring guidelines:
- Long RESPONSES should score equally well as short RESPONSES.
- Answers that purposely do not answer the question, such as 'I don't know' and model refusals, should also be counted as
RELEVANT.
- RESPONSE must be relevant to the entire PROMPT to get a score of 10.
- RELEVANCE score should increase as the RESPONSE provides RELEVANT context to more parts of the PROMPT.
- RESPONSE that is RELEVANT to none of the PROMPT should get a score of 0.
- RESPONSE that is RELEVANT to some of the PROMPT should get a score of 2, 3, or 4.
- RESPONSE that is RELEVANT to most of the PROMPT should get a score between a 5, 6, 7 or 8.
- RESPONSE that is RELEVANT to the entire PROMPT should get a score of 9 or 10.
- RESPONSE that is RELEVANT and answers the entire PROMPT completely should get a score of 10.
- RESPONSE that confidently FALSE should get a score of 0.
- RESPONSE that is only seemingly RELEVANT should get a score of 0.
- Never elaborate.

Please answer with this template:
TEMPLATE:
Criteria: <Provide the criteria for this evaluation>
Supporting Evidence: <Provide your reasons for scoring based on the listed criteria step by step. Tie it back to the evaluation
being completed.>
Score: <The score 0-10 based on the given criteria>"""
```

https://www.trulens.org/

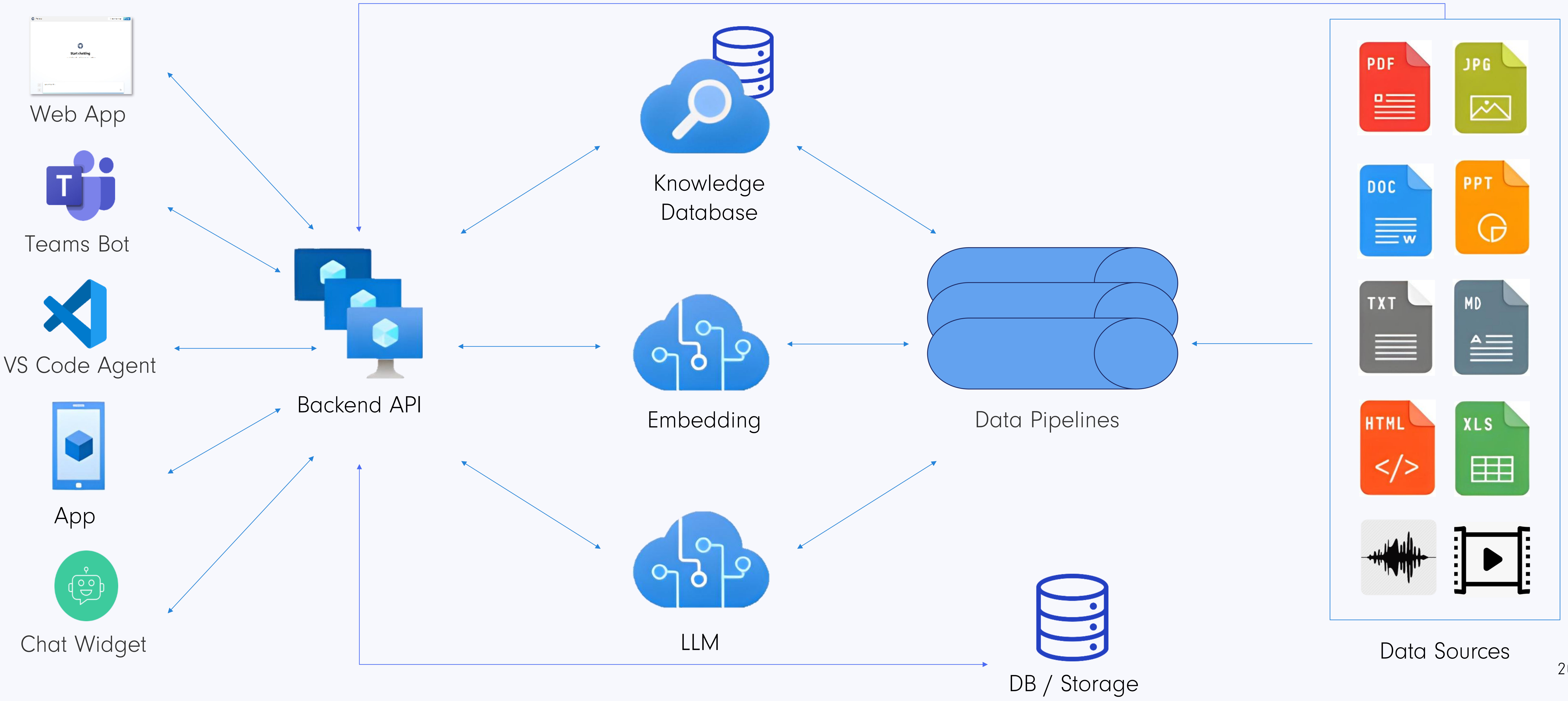
Recognized Challenges

Front End	Back End	Optimization
Customization Demands	Automating Data Flow	Feedback Loop
Chat History	Security Enhancements	Monitoring and Optimization
Navigable Links and Schema	Scalability	System Integration

PoC Architecture Recap



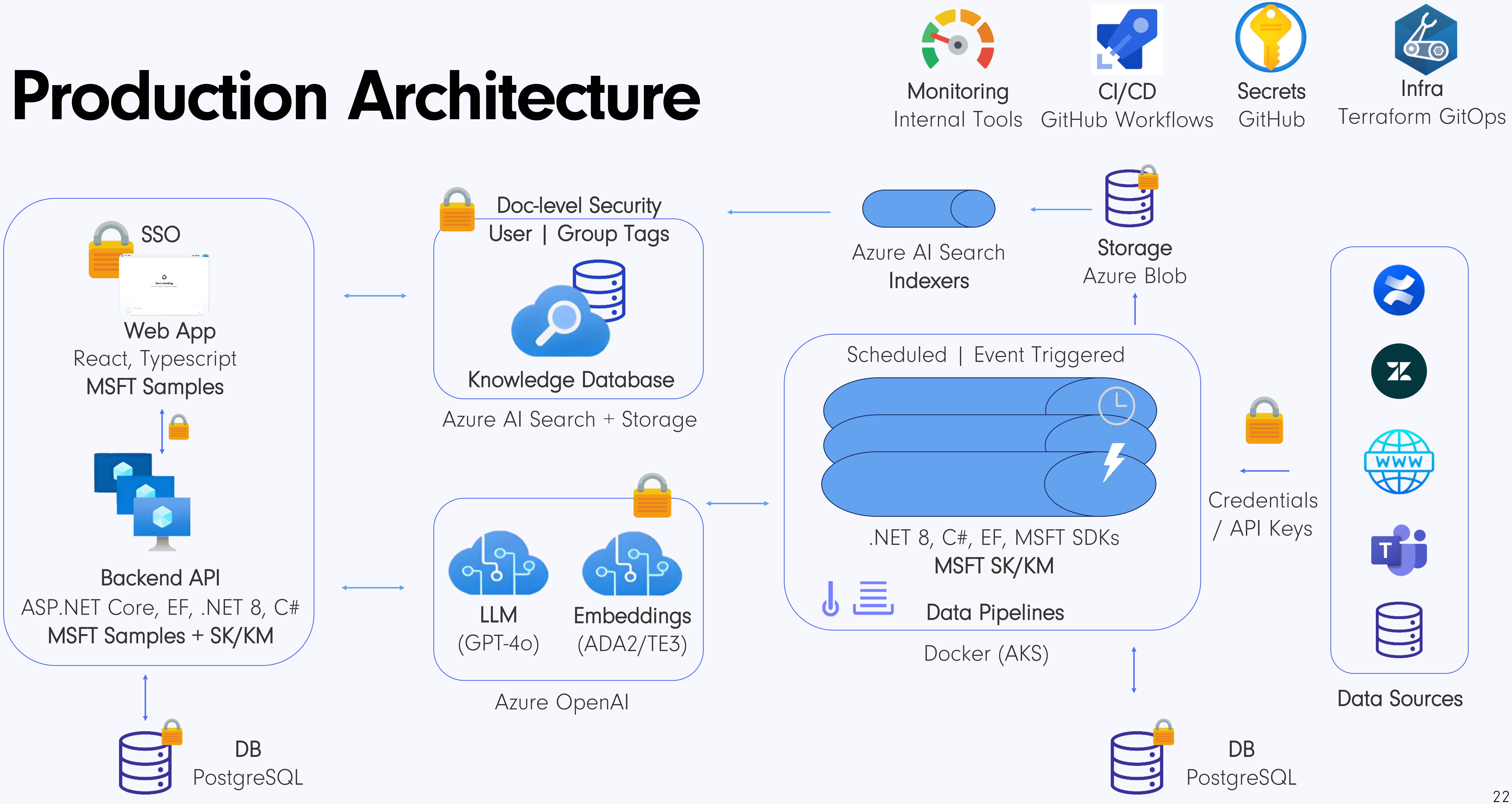
High-Level Overview



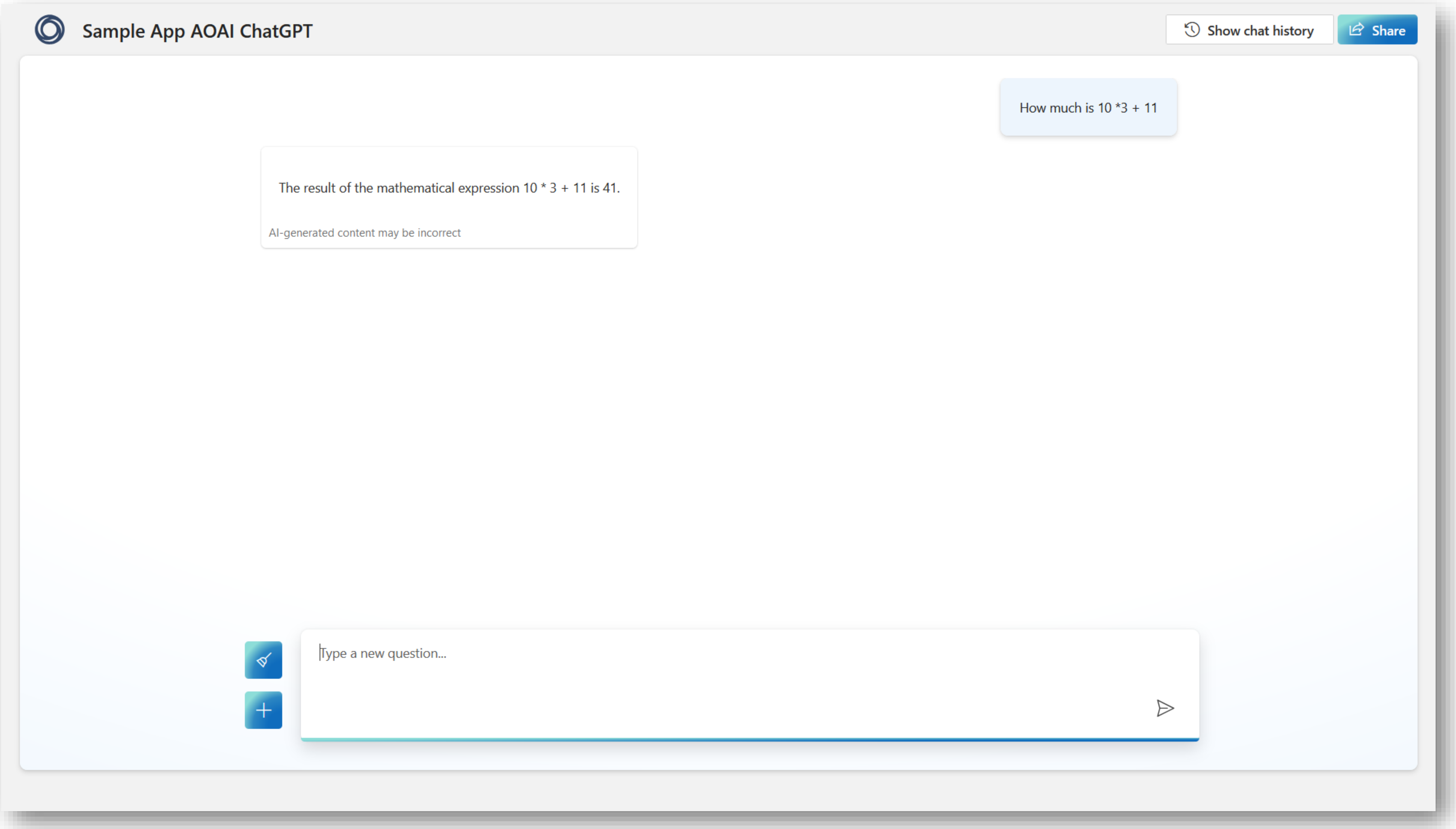
Customization Needs

- All-in-1 Assistants
- Cloud Agnostic
- Extended References
- Enhanced Feedback
- Enterprise Guidelines
- Styling & Localization
- Monitoring & Optimization
- Security

Production Architecture

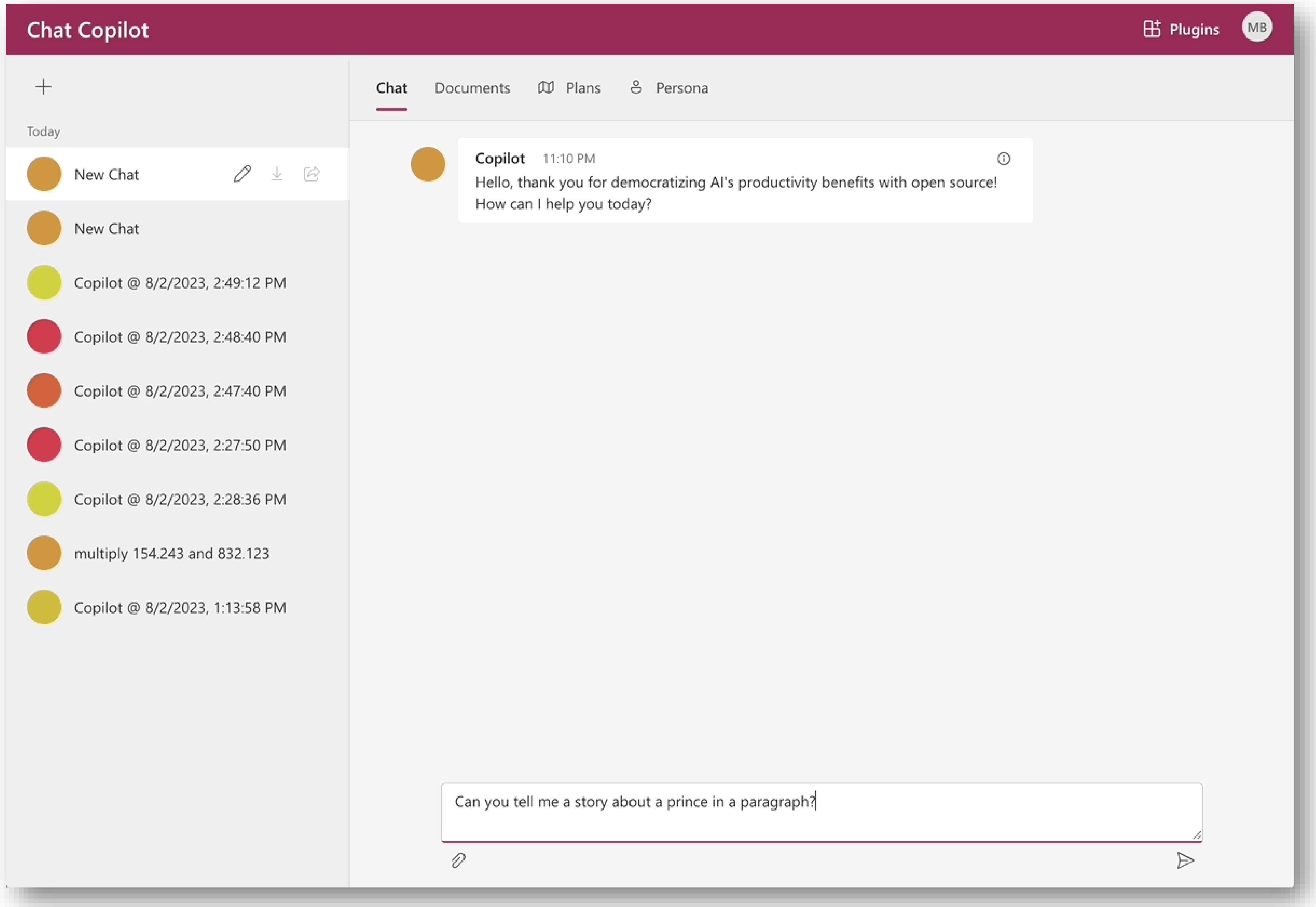


Technologies & Frameworks



https://github.com/microsoft/sample-app-aoai-chatGPT

React, Typescript
Python
Azure OpenAI API (UYD)



https://github.com/microsoft/chat-copilot/

React, Typescript
ASP.NET Core, .NET 8, C#
Semantic Kernel + Kernel Memory

LLMs, Chats, Tools

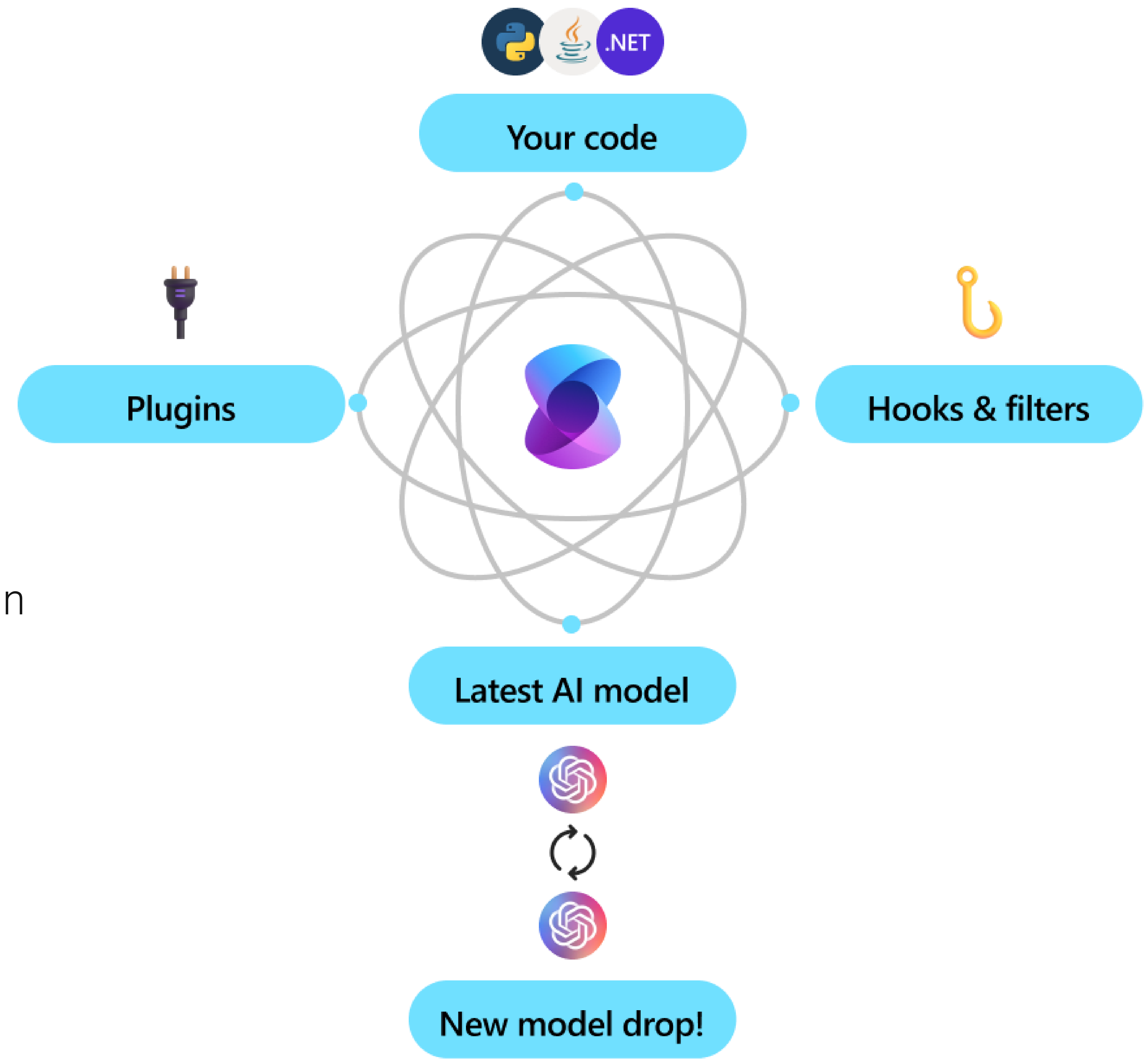
Semantic Kernel
A lightweight, **open-source** development kit

Enterprise-ready
Flexible, secure, modular, and observable

Orchestration & Plans
Combines AI models, embeddings, prompts
with APIs & tools to perform actions & business automation

Modular and Extensible
Many out-of-the-box connectors
Support for integrating *existing* code as **plugin**

Cross-Platform
.NET, Python, and Java



https://learn.microsoft.com/en-us/semantic-kernel/overview/

Memory, Data, Workflows

Kernel Memory
A **multi-modal, open-source AI Service** for efficient datasets indexing

Data Pipelines & Workflow Orchestration
Supports Data Retrieval, Custom Pipelines, and Semantic Memory processing

RAG Support
Advanced querying via embeddings and LLMs, over multiple knowledge bases

Built-in Data Formats & Transformations + Custom
Supports various data types, including PDFs, documents, web pages, and images

Out-of-the-Box Connectors + Custom
Support a wide range of data stores (Vector DBs, RDBMS, File System, etc.)

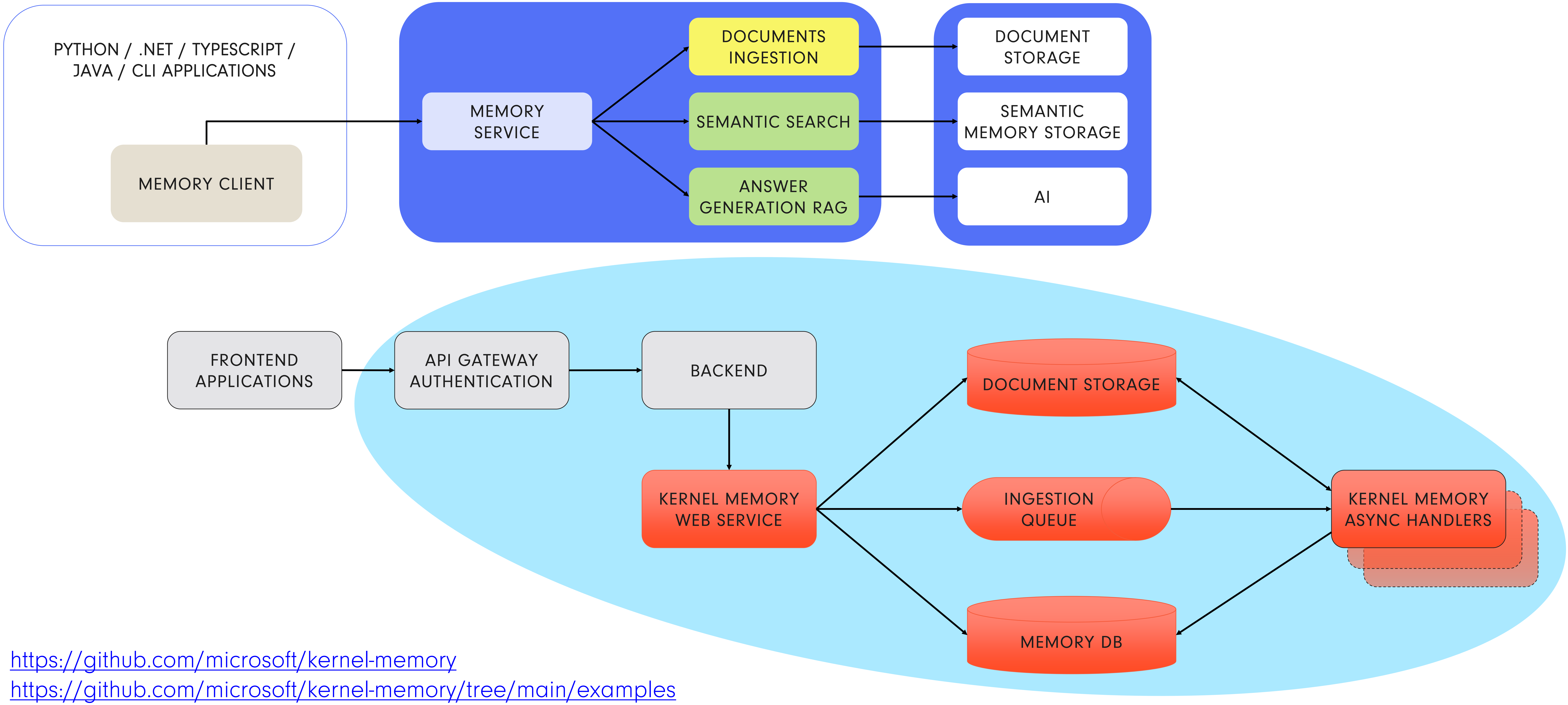
Integrates with external tools like Azure OpenAI, ChatGPT and Microsoft Copilot

Enterprise-proof

Flexible, modular, observable, and secure

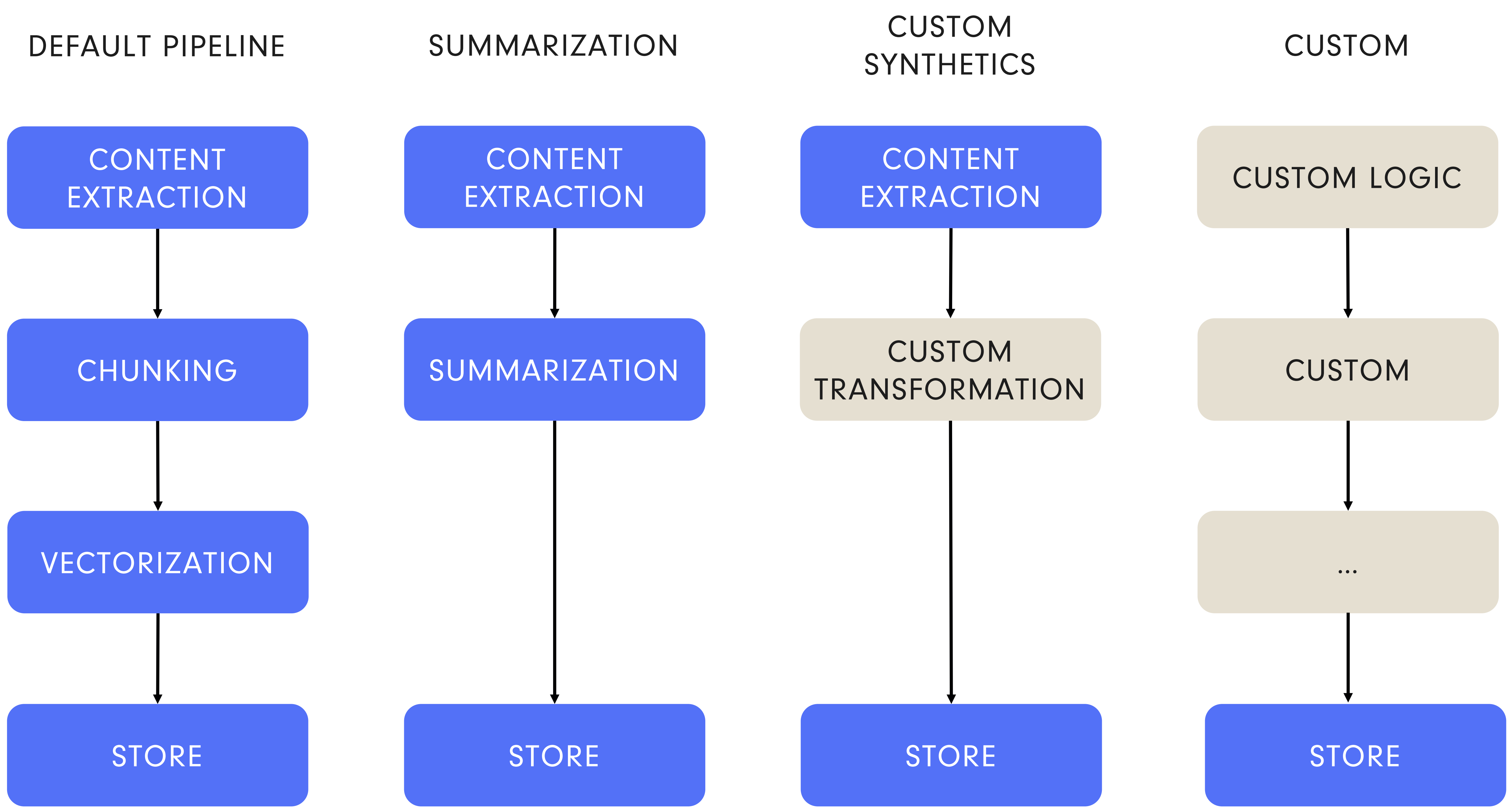
https://microsoft.github.io/kernel-memory/

Data Pipelines



https://github.com/microsoft/kernel-memory
https://github.com/microsoft/kernel-memory/tree/main/examples

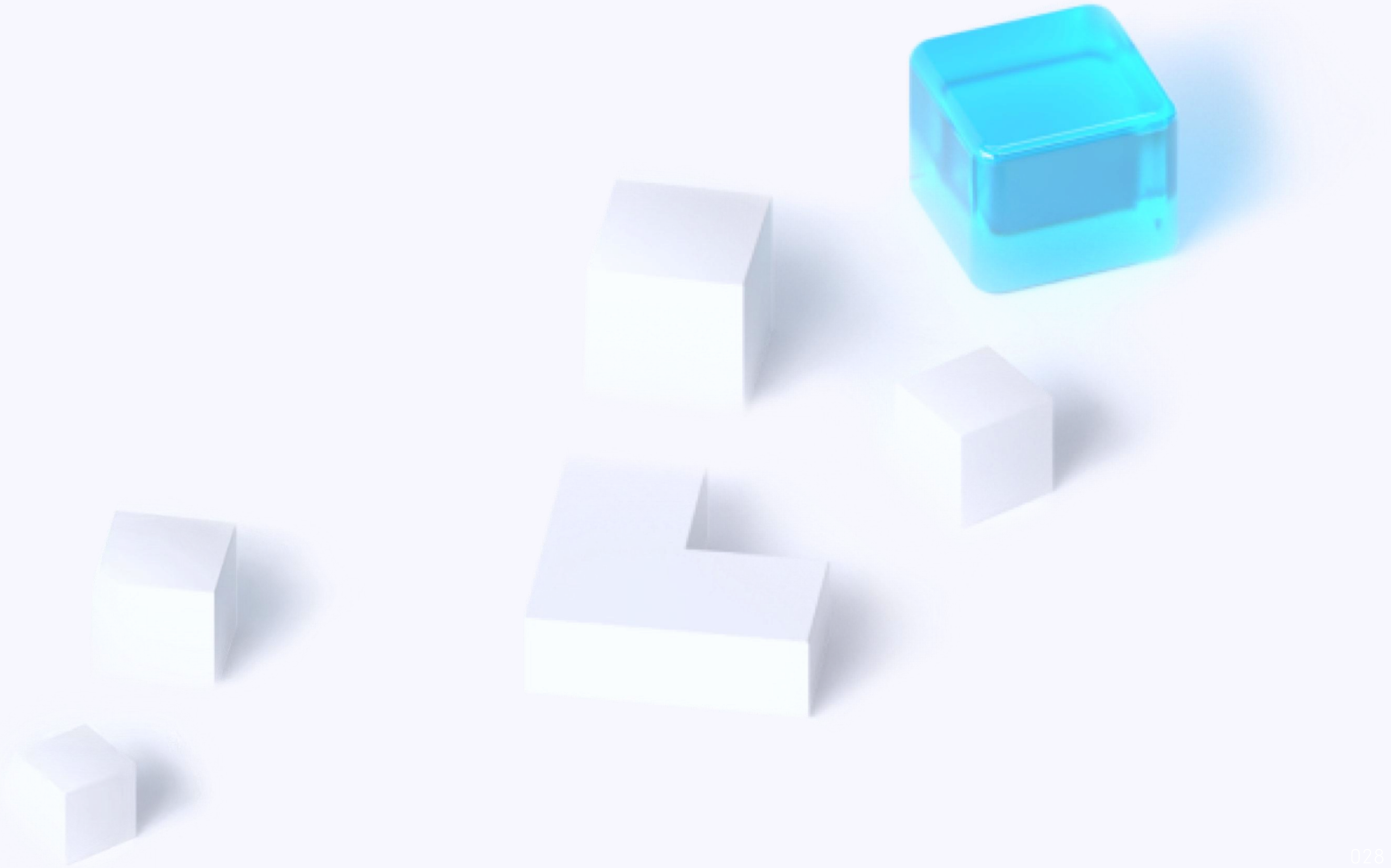
Data Pipelines




```
memory.Orchestrator.AddHandler<TextExtractionHandler>("extract_text");
memory.Orchestrator.AddHandler<TextPartitioningHandler>("split_text_in_partitions");
memory.Orchestrator.AddHandler<GenerateEmbeddingsHandler>("generate_embeddings");
memory.Orchestrator.AddHandler<SummarizationHandler>("summarize");
memory.Orchestrator.AddHandler<SaveRecordsHandler>("save_memory_records");

/*********************************************************
 * Import files using custom handlers
 *********************************************************/

// Use the custom handlers with the memory object
await memory.ImportDocumentAsync(
    new Document("inProcessTest")
        .AddFile("file1-Wikipedia-Carbon.txt")
        .AddFile("file2-Wikipedia-Moon.txt")
        .AddFile("file3-lorem-ipsum.docx")
        .AddFile("file4-KM-Readme.pdf")
        .AddFile("file5-NASA-news.pdf")
        .AddTag("testName", "example3"),
    index: "user-id-1",
    steps:
    [
        "extract_text",
        "split_text_in_partitions",
        "generate_embeddings",
        "save_memory_records"
    ]);
```

https://github.com/microsoft/kernel-memory
https://github.com/microsoft/kernel-memory/tree/main/examples

Demo



Lessons Learned (Part 1)

Data is King
High-quality, well-prepared data is essential for success and contextually relevant responses.

Cross-Functional Collaboration
The key for ensuring all needs are met is the collaboration between AI teams, developers, and end-users

Master Retrieval Techniques
Efficient indexing, data enrichment, and retrieval methods ensure fast, relevant results.

Iterative Approach
Continuously test, refine, and optimize. Constant feedback loops are vital for improving accuracy and performance over time.

Lessons Learned (Part 2)

LLM-as-a-Judge
Use both human feedback and automated evaluation to measure the overall Assistant's impact.

Continuous Improvement
RAG-based solutions evolve rapidly. Stay updated with new methods and technologies.

Scalability and Flexibility
Ensure the Assistant remains scalable and adaptable to growing data and user demands.

Security & Access Management
Implement robust security measures and ensure compliance to protect sensitive information.

What's Next

Evaluation and CI Empowerment

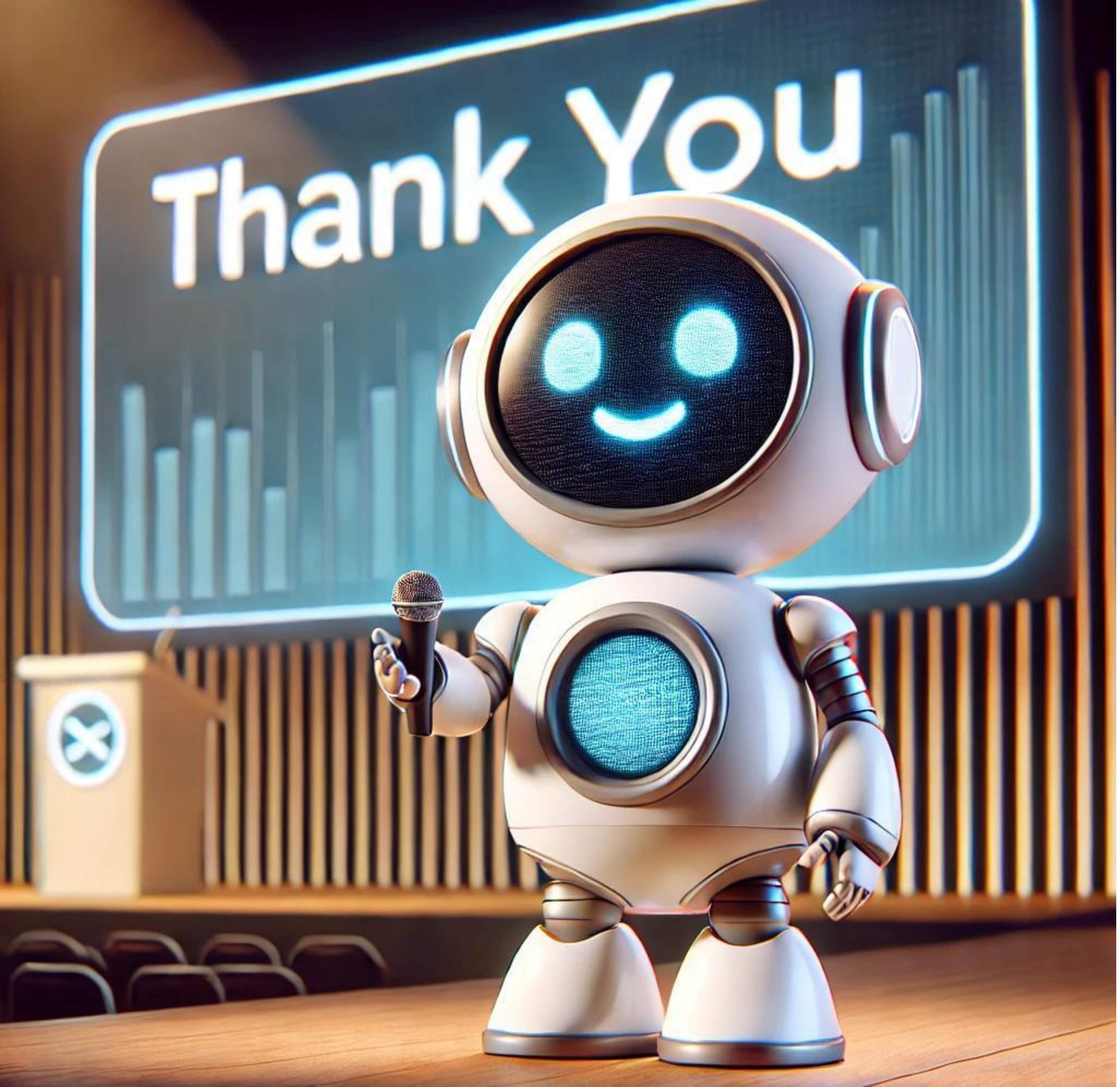
- **Synthetic Ground Truth** to strengthening LLM-as-a-Judge evaluation
- **Advanced Monitoring Tools** in production like Azure Prompt Flow, Nebuly, or LangSmith

Architectural Enhancements & Solutions

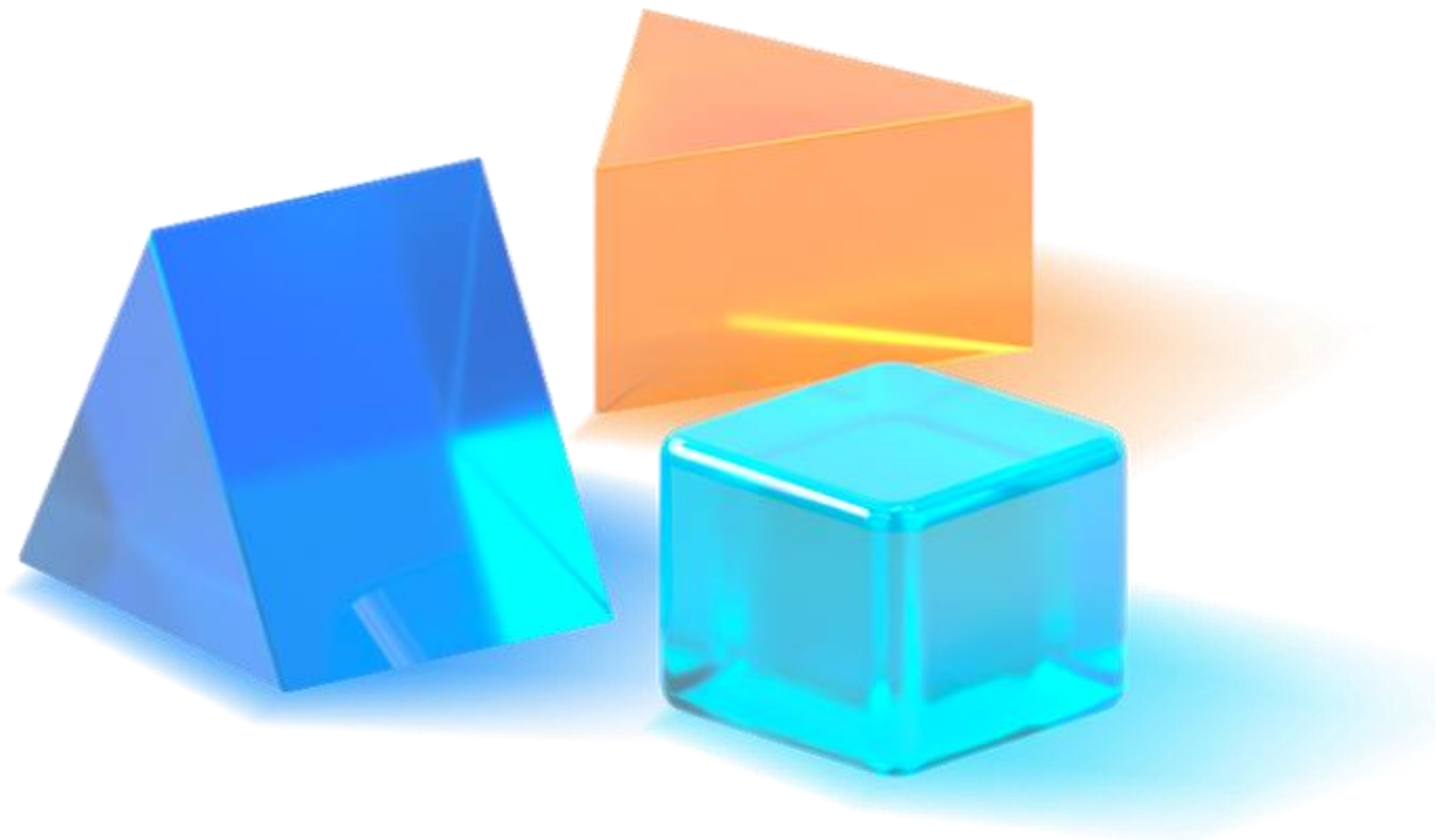
- **Semantic Cache** to improve efficiency by reusing cached context.
- **New Frameworks**: Evolving architectural solutions in the RAG landscape

New Approaches

- **AI Agents**: autonomous systems that combine the adaptability of LLMs with the precision of traditional programming to **make decisions** and **take actions** toward specific goals
- **Advanced Retrieval and data *connections*** to improve understanding, reduce hallucinations, and improve contextualization



Questions?



Additional References

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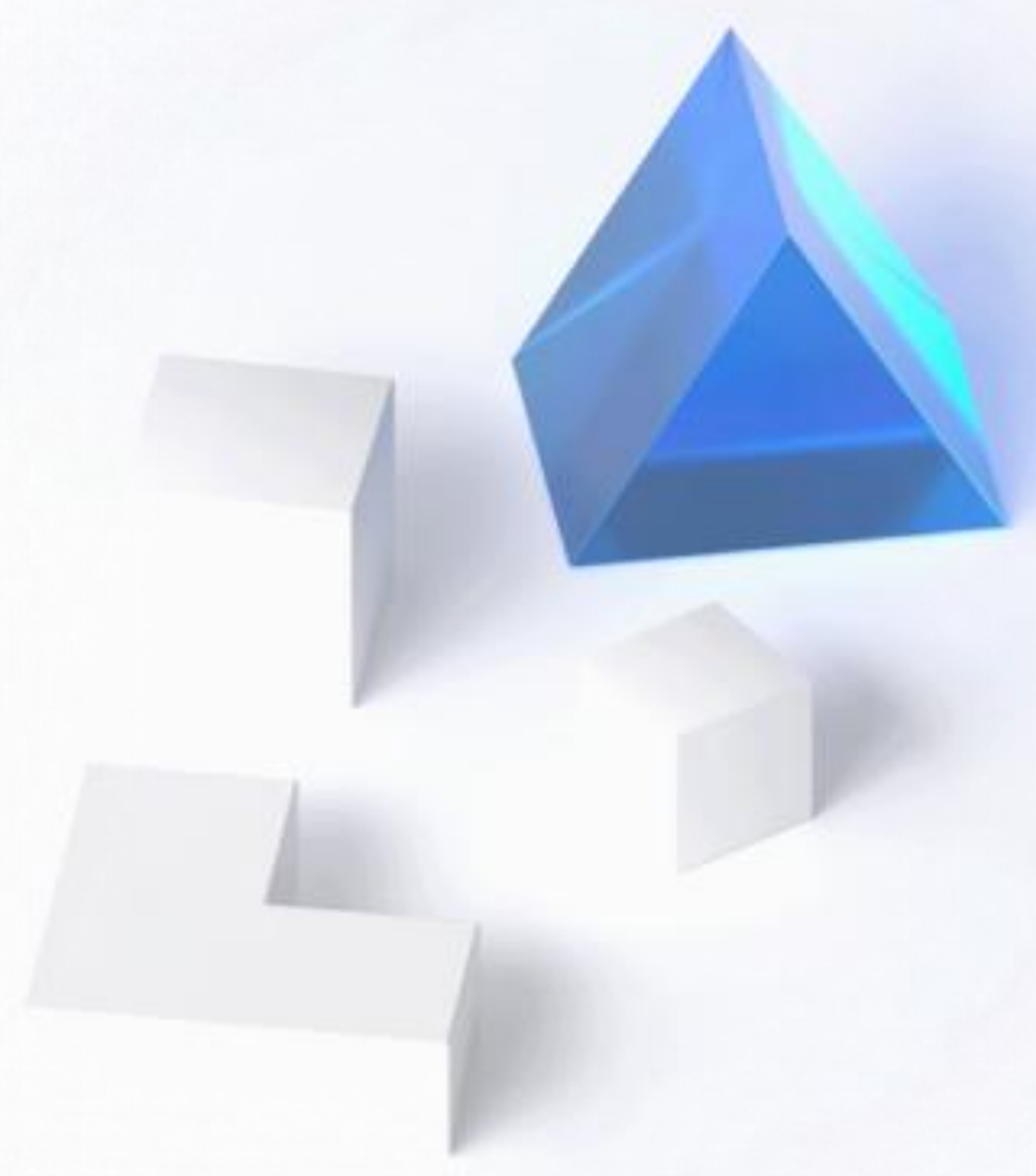
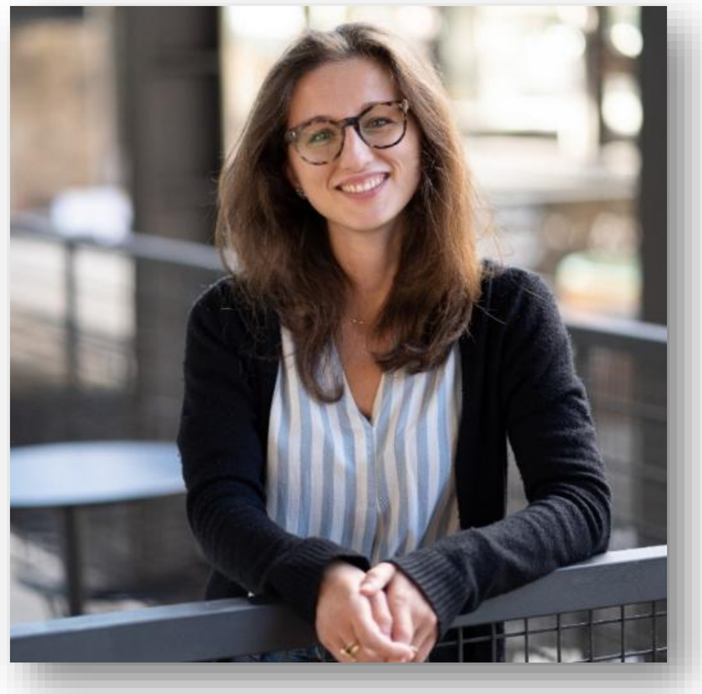
https://learn.microsoft.com/en-us/azure/search/
https://learn.microsoft.com/en-us/azure/ai-services/openai/use-your-data-quickstart
https://www.trulens.org/
https://github.com/microsoft/chat-copilot/
https://github.com/microsoft/sample-app-aoai-chatGPT
https://learn.microsoft.com/en-us/semantic-kernel/overview/
https://github.com/microsoft/kernel-memory
https://github.com/microsoft/kernel-memory/tree/main/examples
https://github.com/Andrew-Jang/RAGHub



About Us



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R&D Data Scientist @ deltatre
Deltatre Innovation Lab

- Biomedical Engineering, focused on sports data analysis.
- AI, Machine Learning, and Deep Learning on multimedia content
- Skilled in exploratory data analysis techniques, handling diverse and complex data types.
- Currently working on RAG-based solutions to advance NLP capabilities
- LinkedIn: https://www.linkedin.com/in/morgana-lalli-b5ab0a172/

About Us

Microsoft Specialist
Programming in C#
Programming in HTML5 with JavaScript & CSS3

Microsoft CERTIFIED
Solutions Developer
Windows Store Apps Using C#
Web Applications

Microsoft CERTIFIED AZURE AI ENGINEER ASSOCIATE

Microsoft CERTIFIED AZURE DATA SCIENTIST ASSOCIATE

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Microsoft Most Valuable Professional (MVP)

- AI, Machine Learning, Deep Learning on multimedia content
- Virtual/Augmented/Mixed Reality
- Immersive video streaming & 3D graphics for sport events
- Cloud solutions, web backends, serverless, video workflows
- Mobile apps dev (Windows / Android / .NET MAUI / Avalonia)
- End-to-end solutions with Microsoft Azure
- Blog: https://gianni.rosagallina.com/en/
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PLURALSIGHT
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