GenAI with Langchain4j and Ollama

Helsinki Java meetup

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About me

Senior software engineer

Pre-owned project at Zalando Helsinki

C → Java → Kotlin → Go

Author of pgx-outbox library

Previous experience with AI

ChatGPT, GitHub Copilot, Claude

Pet project with OpenAI API calls

Ollama

Like Docker but for LLMs

Local inference, minimal setup

Written in Go, uses *llama.cpp*

127K stars at GitHub

Stargazers

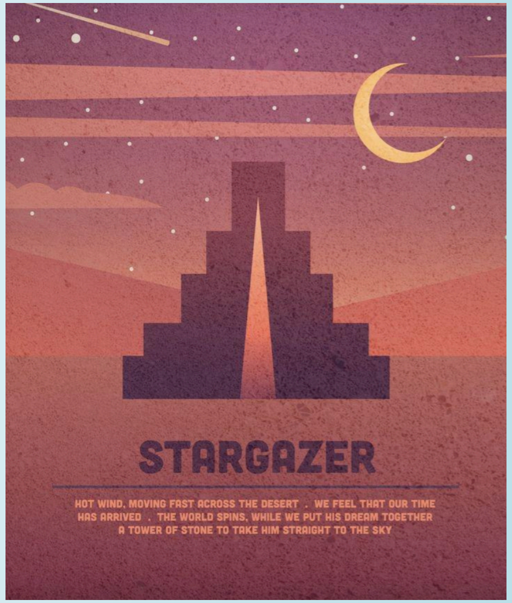
OpenJDK 20K

Kotlin 50K

Spring 57K, Boot 76K

Kubernetes 113K

Golang 126K


STARGAZER
HOT WIND, MOVING FAST ACROSS THE DESERT . WE FEEL THAT OUR TIME HAS ARRIVED . THE WORLD SPINS, WHILE WE PUT HIS DREAM TOGETHER A TOWER OF STONE TO TAKE HIM STRAIGHT TO THE SKY

Ollama demo

```
> ollama pull llama3.2

> ollama run llama3.2

> ollama ps

>>> Please, briefly compare Java and Go

>>> /bye
```

Supported models

Llama by Meta

Phi by Microsoft

Mistral

Gemma by Google

Qwen by Alibaba

DeepSeek

Ollama APIs

Ollama-style: */api/generate*

```
curl -X POST http://localhost:11434/api/generate \
     -H "Content-Type: application/json" \
     -d '{
       "model": "llama3.2",
       "prompt": "Please, briefly compare Java and Go",
       "stream": false
     }'
```

OpenAI-compatible: */v1/chat/completions*

Talking to LLMs

Langchain4j

Spring AI

Official SDKs: OpenAI, AWS, etc

Langchain4j + Ollama

```java
import dev.langchain4j.model.chat.ChatLanguageModel;
import dev.langchain4j.model.ollama.OllamaChatModel;

ChatLanguageModel model = OllamaChatModel.builder()
        .baseUrl("http://localhost:11434")
        .modelName("llama3.2:1b")
        .build();

var answer = model.chat("Why Java is still awesome in 2025?");

log.info("Response from LLM -> {}", answer);
```

Chat Language Model

```java
package dev.langchain4j.model.chat;

public interface ChatLanguageModel {

    // main API to interact with a chat model
    default ChatResponse chat(ChatRequest chatRequest)

    default String chat(String userMessage)
```

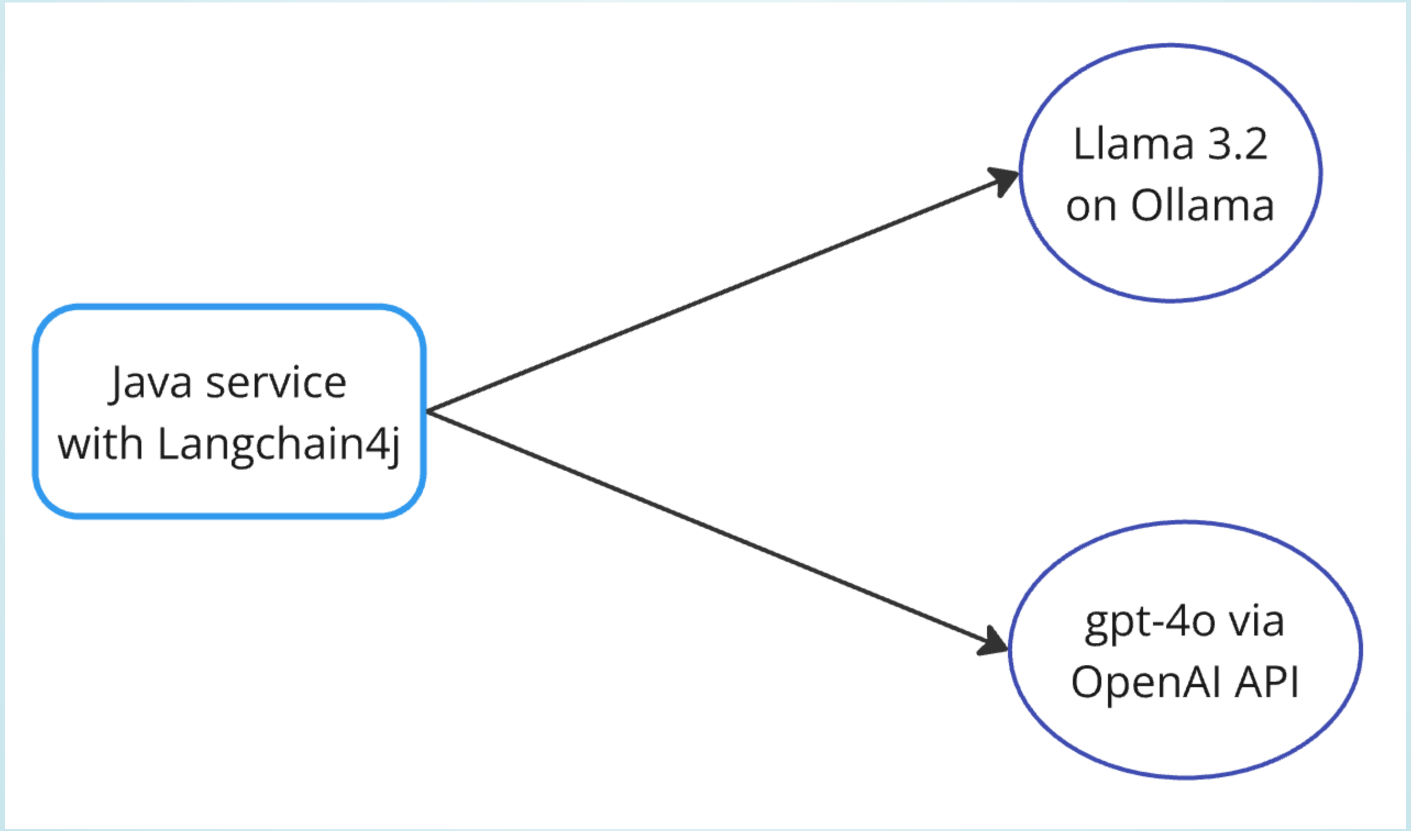
Langchain4j + OpenAI

```java
import dev.langchain4j.model.openai.OpenAiChatModel;

var model = OpenAiChatModel.builder()
        .apiKey(System.getenv("OPENAI_API_KEY"))
        .modelName("gpt-4o")
        .build();

var answer = model.chat("Why Java is still awesome in 2025?");
```

Langchain4j demo



Streaming model

```
var model = OllamaStreamingChatModel.builder().baseUrl("http://local

model.chat("Provide a long explanation why Java is awesome",
        new StreamingChatResponseHandler() {
            public void onPartialResponse(String token) {
                out.print(token);
            }

            public void onError(Throwable error) {
                // handle error
            }

            public void onCompleteResponse(ChatResponse response) {
                out.println();
```

Streaming pitfalls

Langchain4j is still 1.0.0-beta1

model.chat() blocks for OpenAI

model.chat() is async call for Ollama

Streaming demo

Using *CompletableFuture*

and *Thread.startVirtualThread*

Server-Sent Events (SSE)

Chat

```java
var scanner = new Scanner(System.in);
var conversation = synchronizedList(new ArrayList<ChatMessage>());

while (true) {
    var userInput = scanner.nextLine();
    conversation.add(UserMessage.from(userInput));

    model.generate(conversation,
        new StreamingResponseHandler<>() {
            public void onComplete(Response<AiMessage> response) {
                conversation.add(response.content());
                out.println("You: ");
            }
    });
}
```

Chat demo

Conversation history in each request

Watch out for *context length / window*

(128K tokens for Llama 3.2)

Image recognition

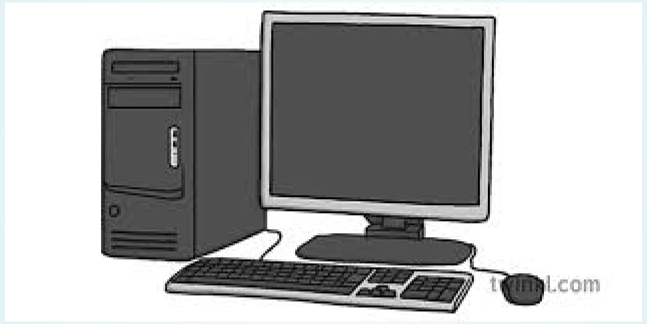
```java
import dev.langchain4j.data.message.*;


var userMessage = UserMessage.from(
    TextContent.from("What do you see?"),
    ImageContent.from(
        readImageInBase64("/computer.jpeg"),
        "image/jpeg"
    )
);

var response = model.chat(userMessage);
```

moondream is the tiniest model

Image recognition demo



```
The image features a desktop computer setup with a monitor,
keyboard, and mouse. The monitor is placed on the right side
of the desk, while the keyboard is situated in front of it.
```

Augmented Generation (AG)

"prompt engineering" at server side

Embeddings

numerical vectors that represent

the semantic meaning of data

in a high-dimensional space

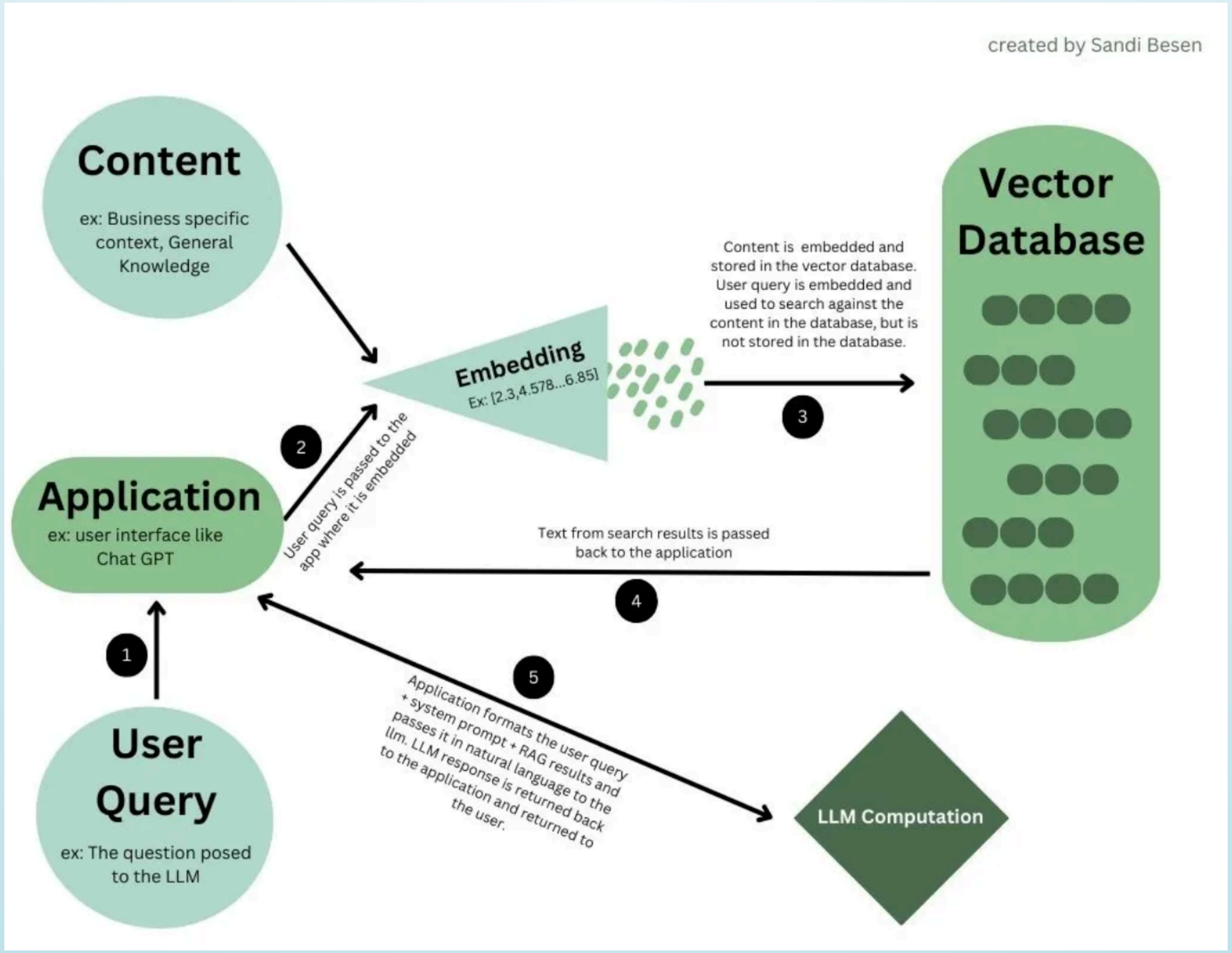
Embeddings

```
import dev.langchain4j.data.embedding.Embedding;
import dev.langchain4j.store.embedding.CosineSimilarity;

// model is nomic-embed-text
Embedding cat = model.embed("Cat is domesticated animal").content();
Embedding ollama = model.embed("Ollama runs LLMs locally").content()

// float[768] vector; normalized hence: [-1, 1]

double similarity = CosineSimilarity.between(cat, ollama);
log.info("Cosine similarity between embeddings is: {}", similarity);
```


created by Sandi Besen
Content
ex: Business specific context, General Knowledge
Embedding
Ex: [2.3,4.578...6.85]
Vector Database
Content is embedded and stored in the vector database. User query is embedded and used to search against the content in the database, but is not stored in the database.
3
2
User query is passed to the app where it is embedded
Application
ex: user interface like Chat GPT
Text from search results is passed back to the application
4
1
5
Application formats the user query + system prompt + RAG results and passes it in natural language to the llm. LLM response is returned back to the application and returned to the user.
User Query
ex: The question posed to the LLM
LLM Computation

Retrieval Augmented Generation (RAG)

"prompt engineering" at server side

using data retrieved from a (vector) database

Vector database

specialized storage for embeddings

and efficient similarity-searching

Vector databases

prototyping: *FAISS* and *ChromaDB*

managed: *Pinecone* and *Weaviate*

large-scale: *Milvus* and *Qdrant*

RAG demo

Embeddings model: *nomic-embed-text*

Embeddings store: Postgres with ***pgvector*** extension

LLM: *Llama* 3.2

Credits

Ignacio López Luna:

ilopezluna/generative-ai-with-testcontainers

Manuel de la Peña:

mdelapenya/generative-ai-with-testcontainers

Testcontainers

Favorite: Postgres, Localstack

Used: ToxiProxy, Redis, Elasticsearch

Ollama can be run in Testcontainers!

Thank you!

github.com/nikolayk812/genai-java