[CS304] Tutorial 12 - Docker

Docker overview

Docker is an open-source engine that automates the deployment of applications into containers.

It is an open platform for developing, shipping, and running applications. Docker enables you to separate your applications from your infrastructure so you can deliver software quickly. With Docker, you can manage your infrastructure in the same ways you manage your applications. By taking advantage of Docker's methodologies for shipping, testing, and deploying code quickly, you can significantly reduce the delay between writing code and running it in production.

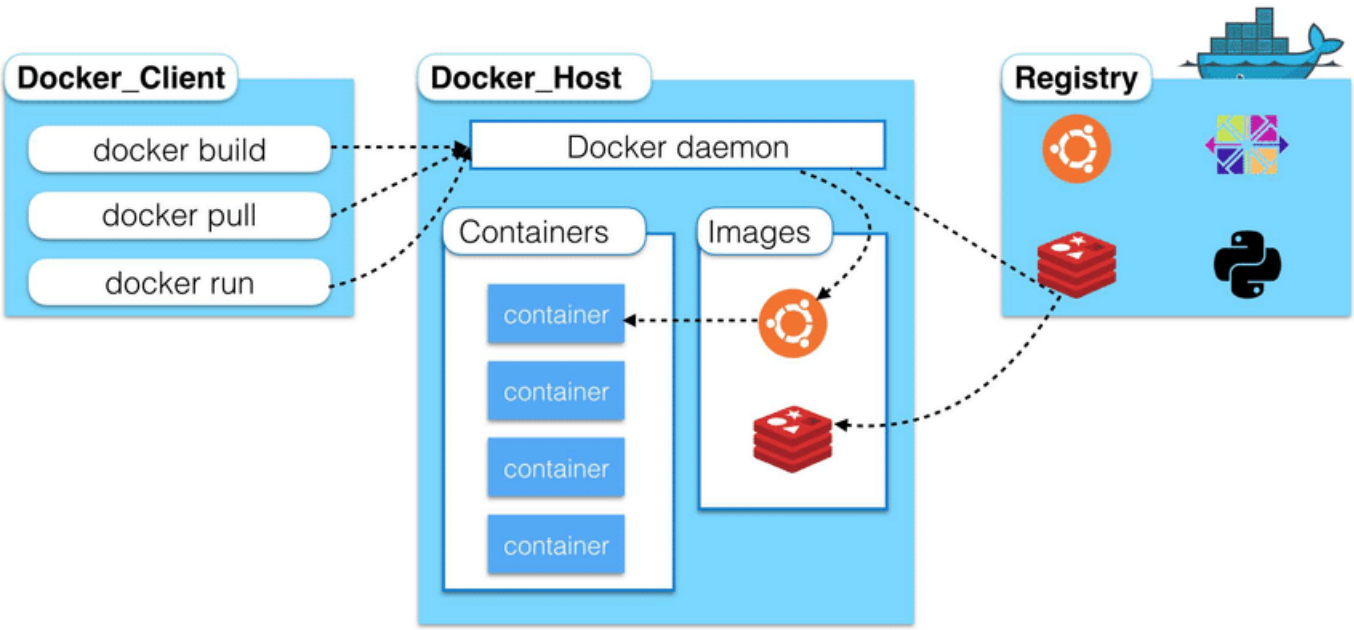
Official Resources:

- Docker：http://www.docker.com
- Docker Hub：https://hub.docker.com

What can I use Docker for:

- Fast, consistent delivery of your applications.
- Responsive deployment and scaling.
- Running more workloads on the same hardware.

Docker components



Images:

When running a container, it uses an isolated filesystem. This custom filesystem is provided by a container image. Since the image contains the container's filesystem, it must contain everything needed to run an application - all dependencies, configurations, scripts, binaries, etc. The image also contains other configuration for the container, such as environment variables, a default command to run, and other metadata.

Containers:

Simply put, a container is a sandboxed process on your machine that is isolated from all other processes on the host machine. That isolation leverages kernel namespaces and cgroups, features that have been in Linux for a long time. Docker has worked to make these capabilities approachable and easy to use. To summarize, a container:

- Is a runnable instance of an image. You can create, start, stop, move, or delete a container using the DockerAPI or CLI.
- Can be run on local machines, virtual machines or deployed to the cloud.
- Is portable (can be run on any OS).
- Is isolated from other containers and runs its own software, binaries, and configurations.

Registries: Docker Hub is the world's largest library and community for container images（from its website)

Part I: Installing Docker

Please refer below to install docker in Ubuntu:

https://docs.docker.com/engine/install/ubuntu/#installation-methods

If you want manage Docker as a non-root user:

https://docs.docker.com/engine/install/linux-postinstall/#manage-docker-as-a-non-root-user

Verify that the Docker Engine installation is successful by running the `hello-world` image.

```
# Enable non-root access
sudo usermod -aG docker $USER
newgrp docker

# Verify installation
docker run hello-world
```

```
Hello from Docker!
This message shows that your installation appears to be working correctly.

To generate this message, Docker took the following steps:
 1. The Docker client contacted the Docker daemon.
 2. The Docker daemon pulled the "hello-world" image from the Docker Hub.
    (amd64)
 3. The Docker daemon created a new container from that image which runs the
    executable that produces the output you are currently reading.
 4. The Docker daemon streamed that output to the Docker client, which sent it
    to your terminal.

To try something more ambitious, you can run an Ubuntu container with:
 $ docker run -it ubuntu bash

Share images, automate workflows, and more with a free Docker ID:
 https://hub.docker.com/

For more examples and ideas, visit:
 https://docs.docker.com/get-started/
```

Part II: Run Teedy in Docker manually

Before using Jenkins, let's build a Docker image manually to understand the process.

2.1 Build Image

1. **Dockerfile** (Example)

   This is the Dockerfile used to build the Teedy project image. Each section installs required dependencies and configures Jetty and OCR tools.

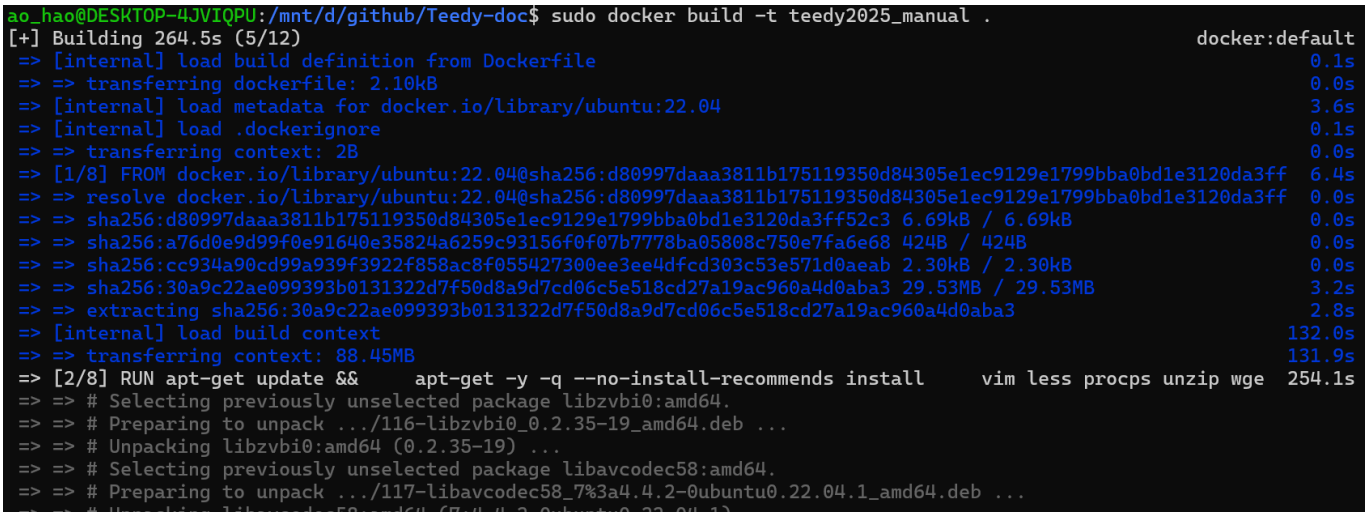
```
# Using a custom image that already includes Ubuntu 22.04
FROM ubuntu:22.04
# Using the LABEL instruction to add metadata to the image,sets the maintainer's
email #address for the image
LABEL maintainer="b.gamard@sismics.com"

# Run Debian in non interactive mode
ENV DEBIAN_FRONTEND noninteractive

# Configure environment variables
ENV LANG C.UTF-8
ENV LC_ALL C.UTF-8
ENV JAVA_HOME /usr/lib/jvm/java-11-openjdk-amd64/
ENV JAVA_OPTIONS -Dfile.encoding=UTF-8 -Xmx1g
ENV JETTY_VERSION 11.0.20
ENV JETTY_HOME /opt/jetty

# clean up unnecessary files after installation to reduce the size of the image.
# Install necessary packages and OCR languages
RUN apt-get update && \
    apt-get -y -q --no-install-recommends install \
    vim less procps unzip wget tzdata openjdk-11-jdk \
    ffmpeg \
```

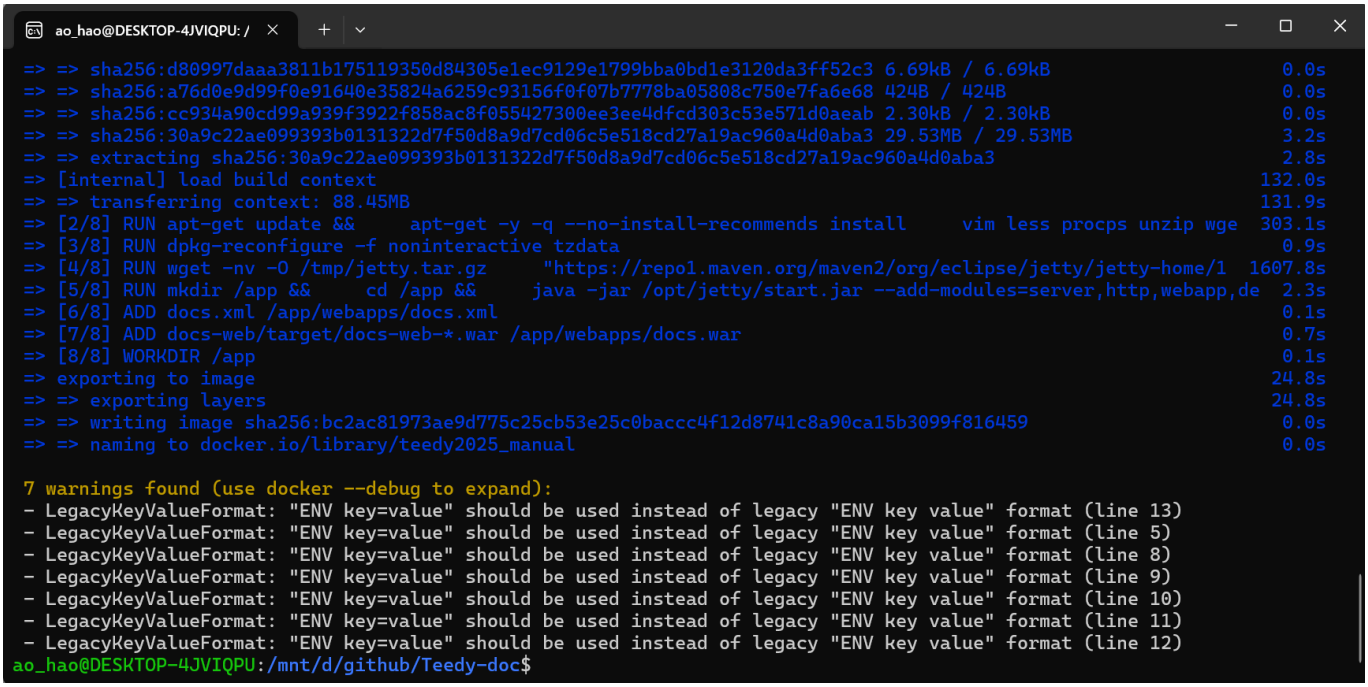
```
    mediainfo \
    tesseract-ocr \
    tesseract-ocr-ara \
    tesseract-ocr-ces \
    tesseract-ocr-chi-sim \
    tesseract-ocr-chi-tra \
    tesseract-ocr-dan \
    tesseract-ocr-deu \
    tesseract-ocr-fin \
    tesseract-ocr-fra \
    tesseract-ocr-heb \
    tesseract-ocr-hin \
    tesseract-ocr-hun \
    tesseract-ocr-ita \
    tesseract-ocr-jpn \
    tesseract-ocr-kor \
    tesseract-ocr-lav \
    tesseract-ocr-nld \
    tesseract-ocr-nor \
    tesseract-ocr-pol \
    tesseract-ocr-por \
    tesseract-ocr-rus \
    tesseract-ocr-spa \
    tesseract-ocr-swe \
    tesseract-ocr-tha \
    tesseract-ocr-tur \
    tesseract-ocr-ukr \
    tesseract-ocr-vie \
    tesseract-ocr-sqi \
    && apt-get clean && \
    rm -rf /var/lib/apt/lists/*
RUN dpkg-reconfigure -f noninteractive tzdata

# Install Jetty server
RUN wget -nv -O /tmp/jetty.tar.gz \
    "https://repo1.maven.org/maven2/org/eclipse/jetty/jetty-
home/${JETTY_VERSION}/jetty-home-${JETTY_VERSION}.tar.gz" \
    && tar xzf /tmp/jetty.tar.gz -C /opt \
    && mv /opt/jetty* /opt/jetty \
    && useradd jetty -U -s /bin/false \
    && chown -R jetty:jetty /opt/jetty \
    && mkdir /opt/jetty/webapps \
    && chmod +x /opt/jetty/bin/jetty.sh

# informs Docker that the container will listen on port 8080 at runtime
EXPOSE 8080

# Install the application
RUN mkdir /app && \
    cd /app && \
    java -jar /opt/jetty/start.jar --add-modules=server,http,webapp,deploy

# Add the local file docs.xml and the built WAR file docs-web-*.war to the
container's Jetty web applications directory.Allows Jetty to load these web
```

```
applications at startup.
ADD docs.xml /app/webapps/docs.xml
ADD docs-web/target/docs-web-*.war /app/webapps/docs.war

# sets the working directory for any RUN, CMD, ENTRYPOINT, COPY, and ADD
instructions that follow it
WORKDIR /app

# sets the default command that will run when a container is started from the
image.
# Here it tells the container to run the Jetty web server by executing the
start.jar file with Java
CMD ["java", "-jar", "/opt/jetty/start.jar"]
```

2. **Build Image**:

```
docker build -t teedy2025_manual .
```

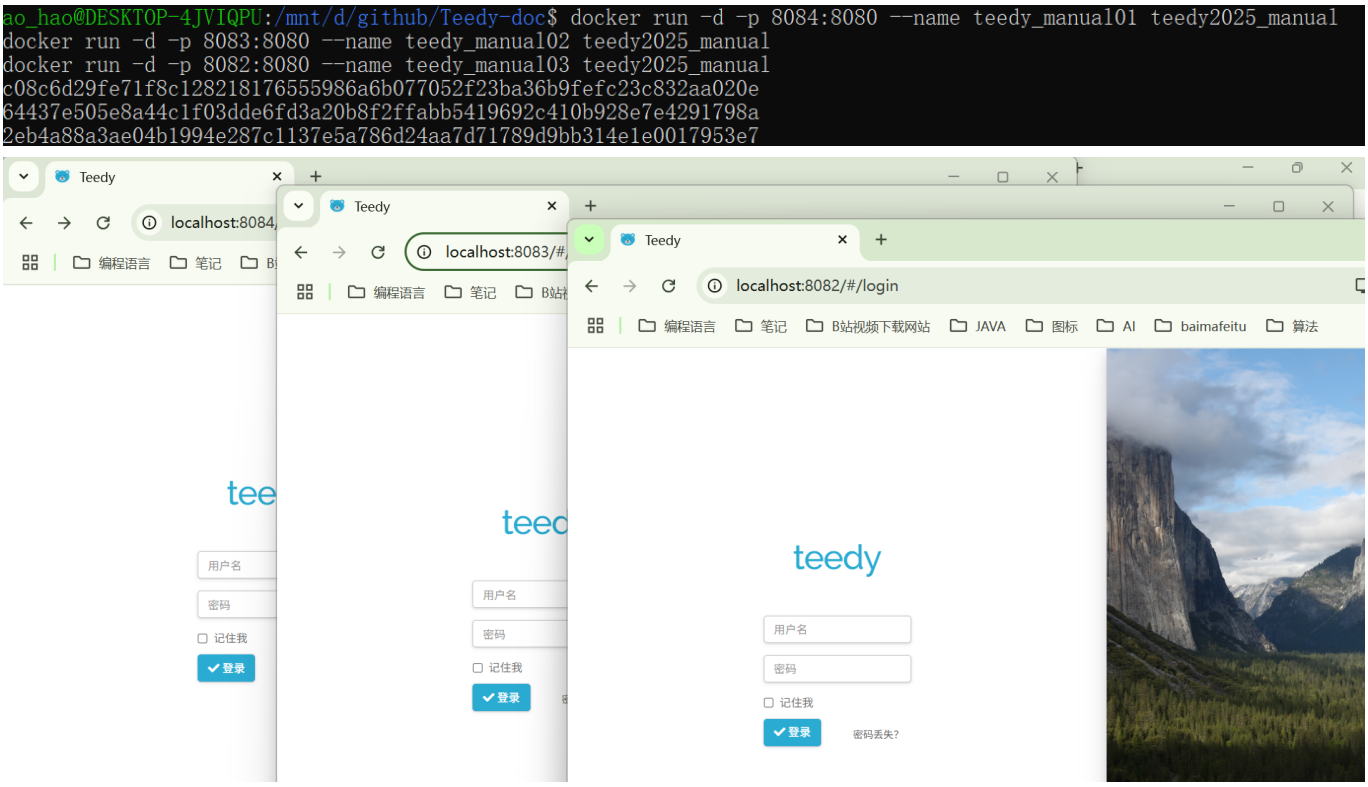




3. **Run Containers**:

```
docker run -d -p 8084:8080 --name teedy_manual01 teedy2025_manual
docker run -d -p 8083:8080 --name teedy_manual02 teedy2025_manual
docker run -d -p 8082:8080 --name teedy_manual03 teedy2025_manual
```

> **Tip**: `-d` flag runs the container in background. `-p` maps host port to container port.



Manage Docker Containers (Optional Section)

If you need to stop, restart, or delete a Docker container manually:

- **Stop a running container**:

```
sudo docker stop teedy_manual01
```

- **Start a stopped container**:

```
sudo docker start teedy_manual01
```

- **Force stop a container**:

```
sudo docker kill teedy_manual01
```

- **Remove a stopped container**:

```
sudo docker rm teedy_manual01
```

- **Force remove a running container**:

```
sudo docker rm -f teedy_manual01
```

- **Check status of containers**:

```
docker ps -a
```

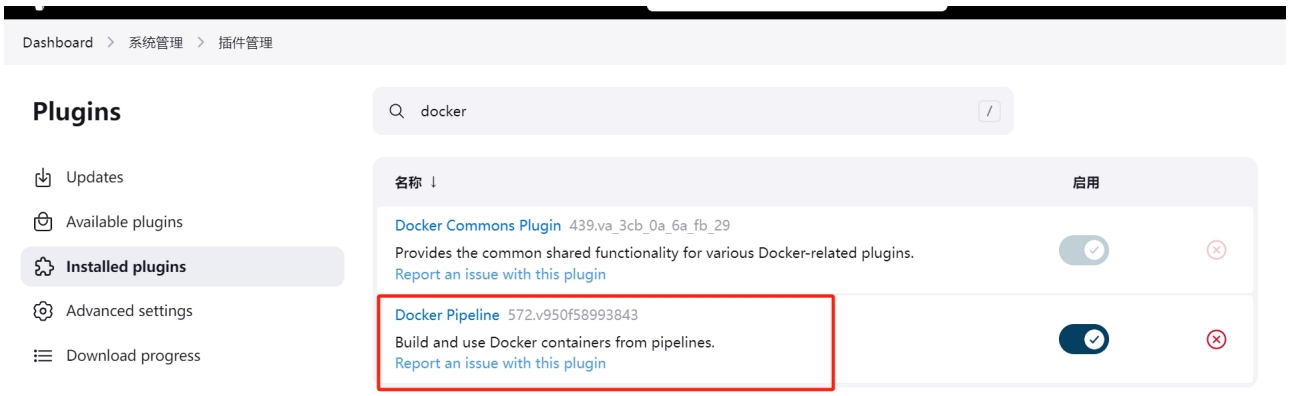
- **View logs of a container**:

```
docker logs teedy_manual01
```

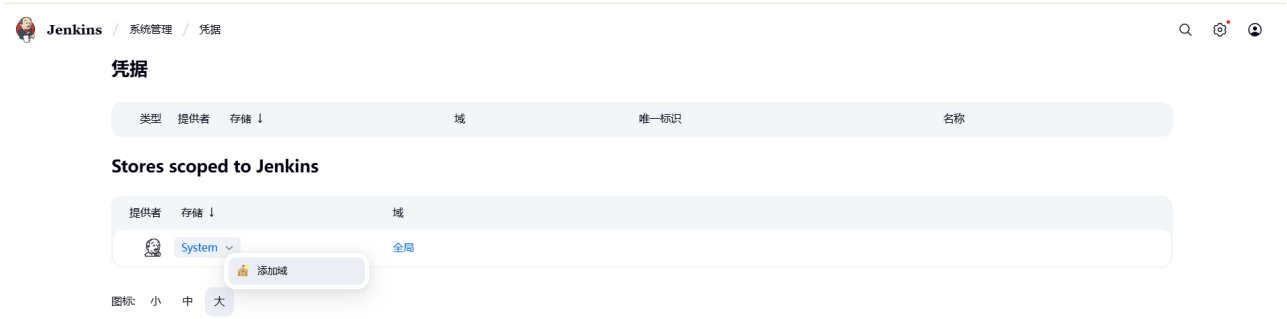
Part III Automated Deployment with Jenkins

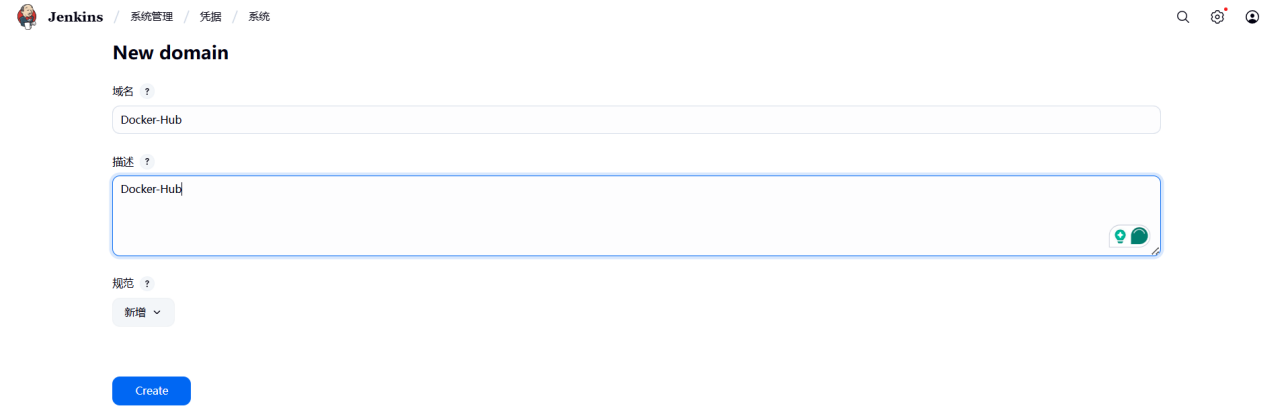
1. Configure jenkins:

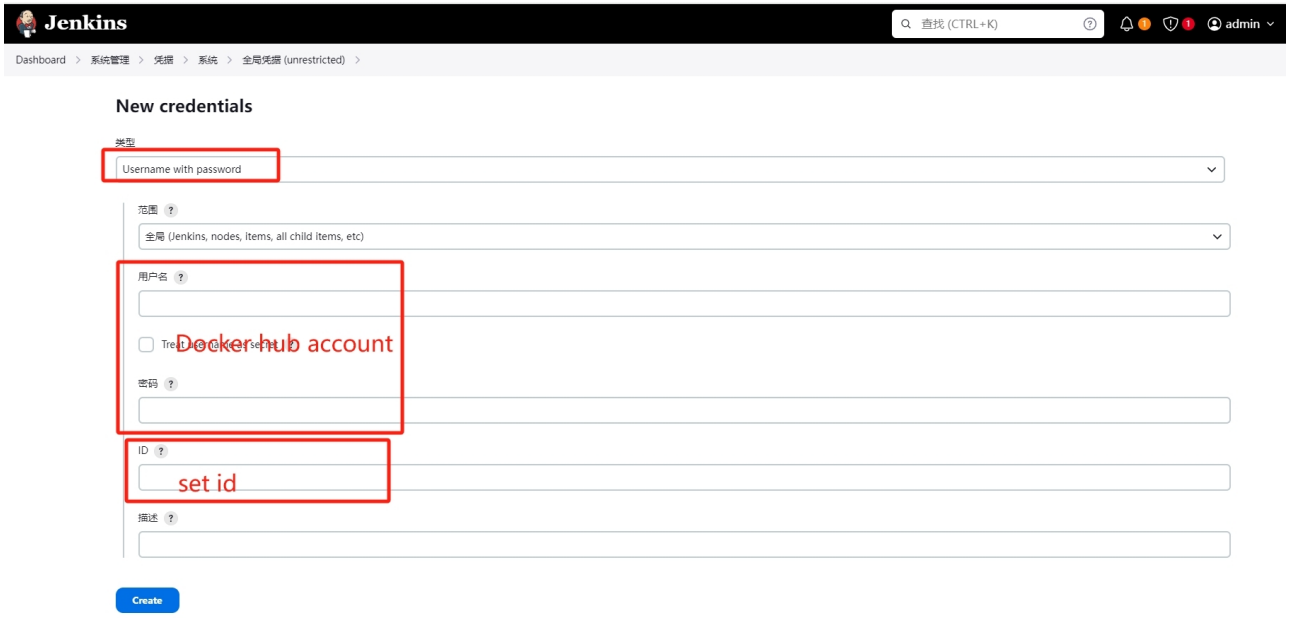
- Install "Docker Pipeline" in your Jenkins. Open "Manage Plugins" and find it under "Available Plugins" and install it:

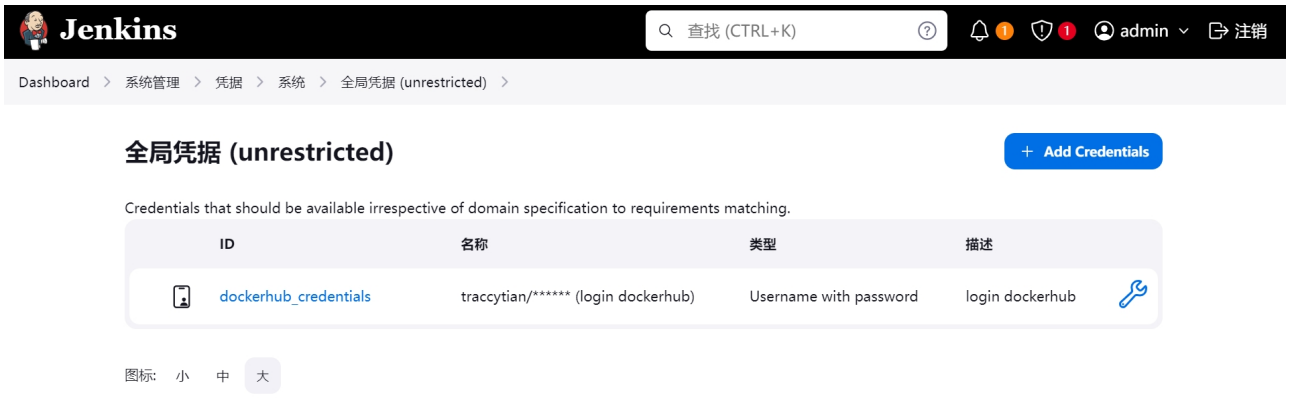


- **Configure Docker Hub account in Jenkins:** Go to **“Manage Jenkins”** → **“Manage Credentials”** → **“System”** → **“New Domain”** → **“Add Credentials”** to add your Docker Hub credentials. If you don’t have a Docker Hub account yet, sign up at https://hub.docker.com/ and create a new repository (e.g., `xx/teedy`).









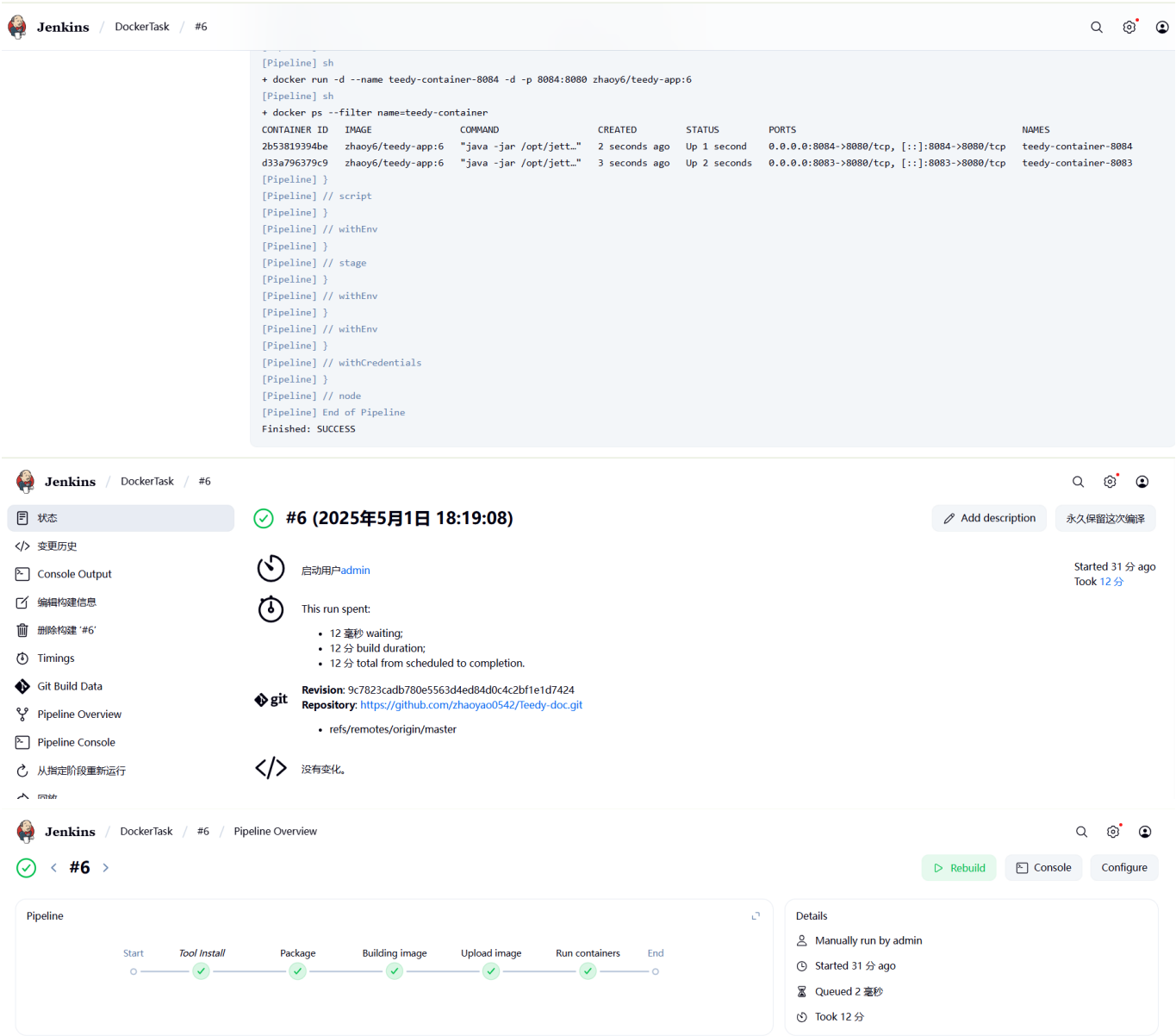
2. `Jenkinsfile` Pipeline Example:

```
pipeline {
    agent any

    environment {
        // define environment variable
        // Jenkins credentials configuration
        DOCKER_HUB_CREDENTIALS = credentials('dockerhub_credentials') // Docker
Hub credentials ID store in Jenkins
        // Docker Hub Repository's name
        DOCKER_IMAGE = 'xx/teedy-app' // your Docker Hub user name and
Repository's name
        DOCKER_TAG = "${env.BUILD_NUMBER}" // use build number as tag
    }

    stages {
        stage('Build') {
            steps {
                checkout scmGit(
                    branches: [[name: '*/master']],
                    extensions: [],
                    userRemoteConfigs: [[url: 'https://github.com/xx/Teedy.git']]
// your github Repository
                )
                sh 'mvn -B -DskipTests clean package'
            }
        }

        // Building Docker images
        stage('Building image') {
            steps {
                script {
                    // assume Dockerfile locate at root
                    docker.build("${env.DOCKER_IMAGE}:${env.DOCKER_TAG}")
                }
            }
        }

        // Uploading Docker images into Docker Hub
        stage('Upload image') {
            steps {
                script {
                    // sign in Docker Hub
                    docker.withRegistry('https://registry.hub.docker.com',
'DOCKER_HUB_CREDENTIALS') {
                        // push image

docker.image("${env.DOCKER_IMAGE}:${env.DOCKER_TAG}").push()

                        //  ：optional: label latest

docker.image("${env.DOCKER_IMAGE}:${env.DOCKER_TAG}").push('latest')
                    }
                }
```

```
            }
        }

        // Running Docker container
        stage('Run containers') {
            steps {
                script {
                // stop then remove containers if exists
                sh 'docker stop teedy-container-8081 || true'
                sh 'docker rm teedy-container-8081 || true'

                // run Container
                docker.image("${env.DOCKER_IMAGE}:${env.DOCKER_TAG}").run(
                    '--name teedy-container-8081 -d -p 8081:8080'
                )


                // Optional: list all teedy-containers
                sh 'docker ps --filter "name=teedy-container"'

                }
            }
        }
    }
}
```

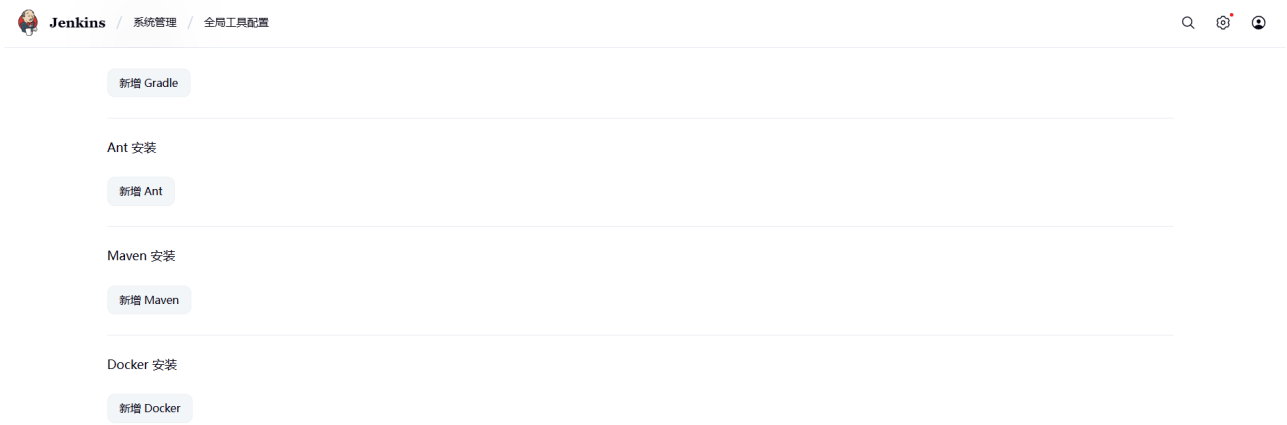
3. Build the Docker Pipeline in Jenkins

Click "Build Now" and wait for results:



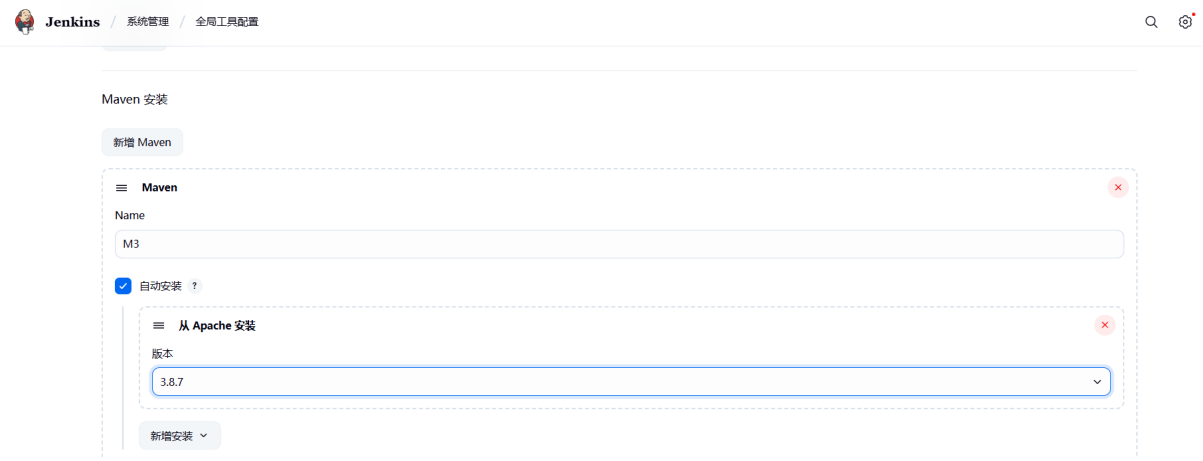
If a "Maven not found" error occurs during the build process, try configuring Maven in Jenkins Global Tools as follows:

1. Go to **Jenkins Dashboard → System Manage → Global Tool Configuration**



2. In the **Maven** section:

- **Name**: Enter a descriptive name (e.g., `M3`)
- **Install automatically**: Check this box to let Jenkins install Maven automatically
- **Version**: Select the desired version from the dropdown (e.g., `3.8.7`)



3. Click **Save** to apply the changes.
4. In your `Jenkinsfile`, use the `tools` directive to reference the Maven installation configured above.

```
pipeline {
    agent any
    tools {
        // Use the name defined in Global Tool Configuration
        maven 'M3'
    }
    stages {
        stage('Build') {
            steps {
                sh 'mvn --version'  // Verify Maven is available
                sh 'mvn -B -DskipTests clean package'
            }
        }
    }
}
```

Part IV: Use **GitHub Actions** to Build and Push Docker Image

GitHub Actions provides CI/CD capabilities directly from GitHub. Here's how to use it to build and push Docker images.

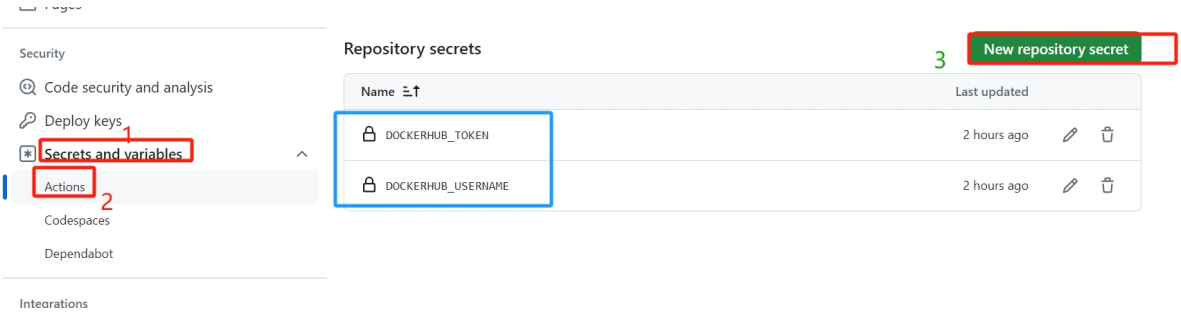
Github Actions Build and push Docker images guide:

https://github.com/marketplace/actions/build-and-push-docker-images

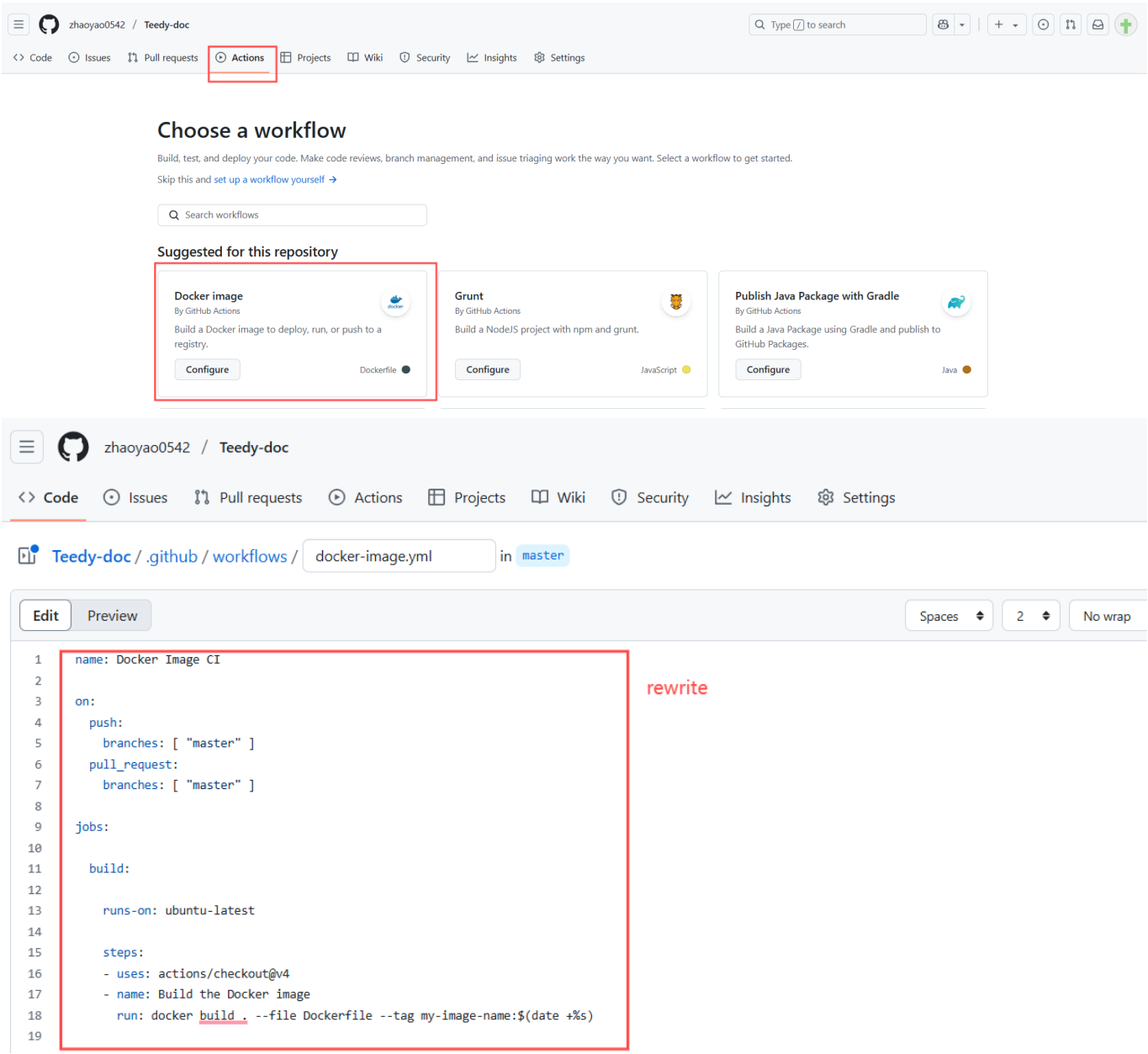
Step 1: Prepare Secrets in GitHub Repo

In your repository, go to **Settings > Secrets and variables > Actions > New repository secret** and add:

- DOCKERHUB_USERNAME
- DOCKERHUB_TOKEN



Step 2: Config GitHub Workflow File



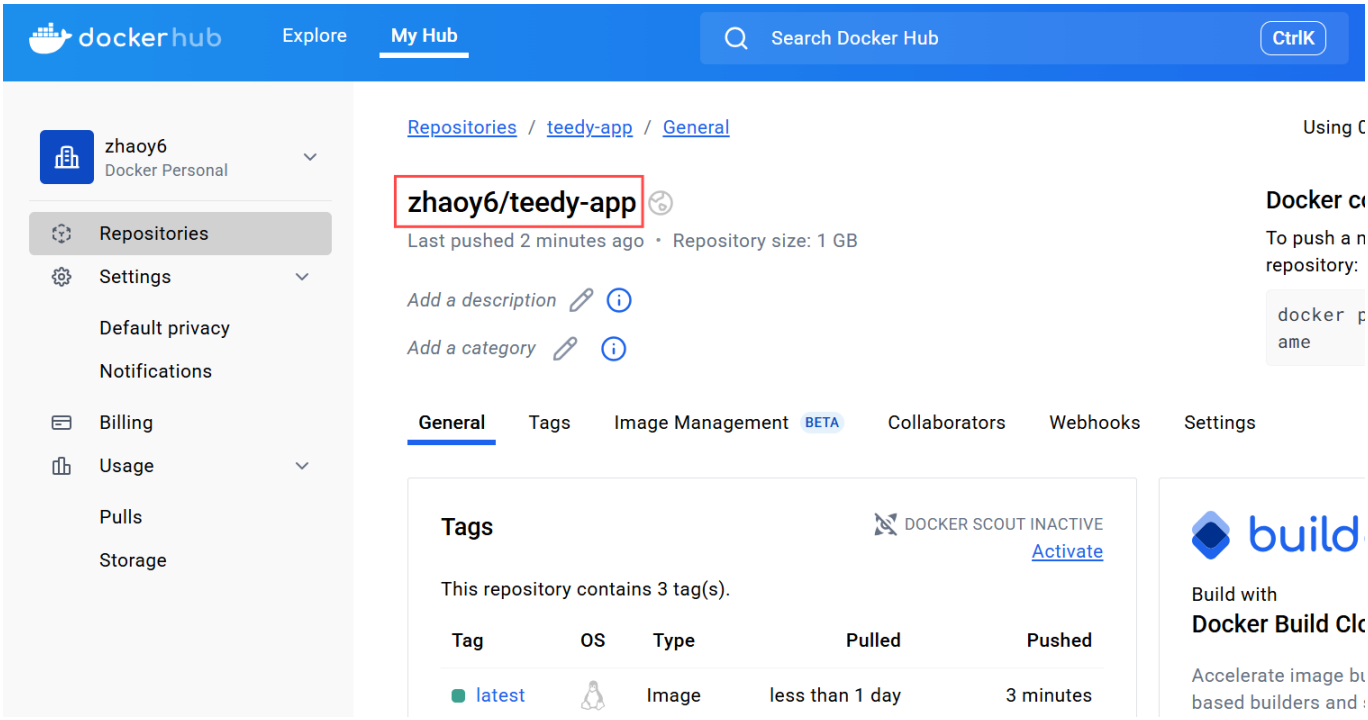
Copy the following to the `docker-image.yml`:

```
name: Maven CI/CD
```

```yaml
on:
  push:
    branches: [master]
    tags: [v*]
  workflow_dispatch:

jobs:
  build_and_publish:
    runs-on: ubuntu-latest

    steps:
      - uses: actions/checkout@v2
      - name: Set up JDK 11
        uses: actions/setup-java@v4
        with:
          java-version: "11"
          distribution: "temurin"
          cache: maven
      - name: Install test dependencies
        run: sudo apt-get update && sudo apt-get -y -q --no-install-recommends
install ffmpeg mediainfo tesseract-ocr tesseract-ocr-deu
      - name: Build with Maven
        run: mvn --batch-mode -Pprod clean install
      - name: Upload war artifact
        uses: actions/upload-artifact@v4
        with:
          name: docs-web-ci.war
          path: docs-web/target/docs*.war

  build_docker_image:
    name: Publish to Docker Hub
    runs-on: ubuntu-latest
    needs: [build_and_publish]

    steps:
      -
        name: Checkout
        uses: actions/checkout@v2
      -
        name: Download war artifact
        uses: actions/download-artifact@v4
        with:
          name: docs-web-ci.war
          path: docs-web/target
      -
        name: Setup up Docker Buildx
        uses: docker/setup-buildx-action@v1
      -
        name: Login to DockerHub
        if: github.event_name != 'pull_request'
        uses: docker/login-action@v1
        with:
          username: ${{ secrets.DOCKERHUB_USERNAME }}
          password: ${{ secrets.DOCKERHUB_TOKEN }}
```

```
      -
        name: Populate Docker metadata
        id: metadata
        uses: docker/metadata-action@v3
        with:
          images: xx/Teedy # Docker Hub repository
          flavor: |
            latest=false
          tags: |
            type=ref,event=tag
            type=raw,value=latest,enable=${{ github.ref_type != 'tag' }}
          labels: |
            org.opencontainers.image.title = Teedy
            org.opencontainers.image.description = Teedy is an open source,
lightweight document management system for individuals and businesses.
            org.opencontainers.image.created = ${{ github.event_created_at }}
            org.opencontainers.image.author = Sismics
            org.opencontainers.image.url = https://teedy.io/
            org.opencontainers.image.vendor = Sismics
            org.opencontainers.image.license = GPLv2
            org.opencontainers.image.version = ${{ github.event_head_commit.id }}
      -
        name: Build and push
        id: docker_build
        uses: docker/build-push-action@v4
        with:
          context: .
          push: ${{ github.event_name != 'pull_request' }}
          tags: ${{ steps.metadata.outputs.tags }}
          labels: ${{ steps.metadata.outputs.labels }}
```

Line 61, Change images to your own dockerhub image.

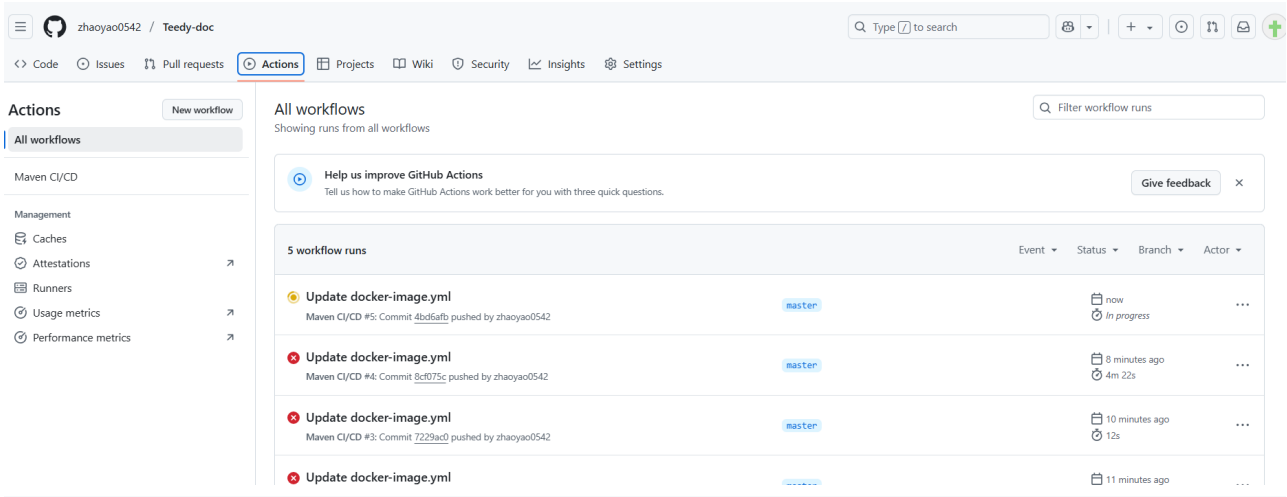


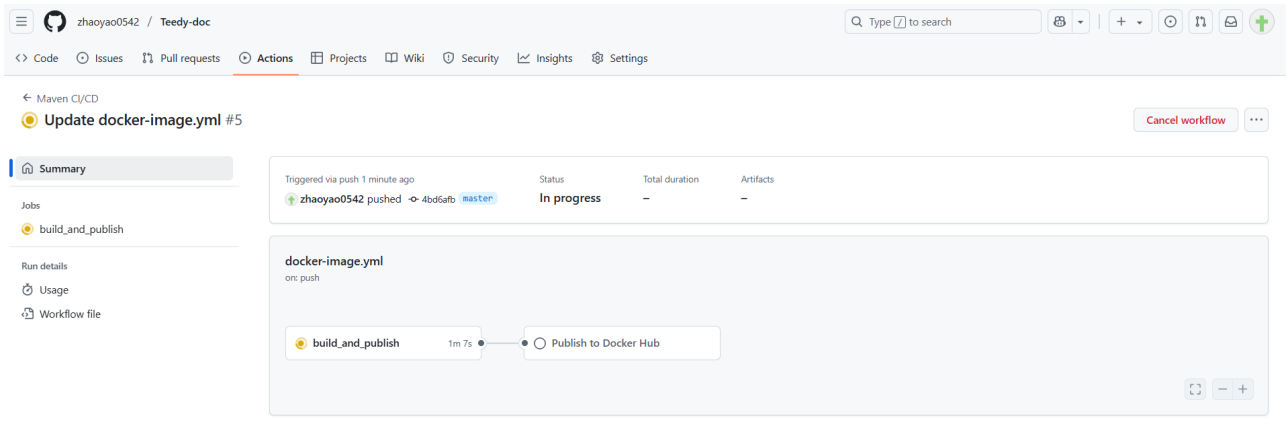
You can compare the above with Teedy's orignal build-deploy.yml.

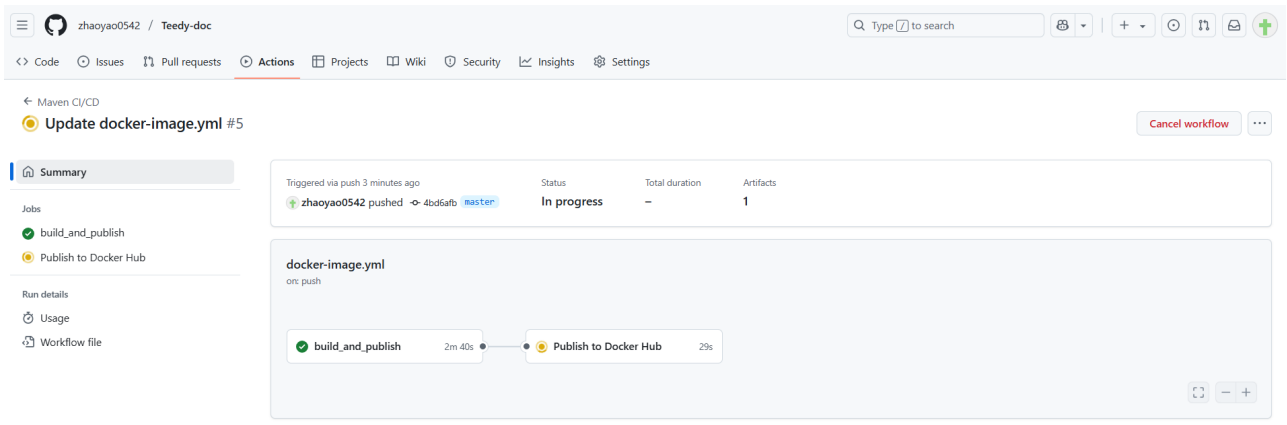
Step 3: Commit and Push

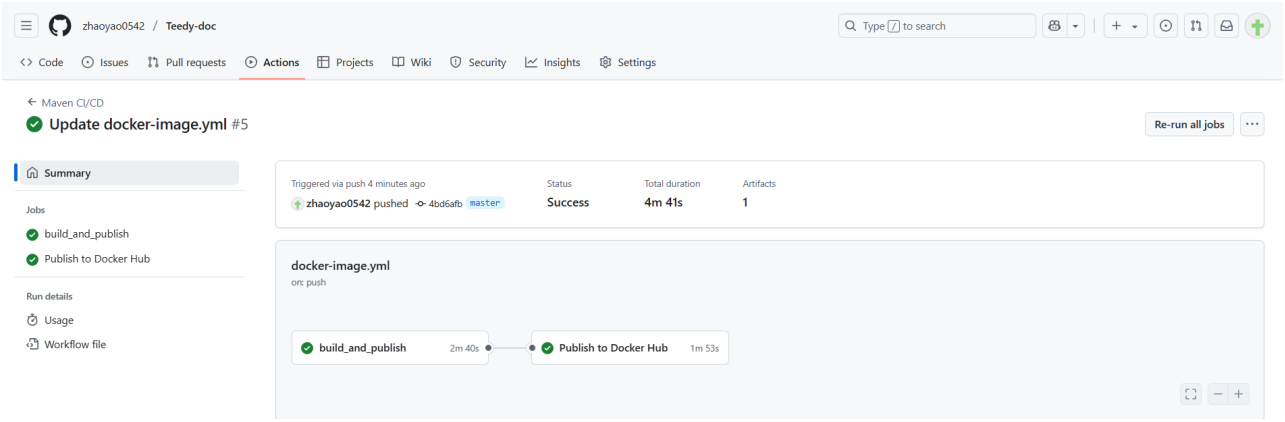
Committing changes will trigger the GitHub Actions workflow, which will:

- Build the Docker image from the Dockerfile
- Push the image to Docker Hub

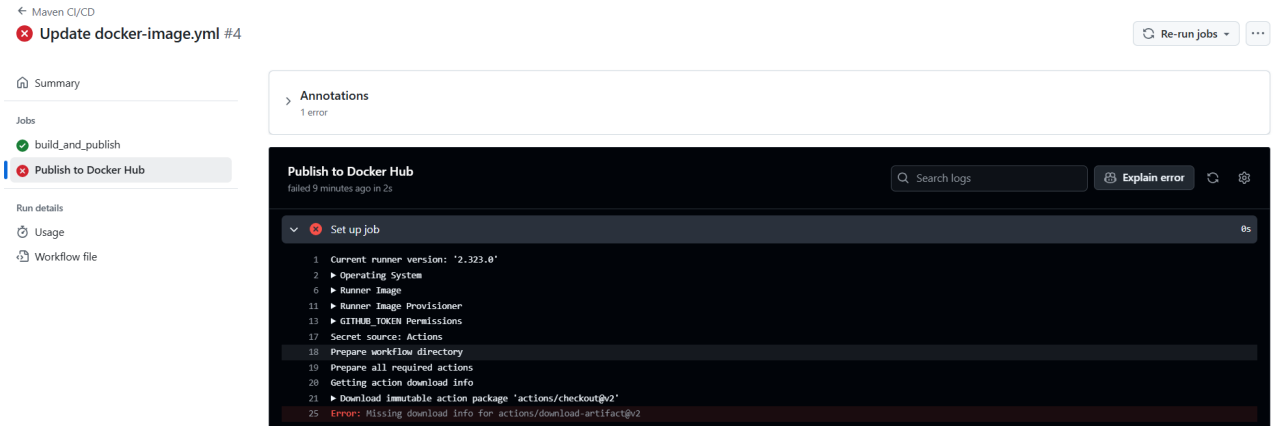








If accout fail, you can click the corresponds button to see detail error:



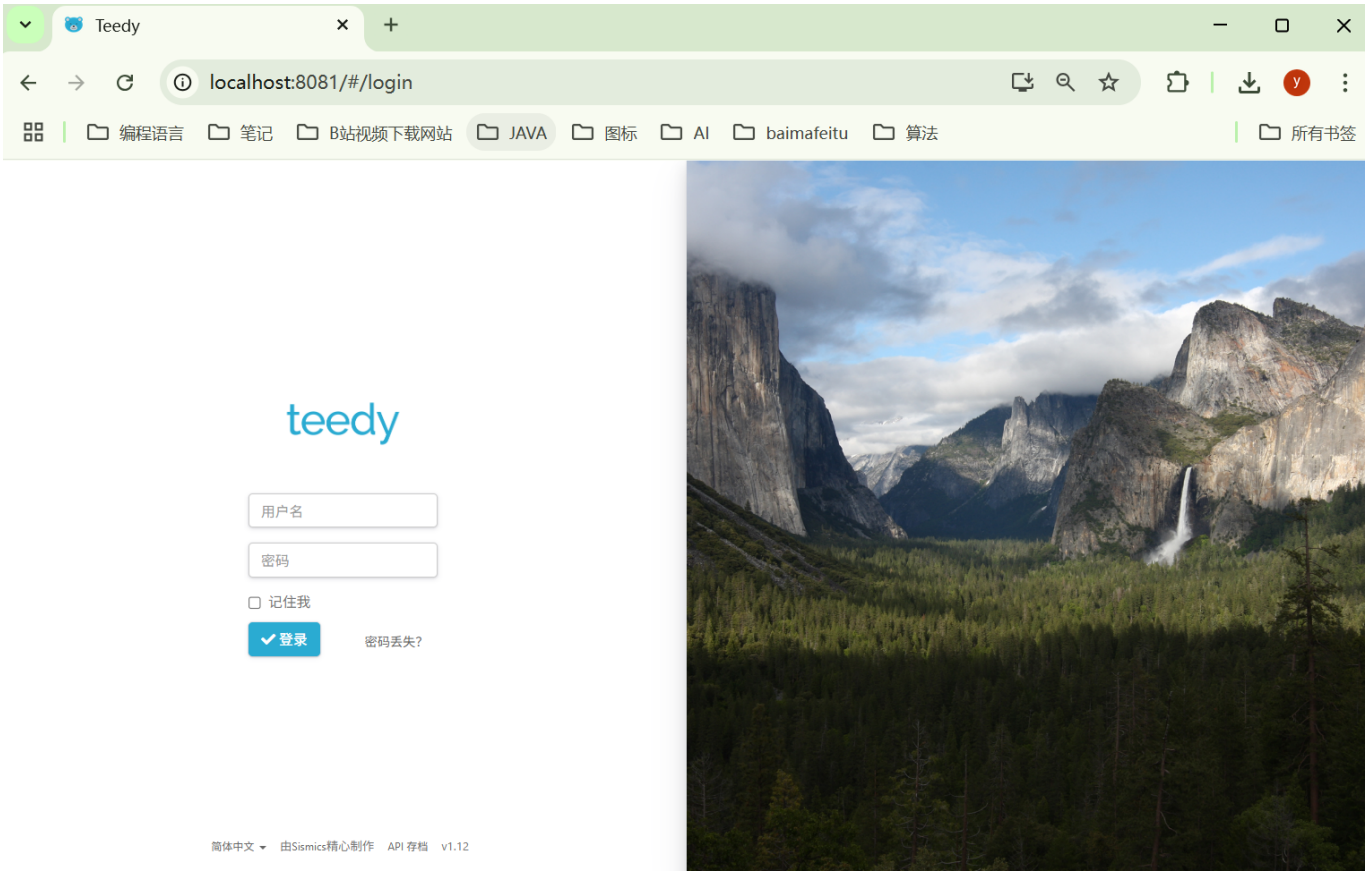
Step 4: Pull and Run Locally

```
docker pull xx/Teedy:tag
docker run -d -p 8081:8080 --name myteedy01 xx/Teedy
```

```
ao_hao@DESKTOP-4JVIQPU:/mnt/d/github/Teedy-doc$ docker pull zhaoy6/teedy-app
Using default tag: latest
latest: Pulling from zhaoy6/teedy-app
30a9c22ae099: Already exists
e73db030b645: Pull complete
3e45d5ec32b4: Pull complete
cfbcf5f16946: Pull complete
04f0ed814a70: Pull complete
f083b07ba6cb: Pull complete
4f2fb00f71de: Pull complete
4f4fb700ef54: Pull complete
Digest: sha256:a8ab4ba287583196ecdcaaf16ee1ad55d1b7f825135adeddd064fea2119faedd
Status: Downloaded newer image for zhaoy6/teedy-app:latest
docker.io/zhaoy6/teedy-app:latest
```

```
ao_hao@DESKTOP-4JVIQPU:/mnt/d/github/Teedy-doc$ docker images
REPOSITORY                                TAG       IMAGE ID       CREATED          SIZE
zhaoy6/teedy-app                          latest    3fd40a8d21ab   8 minutes ago    1.04GB
zhaoy6/teedy-app                          7         72bf368374f9   22 hours ago     1.04GB
registry.hub.docker.com/zhaoy6/teedy-app  7         72bf368374f9   22 hours ago     1.04GB
registry.hub.docker.com/zhaoy6/teedy-app  latest    72bf368374f9   22 hours ago     1.04GB
zhaoy6/teedy-app                          6         cd9f50823ed6   22 hours ago     1.04GB
registry.hub.docker.com/zhaoy6/teedy-app  6         cd9f50823ed6   22 hours ago     1.04GB
teedy2025_manual                          latest    bc2ac81973ae   41 hours ago     1.04GB
docker                                    dind      721f8c2d3591   13 days ago      395MB
hello-world                               latest    74cc54e27dc4   3 months ago     10.1kB
```

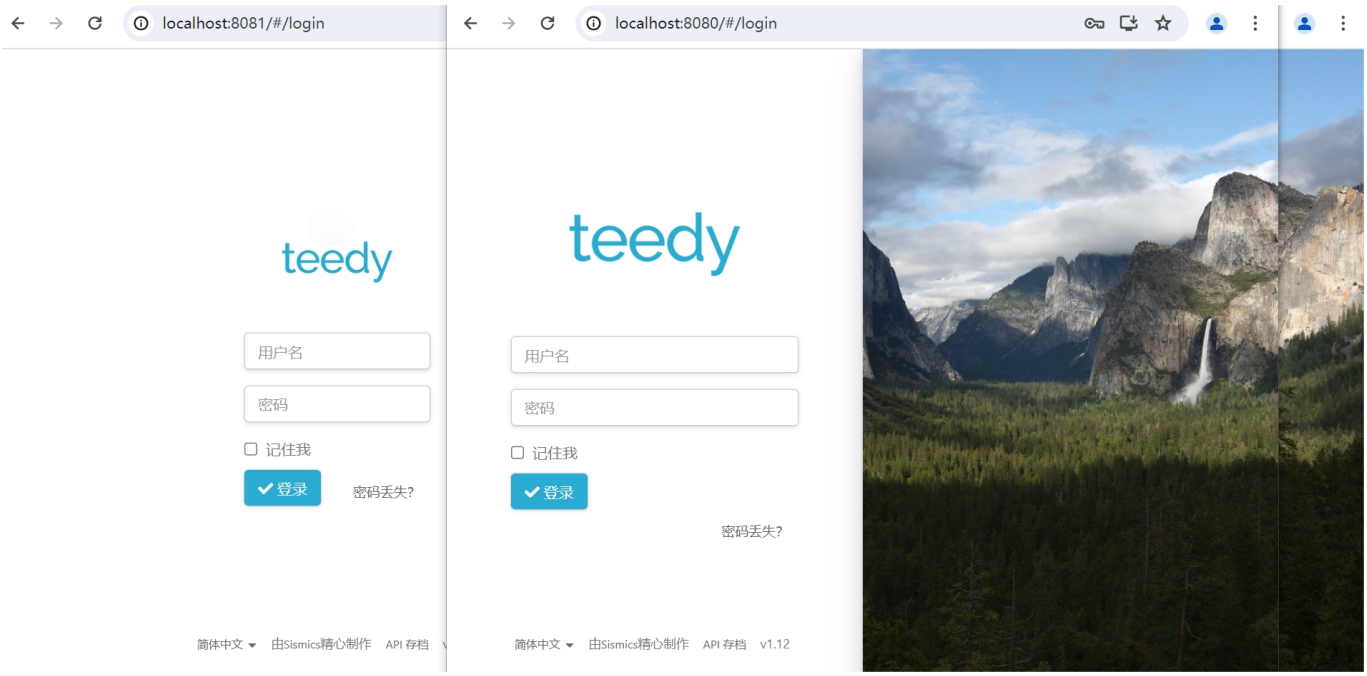
```
ao_hao@DESKTOP-4JVIQPU:/mnt/d/github/Teedy-doc$ docker run -d -p 8081:8080 --name myteedy01 zhaoy6/teedy-app:latest
47d2ddf5a1f03ca9179b66e06ae7749ca90b8d329f03ace142b8bd5cbc61210c
```



You can also use official image:

```
docker pull sismics/docs:latest
```

```
root@LAPTOP-H9VR9D4P:~# docker pull sismics/docs:latest
latest: Pulling from sismics/docs
bccd10f490ab: Pull complete
5d890301af4d: Pull complete
eefa7a0fbceb: Pull complete
ee3489578d09: Pull complete
069ef754ac50: Pull complete
3018db1b72ec: Pull complete
2ba6d61a4372: Pull complete
4f4fb700ef54: Pull complete
Digest: sha256:deb9eb2a1138efc52131bcda0a3cc28e455888c2c55171cfea47c26a9a7a6e3a
Status: Downloaded newer image for sismics/docs:latest
docker.io/sismics/docs:latest
root@LAPTOP-H9VR9D4P:~# docker images
REPOSITORY     TAG       IMAGE ID       CREATED         SIZE
sismics/docs   latest    d3b3dfb621fb   3 weeks ago     1.04GB
hello-world    latest    d2c94e258dcb   12 months ago   13.3kB
root@LAPTOP-H9VR9D4P:~# docker run -d -p 8080:8080 --name myteedy sismics/docs
4a65908b544b1205311bdd[illegible]
root@LAPTOP-H9VR9D4P:~# docker ps
CONTAINER ID   IMAGE          COMMAND                  CREATED         STATUS         PORTS                                                NAMES
4a65908b544b   sismics/docs   "java -jar /opt/jett…"   6 seconds ago   Up 4 seconds   0.0.0.0:8080->8080/tcp, :::8080->8080/tcp   myteedy
CONTAINER ID   IMAGE                          COMMAND                  CREATED          STATUS          PORTS                                                NAMES
1ab22cdb75ad   traccytian/teedytest2024       "bin/jetty.sh run"       4 seconds ago    Up 3 seconds    0.0.0.0:8081->8080/tcp, :::8081->8080/tcp   myteedy01
4a65908b544b   sismics/docs                   "java -jar /opt/jett…"   2 minutes ago    Up 2 minutes    0.0.0.0:8080->8080/tcp, :::8080->8080/tcp   myteedy
root@LAPTOP-H9VR9D4P:~#
```


localhost:8081/#/login
teedy
用户名
密码
记住我
登录
密码丢失?
简体中文
由Sismics精心制作
API 存档
localhost:8080/#/login
teedy
用户名
密码
记住我
登录
密码丢失?
简体中文
由Sismics精心制作
API 存档
v1.12