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SPRING AI

GENERATIVE ARTIFICIAL INTELLIGENCE CON JAVA

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

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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>> {

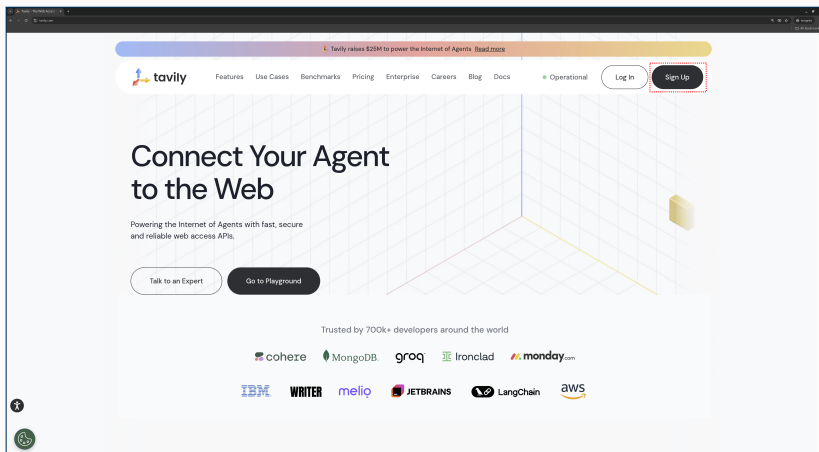
    /**
     * Retrieves relevant documents from an underlying data source based on the given
     * query.
     * @param query The query to use for retrieving documents
     * @return The list of relevant documents
     */
    List<Document> retrieve(Query query);

    default List<Document> apply(Query query) {
        return retrieve(query);
    }
}
```

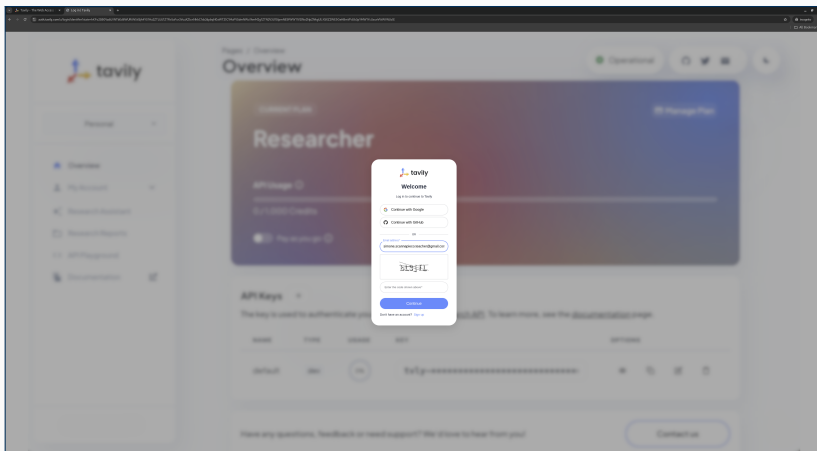
➔ Servizio RAG Ollama Web Search

- 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

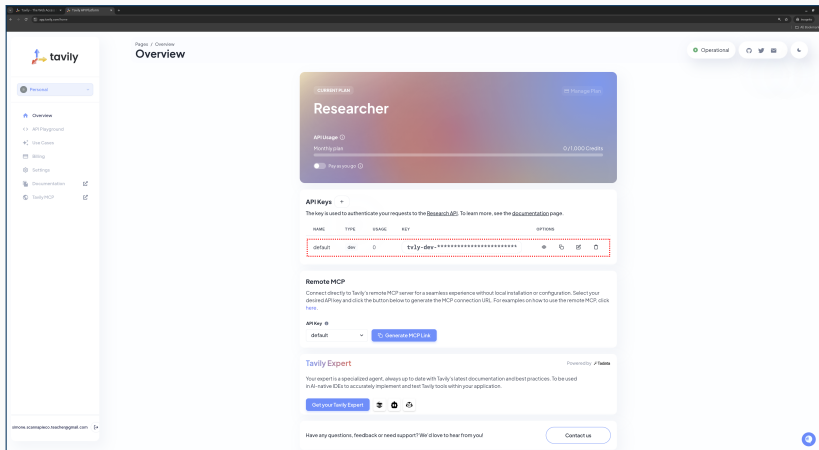
- 1 Accedere al portale <https://tavily.com/> e cliccare il pulsante Sign up






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 is a sidebar with navigation links: Overview, API Playground, Use Cases, Billing, Settings, Documentation, and Tavily MCP. The main content area is titled 'Overview' and features a 'CURRENT PLAN' card for 'Researcher' with a monthly plan and 9/1,000 credits. Below this is the 'API Keys' section, which contains a table with one key named 'default' of type 'dev'. The key value is 'tvlly-dev-*****' and is highlighted with a red dashed box. Below the table is the 'Remote MCP' section, which includes a 'Generate MCP Link' button. At the bottom, there is a 'Tavily Expert' section and a 'Contact Us' button.

NAME	TYPE	USAGE	KEY	OPTIONS
default	dev	0	tvlly-dev-*****	  

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