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SPRING AI

GENERATIVE ARTIFICIAL INTELLIGENCE CON JAVA

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 RAG WEB SEARCH

- ➔ Il vector store **non** è l'unico *data source* dal quale Spring AI può attingere documenti
 - ➔ **VectorStoreDocumentRetriever** unica implementazione di **DocumentRetriever** (Spring AI <= 1.0.3)
 - ➔ Possibile utilizzare informazione dal web (*RAG web search*)
 - ➔ Metodo efficace per mitigare la *knowledge cut-off* di LLM
 - ⚠ Utilizzo di connettori API appositi (es. Google Web Search API)

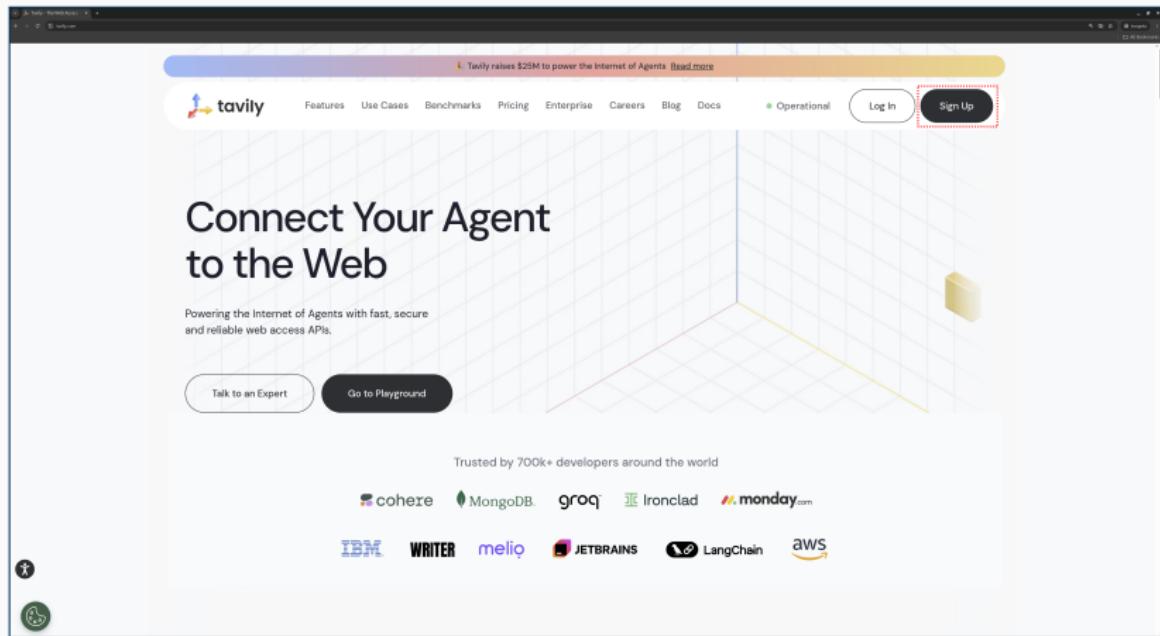
Interfaccia per recupero documenti

```
/**  
 * Component responsible for retrieving {@link Document}s from an underlying data source,  
 * such as a search engine, a vector store, a database, or a knowledge graph.  
 *  
 * @author Christian Tzolov  
 * @author Thomas Vitale  
 * @since 1.0.0  
 */  
public interface DocumentRetriever extends Function<Query, List<Document>> {  
  
    /**  
     * Retrieves relevant documents from an underlying data source based on the given  
     * query.  
     * @param query The query to use for retrieving documents  
     * @return The list of relevant documents  
     */  
    List<Document> retrieve(Query query);  
  
    default List<Document> apply(Query query) {  
        return retrieve(query);  
    }  
}
```

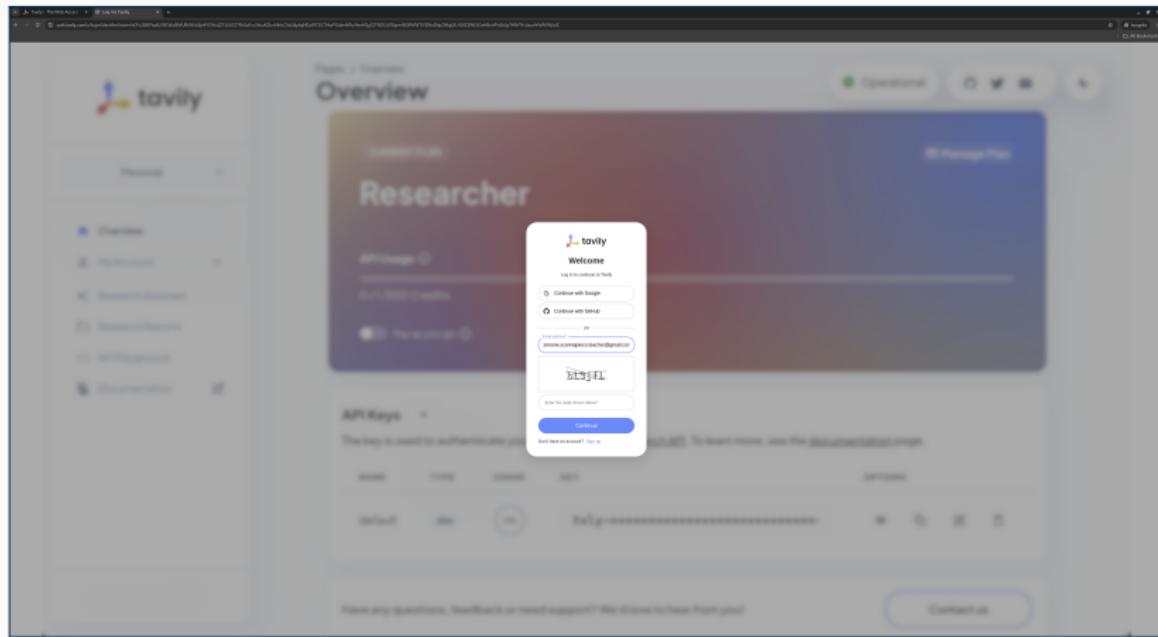
➔ Servizio RAG Ollama Web Search

- 1 Creazione account Tavily e API key
- 2 Modifica variabili di ambiente
- 3 Creazione implementazione *document retriever* tramite *web search*
- 4 Modifica configurazione RAG
- 5 Modifica interfaccia e implementazione servizio
- 6 Modifica proprietà applicativo
- 7 Test delle funzionalità con Postman/Insomnia

- 1 Accedere al portale <https://tavily.com/> e cliccare il pulsante Sign up



2 Creare una nuova utenza



3 Accedere al portale e selezionare la API key di default

The screenshot shows the Tavily developer portal interface. On the left, there's a sidebar with navigation links: Personal, Overview, API Playground, Use Cases, Billing, Settings, Documentation, and Tavily MCP. The main area is titled "Overview" and features a "CURRENT PLAN" card for a "Researcher" plan. The card displays "API Usage 0", "Monthly plan 0/1,000 Credits", and a "Personal" usage bar at 0%. Below this is a table titled "API Keys" with one row:

Name	Type	Usage	Key	Options
default	dev	0	tavily-dev-*****	

Below the table, there's a "Remote MCP" section with a "Generate MCP Link" button. At the bottom, there's a "Tavily Expert" section with a "Get your Tavily Expert" button and a "Contact us" button.

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": "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": "...",  
                "TAVILY_SEARCH_API_KEY": "..."  
            }  
        }  
    ]  
}
```

File settings.json

```
{  
    "java.configuration.updateBuildConfiguration": "interactive",  
    "java.test.config": {  
        "env": {  
            "GOOGLE_AI_API_KEY": "...",  
            "HUGGING_FACE_HUB_TOKEN": "...",  
            "TAVILY_SEARCH_API_KEY": "..."  
        }  
    }  
}
```

Document retriever via web search - I

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

...

public class WebSearchDocumentRetriever implements DocumentRetriever {

    private static final Logger logger = LoggerFactory.getLogger(WebSearchDocumentRetriever.class);

    private static final String TAVILY_API_KEY = "TAVILY_SEARCH_API_KEY";
    private static final String TAVILY_BASE_URL = "https://api.tavily.com/search";
    private static final int DEFAULT_RESULT_LIMIT = 5;
    private final int resultLimit;
    private final RestClient restClient;

    public WebSearchDocumentRetriever(RestClient.Builder clientBuilder, int resultLimit) {
        Assert.notNull(clientBuilder, "clientBuilder cannot be null");
        String apiKey = System.getenv(TAVILY_API_KEY);
        Assert.hasText(apiKey, "Environment variable " + TAVILY_API_KEY + " must be set");
        this.restClient = clientBuilder
            .baseUrl(TAVILY_BASE_URL)
            .defaultHeader(HttpHeaders.AUTHORIZATION, "Bearer " + apiKey)
            .build();
        if (resultLimit <= 0) {
            throw new IllegalArgumentException("resultLimit must be greater than 0");
        }
        this.resultLimit = resultLimit;
    }

    ...
}
```

Document retriever via web search - II

```
...
@Override
public List<Document> retrieve(Query query) {
    Assert.notNull(query, "query cannot be null");
    String q = query.text();
    Assert.hasText(q, "query.text() cannot be empty");

    TavilyResponsePayload response = restClient.post()
        .body(new TavilyRequestPayload(q, "advanced", resultLimit))
        .retrieve()
        .body(TavilyResponsePayload.class);

    if (response == null || CollectionUtils.isEmpty(response.results())) {
        return List.of();
    }

    List<Document> docs = new ArrayList<>(response.results().size());
    for (TavilyResponsePayload.Hit hit : response.results()) {
        // Map each Tavily hit into a Spring AI Document with metadata and score.
        Document doc = Document.builder()
            .text(hit.content())
            .metadata("title", hit.title())
            .metadata("url", hit.url())
            .score(hit.score())
            .build();
        docs.add(doc);
    }
    return docs;
}

@JsonNaming(PropertyNamingStrategies.SnakeCaseStrategy.class)
record TavilyRequestPayload(String query, String searchDepth, int maxResults) {}
...
```

Document retriever via web search - III

```
...
record TavilyResponsePayload(List<Hit> results) {
    record Hit(String title, String url, String content, Double score) {}
}

public static Builder builder() {
    return new Builder();
}

public static class Builder {
    private RestClient.Builder clientBuilder;
    private int resultLimit = DEFAULT_RESULT_LIMIT;

    private Builder() {}

    public Builder restClientBuilder(RestClient.Builder clientBuilder) {
        this.clientBuilder = clientBuilder;
        return this;
    }

    public Builder maxResults(int maxResults) {
        if (maxResults <= 0) {
            throw new IllegalArgumentException("maxResults must be greater than 0");
        }
        this.resultLimit = maxResults;
        return this;
    }

    public WebSearchDocumentRetriever build() {
        return new WebSearchDocumentRetriever(clientBuilder, resultLimit);
    }
}
```

Configurazione Vector Store

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

import it.venis.ai.spring.demo.rag.WebSearchDocumentRetriever;

...

@Configuration
public class RAGConfig {

    ...

    @Bean
    public RetrievalAugmentationAdvisor webSearchRetrievalAugmentationAdvisor(RestClient.Builder restClientBuilder) {

        return RetrievalAugmentationAdvisor.builder()
            .documentRetriever(WebSearchDocumentRetriever.builder()
                .restClientBuilder(restClientBuilder).maxResults(1).build())
            .build();
    }

}
```

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 getGeminiRAGAnswer(QuestionRequest request);

    public Answer getOllamaRAGAnswer(QuestionRequest request);

    public Answer getOllamaWebSearchRAGAnswer(QuestionRequest request);

}
```

Implementazione servizio

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

...
@Service
@Configuration
public class RAGServiceImpl implements RAGService {

    ...
    private RetrievalAugmentationAdvisor webSearchRetrievalAugmentationAdvisor;

    public RAGServiceImpl(
        @Qualifier("geminiChatClient") ChatClient geminiChatClient,
        @Qualifier("ollamaChatClient") ChatClient ollamaChatClient,
        @Qualifier("ollamaMemoryChatClient") ChatClient ollamaMemoryChatClient,
        @Qualifier("geminiVectorStore") VectorStore geminiVectorStore,
        @Qualifier("ollamaVectorStore") VectorStore ollamaVectorStore,
        @Qualifier("geminiRetrievalAugmentationAdvisor") RetrievalAugmentationAdvisor geminiRetrievalAugmentationAdvisor,
        @Qualifier("webSearchRetrievalAugmentationAdvisor") RetrievalAugmentationAdvisor webSearchRetrievalAugmentationAdvisor)

        this.geminiChatClient = geminiChatClient;
        this.ollamaChatClient = ollamaChatClient;
        this.ollamaMemoryChatClient = ollamaMemoryChatClient;
        this.geminiVectorStore = geminiVectorStore;
        this.ollamaVectorStore = ollamaVectorStore;
        this.geminiRetrievalAugmentationAdvisor = geminiRetrievalAugmentationAdvisor;
        this.webSearchRetrievalAugmentationAdvisor = webSearchRetrievalAugmentationAdvisor;
    }

    ...
}
```

Implementazione controllore REST

```
package it.venis.ai.spring.demo.controllers;  
  
...  
  
@RestController  
public class QuestionController {  
  
    ...  
  
    @PostMapping("/ollama/ask/rag")  
    public Answer getOllamaRAGAnswer(@RequestBody QuestionRequest request) {  
  
        return this.ragService.getOllamaRAGAnswer(request);  
  
    }  
  
    @PostMapping("/ollama/ask/rag/web-search")  
    public Answer getOllamaWebSearchRAGAnswer(@RequestBody QuestionRequest request) {  
  
        return this.ragService.getOllamaWebSearchRAGAnswer(request);  
  
    }  
}
```



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

Branch: 11-spring-ai-gemini-ollama-rag-web-search