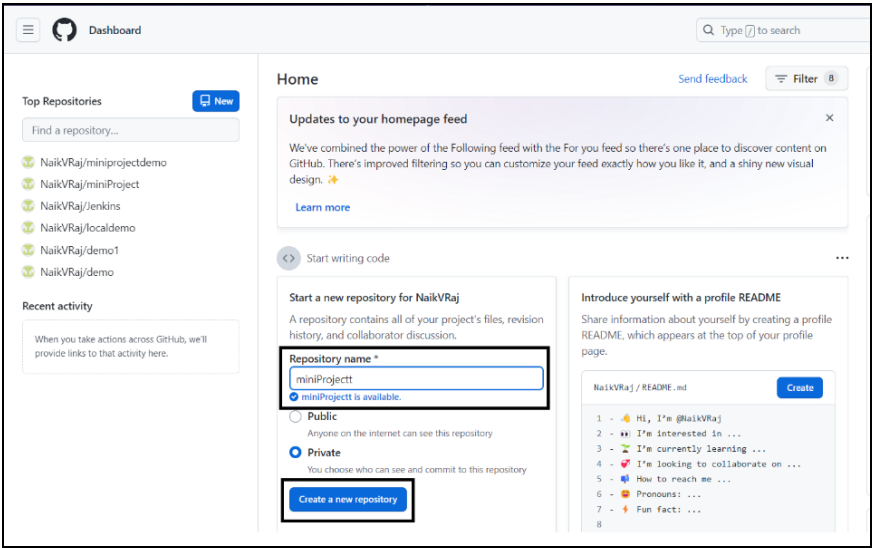
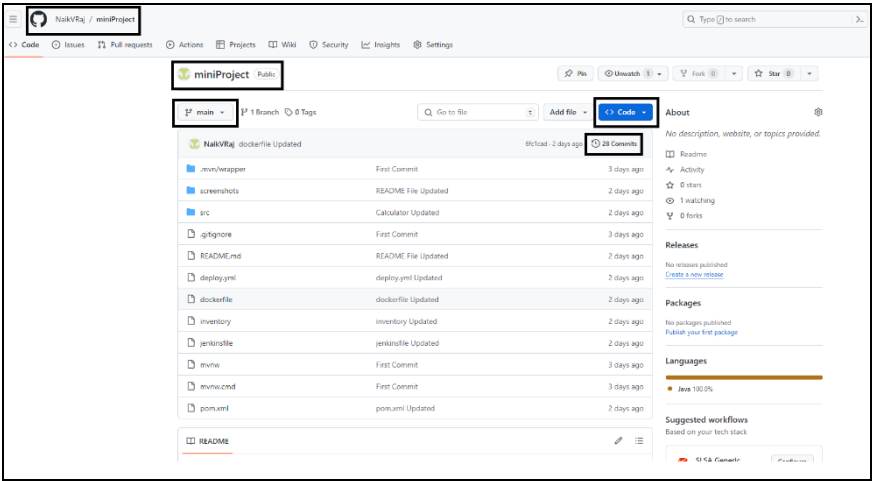


SCREENSHOTS

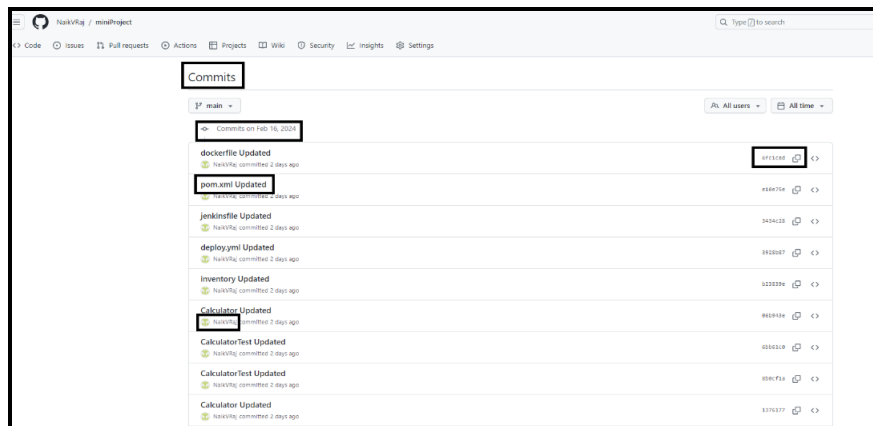
GITHUB



GitHub new Repository

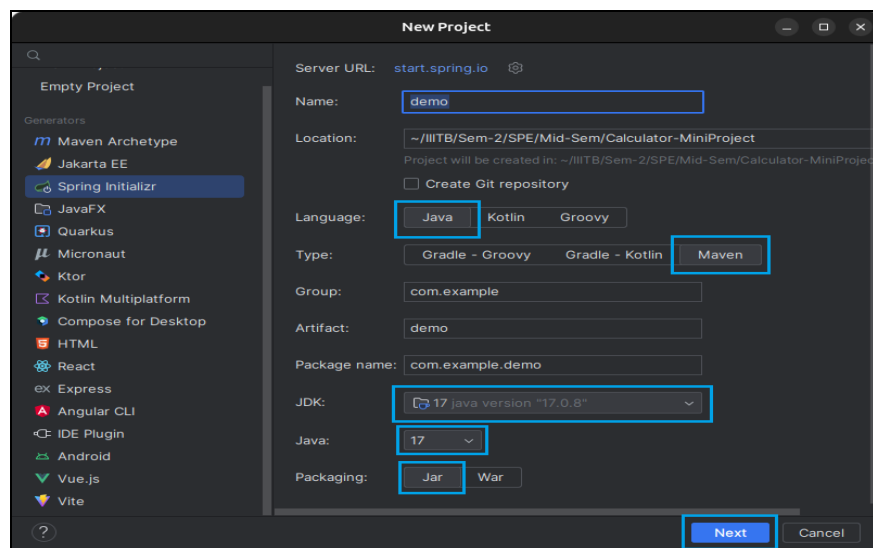


Repository Page

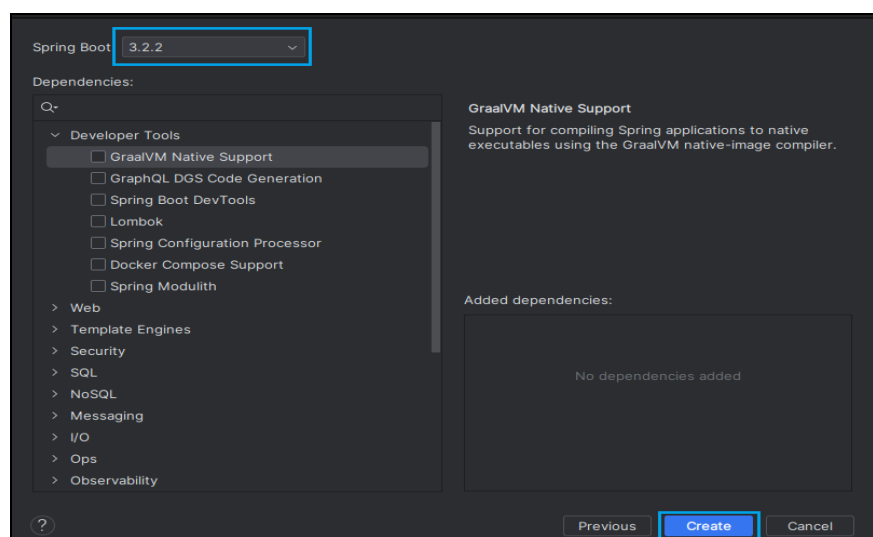


Commit History

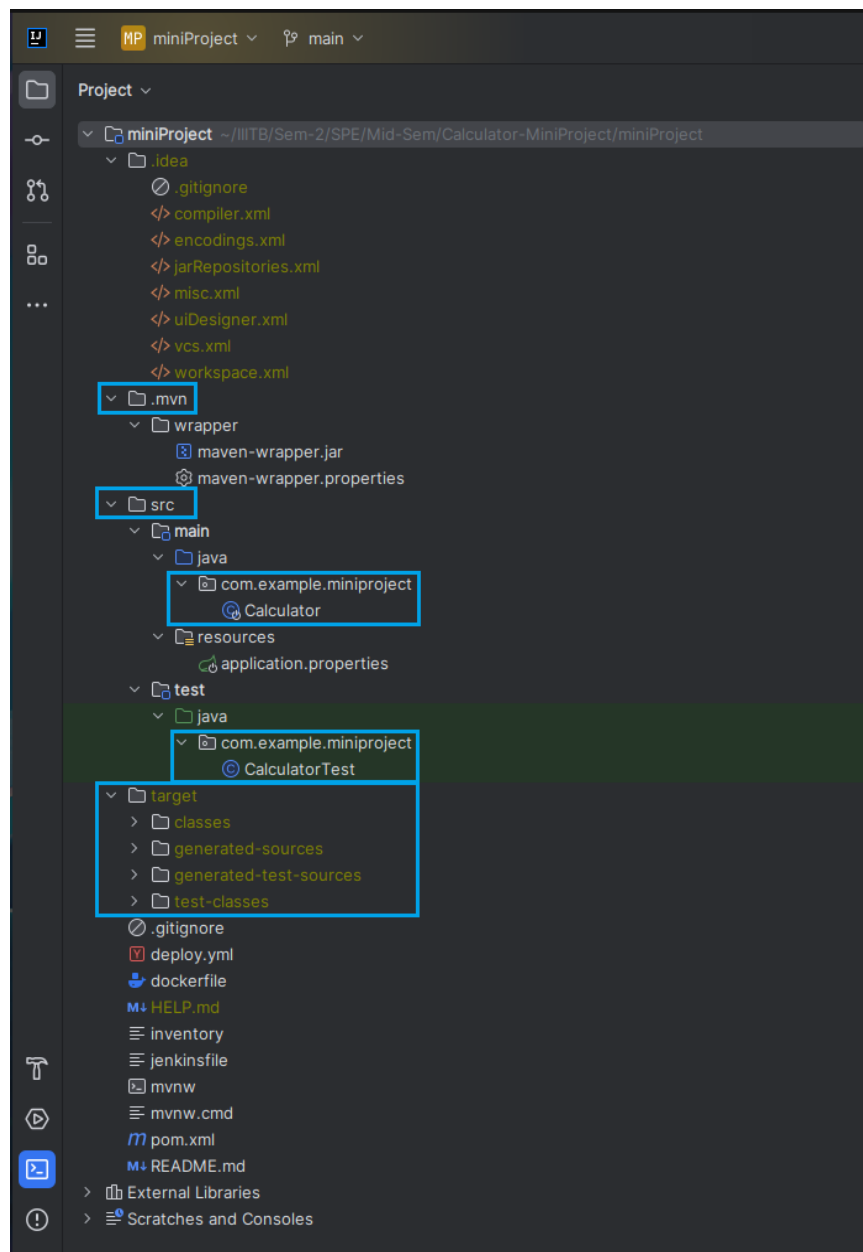
IntelliJ



IntelliJ Project Creation - I



IntelliJ Project Creation - II



Project Directory Structure

```

Test.java Calculator.java deploy.yml dockerfile M+ HELP.md inventory jenkinsfile M+ README.m
<?xml version="1.0" encoding="UTF-8"?>
<project xmlns="http://maven.apache.org/POM/4.0.0" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xsi:schemaLocation="http://maven.apache.org/POM/4.0.0 https://maven.apache.org/xsd/maven-4.0.0.xsd">
  <modelVersion>4.0.0</modelVersion>
  <parent>
    <groupId>org.springframework.boot</groupId>
    <artifactId>spring-boot-starter-parent</artifactId>
    <version>3.2.2</version>
    <relativePath><!-- lookup parent from repository --></relativePath>
  </parent>
  <groupId>com.example</groupId>
  <artifactId>miniProject</artifactId>
  <version>0.0.1-SNAPSHOT</version>
  <name>miniProject</name>
  <description>miniProject</description>
  <properties>
    <java.version>17</java.version>
  </properties>
  <dependencies>
    <dependency>
      <groupId>org.springframework.boot</groupId>
      <artifactId>spring-boot-starter</artifactId>
      <version>3.2.2</version>
    </dependency>
    <dependency>
      <groupId>org.springframework.boot</groupId>
      <artifactId>spring-boot-starter-test</artifactId>
      <version>3.2.2</version>
    </dependency>
    <dependency>
      <groupId>org.springframework.boot</groupId>
      <artifactId>spring-boot-starter-web</artifactId>
      <version>3.2.2</version>
    </dependency>
  </dependencies>

```

Dependency Addition

```

43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60
61
<dependency>
  <groupId>org.junit.jupiter</groupId>
  <artifactId>junit-jupiter-api</artifactId>
  <version>5.10.1</version>
  <scope>test</scope>
</dependency>
</dependencies>

<build>
  <plugins>
    <plugin>
      <groupId>org.springframework.boot</groupId>
      <artifactId>spring-boot-maven-plugin</artifactId>
    </plugin>
  </plugins>
  <finalName>miniProject</finalName>
</build>

```

JUnit Dependency Insertion

```

package com.example.miniproject;

import org.springframework.boot.SpringApplication;
import org.springframework.boot.autoconfigure.SpringBootApplication;
import org.springframework.web.bind.annotation.RestController;

import java.io.BufferedReader;
import java.io.IOException;
import java.io.InputStreamReader;

@SpringBootApplication
@RestController
public class Calculator {

    public static void main(String[] args) throws IOException, InterruptedException {
        SpringApplication.run(Calculator.class, args);
    }
}

```

Java Class libraries and Annotation

```

public static double performFactorial(int n) {
    if (n < 0) {
        System.out.println("Error: Factorial of a negative number is undefined!");
        return Double.NaN;
    } else {
        long factorial = 1;
        for (int i = 1; i <= n; i++) {
            factorial *= i;
        }
        return factorial;
    }
}

```

Factorial Function

```

@Test
public void testPerformFactorial() {
    double result = Calculator.performFactorial(5);
    assertEquals(expected: 120, result, message: "Testing factorial function");
}

```

Factorial Test Case

JENKINS

Dashboard > Manage Jenkins > Tools

Ansible installations

Ansible installations ^ Edited

Add Ansible

Ansible

Name

ansible

Path to ansible executables directory

usr/bin

☒ Install automatically ⓘ

Add installer ▾

Add Ansible

Ansible Installation

Dashboard > Manage Jenkins > Tools

Maven installations

Maven installations ^ Edited

Add Maven

Maven

Name

maven

☒ Install automatically ⓘ

Install from Apache

Version

3.5.6

Add installer ▾

Add Maven

Maven Installation

Dashboard > Manage Jenkins > Tools

Docker installations

Docker installations ^ Edited

Add Docker

Docker

Name

docker

☒ Install automatically ⓘ

Add installer ▾

Add Docker

Save

Apply

Docker Installation

Q pipeline	
Name	Enabled
Docker Pipeline 572.v950f5093843 Build and use Docker containers from pipelines. Report an issue with this plugin	<input checked="" type="checkbox"/>
Pipeline 396.v8c21c963d92d A suite of plugins that lets you orchestrate automation, simple or complex. See Pipeline as Code with Jenkins for more details. Report an issue with this plugin	<input checked="" type="checkbox"/>
Pipeline Graph Analysis Plugin 202.v8_d268e4e0b_3 Provides a REST API to access pipeline and pipeline run data. Report an issue with this plugin	<input type="checkbox"/>
Pipeline: API 1283.v99c10937efcb_ Plugin that defines Pipeline API. Report an issue with this plugin	<input type="checkbox"/>
Pipeline: Basic Steps 1042.vc7b_140c4a_e0c Commonly used steps for Pipelines. Report an issue with this plugin	<input type="checkbox"/>
Pipeline: Build Step 540.vb_e0849e1a_b_00 Adds the Pipeline step build to trigger builds of other jobs. Report an issue with this plugin	<input type="checkbox"/>
Pipeline: Declarative 2.2168.vf921b_4e72c73 An opinionated, declarative Pipeline. Report an issue with this plugin	<input type="checkbox"/>
Pipeline: Declarative Extension Points API 2.2168.vf921b_4e72c73 APIs for extension points used in Declarative Pipelines. Report an issue with this plugin	<input type="checkbox"/>

Pipeline plugins installation

Q docker	
Name	Enabled
CloudBees Docker Build and Publish plugin 1.4.0 This plugin enables building Dockerfile based projects, as well as publishing of the built images/repos to the docker registry. Report an issue with this plugin	<input checked="" type="checkbox"/>
Docker API Plugin 3.3.4-06.v390_8_3e0e342c This plugin provides docker-java API for other plugins. Report an issue with this plugin	<input type="checkbox"/>
This plugin is up for adoption! We are looking for new maintainers. Visit our Adopt a Plugin initiative for more information.	
Docker Commons Plugin 439.v8_3cb_0a_0a_f0_39 Provides the common shared functionality for various Docker related plugins. Report an issue with this plugin	<input type="checkbox"/>
Docker Pipeline 572.v950f5093843 Build and use Docker containers from pipelines. Report an issue with this plugin	<input checked="" type="checkbox"/>
docker-build-step 2.11 This plugin allows to add various docker commands to your job as build steps. Report an issue with this plugin	<input checked="" type="checkbox"/>

Docker plugins installation

Q github	
Name	Enabled
GitHub 1.37.3.1 This plugin integrates GitHub to Jenkins. Report an issue with this plugin	<input type="checkbox"/>
GitHub API Plugin 1.318-461.v7a_c09c9fa_063 This plugin provides GitHub API for other plugins. Report an issue with this plugin	<input type="checkbox"/>
GitHub Branch Source Plugin 1772.v8_09eda_d018d4 Multibranch projects and organization folders from GitHub. Maintained by CloudBees, Inc. Report an issue with this plugin	<input checked="" type="checkbox"/>
Pipeline: GitHub Groovy Libraries 42.v0739460c0a_c4 Allows Pipeline Groovy libraries to be loaded on the fly from GitHub. Report an issue with this plugin	<input checked="" type="checkbox"/>

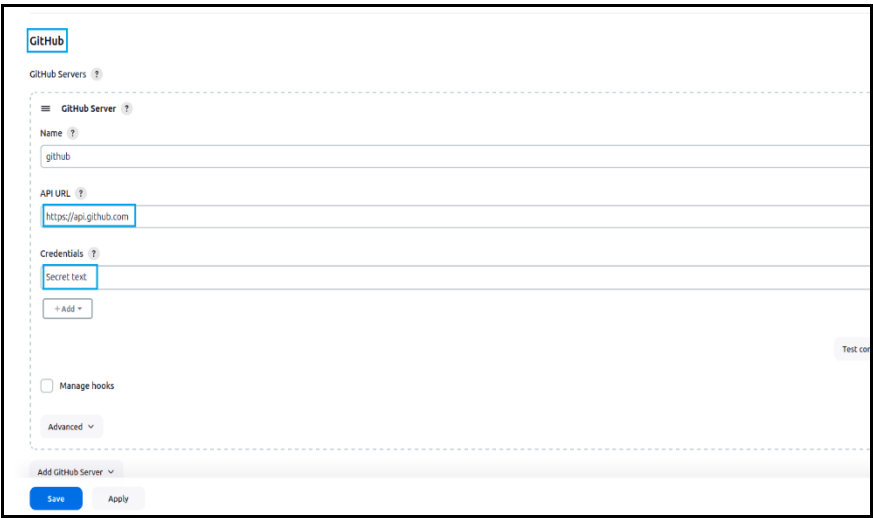
GitHub plugins installation



Ansible plugins installation



Fig. 5.4.8 Adding Admin e-mail Address



Adding GitHub Server Credentials

DashboardManage JenkinsCredentials

System

(global)

a5b2b263-07ba-43f2-af9a-7a1862d3de5a

Secret text

System

(global)

f59f6cd7-ed0b-494c-941a-334111b4185b

Secret text

System

(global)

b77e1fe3-d8bc-44d6-a1b5-cf3d699b0807

Secret text

System

(global)

6343e3ff-9f21-4efb-99b7-ea7cffe64536

Secret text

System

(global)

a3a90af1-e8a2-430b-b737-b99ef8639c5a

Secret text

System

(global)

19ca0060-e304-47c9-b25c-4db58ff59df6

Secret text

System

(global)

8f5f1729-664c-4050-9400-d8a1573450d

Secret text

System

(global)

nalkraj

nalkraj

System

(global)

demo

demo

System

(global)

demo2

demo2

System

(global)

localhost

vraj-nali/***** (login user credentials)

Stores scoped to Jenkins

PStore :

Domains

System

(global)

Icons: SML

Selecting Required Credentials

DashboardminiProject-Calculator

StatusminiProject-Calculator

Changes

Build Now

Configure

Delete Pipeline

Full Stage View

GitHub

Rename

Pipeline Syntax

Build History

trend

Filter builds...

#1Feb 16, 2024, 2:06 PM

#2Feb 16, 2024, 12:22 PM

#3Feb 16, 2024, 12:20 PM

#4Feb 16, 2024, 12:19 PM

#5Feb 16, 2024, 12:17 PM

Assum feed for all

Assum feed for failures

Stage View

	Declarative: Tool Install	Build Maven	JUnit Tests	Build docker image	Push to docker hub	Stop and Remove Existing Container	Run Ansible Playbook
Average stage times: (Average full run time: ~49s)	453ms	10s	5s	6s	29s	2s	10s
Feb 16 14:06	656ms	21s	5s	14s	27s	4s	14s
Feb 16 12:22	411ms	9s	6s	4s	35s	1s	6s
Feb 16 12:09	410ms	8s	5s	4s	28s	2s	
Feb 16 12:19	410ms	8s	5s	4s	25s		
Feb 16 12:18	423ms	9s	5s	5s			
Feb 16 12:17	411ms	8s	5s				

Running Pipeline in Jenkins

```

pipeline {
    agent any
    tools {
        maven 'maven'
    }
    stages {

        // Stage to checkout source code and build with Maven
        stage('Build Maven') {
            steps {
                // Checkout source code from Git repository
                checkout scmGit(branches: [[name: '*/main']], extensions: [],
userRemoteConfigs: [[url: 'https://github.com/NaikVRaj/miniProject/']])
                // Build project with Maven
                sh 'mvn clean install'
            }
        }

        // Stage to run JUnit tests
        stage('JUnit Tests') {
            steps {
                // Run JUnit tests with Maven
                sh 'mvn test'
            }
        }

        // Stage to build Docker image
        stage('Build docker image') {
            steps {
                script {
                    // Build Docker image
                    sh 'docker build -t naikvraj/miniProject .'
                }
            }
        }

        // Stage to push Docker image to Docker Hub
        stage('Push to docker hub') {
            steps {
                script {
                    // Login to Docker Hub with credentials
                    withCredentials([string(credentialsId: 'demo2', variable:
'speminiproject')]) {
                        sh 'docker login -u naikvraj -p ${speminiproject}'
                    }
                    // Push Docker image to Docker Hub
                    sh 'docker push naikvraj/miniProject'
                }
            }
        }

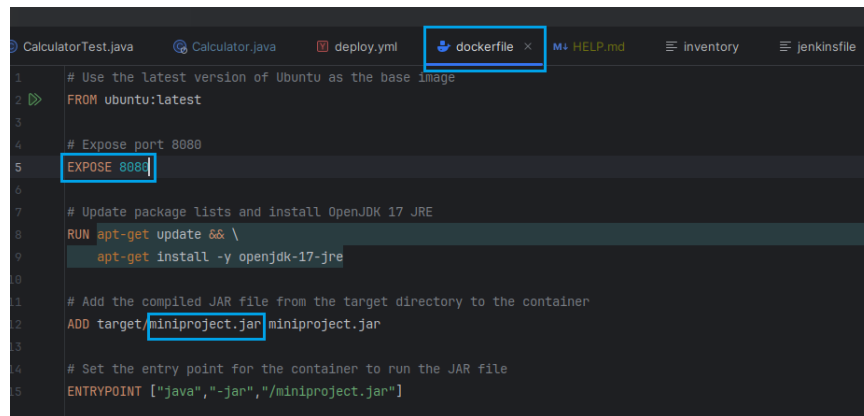
        // Stage to stop and remove existing Docker container
        stage('Stop and Remove Existing Container') {
            steps {
                script {
                    // Stop and remove existing Docker container named miniProject if
it exists then
                    sh 'docker rm -f miniProject || true'
                }
            }
        }

        // Stage to run Ansible playbook for deployment
        stage('Run Ansible Playbook') {
            steps {
                script {
                    // Run Ansible playbook for deployment
                    ansiblePlaybook(
                        playbook: 'deploy.yml',
                        inventory: 'inventory'
                    )
                }
            }
        }
    }
}

```

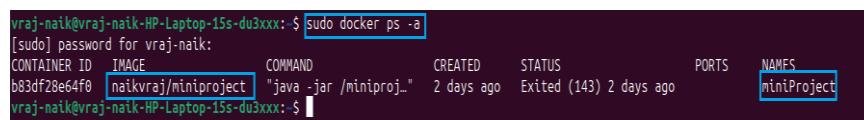
Jenkins Piepline Script

DOCKER



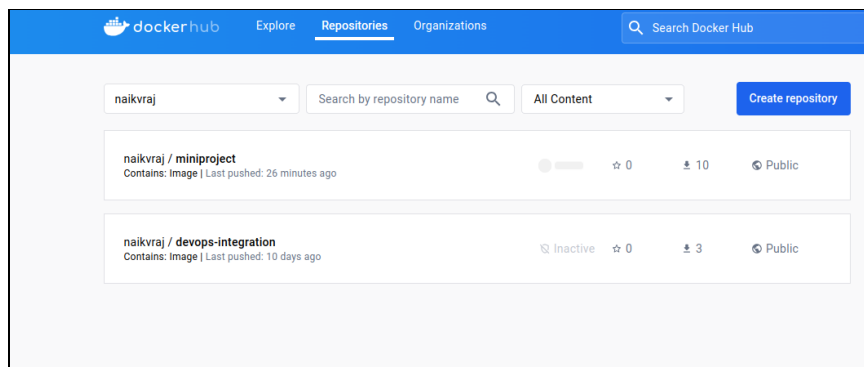
```
1 # Use the latest version of Ubuntu as the base image
2 FROM ubuntu:latest
3
4 # Expose port 8080
5 EXPOSE 8080
6
7 # Update package lists and install OpenJDK 17 JRE
8 RUN apt-get update && \
9     apt-get install -y openjdk-17-jre
10
11 # Add the compiled JAR file from the target directory to the container
12 ADD target/miniproject.jar miniproject.jar
13
14 # Set the entry point for the container to run the JAR file
15 ENTRYPOINT ["java", "-jar", "/miniproject.jar"]
```

DockerFile



```
vraj-naik@vraj-naik-HP-Laptop-15s-du3xxx:~$ sudo docker ps -a
[sudo] password for vraj-naik:
CONTAINER ID   IMAGE          COMMAND                  CREATED    STATUS    PORTS    NAMES
b83df28e64f0   naikvraj/miniproject   "java -jar /miniproj.."  2 days ago    Exited (143) 2 days ago    miniProject
vraj-naik@vraj-naik-HP-Laptop-15s-du3xxx:~$
```

Containers on the system



dockerhub Explore Repositories Organizations Search Docker Hub

naikvraj Search by repository name All Content Create repository

naikvraj / miniproject	Contains: image Last pushed: 26 minutes ago	0	10	Public
naikvraj / devops-integration	Contains: image Last pushed: 10 days ago	Inactive	3	Public

DockerHub repository

```
vraj-naik@vraj-naik-HP-Laptop-15s-du3xxx:~$ sudo docker ps -a
```

CONTAINER ID	IMAGE	COMMAND	CREATED	STATUS	PORTS	NAMES
8a99d3996b39	naikvraj/miniProject	"java -jar /miniProj..."	27 minutes ago	Exited (0) 19 minutes ago		miniProject
a267f6f02899	user_creator	"/create_users.sh"	5 days ago	Exited (255) 3 days ago		user_creation_container
8f4fabcc3871a	ubuntu	"/bin/bash"	5 days ago	Created		hopeful_lanarr


```
vraj-naik@vraj-naik-HP-Laptop-15s-du3xxx:~$ sudo docker images
```

REPOSITORY	TAG	IMAGE ID	CREATED	SIZE
naikvraj/miniProject	latest	8d2df1f530ce	29 minutes ago	691MB
naikvraj/miniProject	<none>	7a688d2ec0bf	41 minutes ago	691MB
naikvraj/miniProject	<none>	8a9c5432a533	3 days ago	691MB
naikvraj/miniProject	<none>	6fe011cd1423	3 days ago	691MB
naikvraj/miniProject	<none>	f9cdfcae0d34	5 days ago	691MB
user_creator	latest	fe1db832ad7d	5 days ago	77.9MB
naikvraj/miniProject	<none>	d35ce7c21495	9 days ago	691MB
naikvraj/miniProject	<none>	c593e729d4f9	9 days ago	691MB
naikvraj/miniProject	<none>	65b2f070ab1d	9 days ago	691MB
naikvraj/miniProject	<none>	95f797fde882	9 days ago	691MB
<none>	<none>	842becf92c9a	9 days ago	691MB
naikvraj/miniProject	<none>	b03ba115e57b	9 days ago	691MB
naikvraj/miniProject	<none>	cbe22328bb98	9 days ago	691MB
naikvraj/miniProject	<none>	8a27300ab785	9 days ago	691MB
naikvraj/miniProject	<none>	0f5e7df0bf06	9 days ago	691MB
naikvraj/miniProject	<none>	077d33bec3f0	9 days ago	691MB
<none>	<none>	5de7bd1b134a	9 days ago	691MB
<none>	<none>	991cde594c2	9 days ago	691MB
naikvraj/devops-Integration	latest	aed7664397bf	10 days ago	680MB
naikvraj/devops-Integration	<none>	d26a82d94c04	11 days ago	680MB
naikvraj/devops-Integration	<none>	e8a0672b34b1	11 days ago	680MB
naikvraj/devops-Integration	<none>	b3f3aa2661b9	11 days ago	680MB
naikvraj/devops-Integration	<none>	6eb162c4816d	12 days ago	680MB
naikvraj/devops-Integration	<none>	fb0414881c2a	12 days ago	680MB
naikvraj/devops-Integration	<none>	004b11f25a5e	12 days ago	680MB
naikvraj/devops-Integration	<none>	8b9986089258	12 days ago	680MB
naikvraj/devops-Integration	<none>	1673ee7cc08c	12 days ago	680MB
naikvraj/devops-Integration	<none>	abe091a0bf01	12 days ago	680MB
naikvraj/devops-Integration	<none>	c3712e39c066	12 days ago	680MB
naikvraj/devops-Integration	<none>	77f9693d5d09	12 days ago	680MB
naikvraj/devops-Integration	<none>	29febd7702d1	12 days ago	680MB
naikvraj/devops-Integration	<none>	2a461cf29af6	12 days ago	680MB
naikvraj/devops-Integration	<none>	6d46c6c23966	12 days ago	680MB
naikvraj/devops-Integration	<none>	f83871432d8a	12 days ago	680MB
naikvraj/devops-Integration	<none>	3c415a81145b	12 days ago	1.08GB
naikvraj/devops-Integration	<none>	e4989d349735	12 days ago	1.08GB
naikvraj/devops-Integration	<none>	8b39ca5f0315	12 days ago	1.08GB
<none>	<none>	6f0afeed160	12 days ago	1.08GB
naikvraj/devops-Integration	<none>	156afbb495be	12 days ago	546MB
naikvraj/devops-Integration	<none>	7c67437e9748	2 weeks ago	546MB

Docker images and containers

1.5 ANSIBLE

```
CalculatorTest.java Calculator.java deploy.yml x dockerfile M+ HELP.md Inventory jenkinsfile M+ R...
```

```

1 ---
2 - name: Pull Docker Image from Docker Hub
3   hosts: localhost
4   remote_user: vraj-naik
5   # connection: local
6   become: false
7   tasks:
8     - name: Pull Docker Image
9       docker_image:
10        name: "naikvraj/miniProject"
11        source: pull
12        register: docker_pull_result
13
14    - name: Display Docker Pull Result
15      debug:
16        var: docker_pull_result
17
18    - name: Start Docker service
19      service:
20        name: docker
21        state: started
22
23    - name: Running container
24      shell: docker run -it -d --name miniProject naikvraj/miniProject

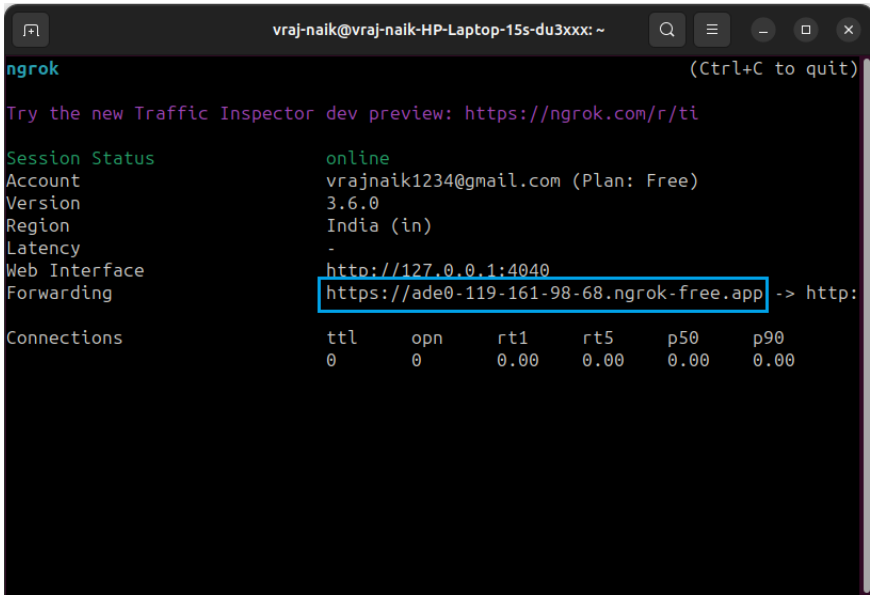
```

deploy.yml File

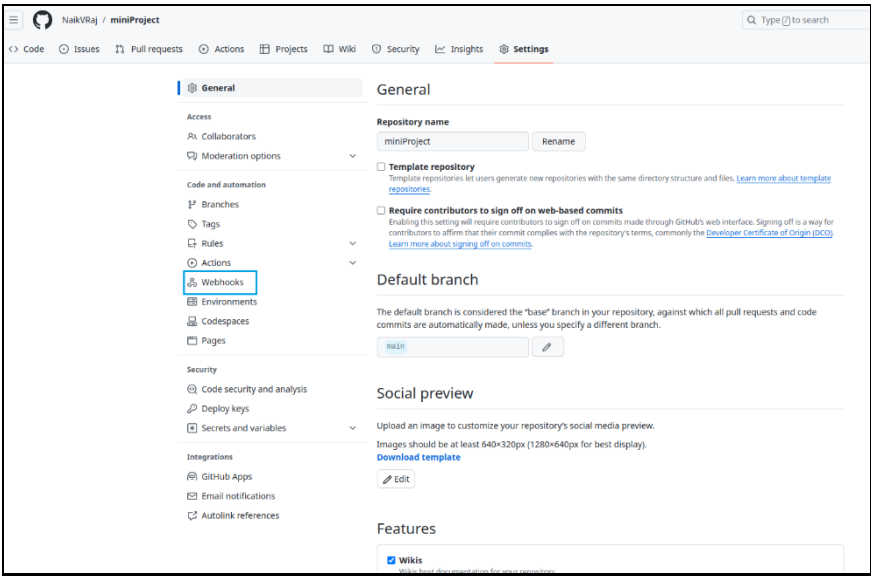
```
ansible_host = localhost ansible_user=vraj-naik ansible_ssh_pass=Vnaik@5421
ansible_ssh_common_args = '-o StrictHostKeyChecking=no'
```

Inventory File

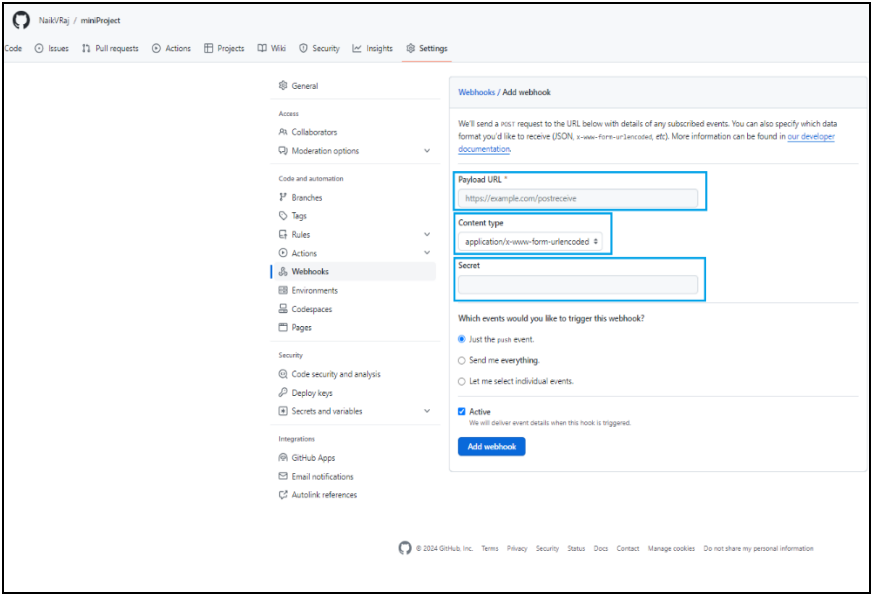
NGROK AND WEBHOOK



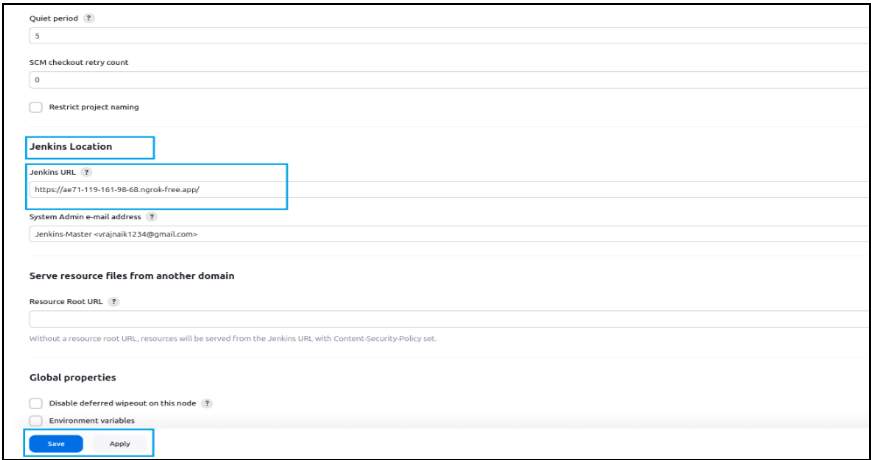
ngrok payload URL



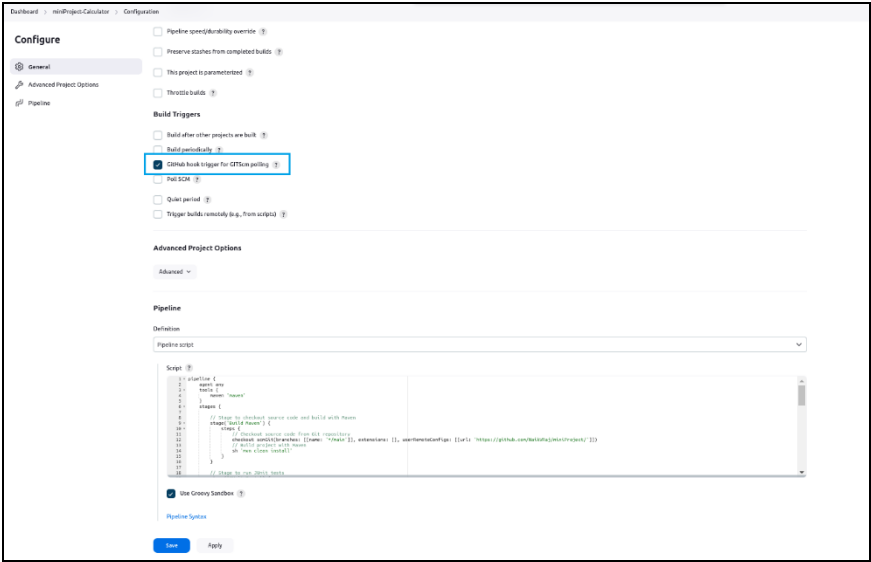
GitHub Webhook



Add Webhook

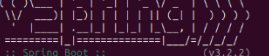


Jenkins Configuration



Jenkins Github Trigger

RUNNING PROJECT

```
vraj-nak@vraj-nak-HP-Laptop-15s-du3xxx~  
vraj-nak@vraj-nak-HP-Laptop-15s-du3xxx:~$ sudo docker start -a -l miniProject  
  
[INFO] 2024-02-25T11:07:21.348Z [main] com.example.miniproject.Calculator : Starting Calculator v0.0.1-SNAPSHOT using Java 17.0.9 with PID 1 (/miniproject.jar started by root "ln")  
[INFO] 2024-02-25T11:07:21.353Z [main] o.s.b.w.embedded.tomcat.TomcatWebServer : Tomcat initialized with port 8081 (http)  
[INFO] 2024-02-25T11:07:22.334Z [main] o.apache.catalina.core.StandardService : Starting service [Tomcat]  
[INFO] 2024-02-25T11:07:22.346Z [main] o.apache.catalina.core.StandardEngine : Starting Servlet engine: [Apache Tomcat/10.1.18]  
[INFO] 2024-02-25T11:07:22.392Z [main] o.o.a.c.c.f.TomcatLocalHostContext : Initializing Spring embedded WebApplicationContext  
[INFO] 2024-02-25T11:07:22.396Z [main] w.s.c.ServletWebServerApplicationContext : Root WebApplicationContext: initialization completed in 922 ms  
[INFO] 2024-02-25T11:07:22.698Z [main] o.s.b.w.embedded.tomcat.TomcatWebServer : Tomcat started on port 8081 (http) with context path ''  
[INFO] 2024-02-25T11:07:22.712Z [main] com.example.miniproject.Calculator : Started Calculator in 1.773 seconds (process running for 2.19)
```

Running docker image

```
*****
*           Welcome to Scientific      *
*           Calculator                 *
*****

Choose an operation:
1. Addition (+)
2. Subtraction (-)
3. Multiplication (x)
4. Division (?)
5. Sine (sin)
6. Cosine (cos)
7. Tangent (tan)
8. Power (^)
9. Pi (?)
10. Square Root (?)
11. Factorial (x!)
12. Logarithm (log)
0. Exit

Enter your choice: 1

Enter the first number:
12

Enter the second number:
23

2024-02-25T11:08:06.995Z INFO 1 --- [main] com.example.miniproject.Calculator : Addition of 12.0 and 23.0 is: 35.0
```

Addition

```
*****
*           Welcome to Scientific      *
*           Calculator                 *
*****

Choose an operation:
1. Addition (+)
2. Subtraction (-)
3. Multiplication (x)
4. Division (/)
5. Sine (sin)
6. Cosine (cos)
7. Tangent (tan)
8. Power (^)
9. PI (π)
10. Square Root (√)
11. Factorial (x!)
12. Logarithm (log)
0. Exit

Enter your choice: 2

Enter the first number:
12
Enter the second number:
23
2024-02-25T11:08:09.380Z INFO 1 --- [main] com.example.miniproject.Calculator : Subtraction of 12.0 and 23.0 is: -11.0
Subtraction of 12.0 and 23.0 is: -11.0
```

Subtraction

```
*****
*               Welcome to Scientific          *
*               Calculator                     *
*****

Choose an operation:
1. Addition (+)
2. Subtraction (-)
3. Multiplication (x)
4. Division (?)
5. Sine (sin)
6. Cosine (cos)
7. Tangent (tan)
8. Power (^)
9. Pi (?)
10. Square Root (?)
11. Factorial (x!)
12. Logarithm (log)
0. Exit

Enter your choice: 3

Enter the first number:
12

Enter the second number:
34

2024-02-25T11:08:13.898Z INFO 1 --- [main] com.example.miniproject.Calculator : Multiplication of 12.0 and 34.0 is: 408.0
```

Multiplication


```
*****
*           Welcome to Scientific           *
*           Calculator                     *
*****

Choose an operation:
1. Addition (+)
2. Subtraction (-)
3. Multiplication (x)
4. Division (?)
5. Sine (sin)
6. Cosine (cos)
7. Tangent (tan)
8. Power (^)
9. PI (?)
10. Square Root (?)
11. Factorial (x!)
12. Logarithm (log)
0. Exit

Enter your choice: 3

Enter the first number:
23

Enter the second number:
-7

2024-02-25T11:08:16.859Z  INFO 1 --- [          main] com.example.miniproject.Calculator      : Multiplication of 23.0 and -7.0 is: -161.0
Multiplication of 23.0 and -7.0 is: -161.0
```

Multiplication with negative

```
*****
*           Welcome to Scientific           *
*           Calculator                     *
*****

Choose an operation:
1. Addition (+)
2. Subtraction (-)
3. Multiplication (x)
4. Division (?)
5. Sine (sin)
6. Cosine (cos)
7. Tangent (tan)
8. Power (^)
9. PI (?)
10. Square Root (?)
11. Factorial (x!)
12. Logarithm (log)
0. Exit

Enter your choice: 4

Enter the first number:
12

Enter the second number:
6

2024-02-25T11:08:21.780Z  INFO 1 --- [          main] com.example.miniproject.Calculator      : Division of 12.0 and 6.0 is: 2.0
Division of 12.0 and 6.0 is: 2.0
```

Division

```
*****
*           Welcome to Scientific           *
*           Calculator                     *
*****

Choose an operation:
1. Addition (+)
2. Subtraction (-)
3. Multiplication (x)
4. Division (?)
5. Sine (sin)
6. Cosine (cos)
7. Tangent (tan)
8. Power (^)
9. PI (?)
10. Square Root (?)
11. Factorial (x!)
12. Logarithm (log)
0. Exit

Enter your choice: 4

Enter the first number:
12

Enter the second number:
0

2024-02-25T11:08:25.337Z  ERROR 1 --- [          main] com.example.miniproject.Calculator      : Error: Division by zero!
2024-02-25T11:08:25.337Z  ERROR 1 --- [          main] com.example.miniproject.Calculator      : Error: Division by zero occurred!
2024-02-25T11:08:25.338Z  INFO 1 --- [          main] com.example.miniproject.Calculator      : Division of 12.0 and 0.0 is: Infinity
Division of 12.0 and 0.0 is: Infinity
```

Divison by Zero

```
*****
*           Welcome to Scientific           *
*           Calculator                       *
*****

Choose an operation:
1. Addition (+)
2. Subtraction (-)
3. Multiplication (x)
4. Division (?)
5. Sine (sin)
6. Cosine (cos)
7. Tangent (tan)
8. Power (^)
9. PI (?)
10. Square Root (?)
11. Factorial (x!)
12. Logarithm (log)
0. Exit

Enter your choice: 4

Enter the first number:
12
Enter the second number:
-78
2024-02-25T11:08:29.377Z INFO 1 --- [          main] com.example.miniproject.Calculator : Division of 12.0 and -78.0 is: -0.15384615384615385
Division of 12.0 and -78.0 is: -0.15384615384615385
```

Division by negative

```
*****
*           Welcome to Scientific           *
*           Calculator                       *
*****

Choose an operation:
1. Addition (+)
2. Subtraction (-)
3. Multiplication (x)
4. Division (?)
5. Sine (sin)
6. Cosine (cos)
7. Tangent (tan)
8. Power (^)
9. PI (?)
10. Square Root (?)
11. Factorial (x!)
12. Logarithm (log)
0. Exit

Enter your choice: 5

Enter the number:
12
2024-02-25T11:08:32.892Z INFO 1 --- [          main] com.example.miniproject.Calculator : Sine of 12.0 is: 0.5365729180004349
Sine of 12.0 is: 0.5365729180004349
```

Sine

```
*****
*           Welcome to Scientific           *
*           Calculator                       *
*****

Choose an operation:
1. Addition (+)
2. Subtraction (-)
3. Multiplication (x)
4. Division (?)
5. Sine (sin)
6. Cosine (cos)
7. Tangent (tan)
8. Power (^)
9. PI (?)
10. Square Root (?)
11. Factorial (x!)
12. Logarithm (log)
0. Exit

Enter your choice: 5

Enter the number:
-7
2024-02-25T11:08:38.741Z INFO 1 --- [          main] com.example.miniproject.Calculator : Sine of -7.0 is: -0.6569865987187891
Sine of -7.0 is: -0.6569865987187891
```

Sine of negative

```
*****
*           Welcome to Scientific           *
*           Calculator                       *
*****

Choose an operation:
1. Addition (+)
2. Subtraction (-)
3. Multiplication (x)
4. Division (?)
5. Sine (sin)
6. Cosine (cos)
7. Tangent (tan)
8. Power (^)
9. PI (?)
10. Square Root (?)
11. Factorial (x!)
12. Logarithm (log)
0. Exit

Enter your choice: 5

Enter the number:
0
2024-02-25T11:08:42.274Z INFO 1 --- [          main] com.example.miniproject.Calculator : Sine of 0.0 is: 0.0
Sine of 0.0 is: 0.0
```

Sine of zero

```
*****
*           Welcome to Scientific           *
*           Calculator                       *
*****

Choose an operation:
1. Addition (+)
2. Subtraction (-)
3. Multiplication (x)
4. Division (/)
5. Sine (sin)
6. Cosine (cos)
7. Tangent (tan)
8. Power (^)
9. PI (?)
10. Square Root (?)
11. Factorial (x!)
12. Logarithm (log)
0. Exit

Enter your choice: 6

Enter the number:
0
2024-02-25T11:08:55.452Z INFO 1 --- [main] com.example.miniproject.Calculator : Cosine of 0.0 is:1.0
Cosine of 0.0 is:1.0
```

Cosine of zero

```
*****
*           Welcome to Scientific           *
*           Calculator                       *
*****

Choose an operation:
1. Addition (+)
2. Subtraction (-)
3. Multiplication (x)
4. Division (/)
5. Sine (sin)
6. Cosine (cos)
7. Tangent (tan)
8. Power (^)
9. PI (?)
10. Square Root (?)
11. Factorial (x!)
12. Logarithm (log)
0. Exit

Enter your choice: 6

Enter the number:
56
2024-02-25T11:09:04.435Z INFO 1 --- [main] com.example.miniproject.Calculator : Cosine of 56.0 is:0.8532201077225842
Cosine of 56.0 is:0.8532201077225842
```

Cosine

```
*****
*           Welcome to Scientific           *
*           Calculator                       *
*****

Choose an operation:
1. Addition (+)
2. Subtraction (-)
3. Multiplication (x)
4. Division (/)
5. Sine (sin)
6. Cosine (cos)
7. Tangent (tan)
8. Power (^)
9. PI (?)
10. Square Root (?)
11. Factorial (x!)
12. Logarithm (log)
0. Exit

Enter your choice: 7

Enter the number:
12
2024-02-25T11:09:10.656Z INFO 1 --- [main] com.example.miniproject.Calculator : Tangent of 12.0 is:-0.6358599286615808
Tangent of 12.0 is:-0.6358599286615808
```

Tangent

```
*****
*           Welcome to Scientific           *
*           Calculator                       *
*****

Choose an operation:
1. Addition (+)
2. Subtraction (-)
3. Multiplication (x)
4. Division (/)
5. Sine (sin)
6. Cosine (cos)
7. Tangent (tan)
8. Power (^)
9. PI (?)
10. Square Root (?)
11. Factorial (x!)
12. Logarithm (log)
0. Exit

Enter your choice: 7

Enter the number:
-7
2024-02-25T11:09:14.777Z INFO 1 --- [main] com.example.miniproject.Calculator : Tangent of -7.0 is:-0.8714479827243188
Tangent of -7.0 is:-0.8714479827243188
```

Tangent of negative

```
*****
*           Welcome to Scientific           *
*           Calculator                       *
*****

Choose an operation:
1. Addition (+)
2. Subtraction (-)
3. Multiplication (x)
4. Division (?)
5. Sine (sin)
6. Cosine (cos)
7. Tangent (tan)
8. Power (^)
9. Pi (?)
10. Square Root (?)
11. Factorial (x!)
12. Logarithm (log)
0. Exit

Enter your choice: 8

Enter the first number:
12
Enter the second number:
2
2024-02-25T11:09:18.813Z  INFO 1 --- [          main] com.example.miniproject.Calculator : Power of 12.0 and 2.0 is: 144.0
Power of 12.0 and 2.0 is: 144.0
```

Power

```
*****
*           Welcome to Scientific           *
*           Calculator                       *
*****

Choose an operation:
1. Addition (+)
2. Subtraction (-)
3. Multiplication (x)
4. Division (?)
5. Sine (sin)
6. Cosine (cos)
7. Tangent (tan)
8. Power (^)
9. Pi (?)
10. Square Root (?)
11. Factorial (x!)
12. Logarithm (log)
0. Exit

Enter your choice: 8

Enter the first number:
12
Enter the second number:
0
2024-02-25T11:09:23.826Z  INFO 1 --- [          main] com.example.miniproject.Calculator : Power of 12.0 and 0.0 is: 1.0
Power of 12.0 and 0.0 is: 1.0
```

Zero Power

```
*****
*           Welcome to Scientific           *
*           Calculator                       *
*****

Choose an operation:
1. Addition (+)
2. Subtraction (-)
3. Multiplication (x)
4. Division (?)
5. Sine (sin)
6. Cosine (cos)
7. Tangent (tan)
8. Power (^)
9. Pi (?)
10. Square Root (?)
11. Factorial (x!)
12. Logarithm (log)
0. Exit

Enter your choice: 8

Enter the first number:
12
Enter the second number:
-8
2024-02-25T11:09:27.848Z  INFO 1 --- [          main] com.example.miniproject.Calculator : Power of 12.0 and -8.0 is: 2.3256803936137784E-9
Power of 12.0 and -8.0 is: 2.3256803936137784E-9
```

Negative Power

```
*****
*           Welcome to Scientific           *
*           Calculator                       *
*****

Choose an operation:
1. Addition (+)
2. Subtraction (-)
3. Multiplication (x)
4. Division (?)
5. Sine (sin)
6. Cosine (cos)
7. Tangent (tan)
8. Power (^)
9. Pi (?)
10. Square Root (?)
11. Factorial (x!)
12. Logarithm (log)
0. Exit

Enter your choice: 9
2024-02-25T11:09:32.486Z  INFO 1 --- [          main] com.example.miniproject.Calculator :
? = 3.141592653589793
? = 3.141592653589793
```

Pi

```
*****
*           Welcome to Scientific           *
*           Calculator                       *
*****

Choose an operation:
1. Addition (+)
2. Subtraction (-)
3. Multiplication (x)
4. Division (?)
5. Sine (sin)
6. Cosine (cos)
7. Tangent (tan)
8. Power (^)
9. Pi (?)
10. Square Root (?)
11. Factorial (x!)
12. Logarithm (log)
0. Exit

Enter your choice: 10

Enter the number:
16
2024-02-25T11:09:40.354Z INFO 1 --- [main] com.example.miniproject.Calculator : Square Root of 16.0 is:4.0
Square Root of 16.0 is:4.0
```

Square Root

```
*****
*           Welcome to Scientific           *
*           Calculator                       *
*****

Choose an operation:
1. Addition (+)
2. Subtraction (-)
3. Multiplication (x)
4. Division (?)
5. Sine (sin)
6. Cosine (cos)
7. Tangent (tan)
8. Power (^)
9. Pi (?)
10. Square Root (?)
11. Factorial (x!)
12. Logarithm (log)
0. Exit

Enter your choice: 10

Enter the number:
123
2024-02-25T11:09:45.269Z INFO 1 --- [main] com.example.miniproject.Calculator : Square Root of 123.0 is:11.090536506409418
Square Root of 123.0 is:11.090536506409418
```

Square Root - 2

```
*****
*           Welcome to Scientific           *
*           Calculator                       *
*****

Choose an operation:
1. Addition (+)
2. Subtraction (-)
3. Multiplication (x)
4. Division (?)
5. Sine (sin)
6. Cosine (cos)
7. Tangent (tan)
8. Power (^)
9. Pi (?)
10. Square Root (?)
11. Factorial (x!)
12. Logarithm (log)
0. Exit

Enter your choice: 10

Enter the number:
-134
2024-02-25T11:09:49.170Z ERROR 1 --- [main] com.example.miniproject.Calculator : Error: Square root of a negative number is undefined!
2024-02-25T11:09:49.179Z INFO 1 --- [main] com.example.miniproject.Calculator : Square Root of -134.0 is:NaN
Square Root of -134.0 is:NaN
```

Square Root of negative

```
*****
*           Welcome to Scientific           *
*           Calculator                       *
*****

Choose an operation:
1. Addition (+)
2. Subtraction (-)
3. Multiplication (x)
4. Division (?)
5. Sine (sin)
6. Cosine (cos)
7. Tangent (tan)
8. Power (^)
9. Pi (?)
10. Square Root (?)
11. Factorial (x!)
12. Logarithm (log)
0. Exit

Enter your choice: 10

Enter the number:
0
2024-02-25T11:09:50.918Z INFO 1 --- [main] com.example.miniproject.Calculator : Square Root of 0.0 is:0.0
Square Root of 0.0 is:0.0
```

Square Root of Zero

```
*****
*           Welcome to Scientific           *
*           Calculator                       *
*****

Choose an operation:
1. Addition (+)
2. Subtraction (-)
3. Multiplication (x)
4. Division (?)
5. Sine (sin)
6. Cosine (cos)
7. Tangent (tan)
8. Power (^)
9. PI (?)
10. Square Root (?)
11. Factorial (x!)
12. Logarithm (log)
0. Exit

Enter your choice: 11

Enter the number:
12
2024-02-25T11:09:54.306Z INFO 1 --- [main] com.example.miniproject.Calculator : Factorial of 12.0 is:4.790016E8
Factorial of 12.0 is:4.790016E8
```

Factorial

```
*****
*           Welcome to Scientific           *
*           Calculator                       *
*****

Choose an operation:
1. Addition (+)
2. Subtraction (-)
3. Multiplication (x)
4. Division (?)
5. Sine (sin)
6. Cosine (cos)
7. Tangent (tan)
8. Power (^)
9. PI (?)
10. Square Root (?)
11. Factorial (x!)
12. Logarithm (log)
0. Exit

Enter your choice: 11

Enter the number:
-1
2024-02-25T11:10:00.814Z ERROR 1 --- [main] com.example.miniproject.Calculator : Error: Factorial of a negative number is undefined!
2024-02-25T11:10:00.815Z INFO 1 --- [main] com.example.miniproject.Calculator : Factorial of -1.0 is:NaN
Factorial of -1.0 is:NaN
```

Factorial of negative

```
*****
*           Welcome to Scientific           *
*           Calculator                       *
*****

Choose an operation:
1. Addition (+)
2. Subtraction (-)
3. Multiplication (x)
4. Division (?)
5. Sine (sin)
6. Cosine (cos)
7. Tangent (tan)
8. Power (^)
9. PI (?)
10. Square Root (?)
11. Factorial (x!)
12. Logarithm (log)
0. Exit

Enter your choice: 11

Enter the number:
0
2024-02-25T11:10:09.922Z INFO 1 --- [main] com.example.miniproject.Calculator : Factorial of 0.0 is:1.0
Factorial of 0.0 is:1.0
```

Factorial of zero

```
*****
*           Welcome to Scientific           *
*           Calculator                       *
*****

Choose an operation:
1. Addition (+)
2. Subtraction (-)
3. Multiplication (x)
4. Division (?)
5. Sine (sin)
6. Cosine (cos)
7. Tangent (tan)
8. Power (^)
9. PI (?)
10. Square Root (?)
11. Factorial (x!)
12. Logarithm (log)
0. Exit

Enter your choice: 12

Enter the number:
12
2024-02-25T11:10:14.350Z INFO 1 --- [main] com.example.miniproject.Calculator : Logarithm of 12.0 is:2.4849066497880004
Logarithm of 12.0 is:2.4849066497880004
```

Log

```
*****
*           Welcome to Scientific           *
*           Calculator                     *
*****

Choose an operation:
1. Addition (+)
2. Subtraction (-)
3. Multiplication (x)
4. Division (?)
5. Sine (sin)
6. Cosine (cos)
7. Tangent (tan)
8. Power (^)
9. Pi (?)
10. Square Root (?)
11. Factorial (x!)
12. Logarithm (log)
0. Exit

Enter your choice: 12

Enter the number:
0
2024-02-25T11:10:16.774Z ERROR 1 --- [main] con.example.miniproject.Calculator : Error: Logarithm of a non-positive number is undefined!
2024-02-25T11:10:16.774Z INFO 1 --- [main] con.example.miniproject.Calculator : Logarithm of 0.0 is:NaN
Logarithm of 0.0 is:NaN
```

Log of Zero

```
*****
*           Welcome to Scientific           *
*           Calculator                     *
*****

Choose an operation:
1. Addition (+)
2. Subtraction (-)
3. Multiplication (x)
4. Division (?)
5. Sine (sin)
6. Cosine (cos)
7. Tangent (tan)
8. Power (^)
9. Pi (?)
10. Square Root (?)
11. Factorial (x!)
12. Logarithm (log)
0. Exit

Enter your choice: 12

Enter the number:
-2
2024-02-25T11:10:18.629Z ERROR 1 --- [main] con.example.miniproject.Calculator : Error: Logarithm of a non-positive number is undefined!
2024-02-25T11:10:18.629Z INFO 1 --- [main] con.example.miniproject.Calculator : Logarithm of -2.0 is:NaN
Logarithm of -2.0 is:NaN
```

Log of negative