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Note



SPRING AI

GENERATIVE ARTIFICIAL INTELLIGENCE CON JAVA

Simone Scannapieco

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

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Note



SETUP PROGETTO SPRING AI

Note

- ➔ Inizializzare un progetto Spring con le seguenti caratteristiche:
 - ➔ Maven come *build tool*
 - ➔ Spring Boot alla versione più recente **non SNAPSHOT**
 - ➔ Linguaggio **Java 21**
 - ➔ Group **it.venis.ai.spring**
 - ➔ Artifact **demo**
 - ➔ jar packaging
 - ➔ Spring Web e OpenAI come dipendenze

Note

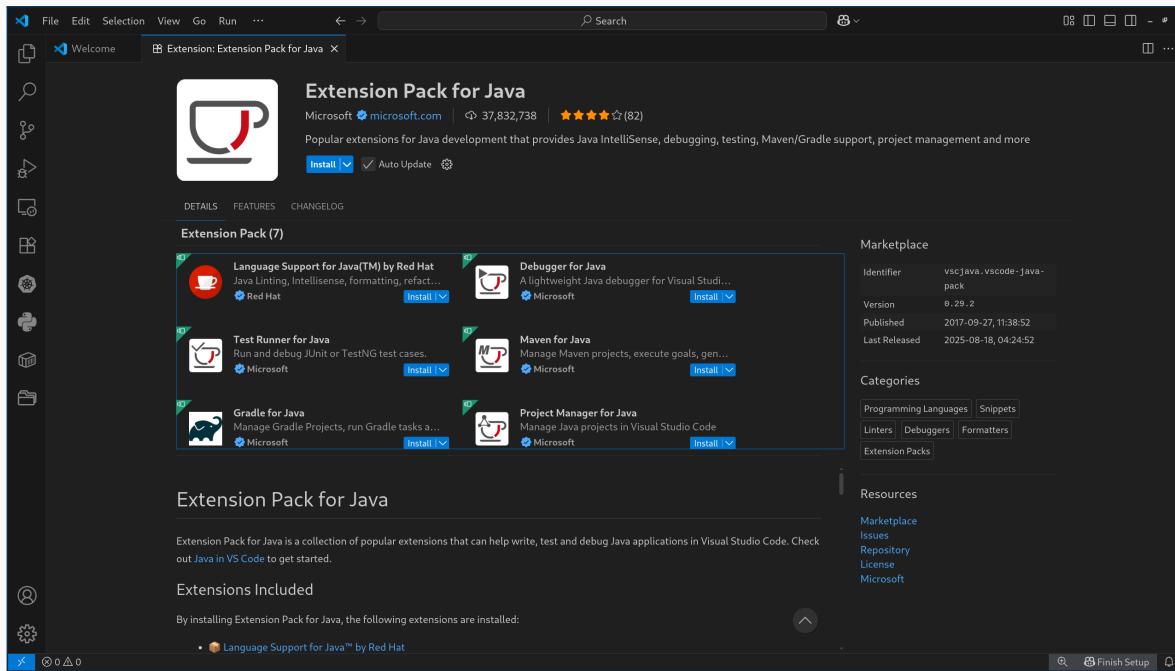
- 1 Inizializzare un nuovo progetto Spring AI
 - 2 Verifica JRE per progetto
 - 3 Esecuzione del progetto

Note

- 1 Da IDE (VSCode)
 - 2 Da Spring Initializr

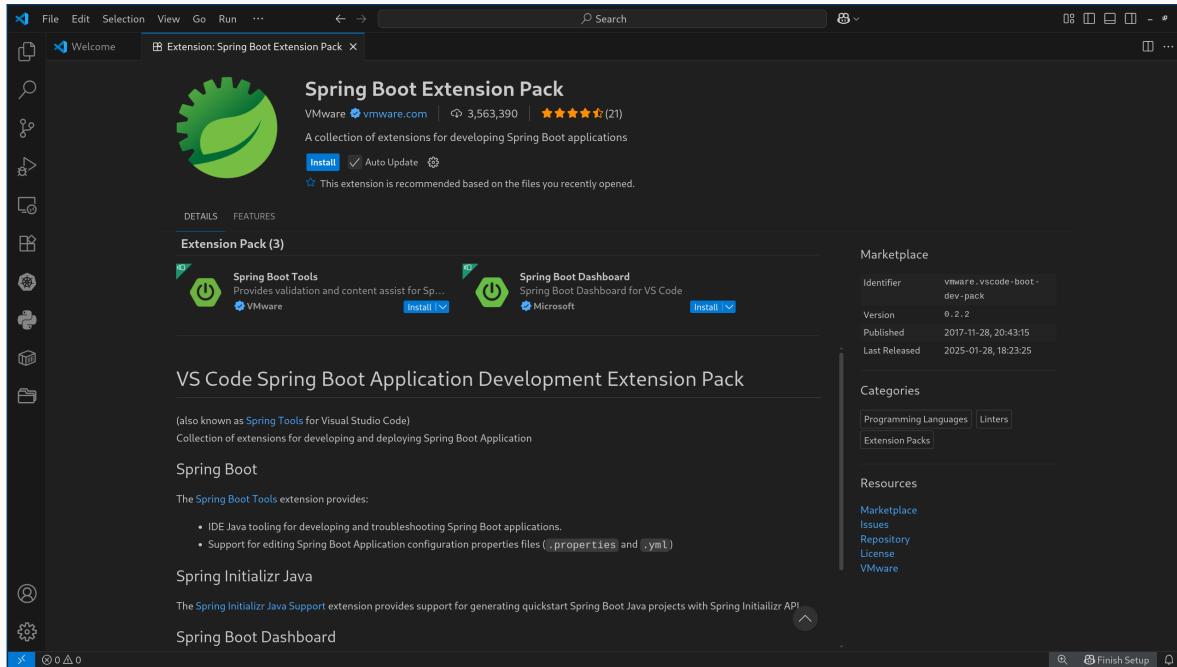
Note

1 Installare le estensioni VSC necessarie



Note

1 Installare le estensioni VSC necessarie



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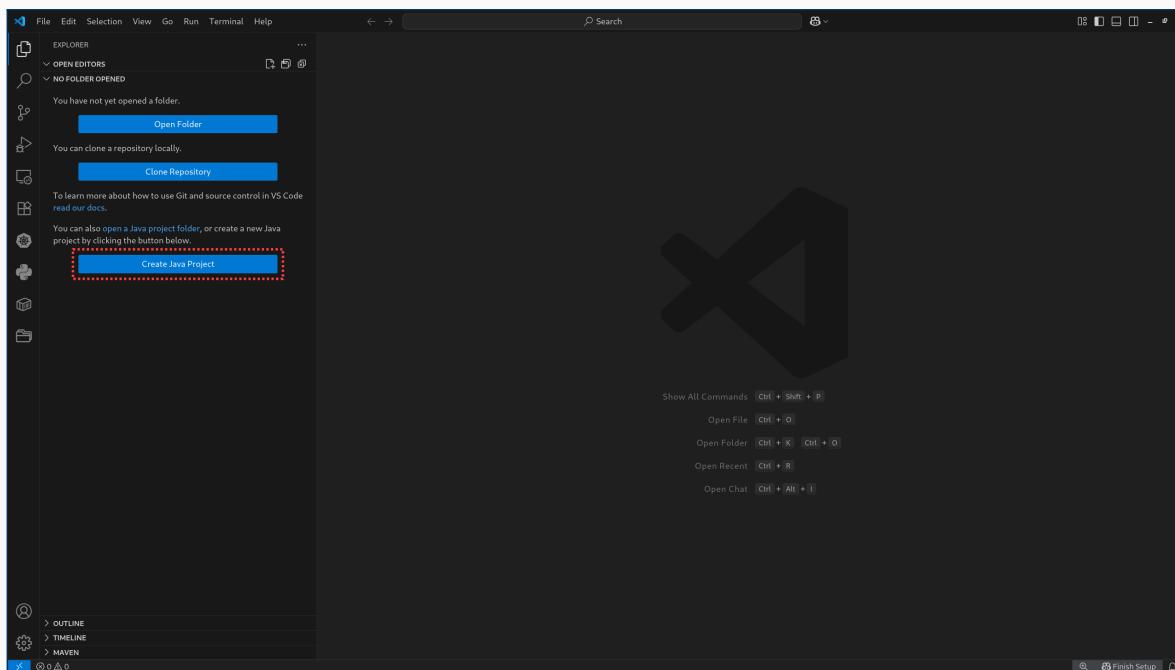
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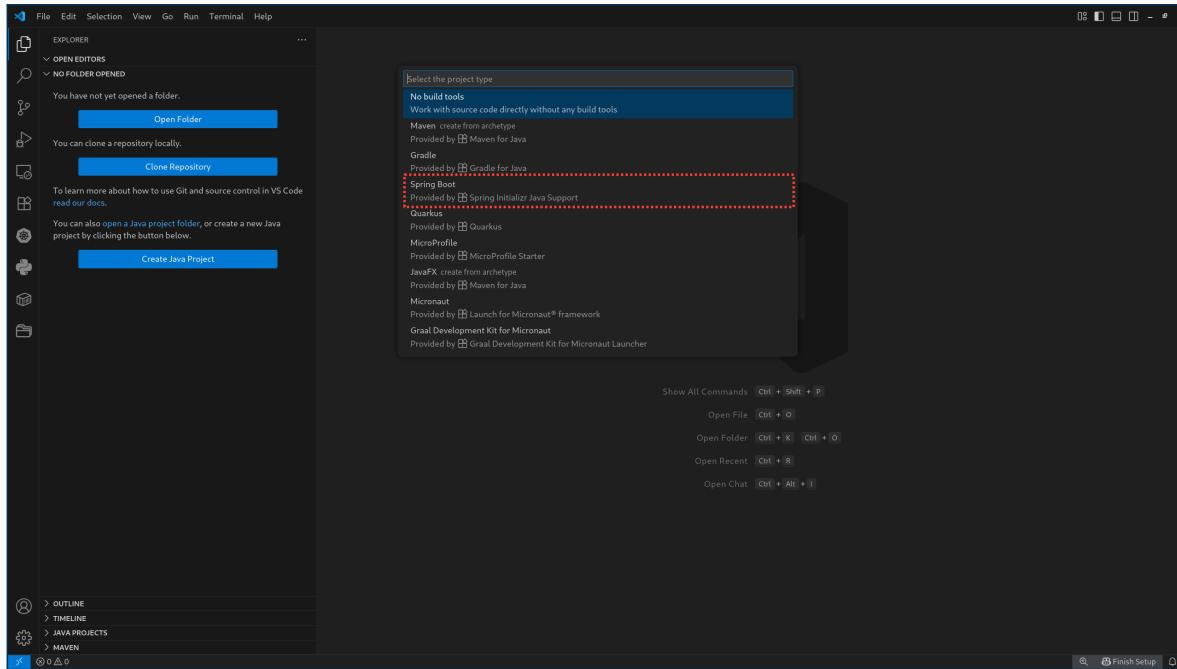
Note

2 Aprire una nuova finestra VSC e selezionare **Create Java Project**



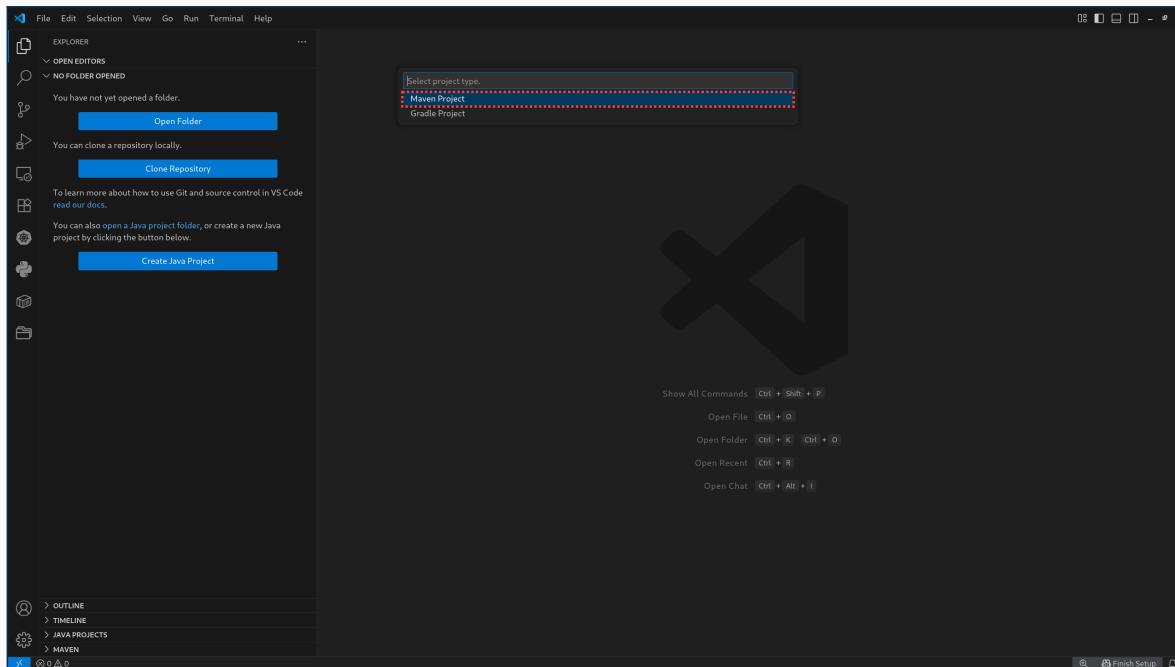
Note

3 Selezionare Spring Boot come tipo di progetto (NON Maven)



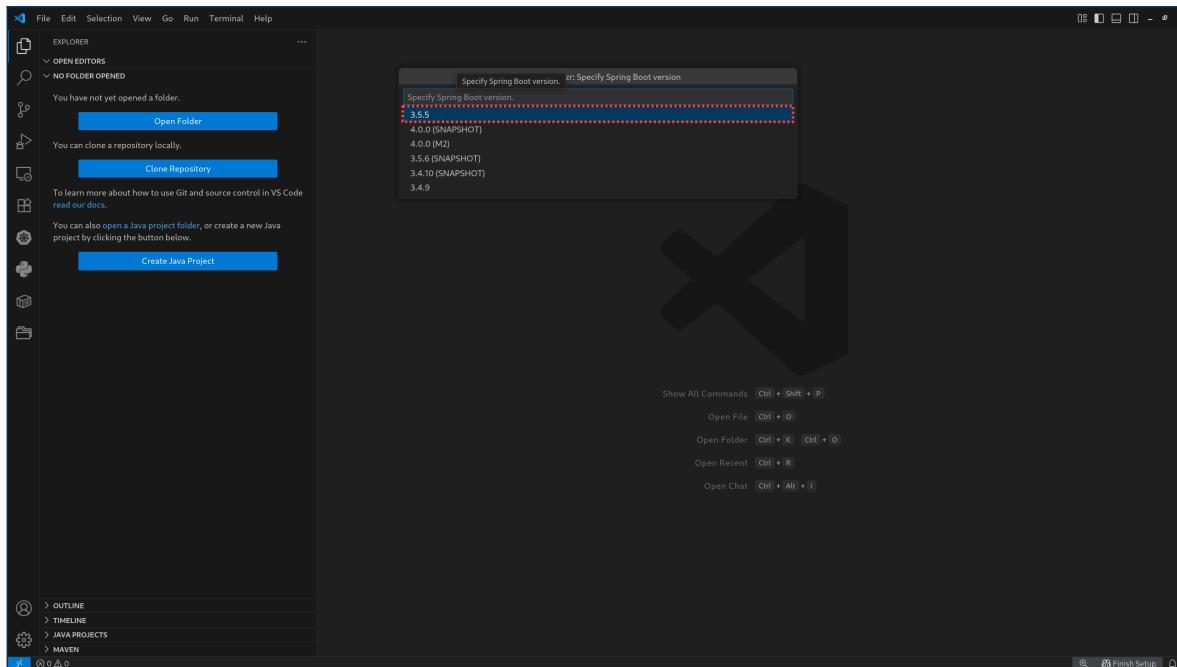
Note

4 Selezionare **Maven project** come tipo di progetto



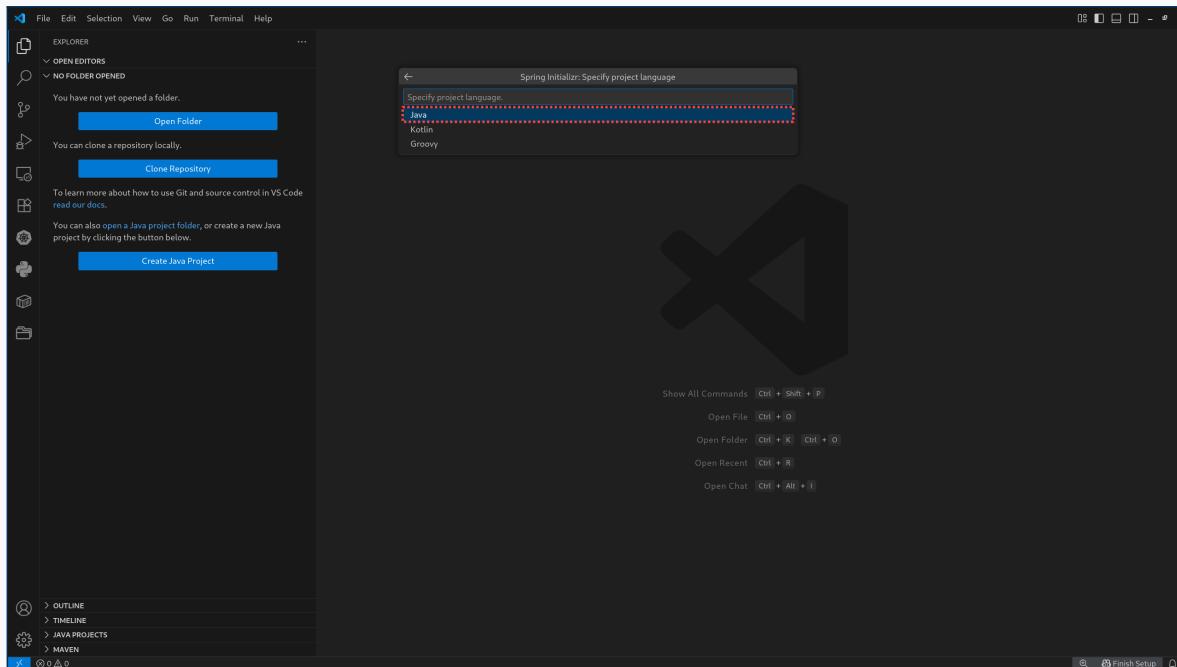
Note

5 Selezionare la versione di Boot per il progetto



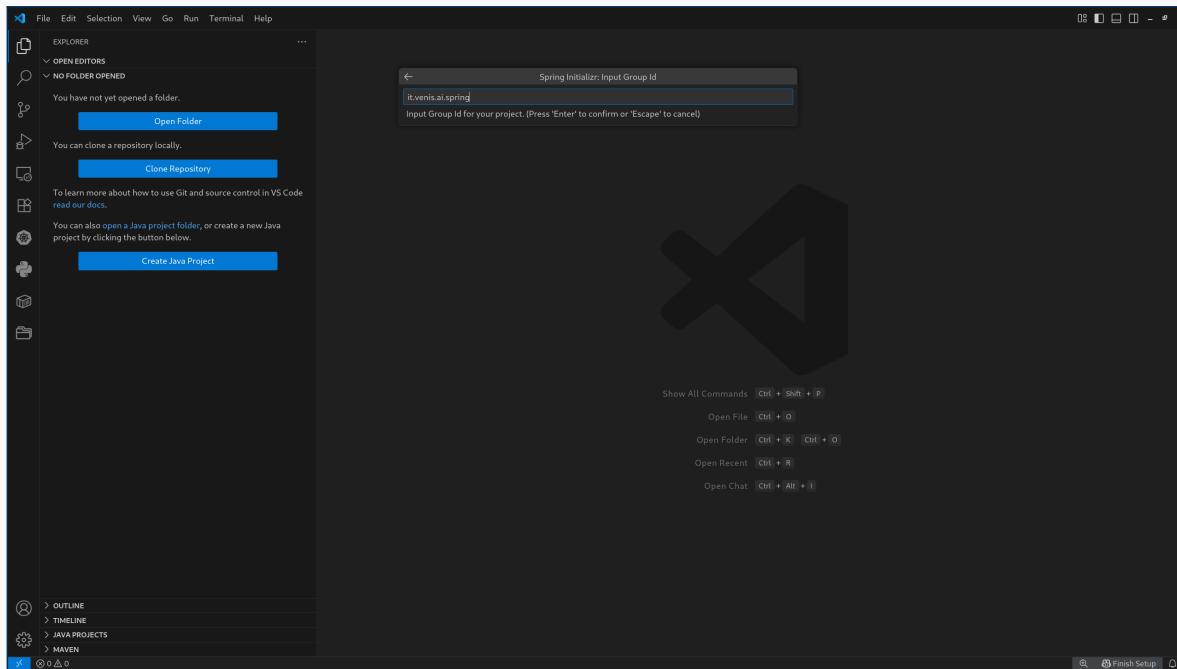
Note

6 Selezionare Java come linguaggio di progetto



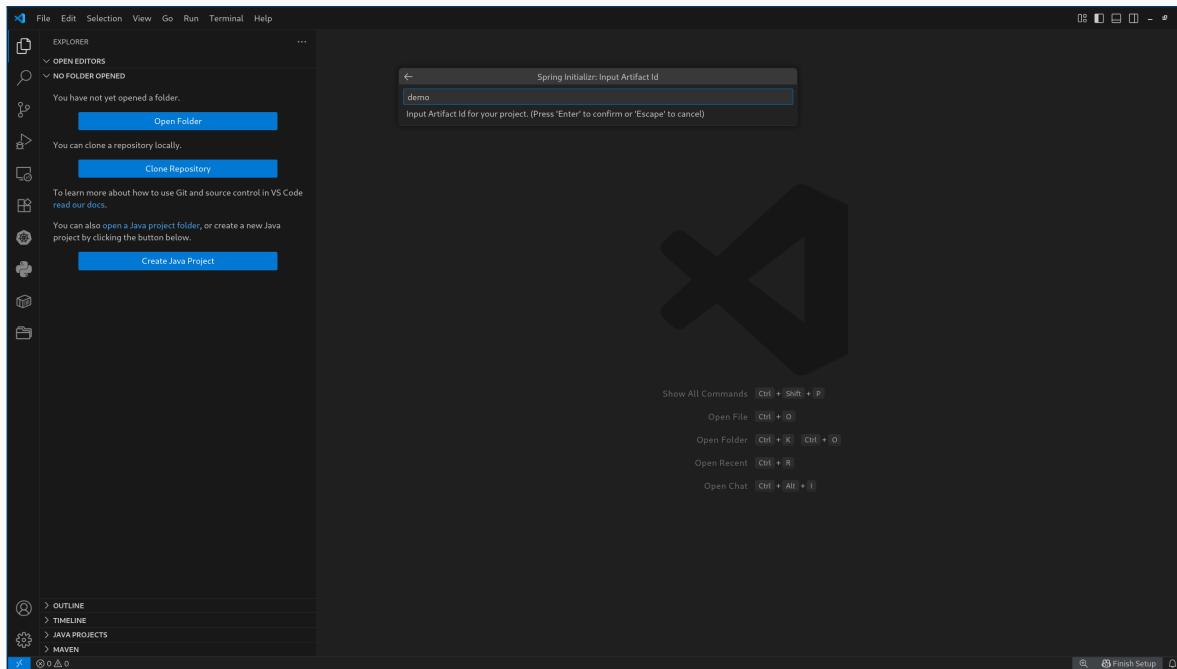
Note

7 Definire il *Group ID* di riferimento del progetto



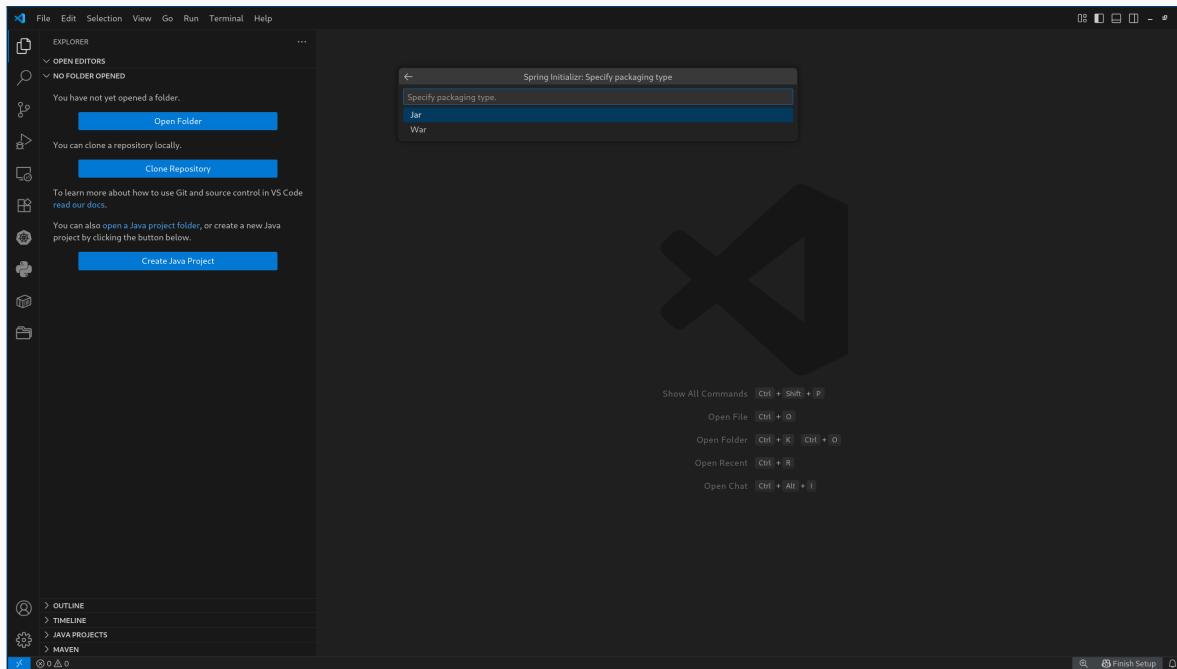
Note

8 Definire l'*Artifact ID* di riferimento del progetto



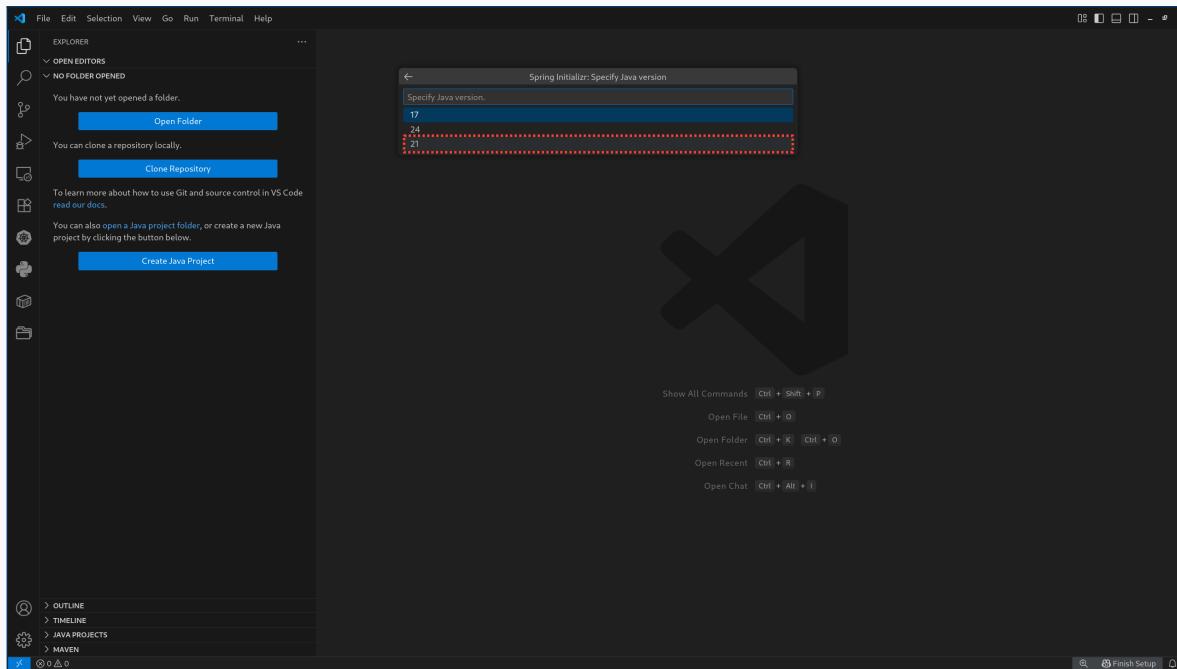
Note

9 Definire la tipologia di *packaging* del progetto



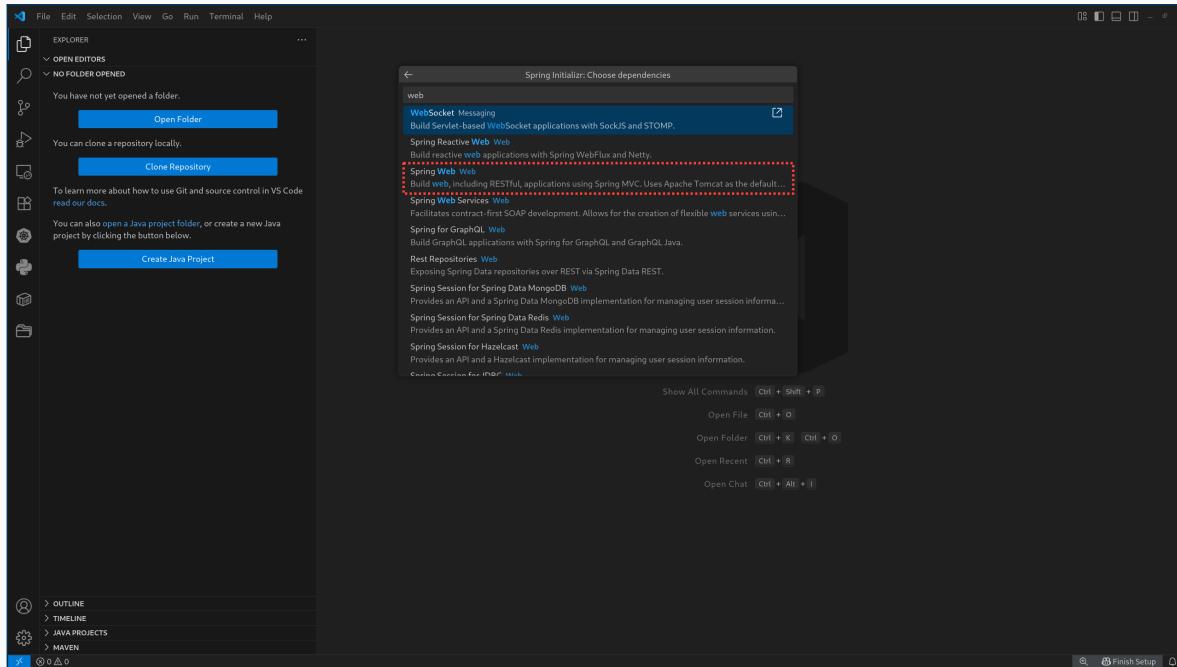
Note

10 Selezionare la versione di Java di riferimento



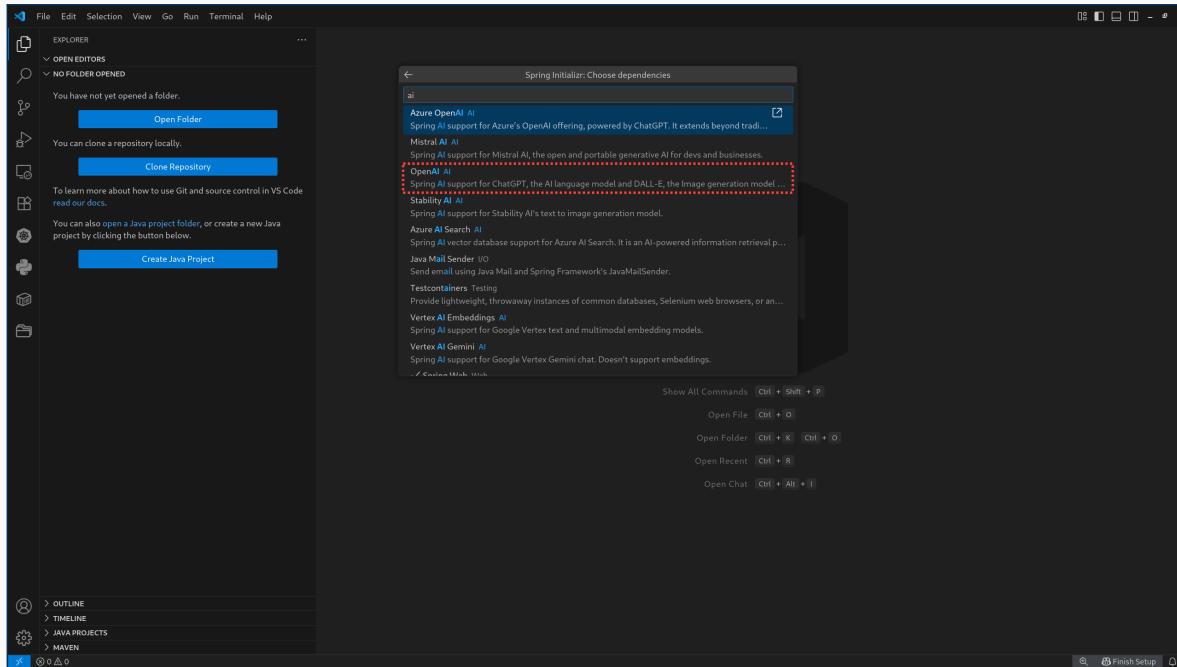
Note

11 Selezionare come prima dipendenza di progetto **Spring Web**



Note

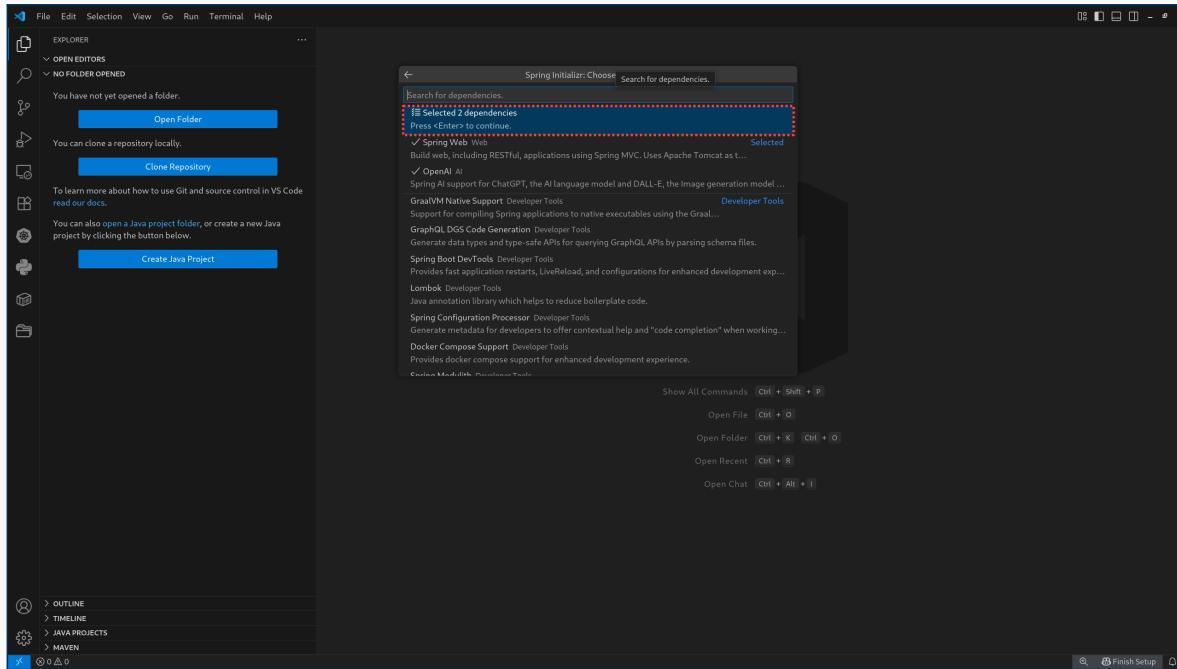
12 Selezionare come seconda dipendenza di progetto OpenAI



Note

PROGETTO SPRING AI INIZIALIZZAZIONE DA IDE (VS CODE)

13 Continuare la creazione del progetto premendo **Enter**



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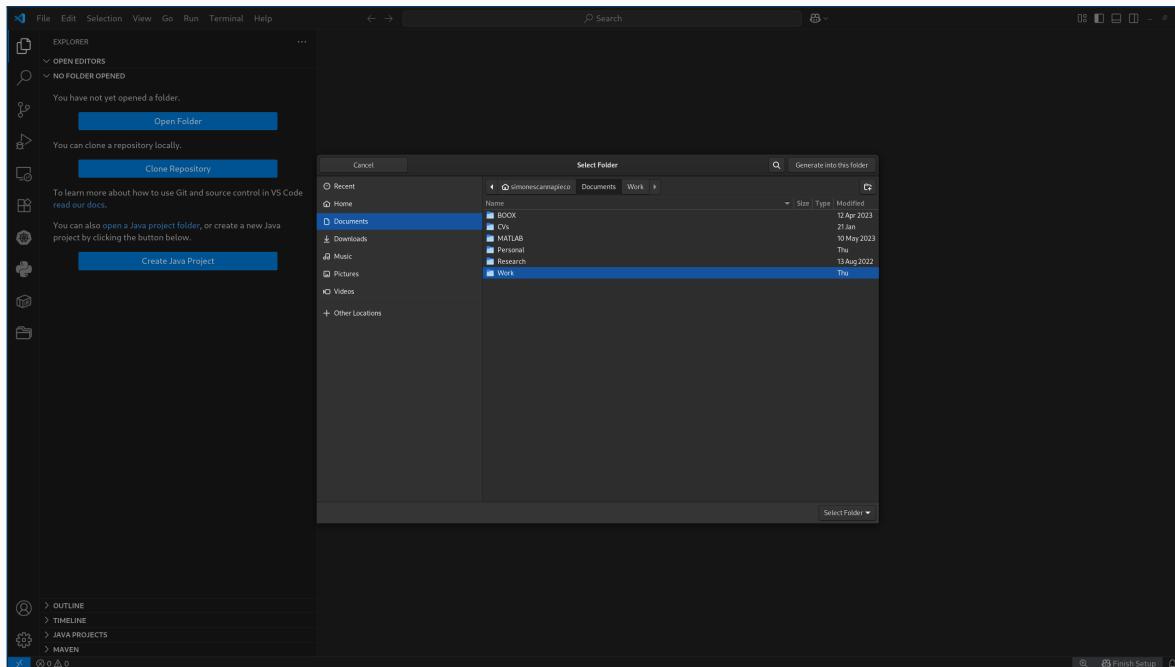
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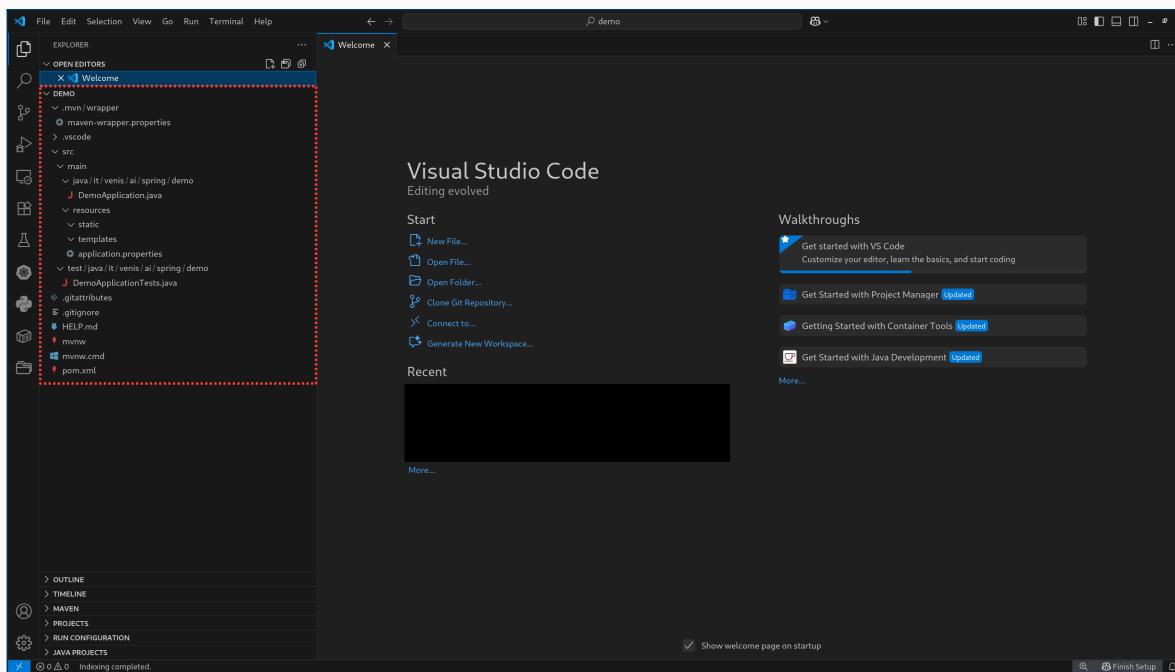
Note

14 Navigare nel FS e selezionare la cartella padre del progetto



Note

15 Verificare i file di progetto nel pannello **Explorer** (**CTRL + SHIFT + E**)



Note

PROGETTO SPRING INIZIALIZZAZIONE DA SPRING INITIALIZER

The screenshot shows the Spring Initializr web interface. At the top, there's a navigation bar with tabs for 'start-spring.js' and 'Incohesive'. The main content area has a header 'spring initializr' with a green logo.

Project settings:

- Language: Java (selected)
- Build Tools: Maven (selected)
- Frameworks: Gradle - Groovy, Gradle - Kotlin, Groovy (radio buttons)

Spring Boot settings:

- Version: 3.5.6 (SNAPSHOT) (selected)
- Other options: 4.0.0 (M2), 3.4.9 (radio buttons)

Project Metadata settings:

- Group: it.venis.ai.spring
- Artifact: demo
- Name: demo
- Description: Demo project for Spring Boot (Web and OpenAI)
- Package name: it.venis.ai.spring.demo
- Packaging: Jar (selected)
- Java version: 24 (selected)
- Java version: 21 (radio button)
- Java version: 17 (radio button)

Dependencies section:

- Add Dependencies... (button)
- Spring Web (selected): Build web, including RESTful, applications using Spring MVC. Uses Apache Tomcat as the default embedded container.
- OpenAI (AI): Spring AI support for ChatGPT, the AI language model and DALL-E, the Image generation model from OpenAI.

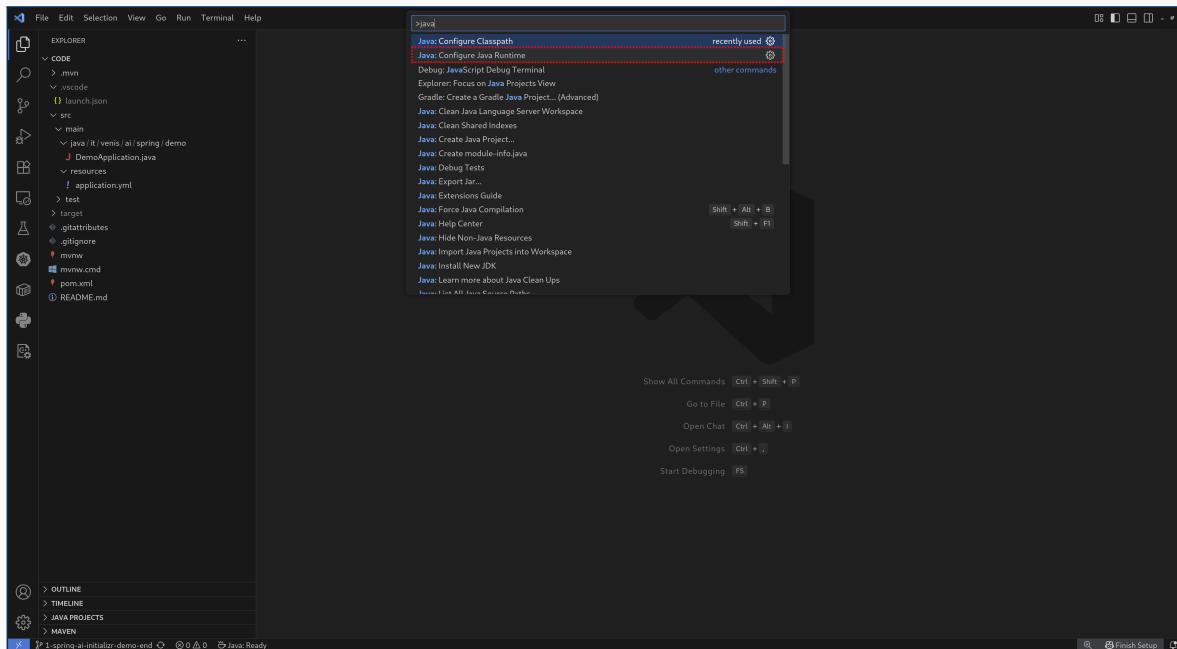
At the bottom, there are 'GENERATE' and 'EXPLORE' buttons, and a three-dot menu icon.

Portale ufficiale

<https://start.spring.io/>

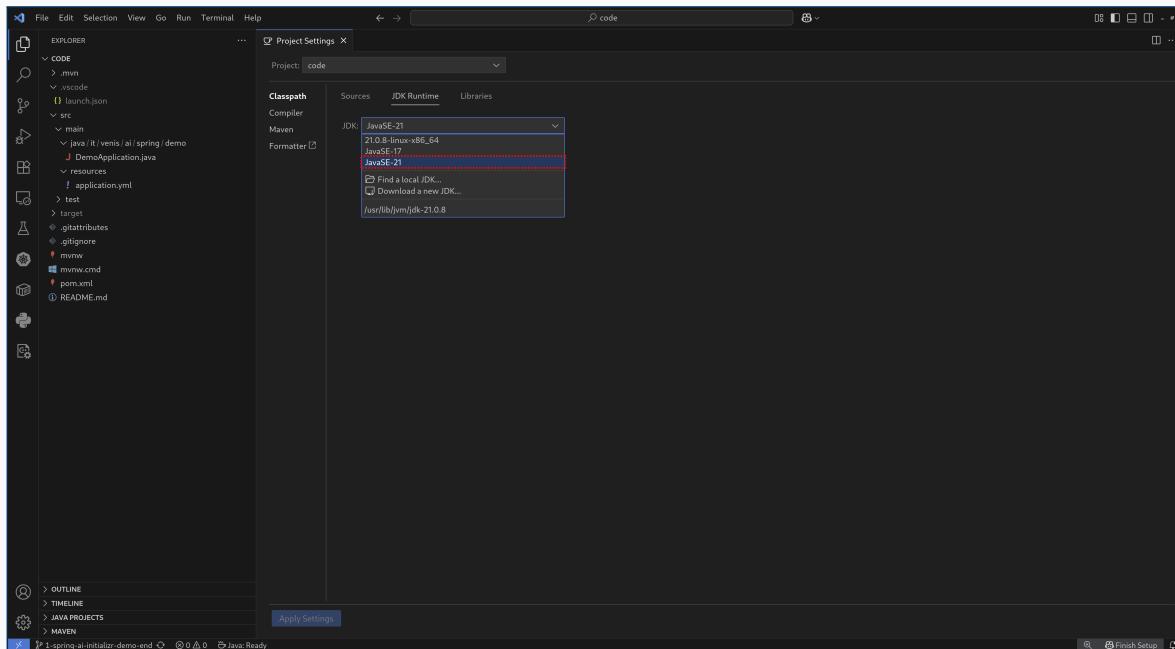
Note

1 Dal pannello dei comandi (**CTRL + SHIFT + P**), Java: Configure Java Runtime



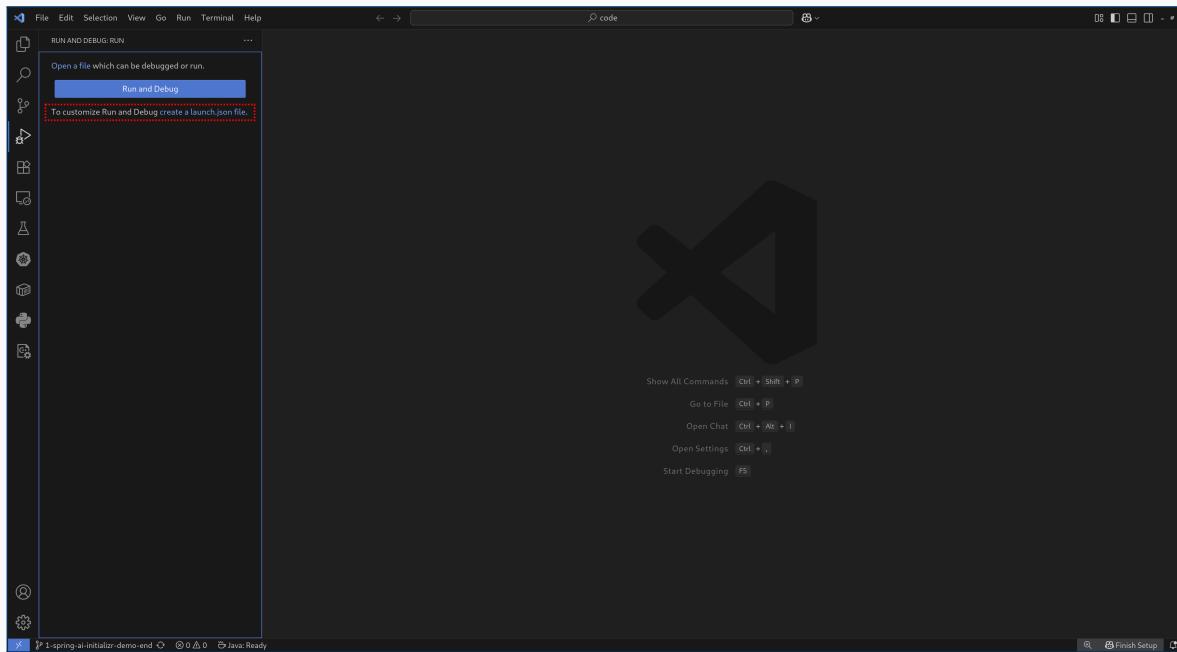
Note

2 Selezionare la JDK 21 precedentemente installata



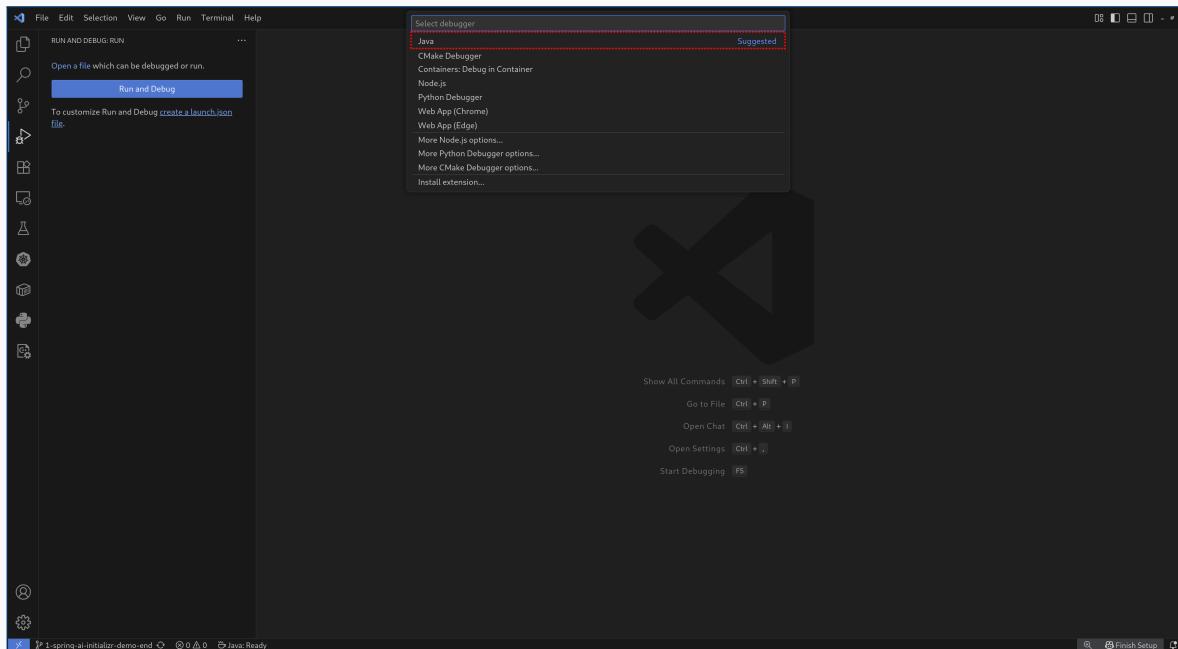
Note

1 Dal pannello di debug (**CTRL + SHIFT + D**), creare un nuovo file `launch.json`



Note

2 Selezionare Java come tipologia di esecuzione/debug



Note

3 Verificare la presenza delle due configurazioni di base



The screenshot shows the VS Code interface with the following details:

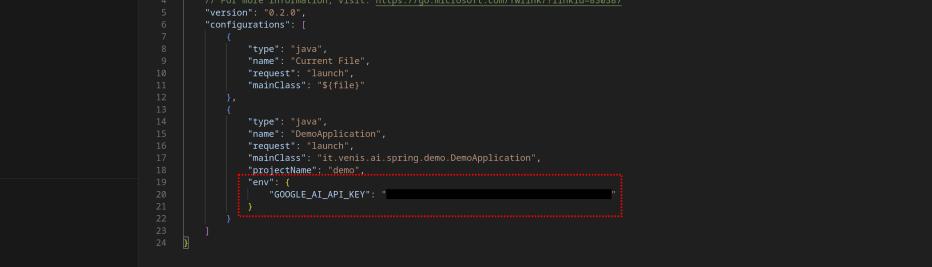
- File Explorer**: Shows a folder structure with a .gitignore file.
- Search Bar**: Displays "code".
- Run and Debug View**: Shows the "launch.json" configuration file open. The file content is as follows:

```
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"
```

- Variables View**: Shows a list of variables.
- Watch View**: Shows a list of watched variables.
- Call Stack View**: Shows a list of call stack frames.
- Breakpoints View**: Shows a list of breakpoints.
- Bottom Status Bar**: Shows file paths (Ln1, Col2), spaces (Spaces: 4), encoding (UTF-8), line numbers (Ln1, Ln2), and file status (JSON with Comments, Java Ready).

Note

4 Aggiungere metadati se necessario (es. variabili di ambiente)



```
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": ""
        }
    }
]
```

Note

1 Eseguendo il progetto, dovremmo ottenere una eccezione!

The screenshot shows the Eclipse IDE interface with the following details:

- File Bar:** File, Edit, Selection, View, Go, Run, Terminal, Help.
- Left Sidebar:** RUN AND DE, VARIABLES, WATCH, CALL STACK, BREAKPOINTS.
- Central Area:** application.xml (Content), PROBLEMS, OUTPUT, DEBUG CONSOLE, TERMINAL, PORTS.
- TERMINAL Tab:** Shows Java application logs:

```
t] 2025-09-02T10:43:17.128+02:00 INFO 122580 --- [demo] [main] o.apache.catalina.core.StandardEngine : Starting Servlet engine : [Apache Tomcat/10.1.44] 2025-09-02T10:43:17.155+02:00 INFO 122580 --- [demo] [main] o.a.c.c.C.Tomcat : [localhost] [/] : Initializing Spring embedded WebApplicationContext 2025-09-02T10:43:17.156+02:00 INFO 122580 --- [demo] [main] w.s.c.ServletWebServerApplicationContext : Root WebApplicationContext ext: initialization completed in 622 ms... 2025-09-02T10:43:17.427+02:00 WARN 122580 --- [demo] [main] ConfigServletWebServerApplicationContext : Exception encountered during context initialization - cancelling refresh attempt: org.springframework.beans.factory.BeanCreationException: Error creating bean with name 'openAiAudioSpeechModel' defined in class path resource [org/springframework/ai/model/openai/autoconfigure/OpenAIAudioSpeechAutoConfiguration.class]: Failed to instantiate [org.springframework.ai.openai.OpenAIAudioSpeechModel]: Factory method 'openAiAudioSpeechModel' threw exception with message: OpenAI API key must be set. Use the connection property: spring.ai.openai.api-key or spring.ai.openai.speech.api-key property. 2025-09-02T10:43:17.428+02:00 INFO 122580 --- [demo] [main] o.apache.catalina.startup.TomcatService : Stopping service [Tomcat]
```
- BREAKPOINTS Tab:** Includes sections for Uncaught Exceptions and Caught Exceptions.
- Bottom Status Bar:** 1-spring-ai-initializer-demo-and..., Java Ready, 6 lines, 8 columns, Space 7, UTF-8, LF, {} (Spring Boot Properties Yaml), Finish Setup.

Note

2 Definiamo la chiave richiesta da Spring AI (`spring.ai.openai.api-key`)

The screenshot shows a Java application running in a Spring Boot IDE. The top navigation bar includes File, Edit, Selection, View, Go, Run, Terminal, Help, and a back/forward button. A search bar labeled 'code' is positioned at the top right. On the left, there's a sidebar with icons for RUN AND DE, VARIABLES, WATCH, CALL STACK, BREAKPOINTS, and a section for 1-spring-ai-initializer-demo-end*. Below the sidebar, tabs for PROBLEMS, OUTPUT, DEBUG CONSOLE, TERMINAL, and PORTS are visible. The TERMINAL tab is active, displaying logs from the application's startup. The logs show various INFO and WARN messages related to the Spring Boot environment and the 'DemoApplication' context. The bottom right corner shows a terminal window titled 'bash' with the command 'Debug: DemoApplication' entered.

```
src > main > resources > application.yml
1 spring:
2   application:
3     name: demo
4   profiles:
5     active: dev
6     apikey:
      api-key: ${GOOGLE_AI_API_KEY}
```

TERMINAL

```
t]
2025-09-02T10:43:17.128+02:00  INFO 122580 --- [demo] [main] o.apache.catalina.core.StandardEngine : Starting Servlet engine
: [Apache Tomcat/10.1.44]
2025-09-02T10:43:17.155+02:00  INFO 122580 --- [demo] [main] o.a.c.c.C.Tomcat@localhost [/] : Initializing Spring mb
embedded WebApplicationContext
2025-09-02T10:43:17.156+02:00  INFO 122580 --- [demo] [main] w.s.c.ServletWebServerApplicationContext : Root WebApplicationCont
ext: initialization completed in 622 ms
2025-09-02T10:43:17.427+02:00  WARN 122580 --- [demo] [main] ConfigServletWebServerApplicationContext : Exception encountered d
uring context initialization - cancelling refresh attempt: org.springframework.beans.factory.BeanCreationException: Error creating bean wi
th name 'openAiAudioSpeechModel' defined in class path resource [org/springframework/ai/model/openai/autoconfigure/OpenAIAudioSpeechAutoCo
nfiguration.class]: Failed to instantiate [org.springframework.ai.model.OpenAIAudioSpeechModel]: Factory method 'openAiAudioSpeechModel'
threw exception with message: OpenAI API key must be set. Use the connection property: spring.ai.openai.api-key or spring.ai.openai.spe
ech.api-key property.
2025-09-02T10:43:17.429+02:00  INFO 122580 --- [demo] [main] o.apache.catalina.core.StandardService : Stopping service [Tomca
t]
2025-09-02T10:43:17.440+02:00  INFO 122580 --- [demo] [main] s.b.a.l.ConditionEvaluationReportLogger :
Error starting ApplicationContext. To display the condition evaluation report re-run your application with 'debug' enabled.
2025-09-02T10:43:17.452+02:00  ERROR 122580 --- [demo] [main] o.s.boot.SpringApplication : Application run failed
org.springframework.beans.factory.BeanCreationException: Error creating bean with name 'openAiAudioSpeechModel' defined in class path reso
urce [org/springframework/ai/model/openai/autoconfigure/OpenAIAudioSpeechAutoConfiguration.class]: Failed to instantiate [org.springframew
ork.ai.openai.OpenAIAudioSpeechModel]: Factory method 'openAiAudioSpeechModel()' threw exception with message: OpenAI API key must be set. U
se the connection property: spring.ai.openai.api-key or spring.ai.openai.speech.api-key property.
         at org.springframework.beans.factory.support.ConstructorResolver.instantiate(ConstructorResolver.java:657) ~[spring-beans-6.2.10.j
ar:6.2.10]
         at org.springframework.beans.factory.support.ConstructorResolver.instantiateUsingFactoryMethod(ConstructorResolver.java:645) ~[spr
ing-beans-6.2.10.jar:6.2.10]
         at org.springframework.beans.factory.support.AbstractAutowireCapableBeanFactory.instantiateUsingFactoryMethod(AbstractAutowireCapa
bleBeanFactory.java:621) ~[spring-beans-6.2.10.jar:6.2.10]
         at org.springframework.beans.factory.support.AbstractAutowireCapableBeanFactory.createBean(AbstractAutowireCapableBeanFactory.java:537) ~[spr
ing-beans-6.2.10.jar:6.2.10]
         at org.springframework.beans.factory.support.AbstractBeanFactory.lambda$doGetBean$0(AbstractBeanFactory.java:335) ~[spring-beans-6.2.10.ja
r:6.2.10]
         at org.springframework.beans.factory.support.DefaultSingletonBeanRegistry.getSingleton(DefaultSingletonBeanRegistry.java:234) ~[spring-beans-6.2.10.ja
r:6.2.10]
         at org.springframework.beans.factory.support.AbstractBeanFactory.getBean(AbstractBeanFactory.java:333) ~[spring-beans-6.2.10.ja
r:6.2.10]
         at org.springframework.context.support.DefaultListableBeanFactory.preInstantiateSingletons(DefaultListableBeanFactory.java:955) ~[spring-c
ontext-6.2.10.jar:6.2.10]
         at org.springframework.context.support.AbstractApplicationContext.refresh(AbstractApplicationContext.java:623) ~[spring-context-6.2.10.ja
r:6.2.10]
         at org.springframework.boot.web.servlet.context.AnnotationConfigServletWebServerApplicationContext.refresh(AnnotationConfigServletWebServerApplicati
onContext.java:163) ~[spring-boot-3.2.0.jar:3.2.0]
         at org.springframework.boot.SpringApplication.refresh(SpringApplication.java:740) ~[spring-boot-3.2.0.jar:3.2.0]
         at org.springframework.boot.SpringApplication.refreshContext(SpringApplication.java:438) ~[spring-boot-3.2.0.jar:3.2.0]
         at org.springframework.boot.SpringApplication.run(SpringApplication.java:368) ~[spring-boot-3.2.0.jar:3.2.0]
         at org.springframework.boot.SpringApplication.run(SpringApplication.java:357) ~[spring-boot-3.2.0.jar:3.2.0]
         at com.example.demo.DemoApplication.main(DemoApplication.java:10) ~[main-class:DemoApplication]
```

Note

3 Ora non dovremmo ottenere eccezioni!

The screenshot shows the VS Code interface with the following details:

- File Explorer:** Shows a project structure with a 'RUN AND DE...' folder containing 'DemoAppl...', and a 'VARIABLES' section.
- Code Editor:** Displays the file `src/main/resources/application.yml` with the following content:

```
spring:
  application:
    name: demo
    # ...
    openai:
      api-key: ${GOOGLE_AI_API_KEY}
```
- Terminal:** Shows the output of the application's startup logs:

```
2025-09-02T10:48:24.983+02:00 INFO 128913 --- [demo] [main] i.venis.ai.spring.demo.DemoApplication : Starting DemoApplication using Java 21.0.8 with PID 128913 (started by simonescanapicino in /home/simonescanapicino)
2025-09-02T10:48:24.985+02:00 INFO 128913 --- [demo] [main] i.venis.ai.spring.demo.DemoApplication : No active profile set, falling back to 1 default profile: "default"
2025-09-02T10:48:25.585+02:00 INFO 128913 --- [demo] [main] o.s.b.w.embedded.tomcat.TomcatWebServer : Tomcat initialized with port 8080 (http)
2025-09-02T10:48:25.593+02:00 INFO 128913 --- [demo] [main] o.apache.catalina.core.StandardService : Starting service [Tomca]
2025-09-02T10:48:25.594+02:00 INFO 128913 --- [demo] [main] o.apache.catalina.core.StandardEngine : Starting Servlet engine : [Apache Tomcat/10.1.44]
2025-09-02T10:48:26.622+02:00 INFO 128913 --- [demo] [main] o.a.c.c.C.Tomcat : [localhost].[] : Initializing Spring embedded WebApplicationContext
2025-09-02T10:48:26.623+02:00 INFO 128913 --- [demo] [main] w.s.c.ServletWebServerApplicationContext : Root WebApplicationContext initialized at 2025-09-02T10:48:26.623+02:00
2025-09-02T10:48:26.624+02:00 INFO 128913 --- [demo] [main] o.s.b.w.embedded.tomcat.TomcatWebServer : Tomcat started on port 8080 (http) with context path '/'
2025-09-02T10:48:26.687+02:00 INFO 128913 --- [demo] [main] i.venis.ai.spring.demo.DemoApplication : Started DemoApplication in 1.379 seconds (process running for 1.639)
```
- Bottom Status Bar:** Shows tabs for '1-spring-ai-initializer-demo-and...', 'DemoApplication (code)', 'Java Ready', 'Not Committed Yet', 'Ln 6, Col 36', 'Spaces: 2', 'UTF-8', 'LF', 'Spring Boot Properties Yaml', and 'Finish Setup'.

Note

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

Branch: 1-spring-ai-initializr

Note