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Note

Spring AI

Generative Artificial Intelligence con Java

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Corso avanzato per Venis S.p.A, Venezia, Italia

Novembre 2025

Note

Retrieval Augmented Generation

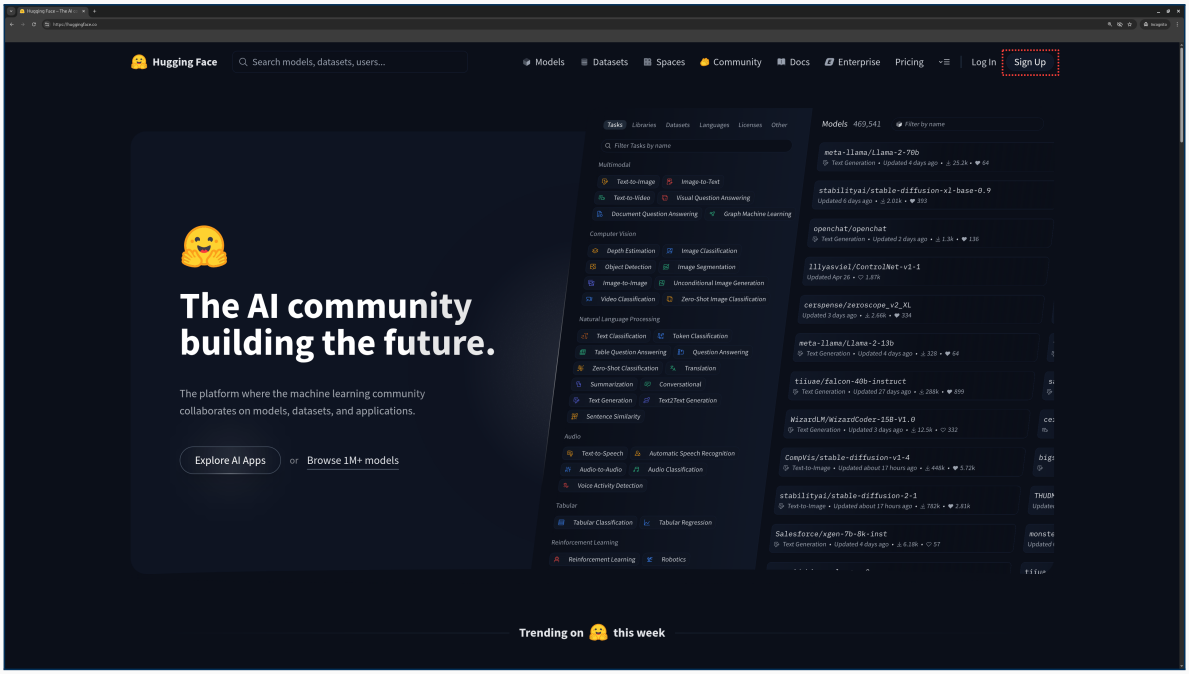
Parte 1

Note

- *Chatbot* Ollama-CV e Gemini-Venis
- Approccio *naive* (informazione testuale estratta tramite GENAI-*assisted web scraping/summarization*)
  1. Iscrizione al portale HuggingFace e creazione *access token*
  2. Verifica e modifica variabili di ambiente
  3. Creazione configurazione ambiente Docker Qdrant
  4. Modifica dipendenze di progetto
  5. Modifica configurazione applicativo
  6. Creazione *prompt templates* per strategia RAG
  7. Configurazione *vector store* per Ollama e Gemini *embeddings*
  8. Creazione *component* per popolamento *vector store* (dati Venis e CV)
  9. Creazione interfaccia e implementazione del servizio
  10. Modifica controllore MVC
  11. *Test* delle funzionalità con Postman/Insomnia

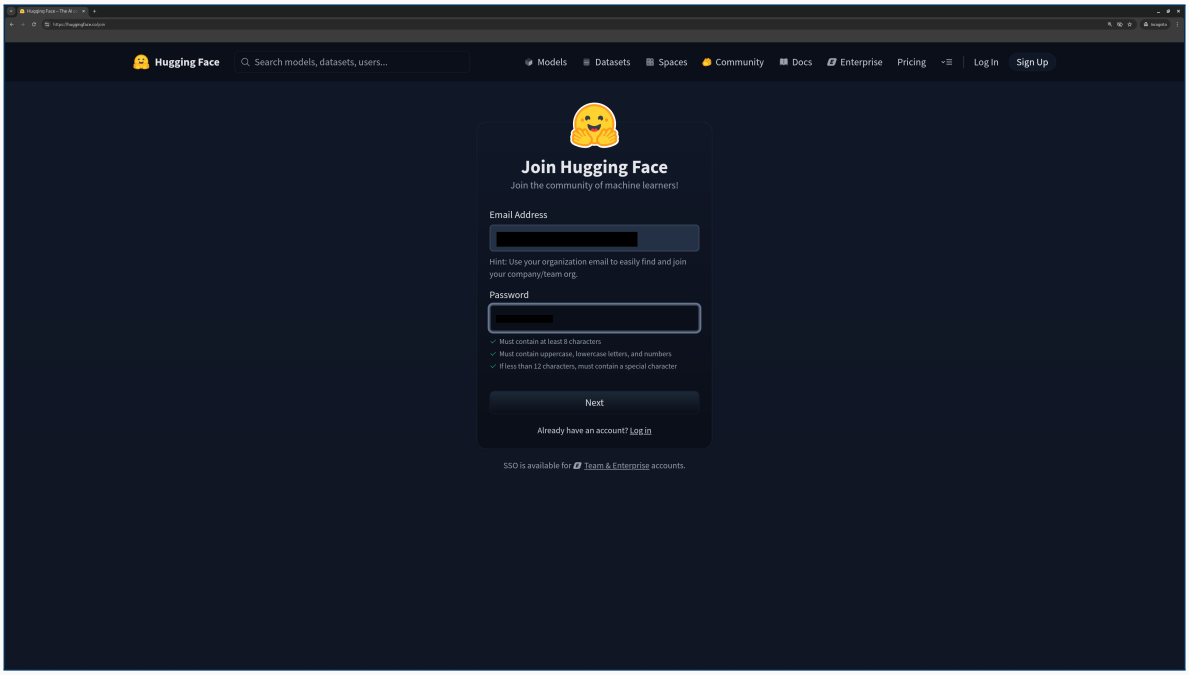
Note

1. Accedere al portale `https://huggingface.co/` e cliccare il pulsante `Sign up`



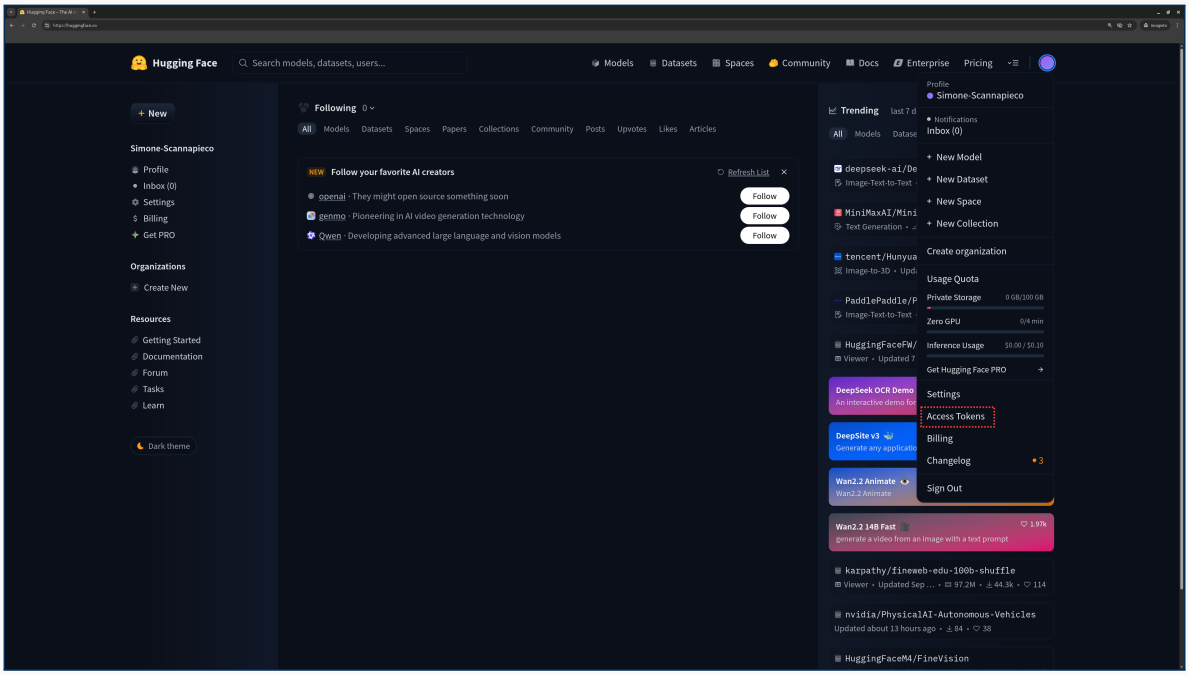
Note

2 Creare una nuova utenza



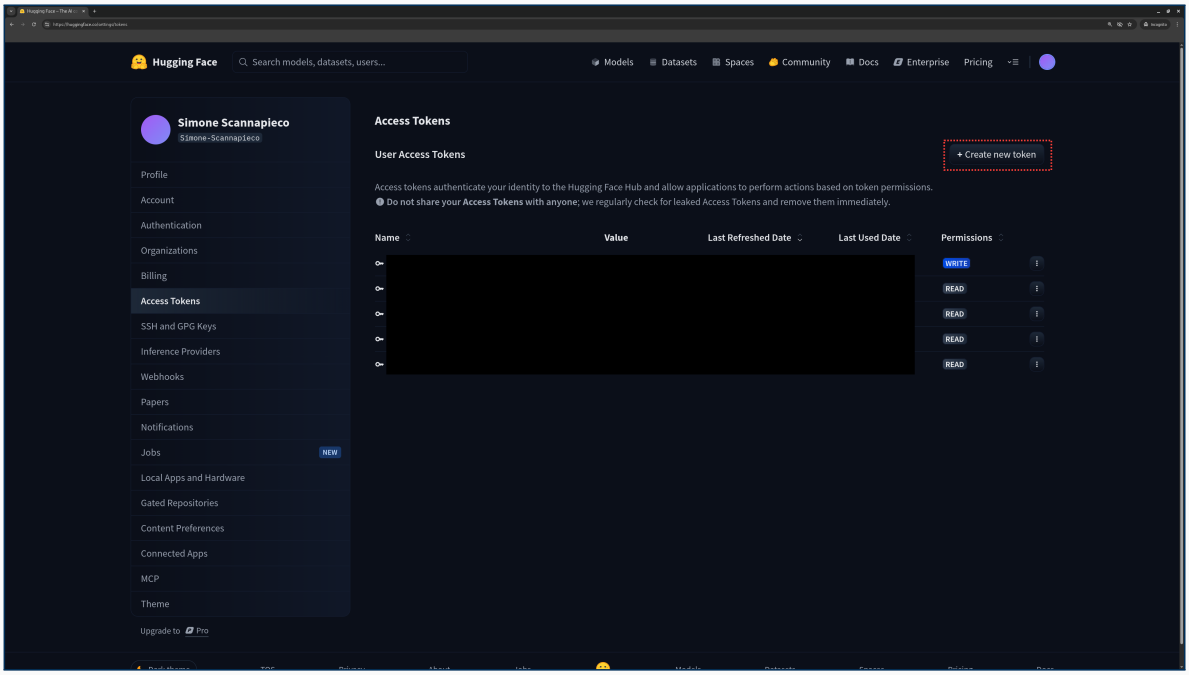
Note

3. Accedere al portale e selezionare `Access Tokens` nel menu in alto a destra



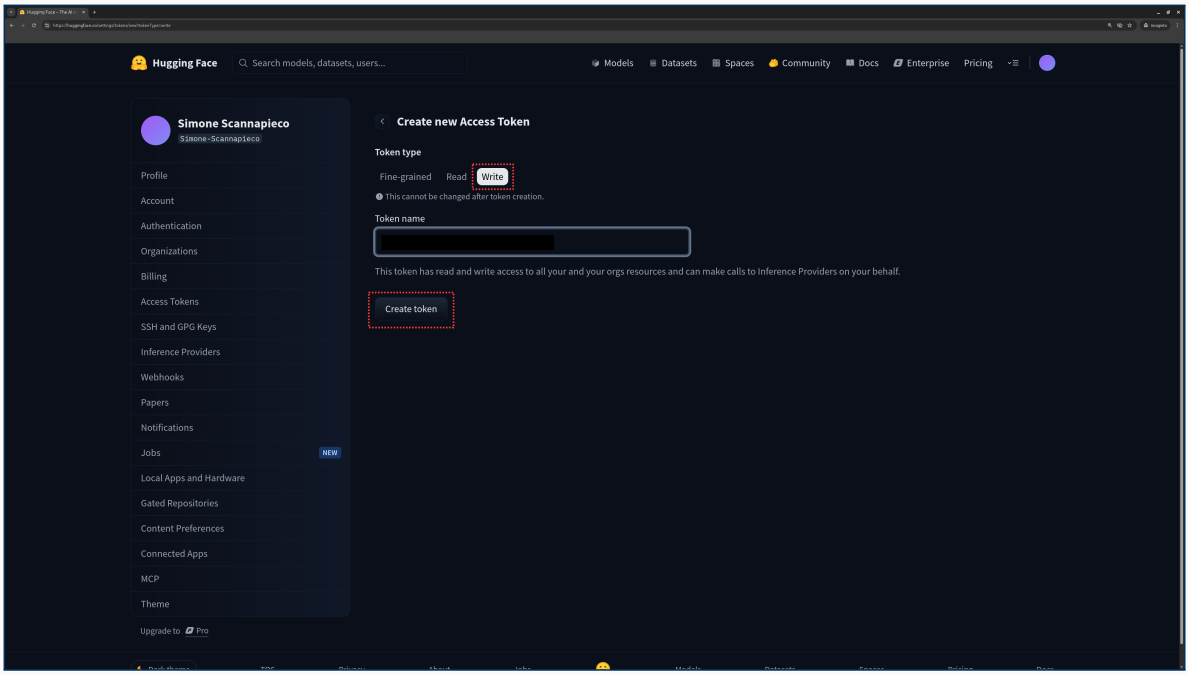
Note

4 Premere sul pulsante `Create new token`



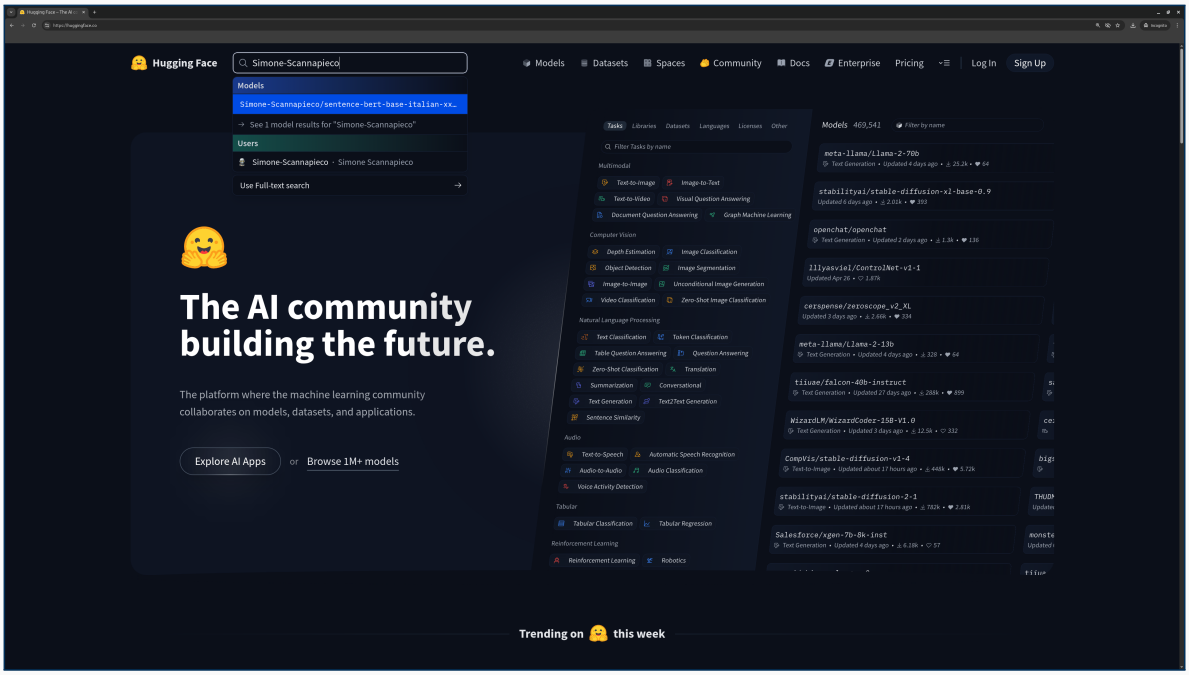
Note

5 Selezionare *token* di tipo `Write`, denominare il *token* e premere `Create token`



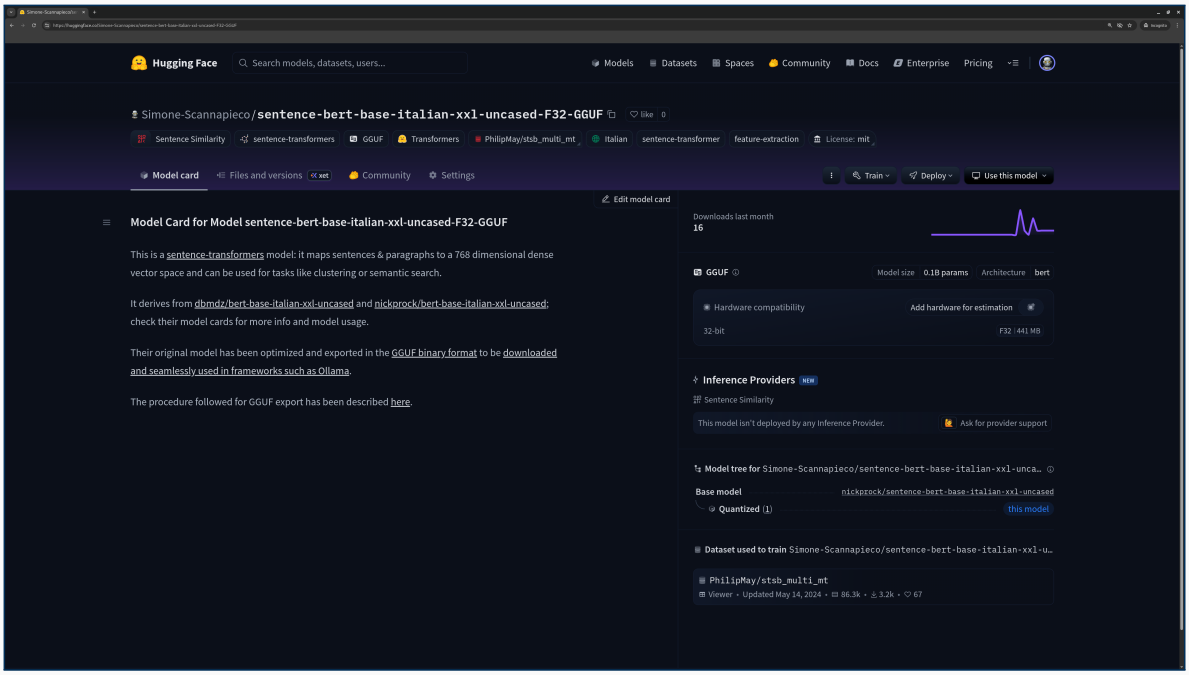
Note

6 Cercare il modello di *embedding*, leggendone la *card*



Note

6 Cercare il modello di *embedding*, leggendone la *card*



Note

File `launch.json`

```
{
    // Use IntelliSense to learn about possible attributes.
    // Hover to view descriptions of existing attributes.
    // For more information, visit: https://go.microsoft.com/fwlink/?linkid=830387
    "version": "0.2.0",
    "configurations": [
        {
            "type": "java",
            "name": "Launch Current File",
            "request": "launch",
            "mainClass": "${file}"
        },
        {
            "type": "java",
            "name": "DemoApplication",
            "request": "launch",
            "mainClass": "it.venis.ai.spring.demo.DemoApplication",
            "projectName": "demo",
            "env": {
                "GOOGLE_AI_API_KEY": "...",
                "HUGGING_FACE_HUB_TOKEN": "..."
            }
        }
    ]
}
```


Note

File `settings.json`

```
{
    "java.compile.nullAnalysis.mode": "disabled",
    "java.configuration.updateBuildConfiguration": "interactive",
    "java.test.config": {
        "env": {
            "GOOGLE_AI_API_KEY": "...",
            "HUGGING_FACE_HUB_TOKEN": "..."
        }
    }
}
```


Note

File `docker-compose.yml`

```yaml
services:
  ...
  spring-ai-vector-store:
    image: qdrant/qdrant:${QDRANT_VERSION:-latest}
    hostname: spring-ai-vector-store
    container_name: spring_ai_vector_store
    ports:
      - ${QDRANT_HTTP_PORT:-6333}:6333
      - ${QDRANT_GRCP_PORT:-6334}:6334
    volumes:
      - spring_ai_vector_store:/qdrant/storage
    restart: unless-stopped

volumes:
  ...
  spring_ai_vector_store:
    name: spring_ai_vector_store
```


Note

File `spring-ai.env`

```
...
# qdrant configuration
QDRANT_VERSION=v1.13.0                                    # default: latest
QDRANT_HTTP_PORT=6333                                       # default: 6333
QDRANT_GRCP_PORT=6334                                       # default: 6334
```


Note

Dipendenze di sistema aggiuntive

```
...
<dependency>
        <groupId>org.springframework.ai</groupId>
        <artifactId>spring-ai-rag</artifactId>
</dependency>
<dependency>
        <groupId>org.springframework.ai</groupId>
        <artifactId>spring-ai-advisors-vector-store</artifactId>
</dependency>
<dependency>
        <groupId>org.springframework.ai</groupId>
        <artifactId>spring-ai-starter-vector-store-qdrant</artifactId>
</dependency>
...
```


Note

Configurazione applicativo

```yaml
spring:
    ...
    autoconfigure:
        exclude:
        - org.springframework.ai.vectorstore.qdrant.autoconfigure.QdrantVectorStoreAutoConfiguration
        # We must disable Vector Store auto-configuration because of two different EmbeddingModel beans
        # (OpenAI-Gemini and Ollama). The goal is to have two different vector collections, one for each
        # family of LLM.
    ai:
        ollama:
            ...
            embedding:
                model: hf.co/Simone-Scannapieco/sentence-bert-base-italian-xxl-uncased-F32-GGUF
        openai:
            ...
            embedding:
                options:
                    model: gemini-embedding-001
        vectorstore:
            qdrant:
                initialize-schema: true
                host: 172.17.0.1
                port: 6334
    ...
```


Note

File erase_llm_volumes.sh

```
#!/bin/bash

volume_name=spring_ai_llm

docker volume rm $volume_name
```

File erase_vector_store_volumes.sh

```
#!/bin/bash

volume_name=spring_ai_vector_store

docker volume rm $volume_name
```


Note

File `get-rag-data-system-ita-prompt.st`

```
Sei un assistente AI in grado di rispondere alle domande dell'utente solo in base
al contesto fornito dalla sezione DOCUMENTI.
Se la risposta non è presente nella sezione DOCUMENTI, informa l'utente di non
sapere la risposta.

DOCUMENTI: <documenti>
```

File `get-rag-data-system-eng-prompt.st`

```
You are an helpful assistant, answering questions based on the given context in
the DOCUMENTS section and no prior knowledge.
If the answer is not in the DOCUMENTS section, then reply that you cannot answer
to the question.

DOCUMENTS: <documenti>
```


Note

Configurazione Vector Store - I

```
package it.venis.ai.spring.demo.config;

import org.springframework.ai.embedding.EmbeddingModel;
import org.springframework.ai.openai.OpenAiEmbeddingModel;
import org.springframework.ai.vectorstore.VectorStore;
import org.springframework.ai.vectorstore.qdrant.QdrantVectorStore;
import org.springframework.beans.factory.annotation.Autowired;
import org.springframework.beans.factory.annotation.Qualifier;
import org.springframework.beans.factory.annotation.Value;
import org.springframework.context.annotation.Bean;
import org.springframework.context.annotation.Configuration;

import io.qdrant.client.QdrantClient;
import io.qdrant.client.QdrantGrpcClient;

@Configuration
public class RAGConfig {

    @Autowired
    public OpenAiEmbeddingModel openAiEmbeddingModel;

    @Autowired
    public EmbeddingModel ollamaEmbeddingModel;

    @Value("${spring.ai.vectorstore.qdrant.host:#{null}}")
    private String qdrantHost;
    @Value("${spring.ai.vectorstore.qdrant.port:#{null}}")
    private String qdrantPort;
    @Value("${spring.ai.vectorstore.qdrant.use-tls:#{null}}")
    private String useTls;

    ...
```


Note

Configurazione Vector Store - II

```
...
@Bean
public QdrantClient qdrantClient() {
    QdrantGrpcClient.Builder grpcClientBuilder = QdrantGrpcClient.newBuilder(
            qdrantHost == null ? "localhost" : qdrantHost,
            qdrantPort == null ? 6334 : Integer.valueOf(qdrantPort),
            useTls == null ? false : Boolean.valueOf(useTls));
    return new QdrantClient(grpcClientBuilder.build());
}

@Value("${spring.ai.vectorstore.qdrant.collection-name.gemini:#{null}}")
private String qdrantCollectionNameGemini;
@Value("${spring.ai.vectorstore.qdrant.collection-name.ollama:#{null}}")
private String qdrantCollectionNameOllama;
@Value("${spring.ai.vectorstore.qdrant.initialize-schema:#{null}}")
private String qdrantInitializeSchema;

@Bean
public VectorStore geminiVectorStore(QdrantClient qdrantClient,
        @Qualifier("openAiEmbeddingModel") EmbeddingModel geminiEmbeddingModel) {
    return QdrantVectorStore.builder(qdrantClient, geminiEmbeddingModel)
        .collectionName(qdrantCollectionNameGemini == null ? "vector_store_gemini" : qdrantCollectionNameGemini)
        .initializeSchema(qdrantInitializeSchema == null ? false : Boolean.valueOf(qdrantInitializeSchema))
        .build();
}

@Bean
public VectorStore ollamaVectorStore(QdrantClient qdrantClient,
        @Qualifier("ollamaEmbeddingModel") EmbeddingModel ollamaEmbeddingModel) {
    return QdrantVectorStore.builder(qdrantClient, ollamaEmbeddingModel)
        .collectionName(qdrantCollectionNameOllama == null ? "vector_store_ollama" : qdrantCollectionNameOllama)
        .initializeSchema(qdrantInitializeSchema == null ? false : Boolean.valueOf(qdrantInitializeSchema))
        .build();
}}
```


Note

Componente popolamento Qdrant - I

```
package it.venis.ai.spring.demo.rag;

...

@Component
public class TextDataLoader {

    private final VectorStore geminiVectorStore;
    private final VectorStore ollamaVectorStore;

    public TextDataLoader(@Qualifier("geminiVectorStore") VectorStore geminiVectorStore,
            @Qualifier("ollamaVectorStore") VectorStore ollamaVectorStore) {
        this.geminiVectorStore = geminiVectorStore;
        this.ollamaVectorStore = ollamaVectorStore;

    }

    @PostConstruct
    public void loadVenisInfoIntoVectorStore() {
        List<String> venisInfo = List.of(...);
        SearchRequest searchRequest = SearchRequest.builder()
                .query("Check")
                .similarityThresholdAll()
                .build();
        List<Document> similarDocs = geminiVectorStore.similaritySearch(searchRequest);
        if (similarDocs.size() == 0) {
            List<Document> documents =
            venisInfo.stream().map(Document::new).collect(Collectors.toList());
            this.geminiVectorStore.add(documents);
        }

    }
    ...
```


Note

Componente popolamento Qdrant - II

```
    ...
    @PostConstruct
    public void loadSSCVInfoIntoVectorStore() {
        List<String> ssCVInfo = List.of(...);
        SearchRequest searchRequest = SearchRequest.builder()
                .query("Check")
                .similarityThresholdAll()
                .build();
        List<Document> similarDocs = ollamaVectorStore.similaritySearch(searchRequest);
        if (similarDocs.size() == 0) {
            List<Document> documents = ssCVInfo.stream().map(Document::new).collect(Collectors.toList());
            this.ollamaVectorStore.add(documents);
        }

    }

}
```


Note

Interfaccia servizio

```
package it.venis.ai.spring.demo.services;

import it.venis.ai.spring.demo.model.Answer;
import it.venis.ai.spring.demo.model.QuestionRequest;

public interface RAGService {

    public Answer getGeminiRAGTextToVectorStoreAnswer(QuestionRequest request);

    public Answer getOllamaRAGTextToVectorStoreAnswer(QuestionRequest request);

}
```


Note

Implementazione servizio - I

```
package it.venis.ai.spring.demo.services;

...

@Service
@Configuration
public class RAGServiceImpl implements RAGService {

    private final ChatClient geminiChatClient;
    private final ChatClient ollamaChatClient;
    private final ChatClient ollamaMemoryChatClient;
    private VectorStore geminiVectorStore;
    private VectorStore ollamaVectorStore;

    public RAGServiceImpl(
            @Qualifier("geminiChatClient") ChatClient geminiChatClient,
            @Qualifier("ollamaChatClient") ChatClient ollamaChatClient,
            @Qualifier("ollamaMemoryChatClient") ChatClient ollamaMemoryChatClient,
            @Qualifier("geminiVectorStore") VectorStore geminiVectorStore,
            @Qualifier("ollamaVectorStore") VectorStore ollamaVectorStore) {

        this.geminiChatClient = geminiChatClient;
        this.ollamaChatClient = ollamaChatClient;
        this.ollamaMemoryChatClient = ollamaMemoryChatClient;
        this.geminiVectorStore = geminiVectorStore;
        this.ollamaVectorStore = ollamaVectorStore;

    }

    ...
```


Note

Implementazione servizio - II

```
...
@Value("classpath:templates/get-rag-data-system-eng-prompt.st")
private Resource ragDataSystemEngPrompt;

@Override
public Answer getGeminiRAGTextToVectorStoreAnswer(QuestionRequest request) {

    SearchRequest searchRequest = SearchRequest.builder()
            .query(request.body().question())
            .topK(4)
            .similarityThreshold(.2)
            .build();

    List<Document> similarDocs = geminiVectorStore.similaritySearch(searchRequest);

    String similarDocsString = similarDocs.stream()
            .map(Document::getText)
            .collect(Collectors.joining(System.lineSeparator()));

    return new Answer(this.geminiChatClient.prompt()
            .system(s -> s.text(this.ragDataSystemEngPrompt)
                    .params(Map.of("documenti", similarDocsString)))
            .user(request.body().question())
            .templateRenderer(StTemplateRenderer.builder().startDelimiterToken('<')
                    .endDelimiterToken('>')
                    .build())
            .call()
            .content());
}

...
```


Note

Implementazione servizio - III

```
    ...
    @Value("classpath:templates/get-rag-data-system-ita-prompt.st")
    private Resource ragDataSystemItaPrompt;

    @Override
    public Answer getOllamaRAGTextToVectorStoreAnswer(QuestionRequest request) {

        SearchRequest searchRequest = SearchRequest.builder()
                .query(request.body().question())
                .topK(4)
                .similarityThreshold(.3)
                .build();

        List<Document> similarDocs = ollamaVectorStore.similaritySearch(searchRequest);

        String similarDocsString = similarDocs.stream()
                .map(Document::getText)
                .collect(Collectors.joining(System.lineSeparator()));

        return new Answer(this.ollamaMemoryChatClient.prompt()
                .advisors(advisorSpec -> advisorSpec.param(ChatMemory.CONVERSATION_ID, request.username()))
                .system(s -> s.text(this.ragDataSystemItaPrompt)
                        .params(Map.of("documenti", similarDocsString)))
                .user(request.body().question())
                .templateRenderer(StTemplateRenderer.builder().startDelimiterToken('<')
                        .endDelimiterToken('>')
                        .build())
                .call()
                .content());
    }

}
```

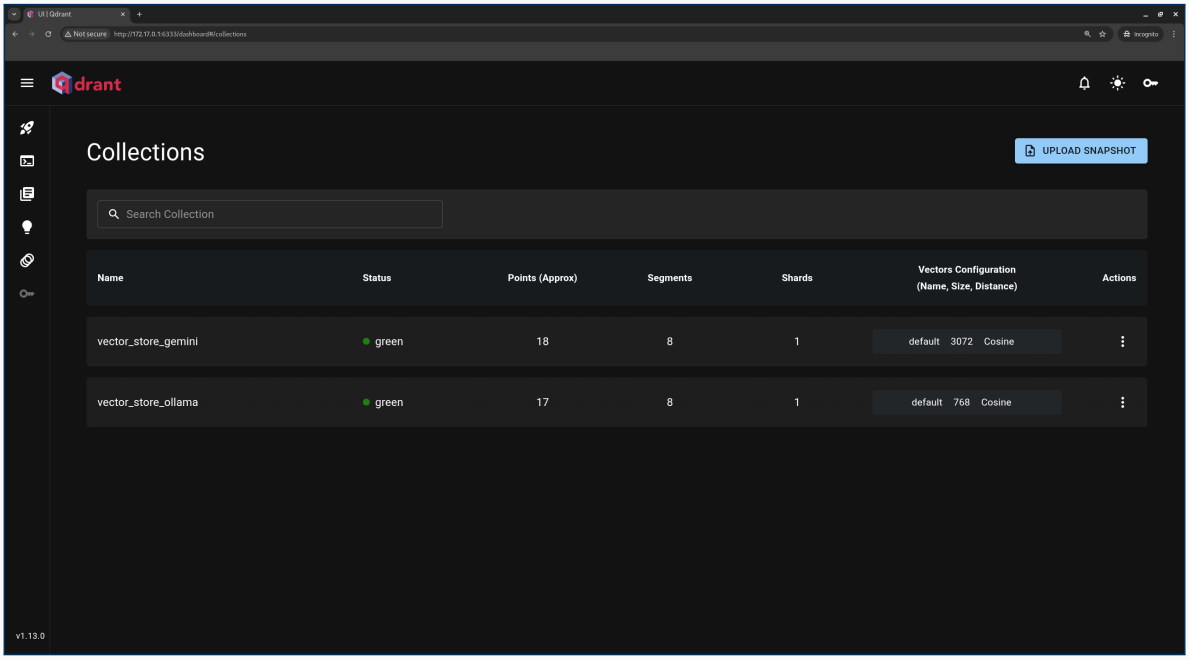

Note

Implementazione controllore REST

```
package it.venis.ai.spring.demo.controllers;

...

@RestController
public class QuestionController {

    private final QuestionService service;
    private final RAGService ragService;

    public QuestionController(QuestionService service, RAGService ragService) {
        this.service = service;
        this.ragService = ragService;
    }

    ...

    @PostMapping("/gemini/ask/rag/text-to-vs/venis")
    public Answer getGeminiRAGTextToVectorStoreAnswer(@RequestBody QuestionRequest request) {
        return this.ragService.getGeminiRAGTextToVectorStoreAnswer(request);
    }

    @PostMapping("/ollama/ask/rag/text-to-vs/cv")
    public Answer getOllamaRAGTextToVectorStoreAnswer(@RequestBody QuestionRequest request) {
        return this.ragService.getOllamaRAGTextToVectorStoreAnswer(request);
    }

}
```


Note

⚠ Verificare la *dashboard* Qdrant (`http://172.17.0.1:6333/dashboard`)



Note

Codice
Branch di riferimento

https://github.com/simonescannapieco/spring-ai-advanced-dgroove-venis-code.git

Branch: 7-spring-ai-gemini-ollama-rag-text-to-vector-store

Note