DATASTAX

Community over Code 2023

Real-time AI made easy: Harnessing Generative AI Functions in Apache Kafka and Apache Pulsar

October, 2023

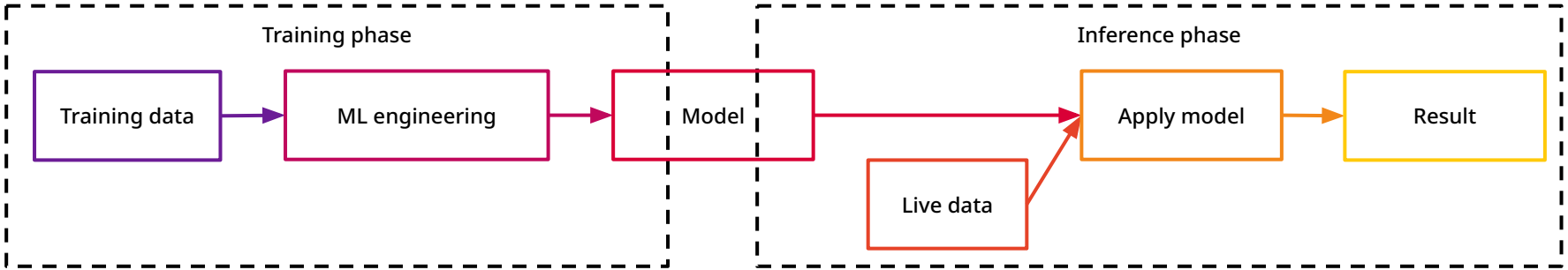
Rise of the GenAI

- ChatGPT was launched in November 2022, less than a year ago
- 2 talks at ApacheCon 2022: vector search only, not AI
- 16 talks including 2 keynotes at Community over Code 2023
- OpenAI valuation at $29Bn, aiming $90Bn
- Related Apache technologies

GenAI is changing the industry landscape

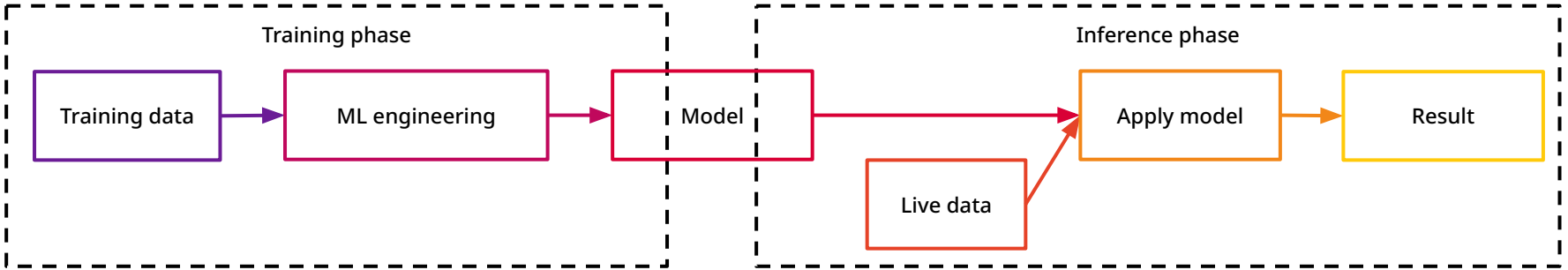
The barrier to AI

Traditional ML



The barrier to AI

Traditional ML

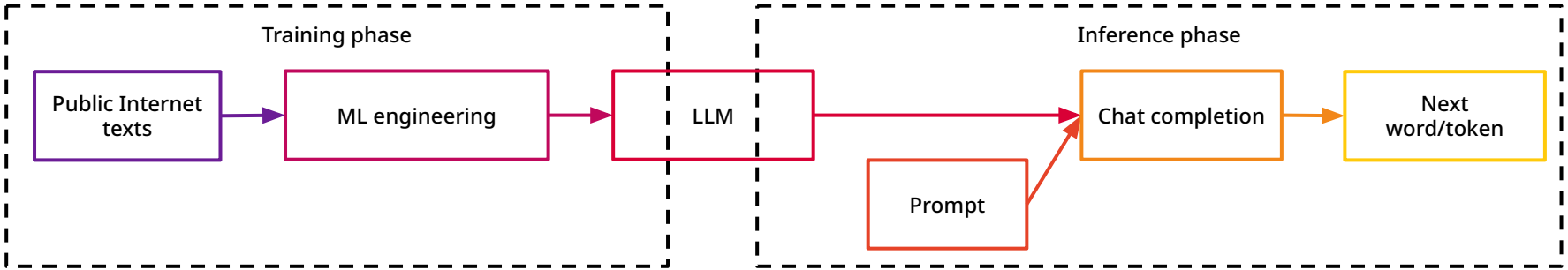


The training phase costs $$$:

- Gathering, cleaning, storing, processing data
- Highly qualified, hard to find ML engineers / data scientists required
- Long process / TTM
- Not reusable, need 1 model per use-case

Lowering the barrier to AI

GPT (Large Language Model)



Lowering the barrier to AI

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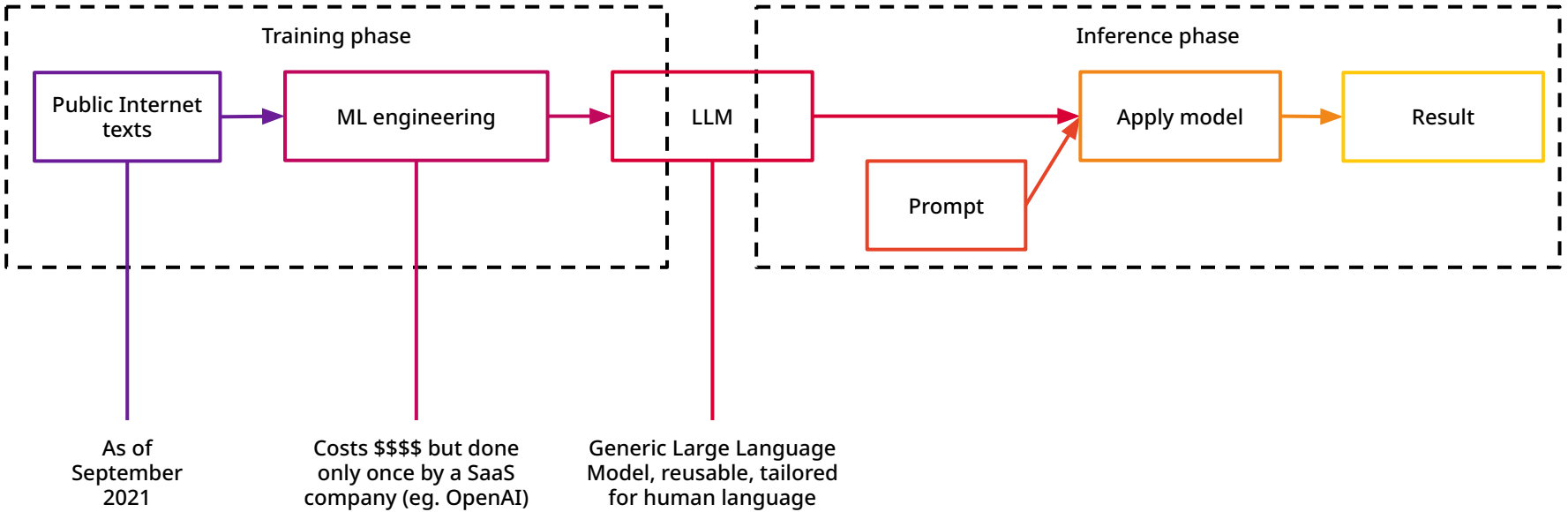


Prompting

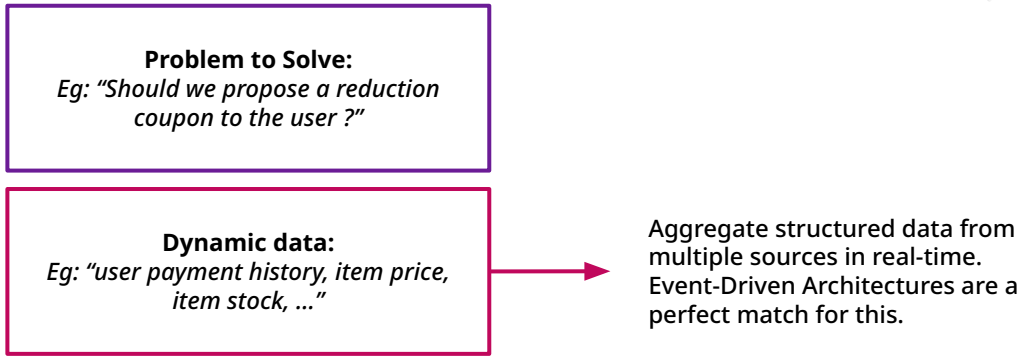
Using GenAI is just about building a prompt

- The problem to solve is not anymore in the model, it’s in the prompt.
- The quality of the description of the problem directly impacts the accuracy of the result.
- The LLM is static:
    - The live data must be included into the prompt
    - Information not present in the LLM training data must be included into the prompt
- The size of the prompt is limited

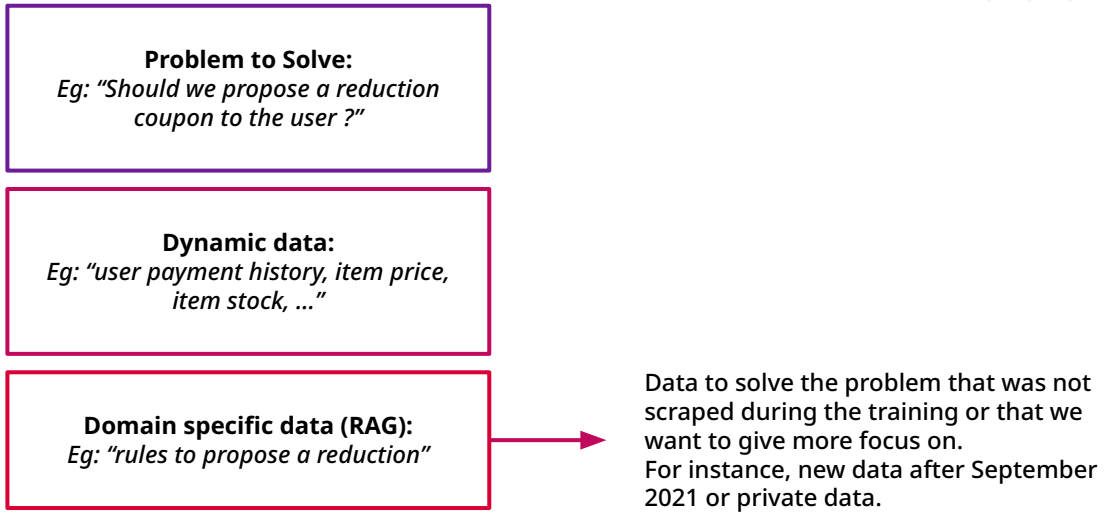
Anatomy of a prompt

Problem to Solve:
Eg: “Should we propose a reduction coupon to the user ?”

Anatomy of a prompt

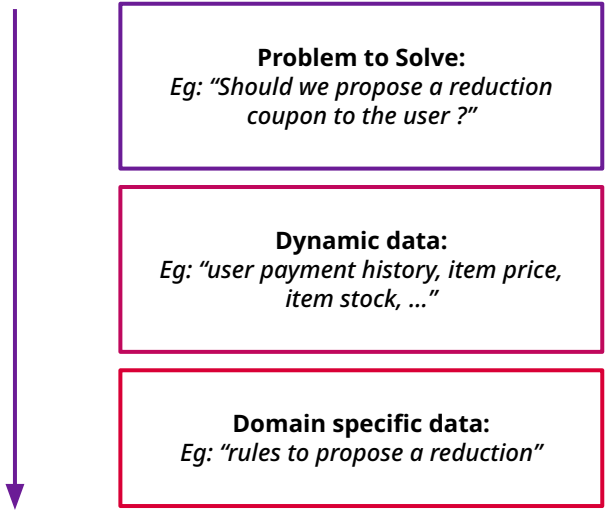


Anatomy of a prompt



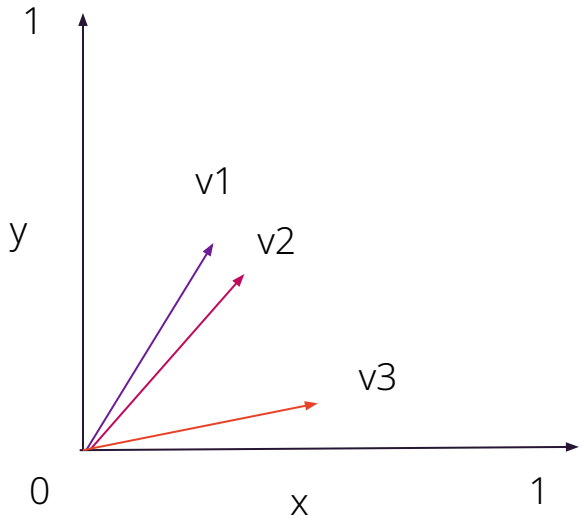
Anatomy of a prompt

Limited size.
For OpenAI's
gpt-3.5-turbo: 4097 tokens
(token ~= word)
For OpenAI's
gpt-3.5-turbo-16k: 16385
tokens



- Problem: the domain specific data is huge and doesn’t fit into the LLM prompt.

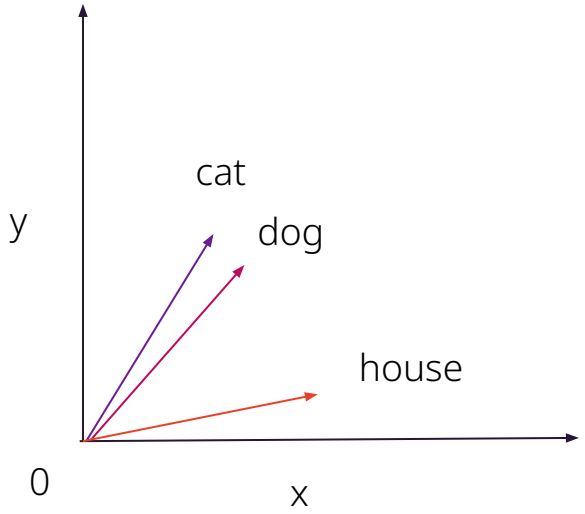
What is a vector/embedding ?



2 dimensions normalised vectors

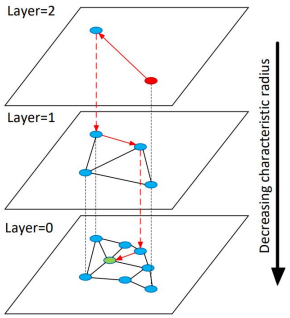
- An embedding model transforms a text into a vector called an embedding.
- The embedding can be N dimensions. For instance OpenAI's embeddings are 1536 dimensions.
- Similarity: v1 is more similar to v2 than v3. This is a simple mathematical formula.

What is a vector/embedding ?



- The vector captures the essence of a word or a block of text within its context.
- The dimensions are the result of the LLM training.

Vector search

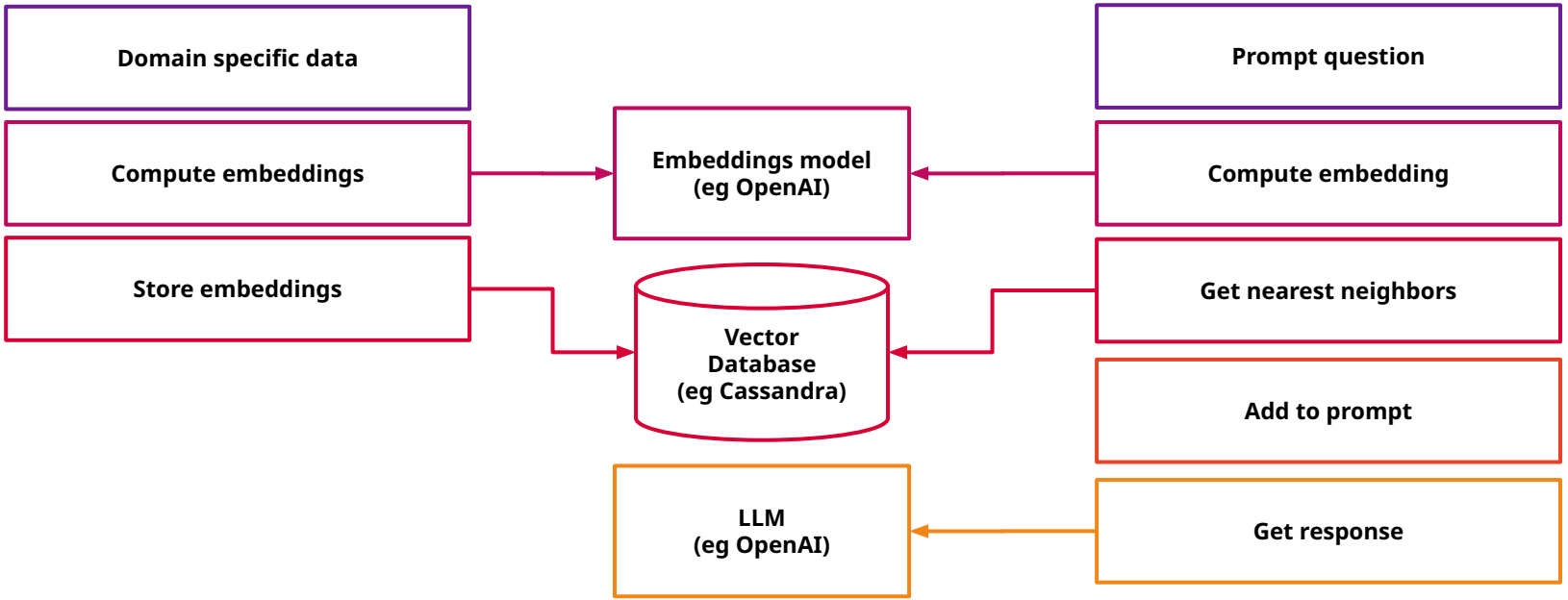


Vector stores / vector databases

- Embeddings storage (with or without metadata depending on the DB)
- Built-in algorithms for fast retrieval of so-called “nearest-neighbors” embeddings (eg. HNSW, JVector, ...)
- Vectors are a new type of data supported in established databases (DataStax AstraDB, Cassandra, ...) and new specialized databases (Pinecone, Milvius, ...)

- Let’s go back to the problem: our domain specific data is huge and doesn’t fit into the LLM prompt.

Retrieval Augmented Generation (RAG)



Generative AI features

Unstructured data

Extract text (eg. from PDF, HTML, ,MS doc)

Normalise (lower case, trim spaces)

Detect/filter/tag language

Split into chunks

Structured data

Compute fields

Drop fields

Flatten

Cast to types

Merge key and value fields

Unwrap key or value

AI operations

Compute embeddings

Store embeddings

Perform vector search

Re-rank (MMR)

Get chat completions

Source/Sink data

Streaming system (Kafka, Pulsar, ...)

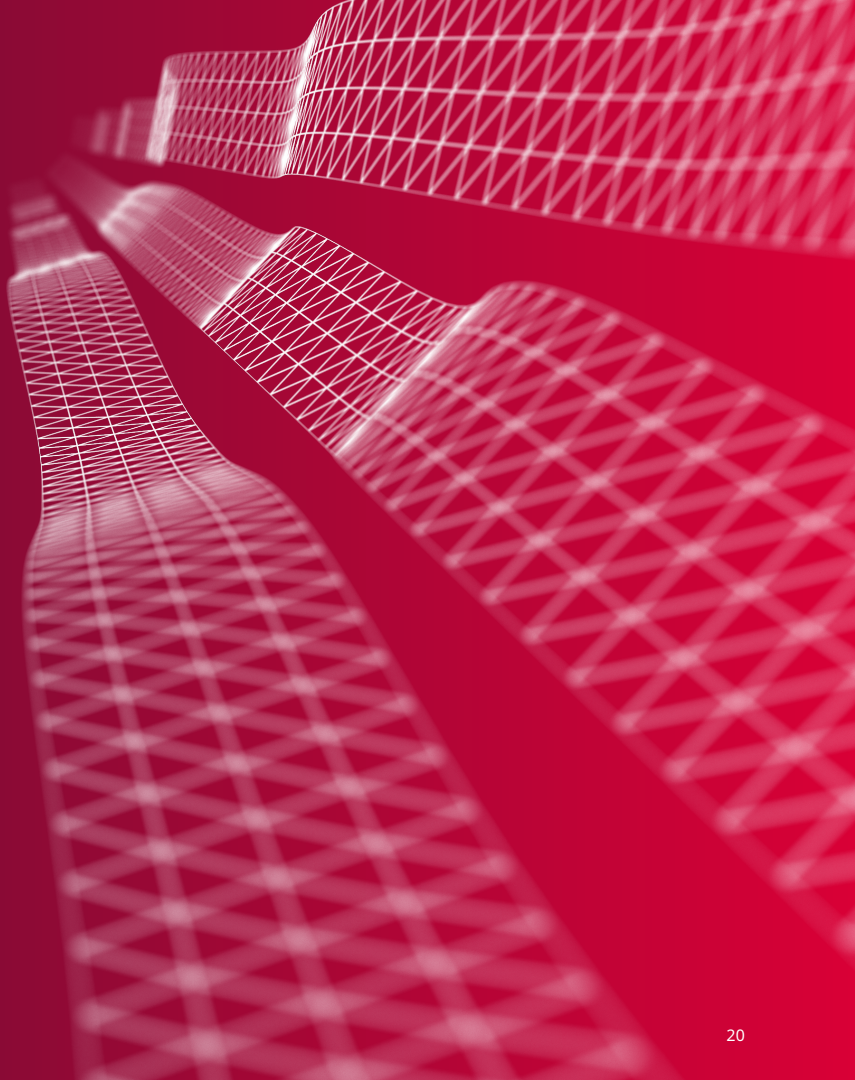
Web site crawling

Database

S3 / block storage

Micro-service

Here comes LangStream



LLMs

OpenAI

Vertex.ai

Hugging Face

AI libraries

LangChain

Apache Tika

LlamaIndex

python

LangStream

Vector stores

Pinecone

cassandra

Milvus

DATASTAX ASTRA DB

Connectors

snowflake

mongoDB.

MySQL

PostgreSQL

redis

cassandra

kafka Connect

Messaging

kafka

PULSAR

Kubernetes-native Kafka-Connect

Gunnar Morling

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An Ideation for Kubernetes-native Kafka Connect

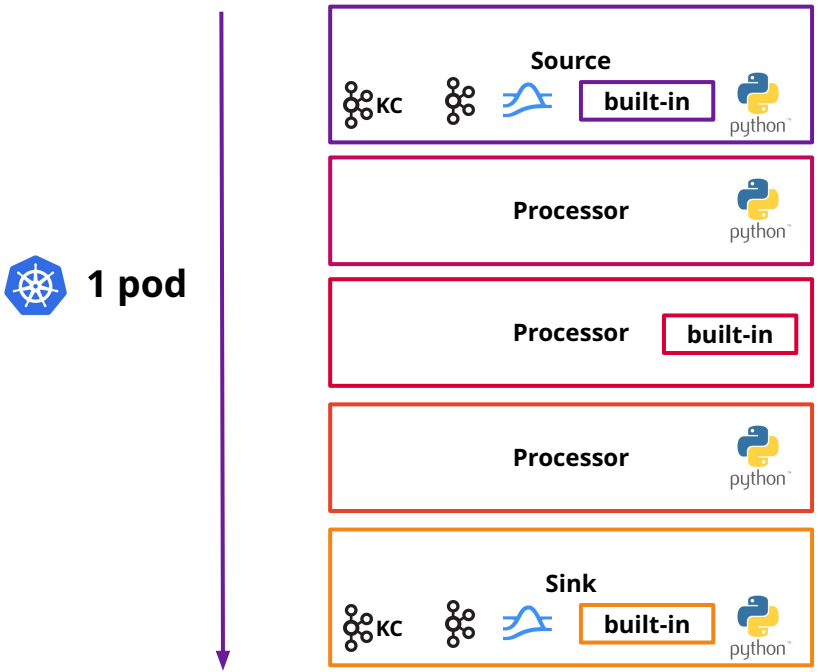
Posted at Sep 6, 2022

Kafka Connect, part of the Apache Kafka project, is a development framework and runtime for connectors which either ingest data into Kafka clusters (*source connectors*) or propagate data from Kafka into external systems (*sink connectors*). A diverse ecosystem of ready-made connectors has come to life on top of Kafka Connect, which lets you connect all kinds of data stores, APIs, and other systems to Kafka in a no-code approach.

With the continued move towards running software in the cloud and on Kubernetes in particular, it's just natural that many folks also try to run Kafka Connect on Kubernetes. On first thought, this should be simple enough: just take the Connect binary and some connector(s), put them into a container image, and schedule it for execution on Kubernetes. As so often, the devil is in the details though: should you use Connect's standalone or distributed mode? How can you control the lifecycle of specific connectors via the Kubernetes control plane? How to make sure different connectors don't compete unfairly on resources such as CPU, RAM, or network bandwidth? In the remainder of this blog post, I'd like to explore running Kafka Connect on Kubernetes, what some of the challenges are for doing so, and how Kafka Connect could potentially be reimagined to become more "Kubernetes-friendly" in the future.

Google Cloud Platform

Composable Agents



Sources:

- Kafka
- Pulsar
- Kafka-Connect
- Python custom
- Web crawler
- S3
- ...

Processors:

- Python custom
- Compute embeddings
- Chat completions
- Compute fields
- Drop fields
- Extract text
- Normalise text
- Detect language
- Split into chunks
- Query Vector DB
- Re-rank documents
- ...

Sinks:

- Kafka
- Pulsar
- Kafka-Connect
- Python custom
- Vector DB
- ...

Declarative low-code

```
topics:
 - name: "input-topic"
   creation-mode: create-if-not-exists
 - name: "output-topic"
   creation-mode: create-if-not-exists
 - name: "history-topic"
   creation-mode: create-if-not-exists
pipeline:
 - name: "convert-to-json"
   type: "document-to-json"
   input: "input-topic"
   configuration:
     text-field: "question"
 - name: "ai-chat-completions"
   type: "ai-chat-completions"
   output: "history-topic"
   configuration:
     model: "${secrets.open-ai.chat-completions-model}"
     completion-field: "value.answer"
     log-field: "value.prompt"
     stream-to-topic: "output-topic"
     stream-response-completion-field: "value"
     min-chunks-per-message: 10
     messages:
       - role: user
         content: "You are a helpful assistant. Below you can find a question from the user.
Please try to help them the best way you can.\n\n{{% value.question}}"
```

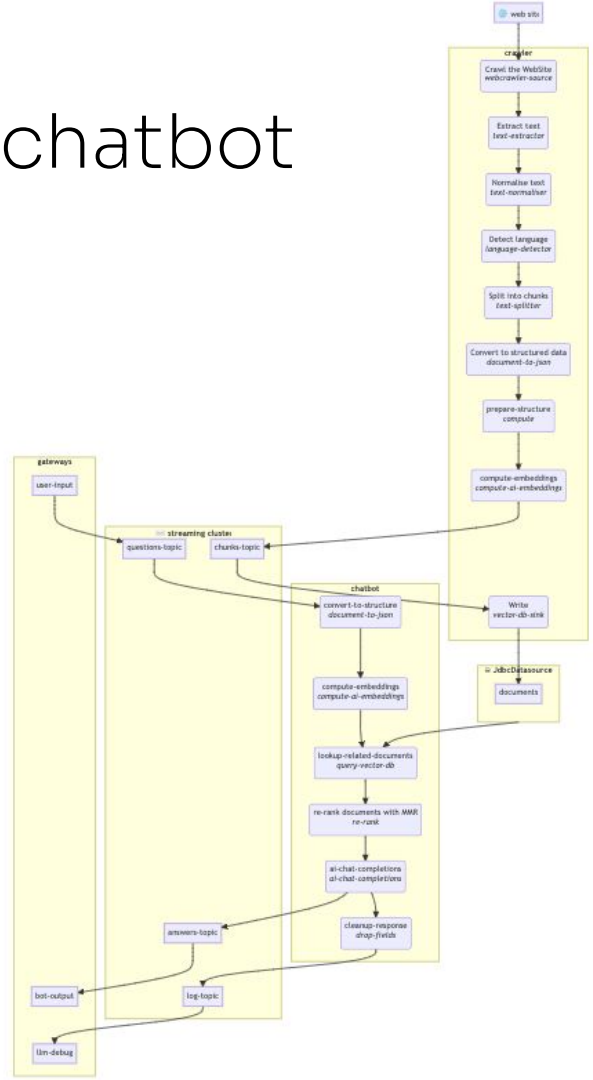
Example application:

- Reads from input-topic
- Asks OpenAI for chat completion
- Writes streamed answer chunks to output-topic
- Writes full answers to history-topic

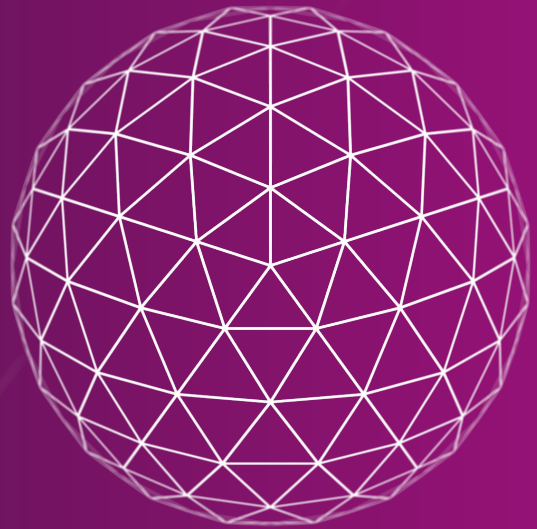
Example application: RAG chatbot

Pipeline 1: Crawl Web site, chunk and store embeddings.
Pipeline 2: Get questions from Kafka, retrieve relevant chunks to answer the question, answer the question with OpenAI chat completions and output results to Kafka.
Gateway: provides Web socket endpoints over the Kafka topics.

Flow chart



Demo



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Thank You

https://langstream.ai

https://github.com/LangStream/langstream

https://astra.datastax.com

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