Containerization & Introduction to the Lab Environment

Updated 11/09/2023

Overview

In this lab, students will learn about containers and create the container that they will use as their environment for the remaining labs

Estimated Time: 45 min

Learning Objectives

1. Create a Dockerfile
2. Build and Run the Container
3. Commit the Container as a New Image

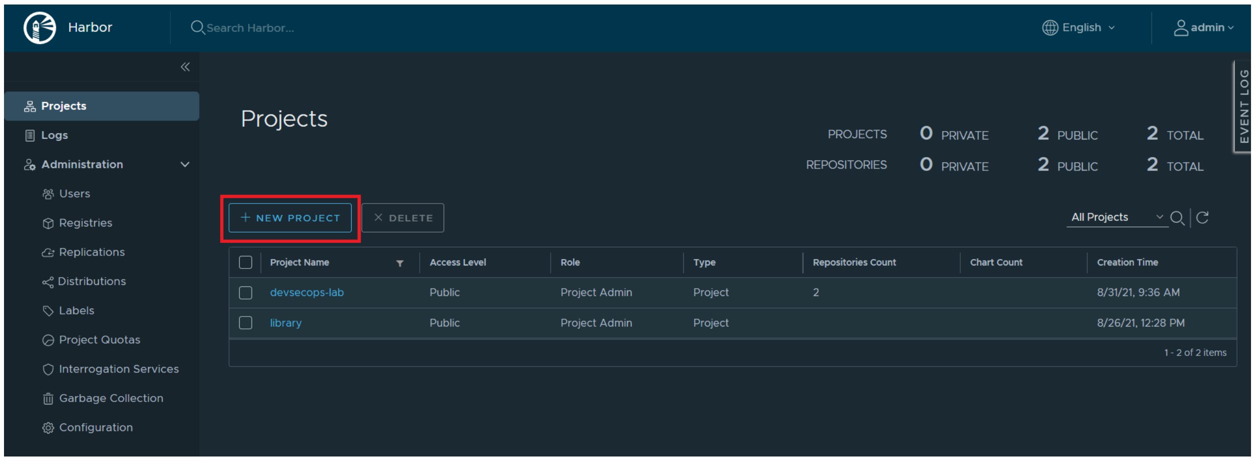
Instructions

Prerequisites

Create a Harbor Project

Create a Harbor project by following the instructions below:

1. Navigate to Harbor in your browser (https://registry.dev.afsmtddso.com/) and click "New Project"



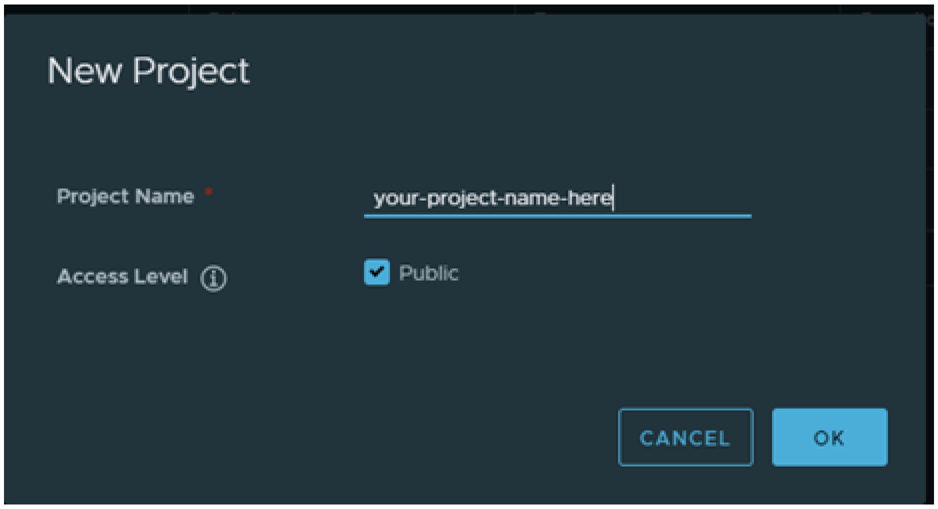
Projects

PROJECTS	0 PRIVATE	2 PUBLIC	2 TOTAL
REPOSITORIES	0 PRIVATE	2 PUBLIC	2 TOTAL

Project Name	Access Level	Role	Type	Repositories Count	Chart Count	Creation Time
devsecops-lab	Public	Project Admin	Project	2		8/31/21, 9:36 AM
library	Public	Project Admin	Project			8/26/21, 12:28 PM

1 - 2 of 2 items

2. Name your project `<first name initial + last name>-harbor-project` and check the "Public" box to make your project accessible without having to provide credentials



New Project

Project Name * your-project-name-here

Access Level ✓ Public

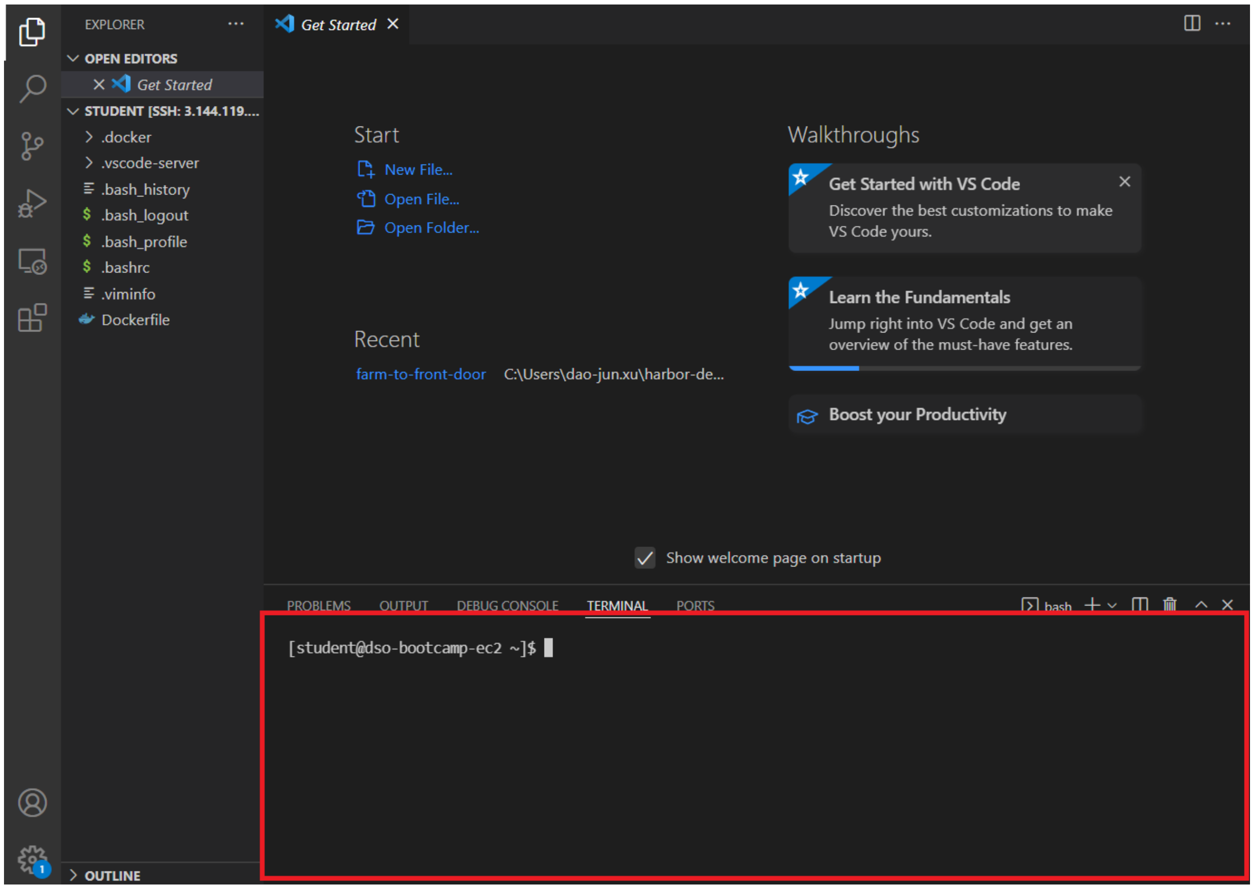
3. Click "OK" to finish creating your new project

Set up Docker

1. SSH into your EC2 with VSCode Remote SSH if you haven't already
2. Provide Docker with your Harbor credentials by following the steps below:

a. Open your intergrated terminal in VSCode

> **Tip:** It should be there already (see image below) but if not,select View in the menu bar and click on "Terminal"


EXPLORER
OPEN EDITORS
Get Started
STUDENT [SSH: 3.144.119....
.docker
.vscode-server
.bash_history
.bash_logout
.bash_profile
.bashrc
.viminfo
Dockerfile
OUTLINE
Start
New File...
Open File...
Open Folder...
Recent
farm-to-front-door C:\Users\dao-jun.xu\harbor-de...
Walkthroughs
Get Started with VS Code
Discover the best customizations to make VS Code yours.
Learn the Fundamentals
Jump right into VS Code and get an overview of the must-have features.
Boost your Productivity
Show welcome page on startup
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS
bash

```
[student@dso-bootcamp-ec2 ~]$
```

b. Run the following command (replace `<USERNAME>` with the username you were given):

```
docker login -u <USERNAME> https://registry.dev.afsmtddso.com/
```

d. Input your Harbor password when prompted. If you see "Login Succeeded," you can move on!

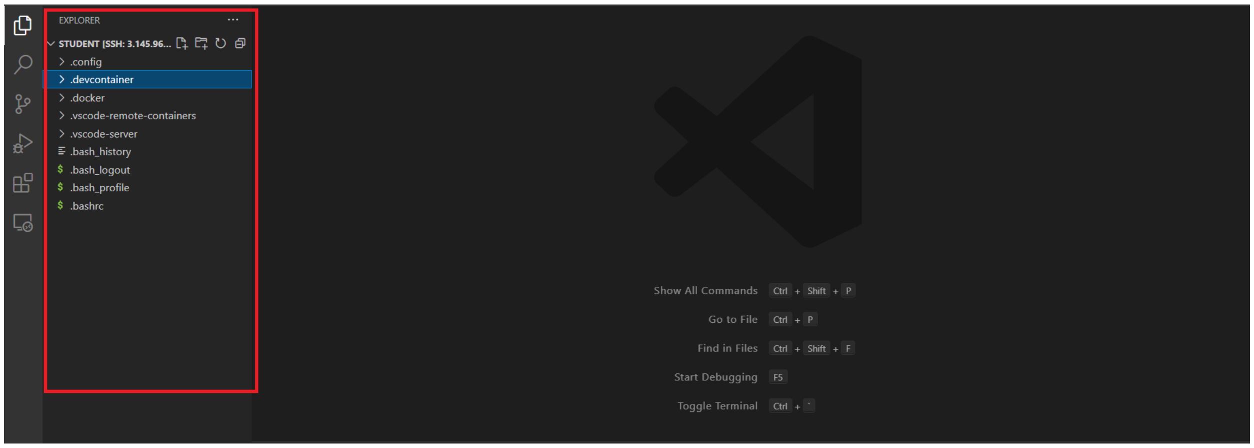
> **Note:** When typing a password into Linux, it doesn't show characters as you type. Don't be surprised if it looks like nothing is happening, just type your password and hit enter!

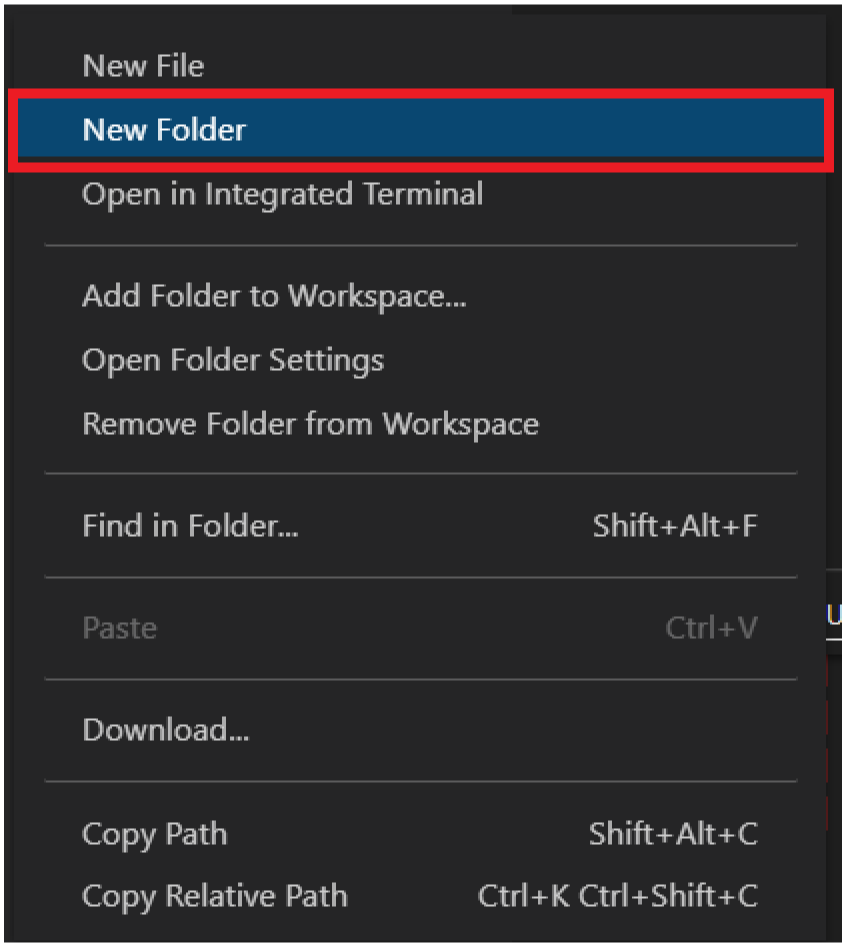
Double-click (or enter) to edit

Create a Dockerfile

1. Under the "Explorer" section (please see first image below) of VSCode on the left side of the screen, right-click and create a new folder named `.devcontainer` (please see second image

below for the menu that you should see after right-clicking)




New File
New Folder
Open in Integrated Terminal
Add Folder to Workspace...
Open Folder Settings
Remove Folder from Workspace
Find in Folder... Shift+Alt+F
Paste Ctrl+V
Download...
Copy Path Shift+Alt+C
Copy Relative Path Ctrl+K Ctrl+Shift+C

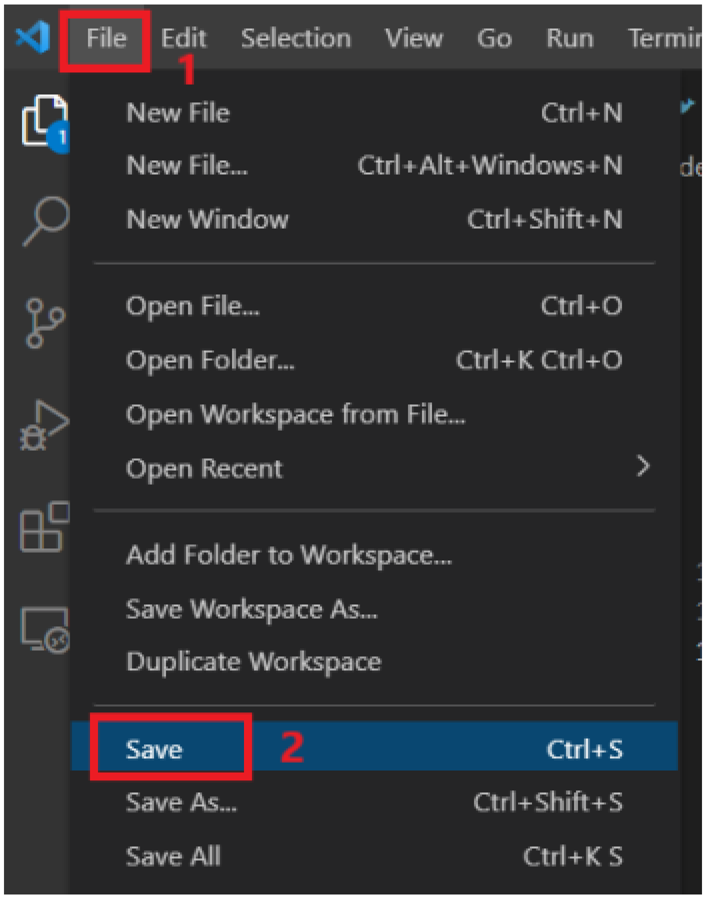
2. Right-click on the `.devcontainer` folder to create a new file called `Dockerfile` within `.devcontainer`
3. Paste the following code into your `Dockerfile`

```
FROM ubuntu:20.04

RUN apt-get update -y && \
    apt-get install curl zip vim git -y && \
    curl "https://awscli.amazonaws.com/awscli-exe-linux-x86_64.zip" -o "awscliv2.zip" && \
    unzip awscliv2.zip && ./aws/install && \
    curl -LO "https://dl.k8s.io/release/$(curl -L -s https://dl.k8s.io/release/stable.txt)/
    install -o root -g root -m 0755 kubectl /usr/local/bin/kubectl && \
    rm kubectl awscliv2.zip && \
    mkdir /root/dso-bootcamp-home

WORKDIR /root/dso-bootcamp-home
```

> **Explanation of code:**
>
> The `FROM` instruction is typically the first instruction in a Dockerfile. Any commands following them act upon the base image. `FROM ubuntu:20.04` in particular will ensure that our container is running ubuntu as the base operating system for this container).
>
> The `RUN` instruction will run all the commands in the statement within the container. These commands install `curl`, `zip`, `vim`, `git`, the AWS CLI, and `kubectl`, which will all be relevant in upcoming labs. The `mkdir` command will create your home directory.
>
> The `WORKDIR` instruction changes the working directory of your container to /root/dso-bootcamp-home so you don't have to worry about changing directories every time you bash into your container.

> **Note:** Running commands in your container requires opening an interactive bash shell, so it is also referred to as "bashing into your container."

4. Save your changes by going to "File" → "Save" or holding down Ctrl + S on your keyboard



Build and Run the Container

1. To build your new environment image, make sure you're in the `~` folder in your integrated terminal (i.e., if the prompt is `[student@dso-bootcamp-ec2 ~]$`) before running the following command:

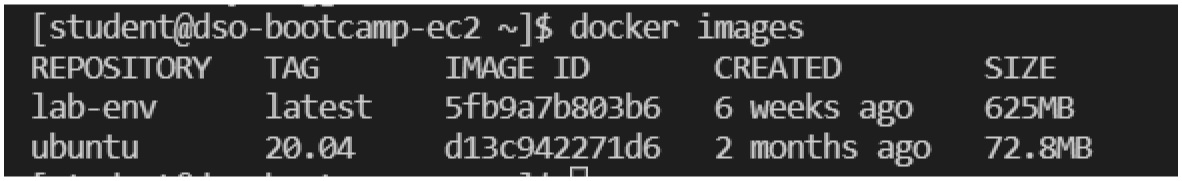
```
docker build -t lab-env .devcontainer
```

> **Note:** The `-t` is how we name our image “lab-env.” If we didn’t specify a name, the system would generate a random name made of letters and numbers.
>
> In the console output of this command, you will see the official `ubuntu:20.04` image being pulled from the Docker registry

2. Verify the image build by running the following command

```
docker images
```

a. You should see an image titled “lab-env”



```
[student@dso-bootcamp-ec2 ~]$ docker images
REPOSITORY   TAG       IMAGE ID       CREATED        SIZE
lab-env      latest    5fb9a7b803b6   6 weeks ago    625MB
ubuntu       20.04     d13c942271d6   2 months ago   72.8MB
```

3. To run this image as a container, run the following command:

```
docker run -v lab-vol:/root --rm --hostname lab-env --name lab-env --memory=200m --
```

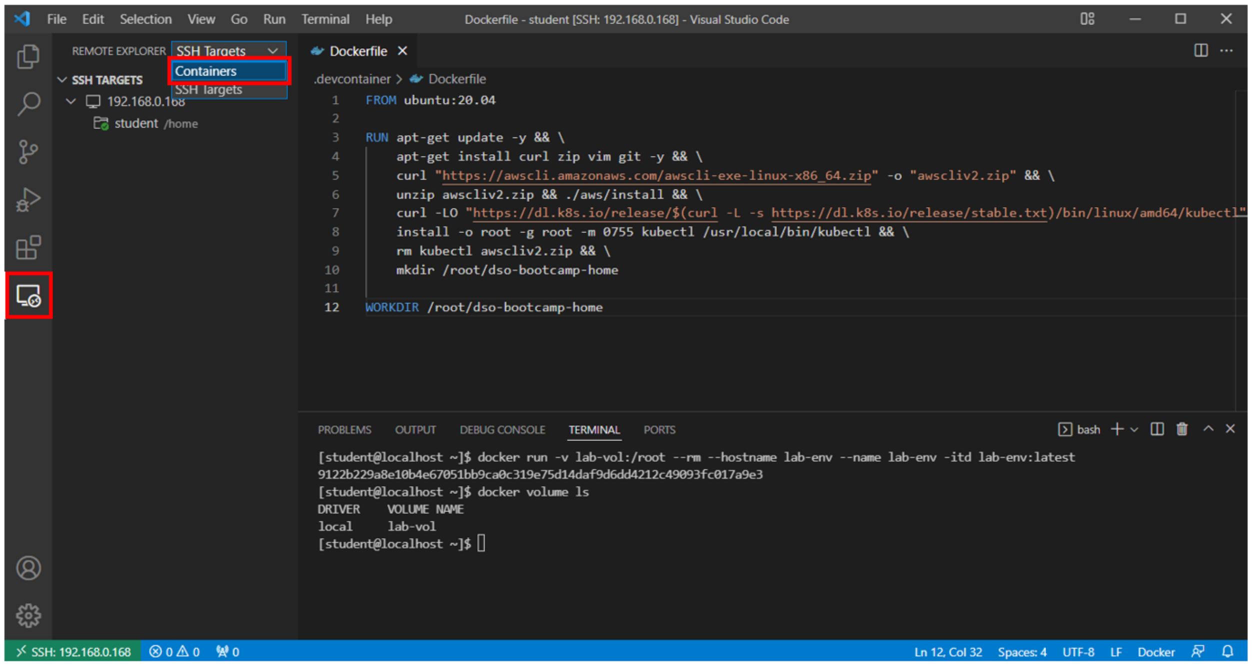
a. Enter your EC2 student password when prompted.

> **Explanation of command:** `-v` attaches a volume or storage system to your container that will persist your data after the container is stopped. In this case, the volume is named `lab-vol` and it is attached in the container on the `/root` directory, so any files placed there will persist. You can verify your persistent storage has been created by running:
>
> ```
> docker volume ls
> ```
>
> `--rm` automatically removes containers in the "Exited" state
>
> `--hostname` will change the hostname of your container; this will help differentiate between which environment you're working on
>
> `--name` specifies the name of your container; in this case, it’s `lab-env`
>
> `--memory` limits the container's memory usage
>
> `--cpus` limits the container's cpu usage
>
> The “it” in `-itd` will allow us execute commands inside the container
>
> The “d” in `-itd` runs the command in detached mode so your container will run in the background of your terminal
>
> The argument at the very end is the name of the image you’re running; in this case, it’s `lab-env:latest`

> ***IMPORTANT:*** For the rest of this course, you'll need to make sure your container is running. Save this command:
>
> ```
> docker ps -a
> ```
>
> This command will show you a list of your existing containers. Check to see that your `lab-env` container is in the list. If it isn't, you'll have to use the `docker run` command from the above section to create the container again.

4. Use VSCode as your editor in the newly created container

   a. Under the "Remote Explorer" tab, click on the drop-down menu and select "Containers"



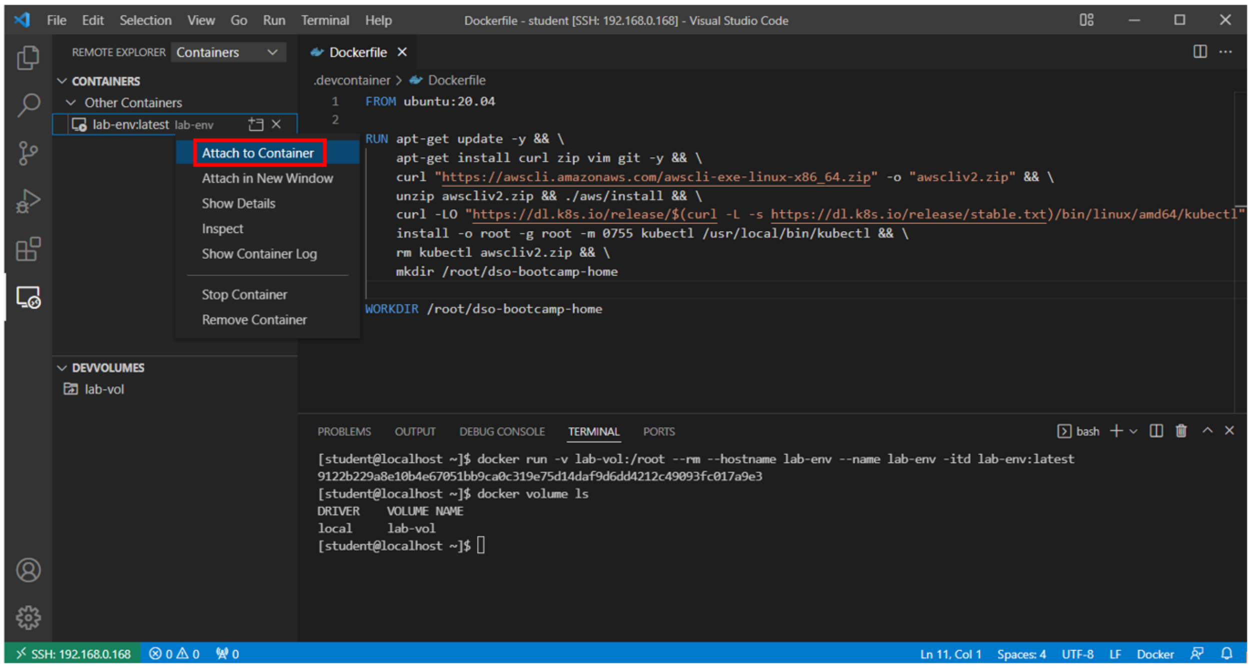
```
FROM ubuntu:20.04

RUN apt-get update -y && \
    apt-get install curl zip vim git -y && \
    curl "https://awscli.amazonaws.com/awscli-exe-linux-x86_64.zip" -o "awscliv2.zip" && \
    unzip awscliv2.zip && ./aws/install && \
    curl -LO "https://dl.k8s.io/release/$(curl -L -s https://dl.k8s.io/release/stable.txt)/bin/linux/amd64/kubectl"
    install -o root -g root -m 0755 kubectl /usr/local/bin/kubectl && \
    rm kubectl awscliv2.zip && \
    mkdir /root/dso-bootcamp-home

WORKDIR /root/dso-bootcamp-home
```

```
[student@localhost ~]$ docker run -v lab-vol:/root --rm --hostname lab-env --name lab-env -itd lab-env:latest
9122b229a8e10b4e67051bb9ca0c319e75d14daf9d6dd4212c49093fc017a9e3
[student@localhost ~]$ docker volume ls
DRIVER    VOLUME NAME
local     lab-vol
[student@localhost ~]$ 
```

   b. Click on "Refresh" and enter your password when prompted

   > **Note:** VSCode will now show a list of running containers and created volumes in your EC2.

   c. Under "Containers", right-click on "lab-env:latest" and select "Attach to Container" to enter your lab environment.


File Edit Selection View Go Run Terminal Help
Dockerfile - student [SSH: 192.168.0.168] - Visual Studio Code
REMOTE EXPLORER Containers
CONTAINERS
Other Containers
lab-env:latest lab-env
Attach to Container
Attach in New Window
Show Details
Inspect
Show Container Log
Stop Container
Remove Container
DEVVOLUMES
lab-vol
Dockerfile
.devcontainer > Dockerfile
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS
bash
SSH: 192.168.0.168
Ln 11, Col 1 Spaces: 4 UTF-8 LF Docker

```
FROM ubuntu:20.04

RUN apt-get update -y && \
    apt-get install curl zip vim git -y && \
    curl "https://awscli.amazonaws.com/awscli-exe-linux-x86_64.zip" -o "awscliv2.zip" && \
    unzip awscliv2.zip && ./aws/install && \
    curl -LO "https://dl.k8s.io/release/$(curl -L -s https://dl.k8s.io/release/stable.txt)/bin/linux/amd64/kubectl"
    install -o root -g root -m 0755 kubectl /usr/local/bin/kubectl && \
    rm kubectl awscliv2.zip && \
    mkdir /root/dso-bootcamp-home

WORKDIR /root/dso-bootcamp-home
```

```
[student@localhost ~]$ docker run -v lab-vol:/root --rm --hostname lab-env --name lab-env -itd lab-env:latest
9122b229a8e10b4e67051bb9ca0c319e75d14daf9d6dd4212c49093fc017a9e3
[student@localhost ~]$ docker volume ls
DRIVER    VOLUME NAME
local     lab-vol
[student@localhost ~]$ 
```

> **Note:** If you get a pop-up saying "Attaching to a container may execute arbitrary code," click "Got it."

d. Enter your password if prompted to when attaching to the container

> **Note:** You can close the previous window if VSCode creates a new window for your container.

e. Open the `dso-bootcamp-home` folder by following the instructions below:

  i. On the side bar, click on the "Explorer" icon

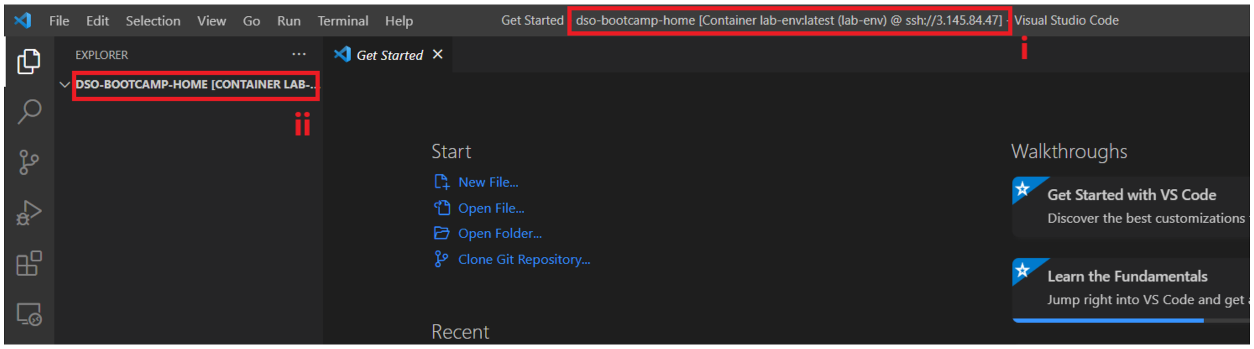
  ii. Click on "Open Folder"

  iii. Enter the path `/root/dso-bootcamp-home` to open

f. Verify that you are in your container environment by checking the following indicators:

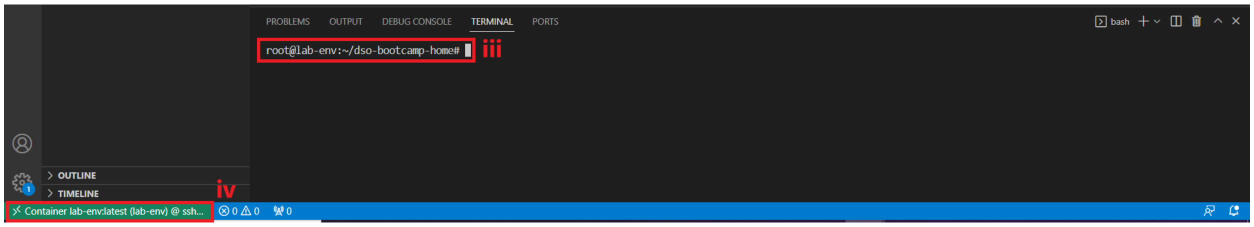
  i. The top of your screen should say `dso-bootcamp-home [Container lab-env:latest (lab-env) ...]`

  ii. Your "Explorer" section should have a dropdown that starts with `DSO-BOOTCAMP-HOME`


File Edit Selection View Go Run Terminal Help
Get Started dso-bootcamp-home [Container lab-env:latest (lab-env) @ ssh://3.145.84.47] - Visual Studio Code
i
EXPLORER
DSO-BOOTCAMP-HOME [CONTAINER LAB-...
ii
Get Started
Start
New File...
Open File...
Open Folder...
Clone Git Repository...
Recent
Walkthroughs
Get Started with VS Code
Discover the best customizations
Learn the Fundamentals
Jump right into VS Code and get

iii. Your terminal should prompt you with `root@lab-env:~/dso-bootcamp-home#`

iv. The bottom left corner of your screen should have a green box that says `Container lab-env:latest (lab-env)`


PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS
bash
iii
OUTLINE
TIMELINE
iv
Container lab-env:latest (lab-env) @ ssh...
0 0 0

```
root@lab-env:~/dso-bootcamp-home#
```

> **Tip:** If your terminal disappears, re-open it by right-clicking on the left pane of the "Explorer" tab and selecting "Open in Integrated Terminal"

5. In the integrated terminal, verify the installation of the required CLI tools by running the following commands individually:

   a. `git --version`

   b. `aws --version`

   c. `kubectl version`

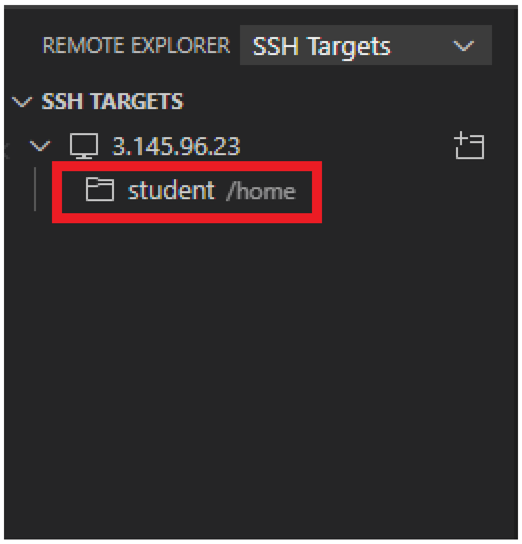
> **Note:** `kubectl version` should return an error that it cannot connect to a server on `localhost:8080`. This is normal, and `kubectl` is functioning correctly if this happens.

Push the Container as a New Image

At the start of this lab, we pulled the `ubuntu:20.04` image from the official Docker registry and used it to build our `lab-env` image. Now that we've successfully built it, we can push `lab-env` to our own registry (i.e., Harbor) to allow other users to pull it and use it on their machines.

1. Go back to your EC2 by switching from "Containers" to "SSH Targets" under the "Remote Explorer" tab

   a. Under your EC2's IP address, you should see your `/home` folder; right-click on it and select "Open on SSH Host in New Window"



   b. Enter your password when prompted

   > **Note:** VSCode will create a new window when editing inside your EC2.

2. Push your image to Harbor by following the steps below:

   a. Duplicate the image and name the new copy at the same time by running the following command, in the terminal, after replacing the placeholders:

```
docker tag lab-env registry.dev.afsmtddso.com/<PROJECT>/<REPOSITORY>:<VERSION TAG>
```

      i. `PROJECT` is the name of the Harbor project you created at the beginning of this lab (should be first initial + last name - harbor-project)

      ii. `REPOSITORY` is the name of your repository. Since we don't have one yet, we can replace it with `lab-env-repo` and it will be created automatically when you push the image.

iii. The `VERSION TAG` is the version. For this project, put `1.0`

> **Note:** Harbor’s hierarchy for storing images is as follows: Projects → Repositories → Artifacts → Images
>
> Projects separate images by either the users that create them or the respective tasks they belong to. Repositories further categorize images based on what they deploy. Artifacts are the different build versions of an image.

b. Run the following command to push the newly tagged image to your Harbor project:

```
docker push registry.dev.afsmtddso.com/<PROJECT>/lab-env-repo:1.0
```