Placement Empowerment Program

Cloud Computing and DevOps Centre

Automate Docker Image Builds Using GitHub Actions: Set up a GitHub Actions workflow to build and push a Docker image to a Docker Hub repository whenever code is pushed to the repository.

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Introduction

In modern software development, automation plays a crucial role in ensuring efficiency and reliability. This Proof of Concept (PoC) demonstrates how to automate Docker image builds using **GitHub Actions** and push them to **Docker Hub**. By integrating CI/CD practices, developers can streamline the containerization process and ensure that every change to the source code triggers an automated build and deployment.

Overview

This PoC covers the following key steps:

1. **Setting up a Dockerfile** – Creating a containerized environment using a simple Nginx-based Docker image.

2. **Configuring GitHub Actions** – Writing a GitHub Actions workflow to automate Docker builds.

3. **Authenticating with Docker Hub** – Using GitHub Secrets for secure login to Docker Hub.

4. **Building and Pushing the Image** – Automating the build and push process upon code commits.

5. **Verifying the Image** – Pulling and running the pushed image locally to confirm success.

Objective

The main objective of this PoC is to:

1. **Automate Docker image builds** using GitHub Actions.

2. **Eliminate manual Docker build and push steps**, reducing deployment overhead.

3. **Ensure consistency in containerized environments** with version-controlled builds.

4. **Enhance CI/CD practices** by integrating Docker with GitHub.

Importance

1. **Increases Developer Productivity:** Automating builds removes repetitive manual tasks.

2. **Ensures Deployment Consistency:** Every build is reproducible and follows a version-controlled process.

3. **Improves Security:** Secrets management in GitHub Actions ensures safe authentication with Docker Hub.

4. **Accelerates CI/CD Pipelines:** Streamlining image builds allows for faster deployments and testing.

5. **Facilitates Collaboration:** Any team member pushing code to the repository automatically triggers a new Docker image build.

Step-by-Step Overview

Step 1:

1. Install Git

Download Git from Git's official website.

Verify installation by opening **Command Prompt (cmd)** and running:

git --version

2. Install Docker Desktop

Download and install Docker Desktop from Docker's official website.

Verify by running:

docker –version

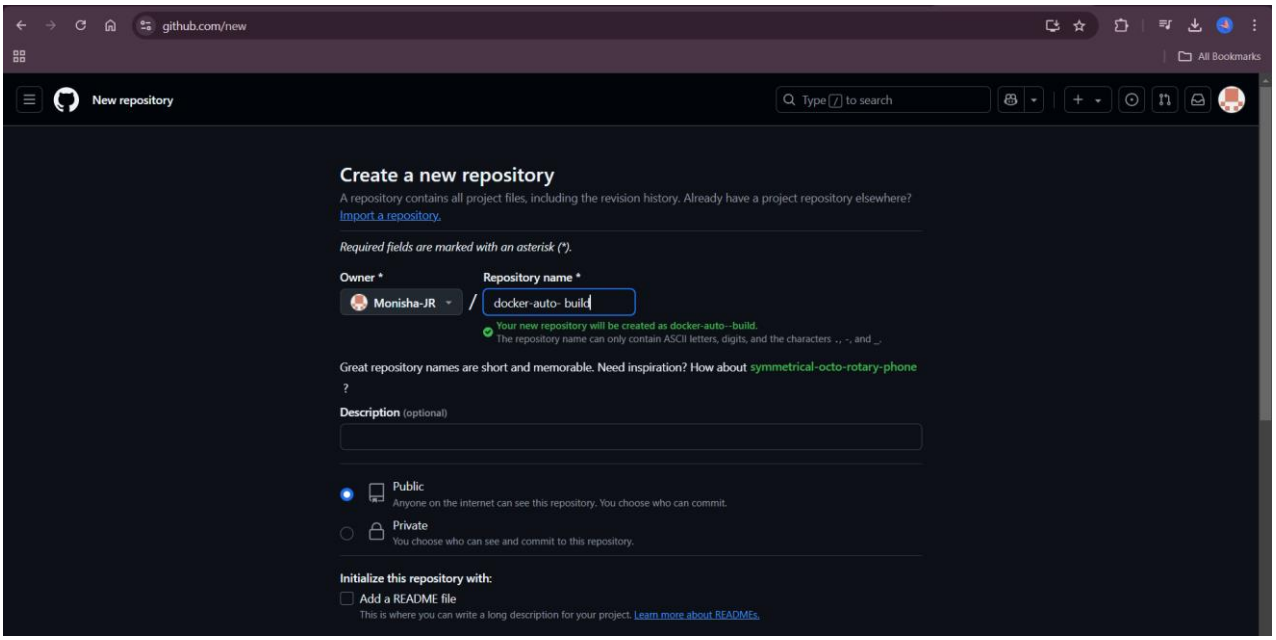
```
C:\Users\user>git --version
git version 2.47.1.windows.2

C:\Users\user>docker --version
Docker version 27.5.1, build 9f9e405
```

Step 2:

1. Go to GitHub and log in.

2. Click **New Repository → Give it a name (e.g., docker-auto-build)**.

3. Choose **Public** or **Private** and click **Create Repository**.



Step 3:

1. Open **Command Prompt (cmd)** and run:

git clone https://github.com/YOUR_GITHUB_USERNAME/docker-auto-build.git

(Replace YOUR_GITHUB_USERNAME with your actual GitHub username.)

2. Navigate into the cloned folder:

cd docker-auto-build

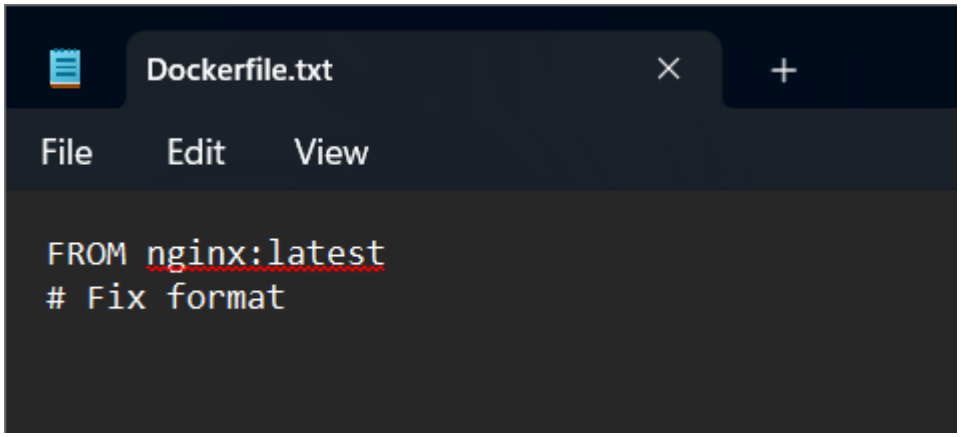
```
C:\Users\user>git clone https://github.com/Monisha-JR/docker-auto--build
Cloning into 'docker-auto--build'...
warning: You appear to have cloned an empty repository.
```

```
C:\Users\user>cd docker-auto--build

C:\Users\user\docker-auto--build>
```

Step 4:

A **Dockerfile** defines how your application should be containerized.

1. Inside the repository folder, create a new file named **Dockerfile**.
2. Open it in **Notepad** .
3. Add the following content (example for an Nginx web server):
4. Save the file.



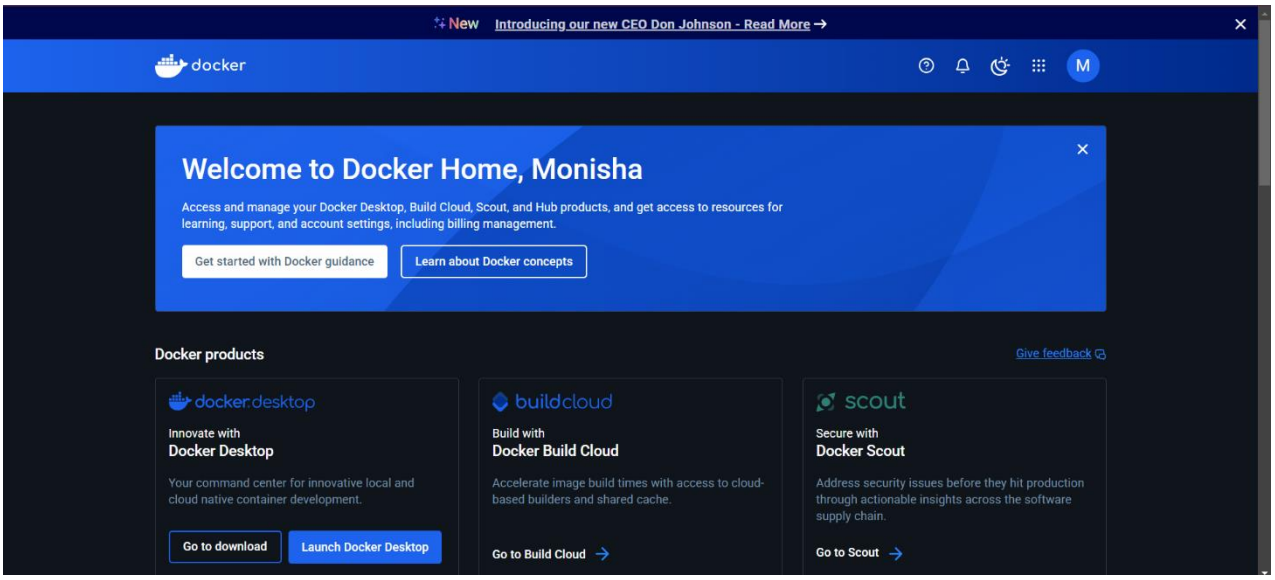
Step 5:

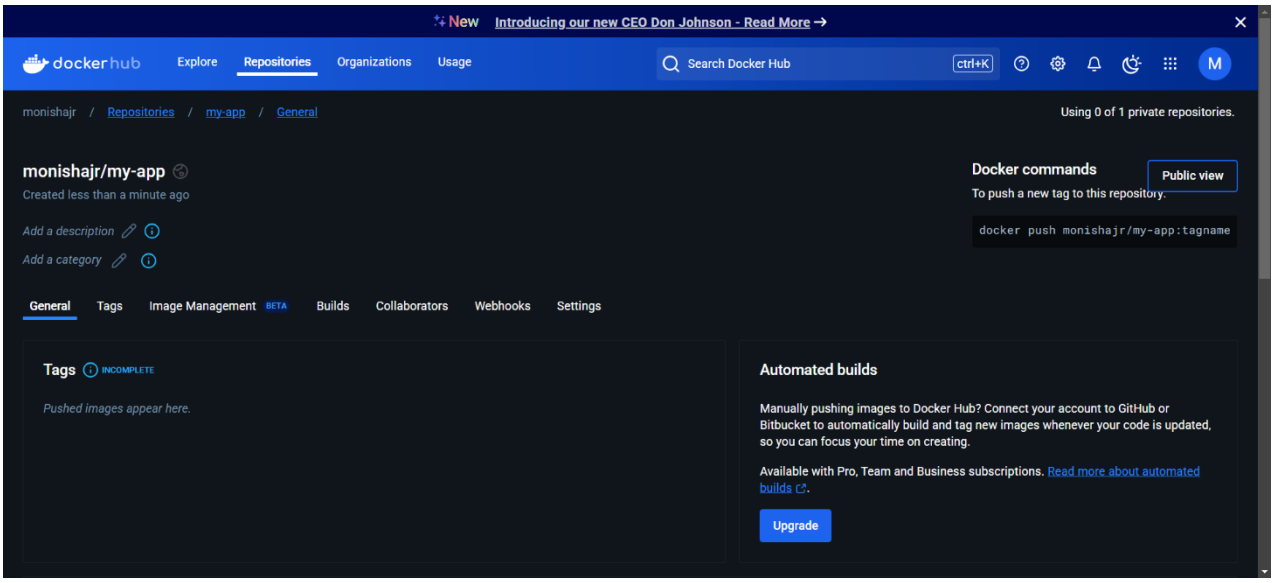
Since we need to push the Docker image to **Docker Hub**, we must store our **Docker Hub username and password** securely in GitHub.

Get a Docker Hub Account

Go to Docker Hub and sign up (if you don't have an account).

Click **Create Repository** → Name it **my-app** → Set it to **Public** or **Private**.


New Introducing our new CEO Don Johnson - Read More →
docker
M
Welcome to Docker Home, Monisha
Access and manage your Docker Desktop, Build Cloud, Scout, and Hub products, and get access to resources for learning, support, and account settings, including billing management.
Get started with Docker guidance
Learn about Docker concepts
Docker products
Give feedback
docker desktop
Innovate with
Docker Desktop
Your command center for innovative local and cloud native container development.
Go to download
Launch Docker Desktop
build cloud
Build with
Docker Build Cloud
Accelerate image build times with access to cloud-based builders and shared cache.
Go to Build Cloud
scout
Secure with
Docker Scout
Address security issues before they hit production through actionable insights across the software supply chain.
Go to Scout


New Introducing our new CEO Don Johnson - Read More →
docker hub
Explore
Repositories
Organizations
Usage
Search Docker Hub
ctrl+K
M
monishajr / Repositories / my-app / General
Using 0 of 1 private repositories.
monishajr/my-app
Created less than a minute ago
Add a description
Add a category
Docker commands
Public view
To push a new tag to this repository.
docker push monishajr/my-app:tagname
General
Tags
Image Management BETA
Builds
Collaborators
Webhooks
Settings
Tags INCOMPLETE
Pushed images appear here.
Automated builds
Manually pushing images to Docker Hub? Connect your account to GitHub or Bitbucket to automatically build and tag new images whenever your code is updated, so you can focus your time on creating.
Available with Pro, Team and Business subscriptions. Read more about automated builds.
Upgrade

Step 6:

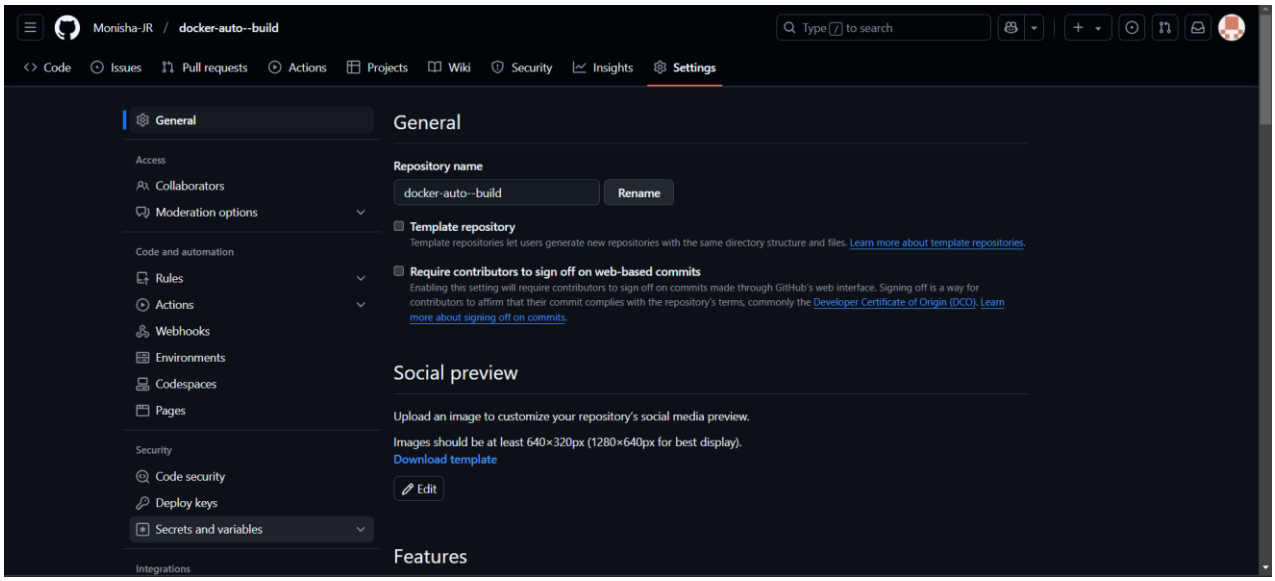
1. Go to your **GitHub repository → Settings → Secrets and variables → Actions**.

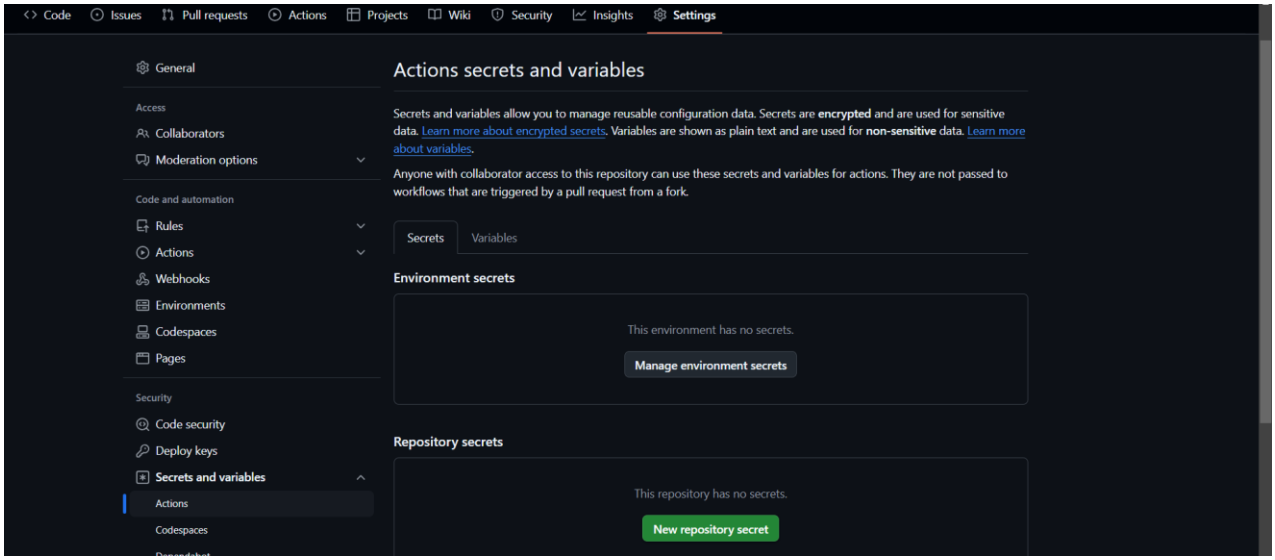
2. Click **New Repository Secret** and add:

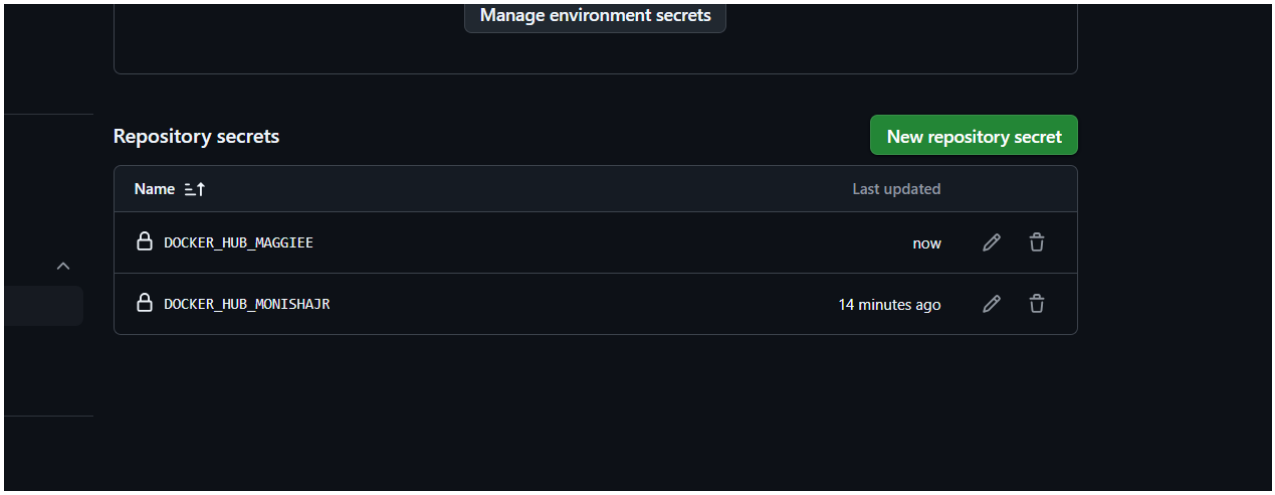
   - **Name:** DOCKER_HUB_USERNAME
   - **Value:** Your Docker Hub username

3. Click **New Repository Secret** again and add:

   - **Name:** DOCKER_HUB_PASSWORD
   - **Value:** Your Docker Hub password







Step 7:

Create the GitHub Actions Directory

Run the following in **Command Prompt**:

mkdir .github\workflows

This creates a folder for GitHub Actions workflows.

```
C:\Users\user\docker-auto--build>mkdir .github\workflows
```

Step 8:

1. Inside .github/workflows, create a new file named **docker-image-build.yml**.

2. Open it in **Notepad** .

3. Add the following code

4. Save the file.

```
C:\Users\user\docker-auto--build>notepad .github\workflows\docker-image- build.yml.txt

C:\Users\user\docker-auto--build>
```

docker-image- build.yml.txt

File Edit View

```yaml
on:
  push:
    branches:
      - main  # Runs when changes are pushed to 'main' branch

jobs:
  build-and-push:
    runs-on: ubuntu-latest

    steps:
      - name: Checkout repository
        uses: actions/checkout@v4

      - name: Log in to Docker Hub
        uses: docker/login-action@v3
        with:
          username: ${{ secrets.DOCKER_HUB_USERNAME }}
          password: ${{ secrets.DOCKER_HUB_PASSWORD }}

      - name: Build Docker image
        run: |
          docker build -t ${{ secrets.DOCKER_HUB_USERNAME }}/my-app:latest .

      - name: Push Docker image to Docker Hub
        run: |
          docker push ${{ secrets.DOCKER_HUB_USERNAME }}/my-app:latest
```

Step 9:

Now, we need to push our changes to GitHub.

1. Add all files to Git:

   git add .

2. Commit the changes:

   git commit -m "Add Dockerfile and GitHub Actions workflow"

3. Push to GitHub:

   git push origin main

```
C:\Users\Hi\docker-auto-build>git add .github/workflows/docker-image-build.yml

C:\Users\Hi\docker-auto-build>git commit -m "Added GitHub Actions workflow for Docker build & push"
[main (root-commit) 9b7cbad] Added GitHub Actions workflow for Docker build & push
 1 file changed, 28 insertions(+)
 create mode 100644 .github/workflows/docker-image-build.yml

C:\Users\Hi\docker-auto-build>git push origin main
Enumerating objects: 5, done.
Counting objects: 100% (5/5), done.
Delta compression using up to 16 threads
Compressing objects: 100% (3/3), done.
Writing objects: 100% (5/5), 675 bytes | 168.00 KiB/s, done.
Total 5 (delta 0), reused 0 (delta 0), pack-reused 0 (from 0)
```

Step 10:

1. Go to your **GitHub repository** → **Actions** tab.

2. You should see a workflow running.

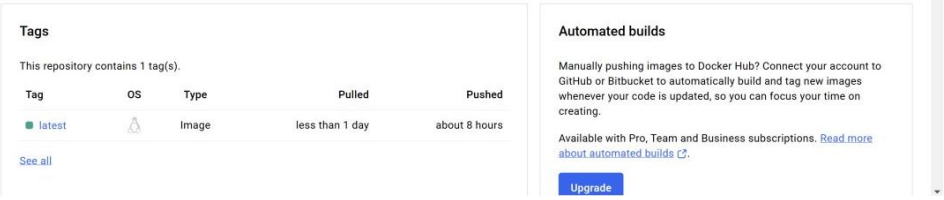
3. Wait for it to complete.

4. If successful, check **Docker Hub** to see if your image is uploaded.

Step 11:

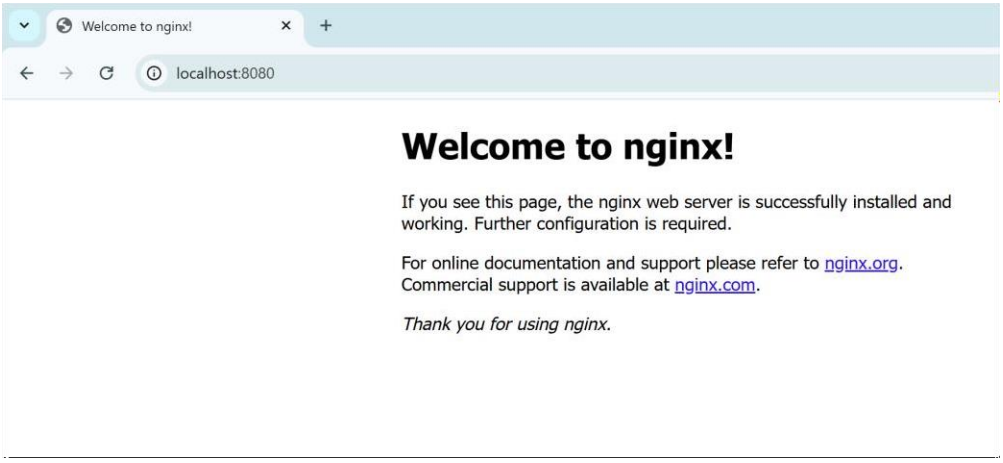
Test the Docker Image

To run the image locally:



docker run -d -p 8080:80 YOUR_DOCKER_HUB_USERNAME/my-app:latest

Now, open **http://localhost:8080** in your browser to see your app running!



PoC is **successfully completed!**

Created a Dockerfile. Configured GitHub Actions to automate Docker image builds. Pushed the image to Docker Hub. Verified the image by pulling and running it locally.

Outcomes

By completing this **Automating Docker Image Builds Using GitHub Actions** PoC, you will:

1. **Understand Docker Image Automation** – Gain hands-on experience in automating Docker image builds using GitHub Actions.

2. **Implement CI/CD for Containerized Applications** – Learn how to integrate GitHub Actions with Docker Hub to streamline the build and deployment process.

3. **Configure Secure Authentication** – Use GitHub Secrets to securely authenticate with Docker Hub, ensuring secure and automated image pushes.

4. **Build and Push Docker Images Efficiently** – Automate the process of building a Docker image and pushing it to a container registry whenever there is a code change.