Exercises: Deployment to Cloud

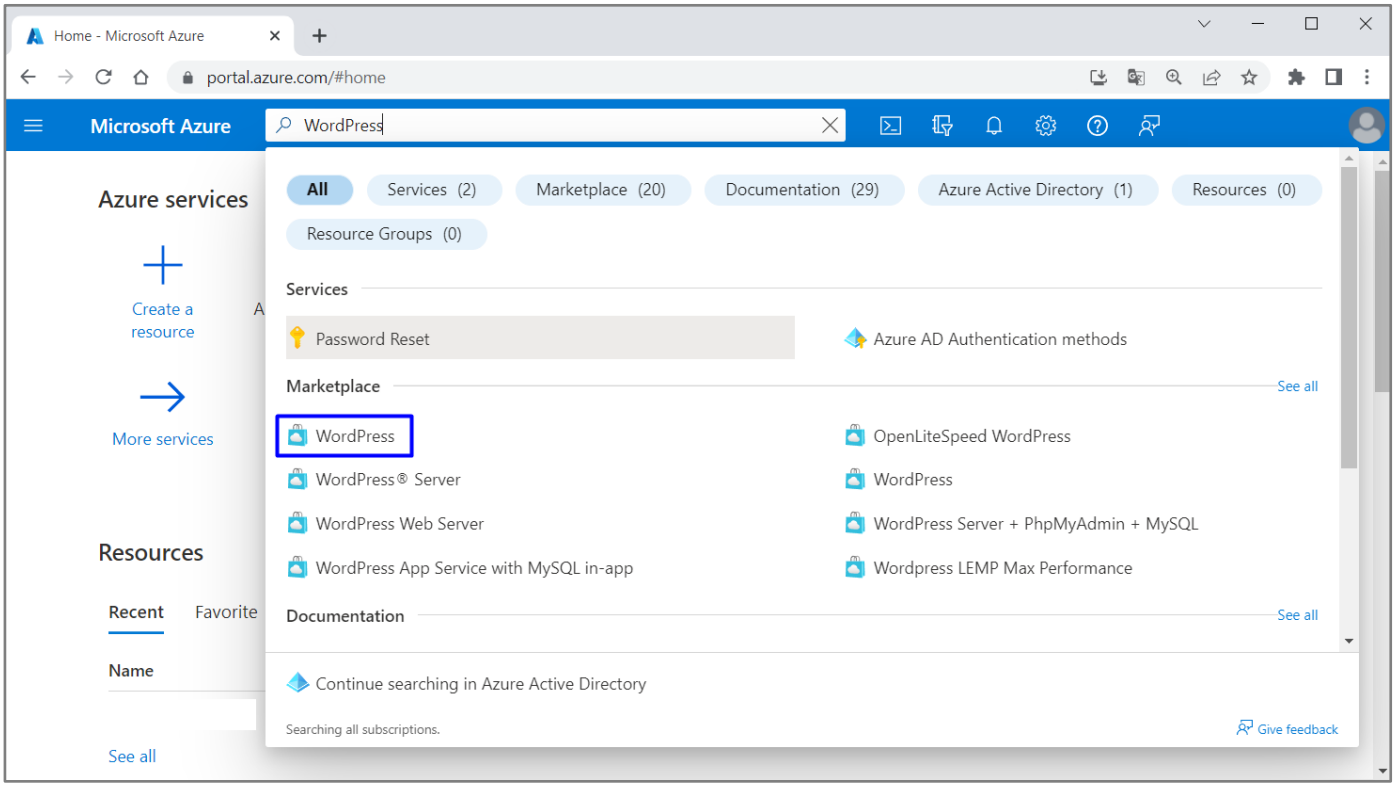
Exercises for the "Containers and Clouds" course @ SoftUni

1. Create WordPress Site Using Azure Portal

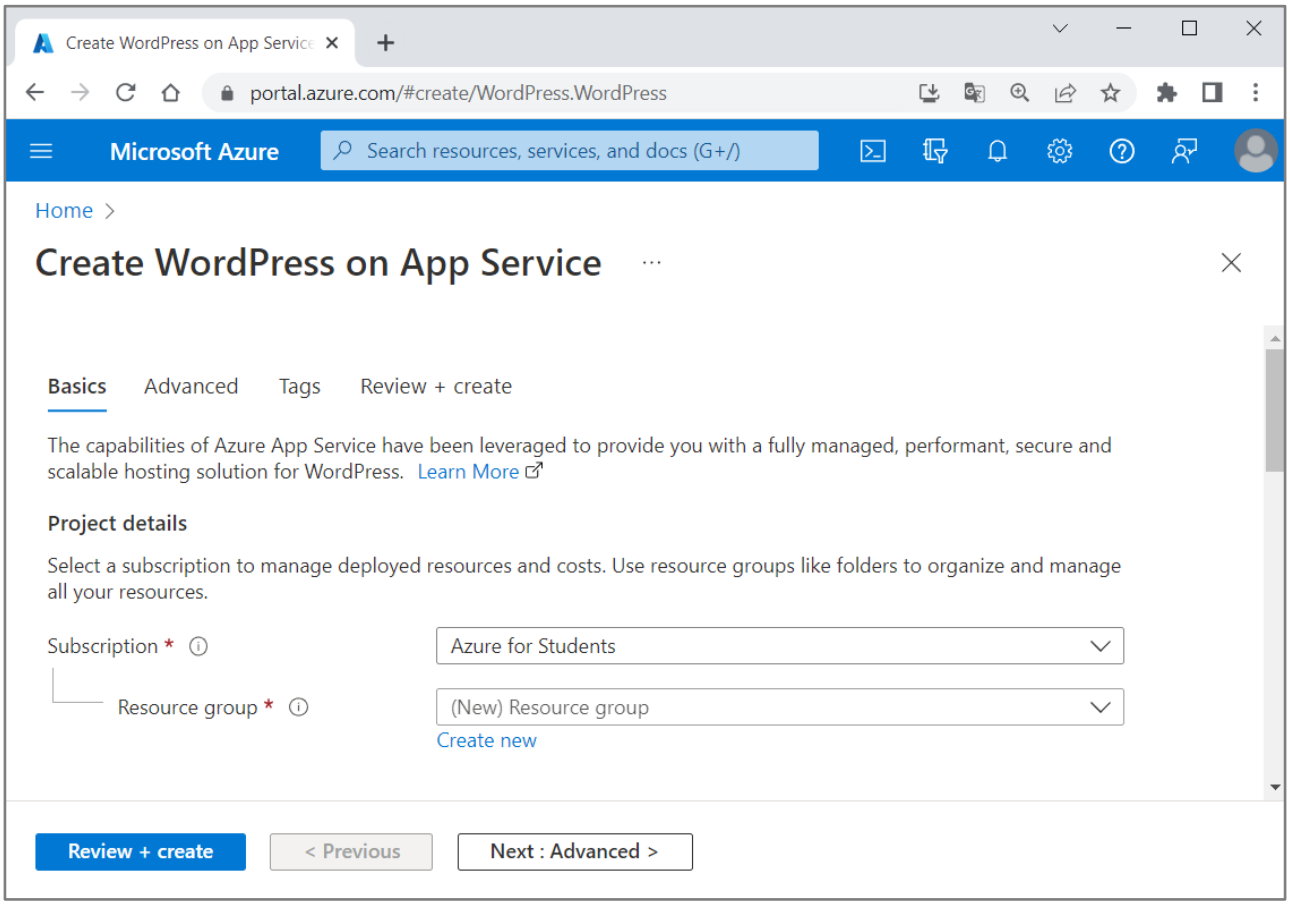
Our task now is to create a **WordPress site in Azure**. **WordPress** can be run on a **few different Azure services**: AKS, Virtual Machines, and App Service. Let's **deploy out first WordPress site** to **Azure App Service** with **Azure Database for MySQL – Flexible Server**.

Step 1: Create the Site

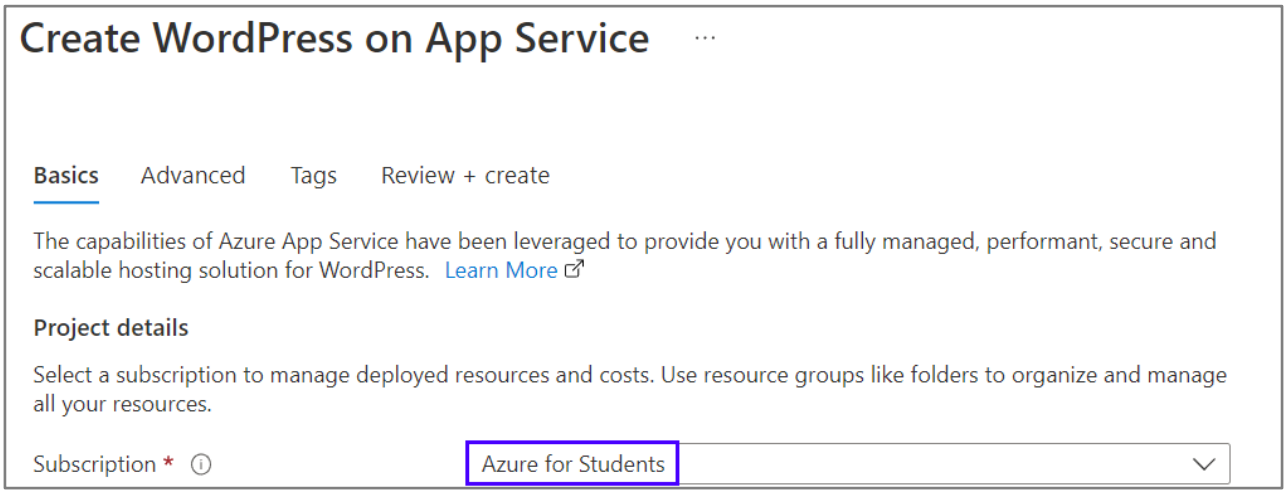
Go to **`Azure Portal`** on https://portal.azure.com and **log in**. Then, in the **search box**, type "**`WordPress`**" and select **`[WordPress]`** from the **Marketplace**:



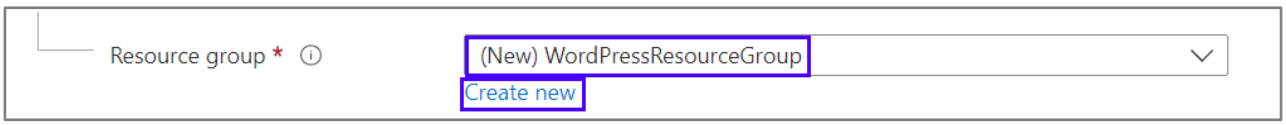
You should be on the "**`Create WordPress on App Service`**" **page**. For your convenience, you can follow this link: https://portal.azure.com/#create/WordPress.WordPress



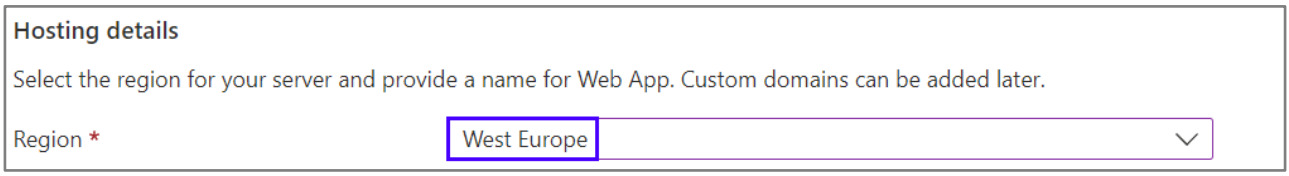
In the "**`Basics`** **tab**, under "**`Project details`**", make sure the **correct subscription is selected** – "**`Azure for Students`**":



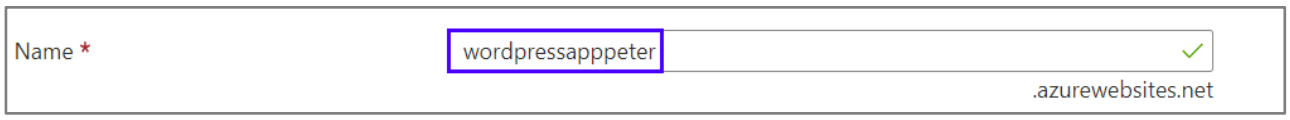
Then choose to **`[Create new resource group]`**. Type "**`WordPressResourceGroup`**" for the **name**:



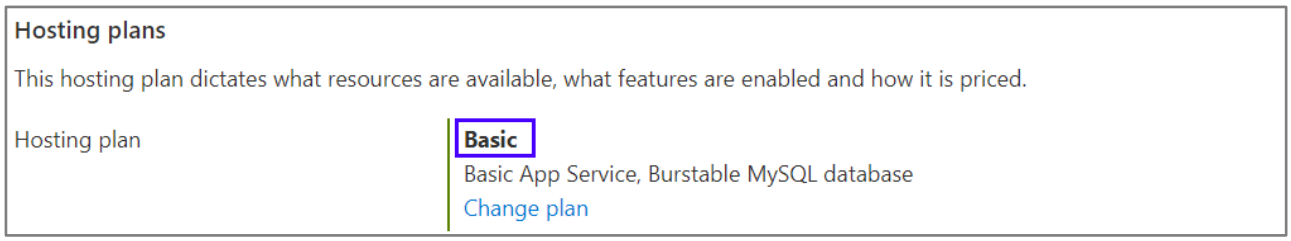
Select a **region** near you that you want to **serve your app** from:



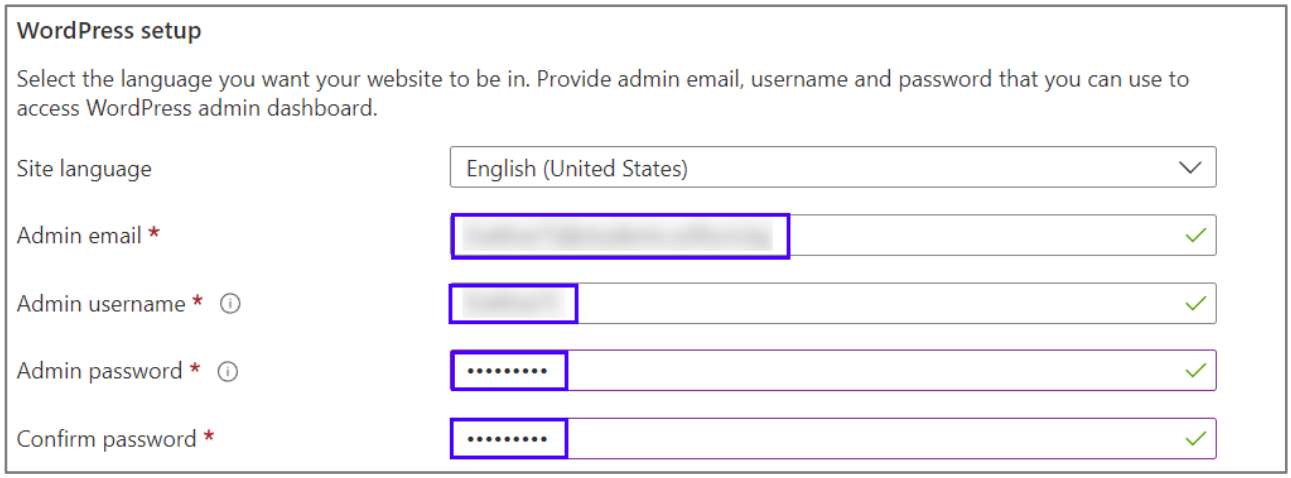
Provide a **name** for the Web App, which should be **unique**. You can name it "**`wordpressapp{your name}`**":



Select **`[Basic]`** for **hosting plan**:

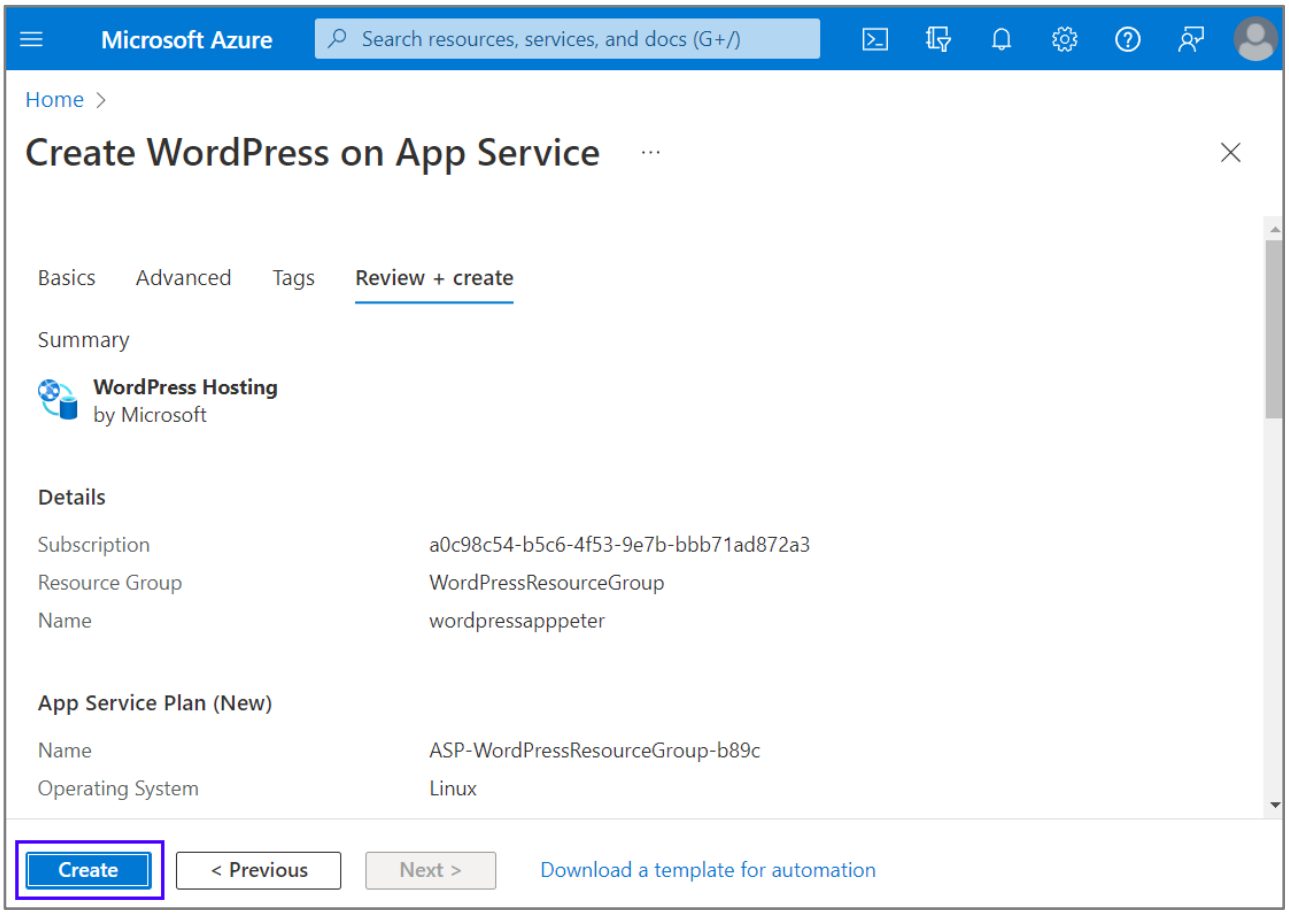


Under "**`WordPress Settings`**", type an **admin email**, **admin username**, **admin password** and **admin confirm password**. The **admin email** here is used for **WordPress administrative sign-in** only:

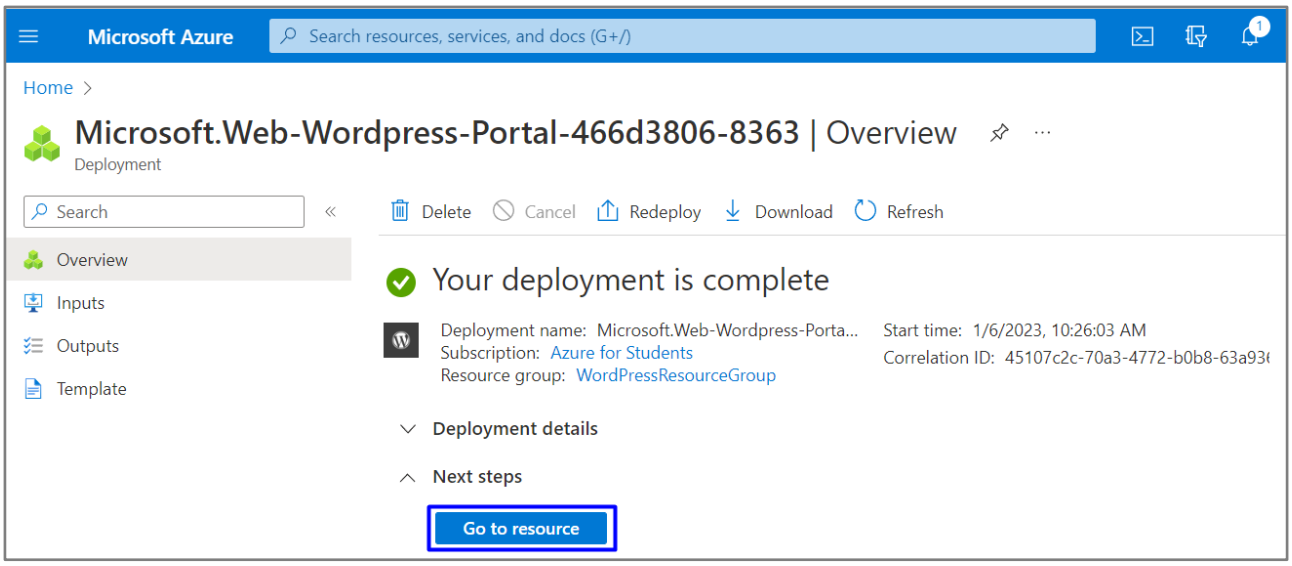


Remember your credentials for later. Then click on **`[Review + create]`**:

Click on **`[Create]`** to **create the resources**:

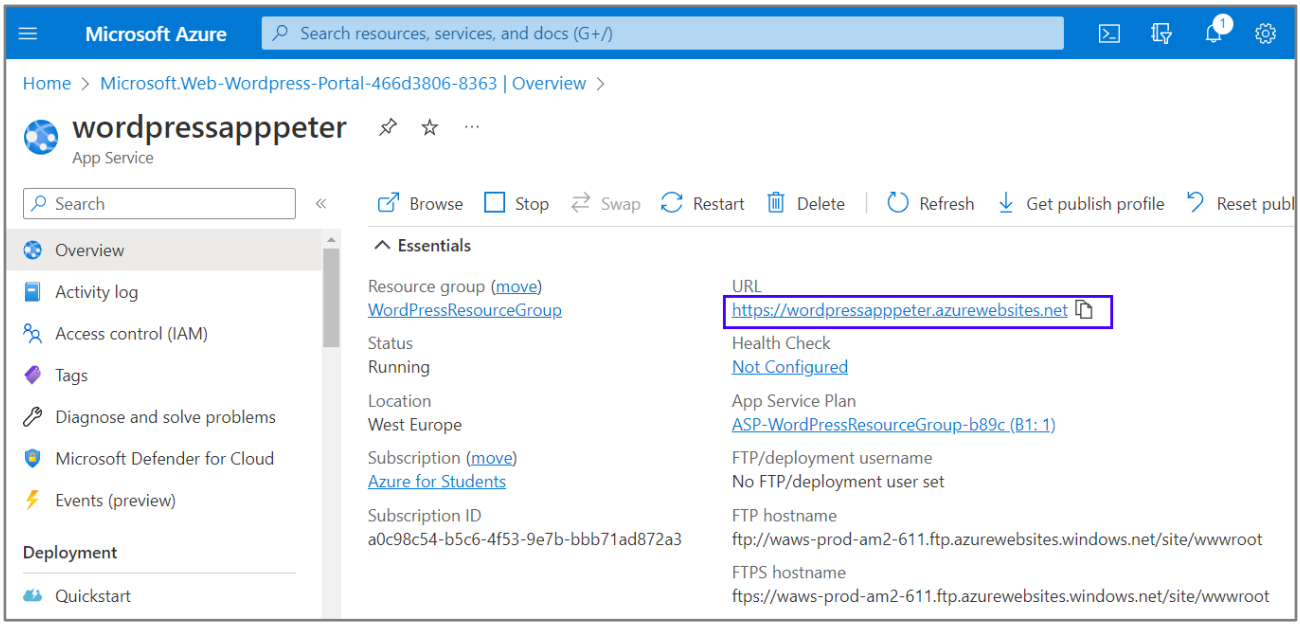


Then **wait for the deployment** to finish and click on the **`[Go to resource]` button**:



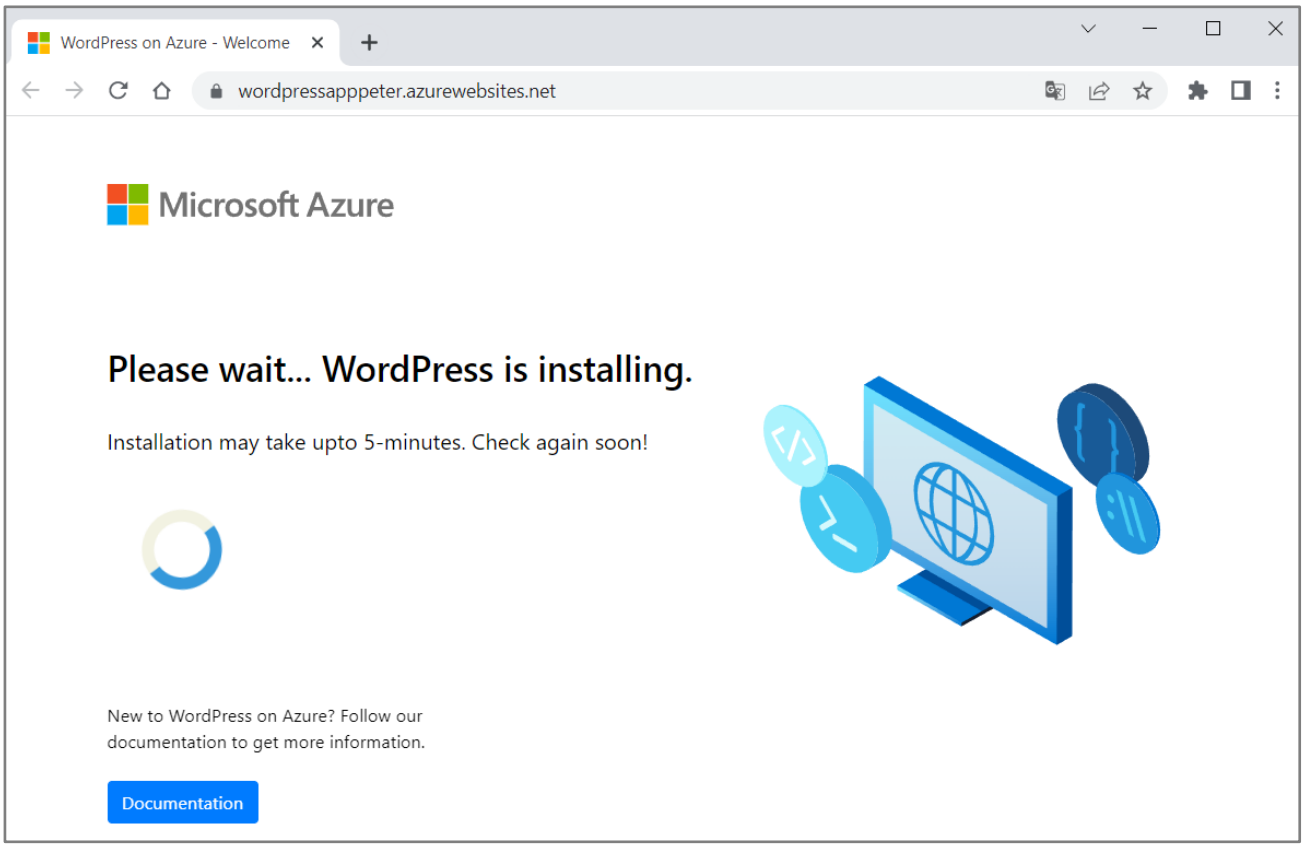
Step 2: Browse Site

You can **click on the URL** of the site in the "**App Service**" **page**, in the **[Overview] tab** to access the site:

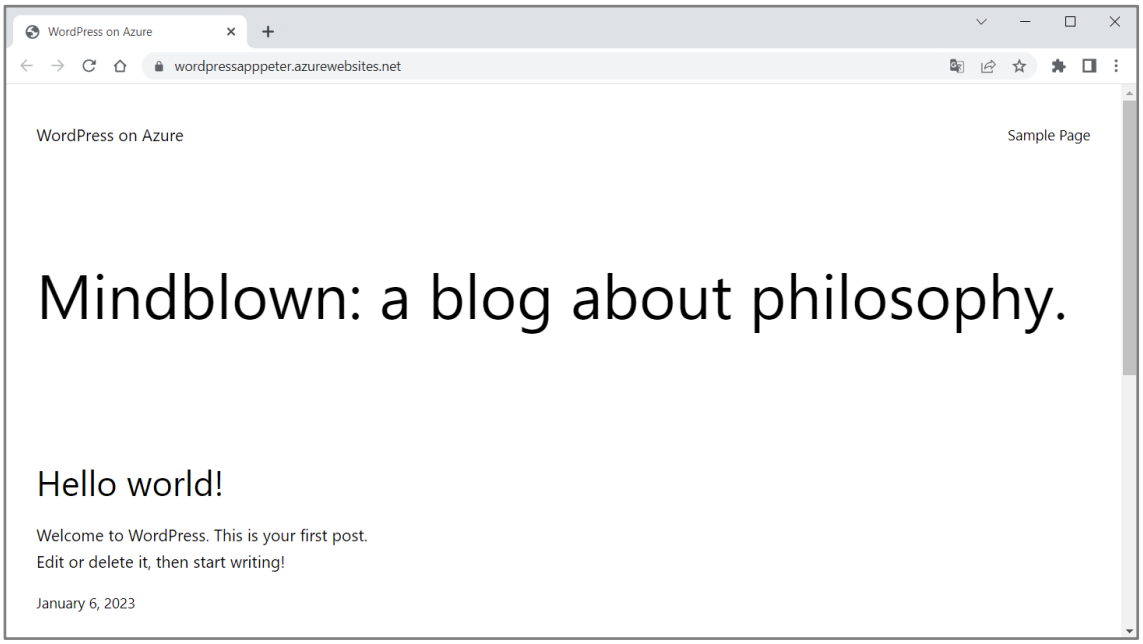


Or you can also **navigate directly** to `https://<app-name>.azurewebsites.net`.

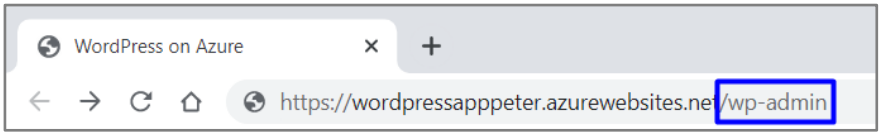
Your **site needs time to install**. **Wait** for it:

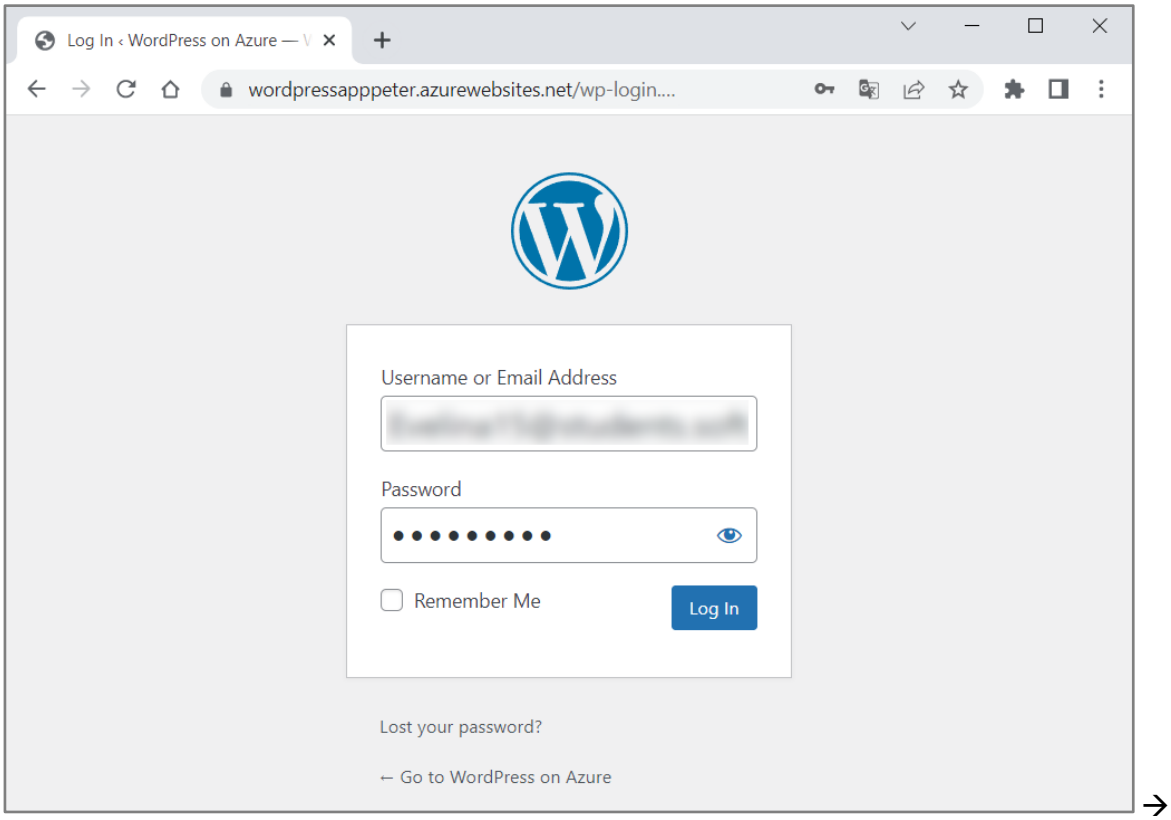


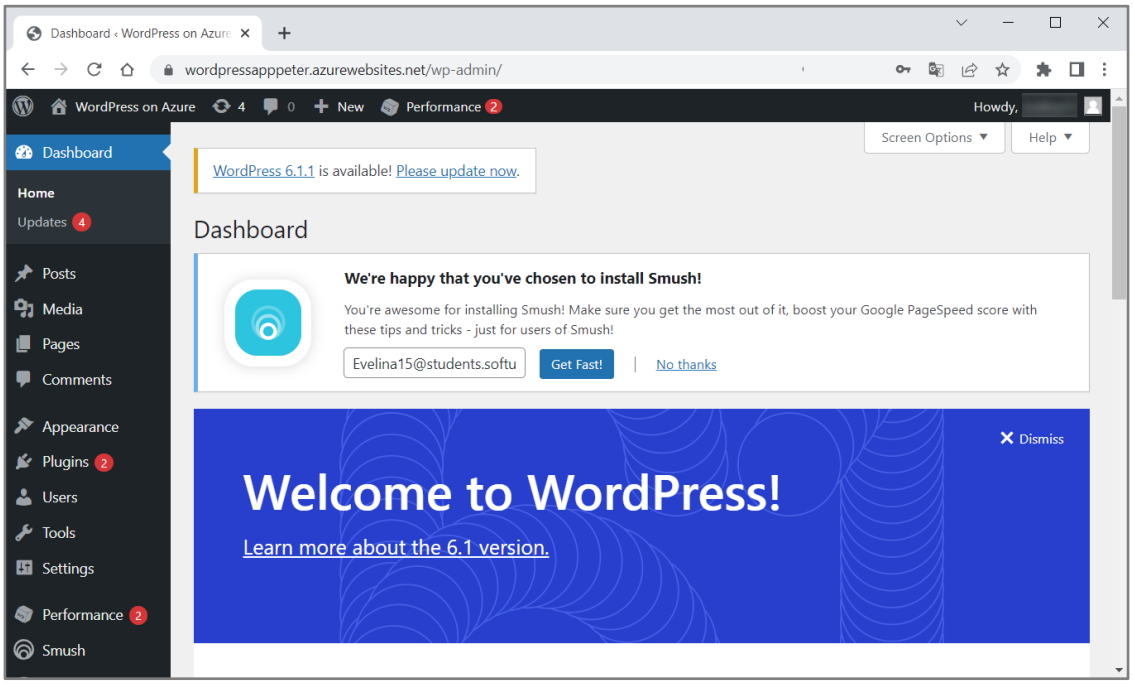
When ready, verify the **app is running properly**. If you **receive an error**, allow a few more minutes for the site to load and then **refresh the browser**.



To **access the `WordPress Admin` page**, browse to **`/wp-admin`** and **use the credentials** you created in the "**`WordPress Settings`" step**:



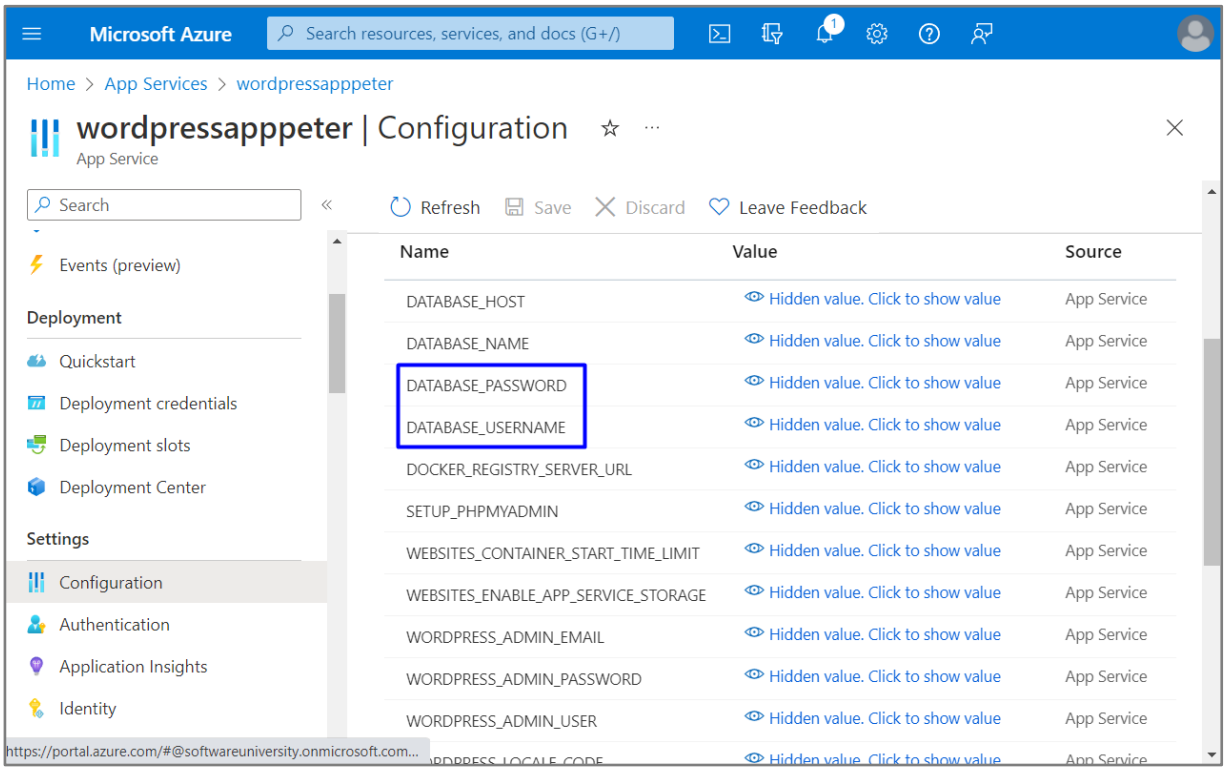




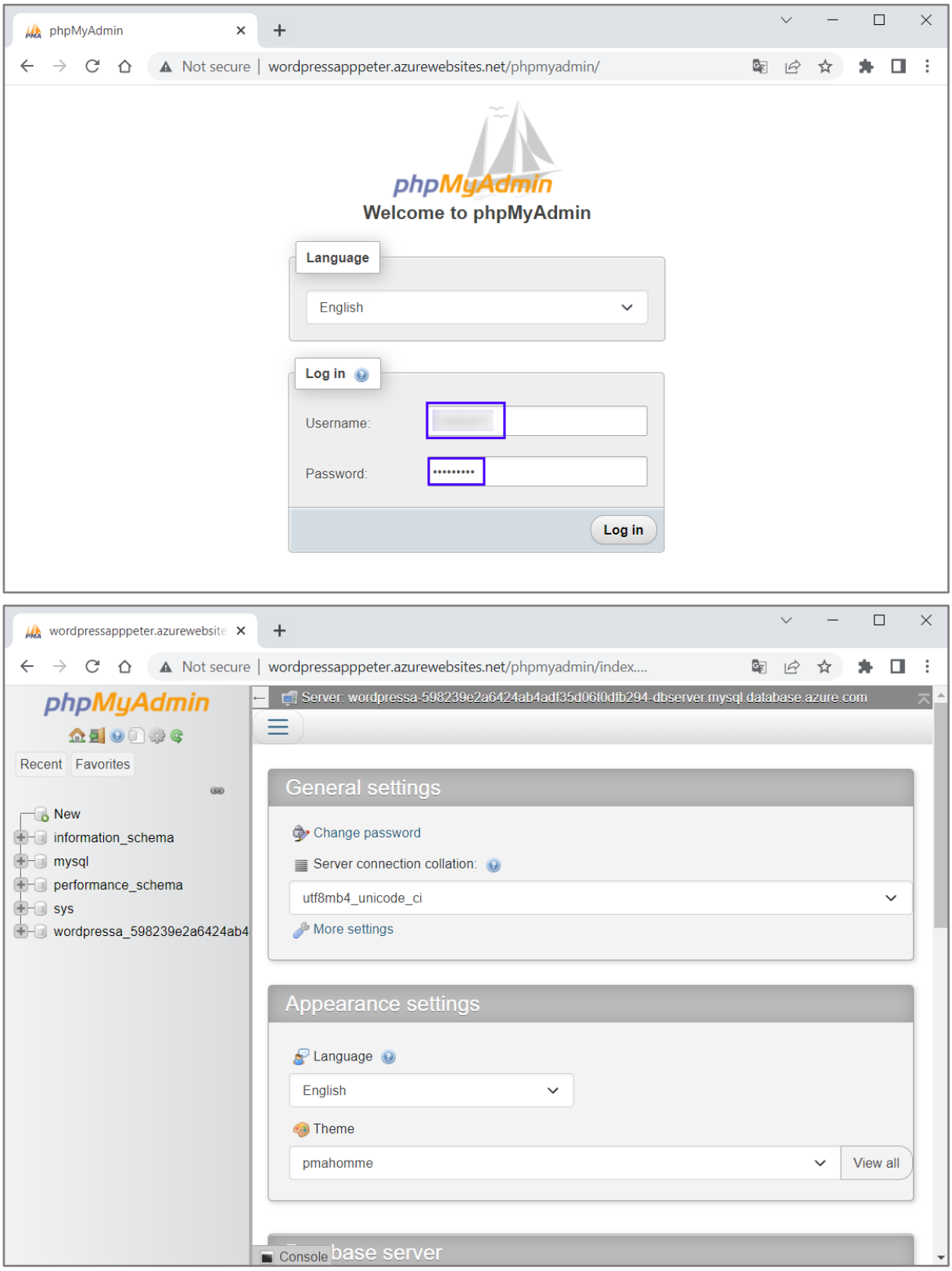
Step 3: Access the Database

You can also **access the MySQL Flexible Server database** but **not directly** because it is created behind a **private Virtual Network**.

To **access or manage the database**, we should first **get its credentials**, which are **generated automatically**. To retrieve these values after the deployment, go to "**Application Settings**" **section** of the "**Configuration**" **page** in **Azure App Service** and **copy the values** of **DATABASE_USERNAME** and **DATABASE_PASSWORD**:



Access the database by using **phpMyAdmin** that's deployed with the WordPress site: navigate to https://<sitename>.azurewebsites.net/phpmyadmin and **log in with the credentials**:

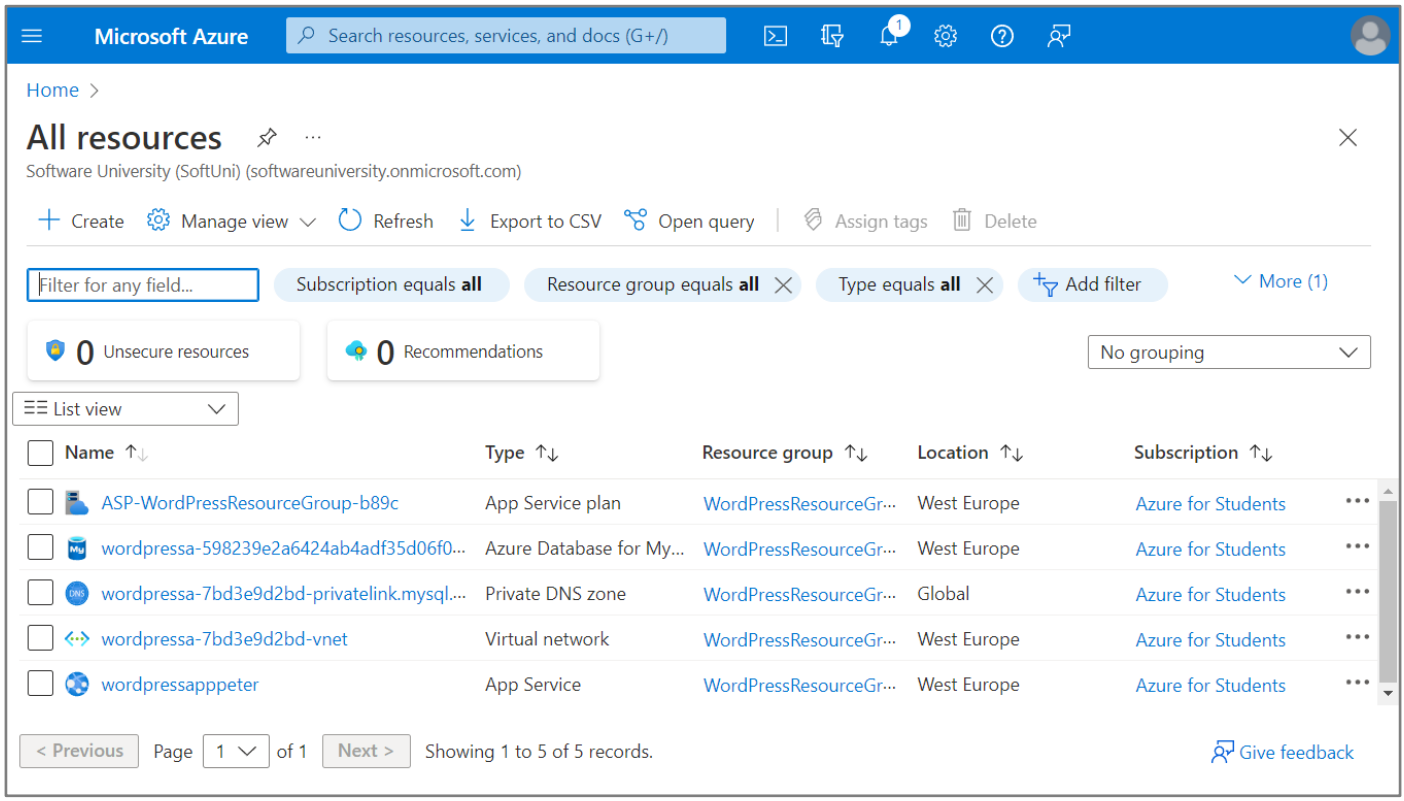


You can **explore the database** and its **tables**.

Step 4: Explore App in Azure Portal

In **`Azure Portal`** you can **see and manage all app resources** that you created.

Look at the **resources** on the "**`All resources`**" **page** (you can search for it in the **search bar**):

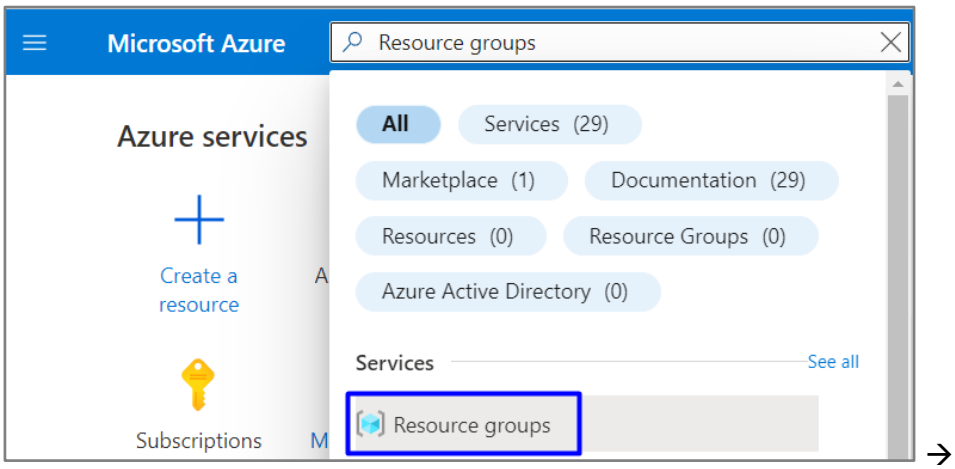


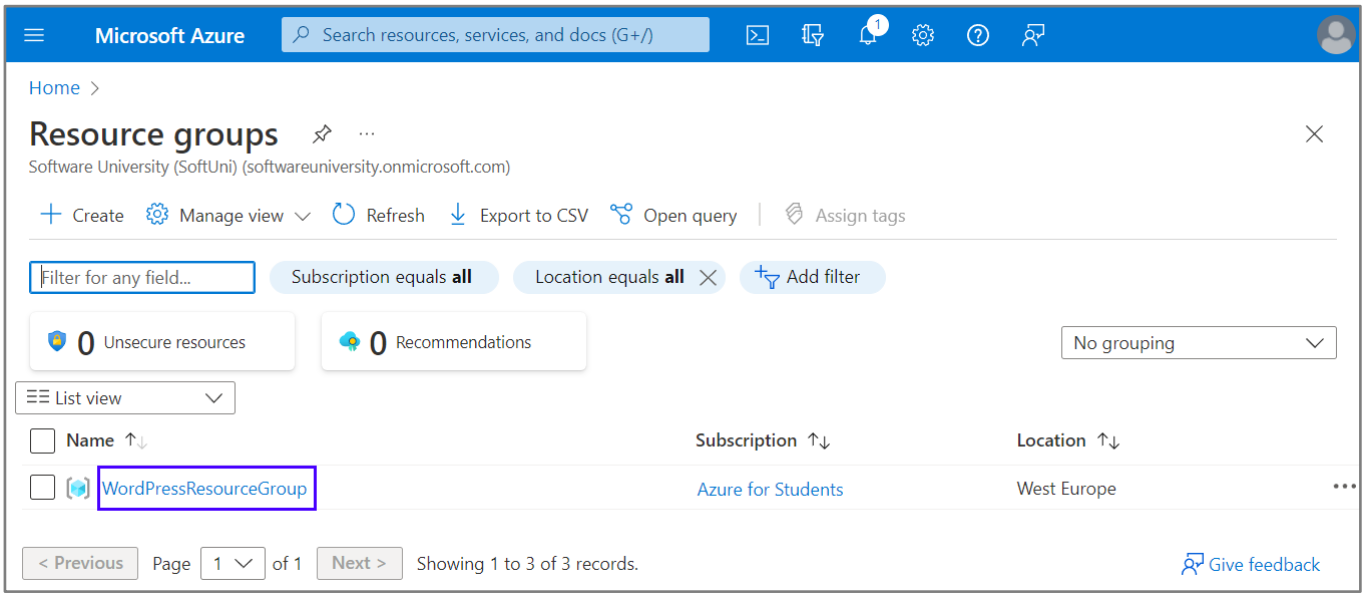
Look at each of resources and **explore `Azure Portal`**.

Step 5: Delete App and Clean Up Resources

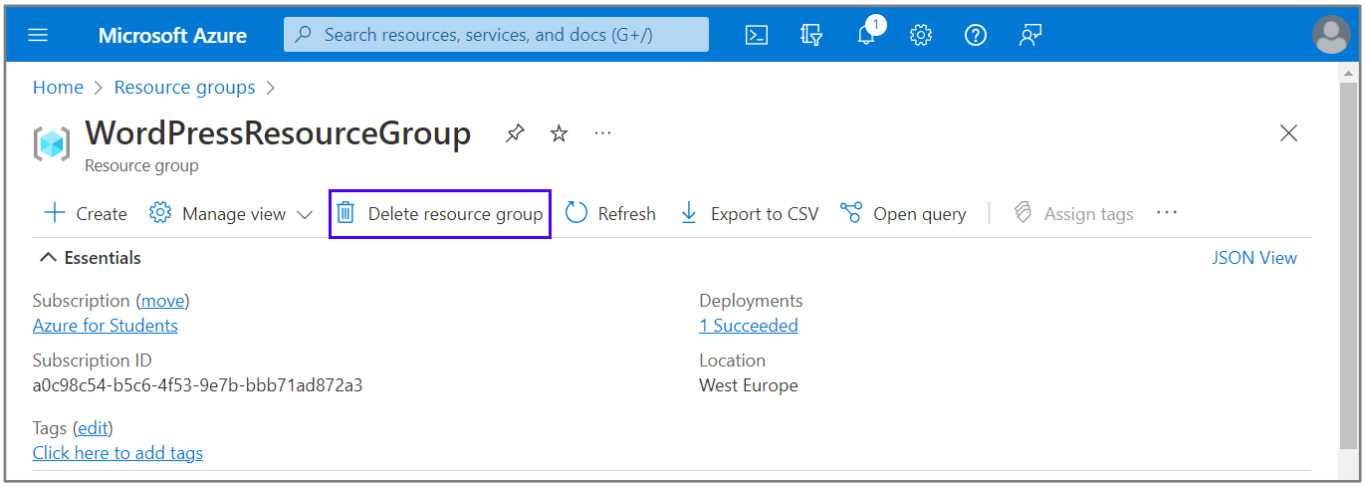
When you have successfully **uploaded your app to `Azure`** and **don't need it anymore**, it is time to **remove it**.

You can **delete all of the app resources** from your **`Azure` subscription** by **deleting the resource group**. Find **all resource groups** by going to **`Azure Portal`** and typing "**`Resource groups`**" in the **search bar**:

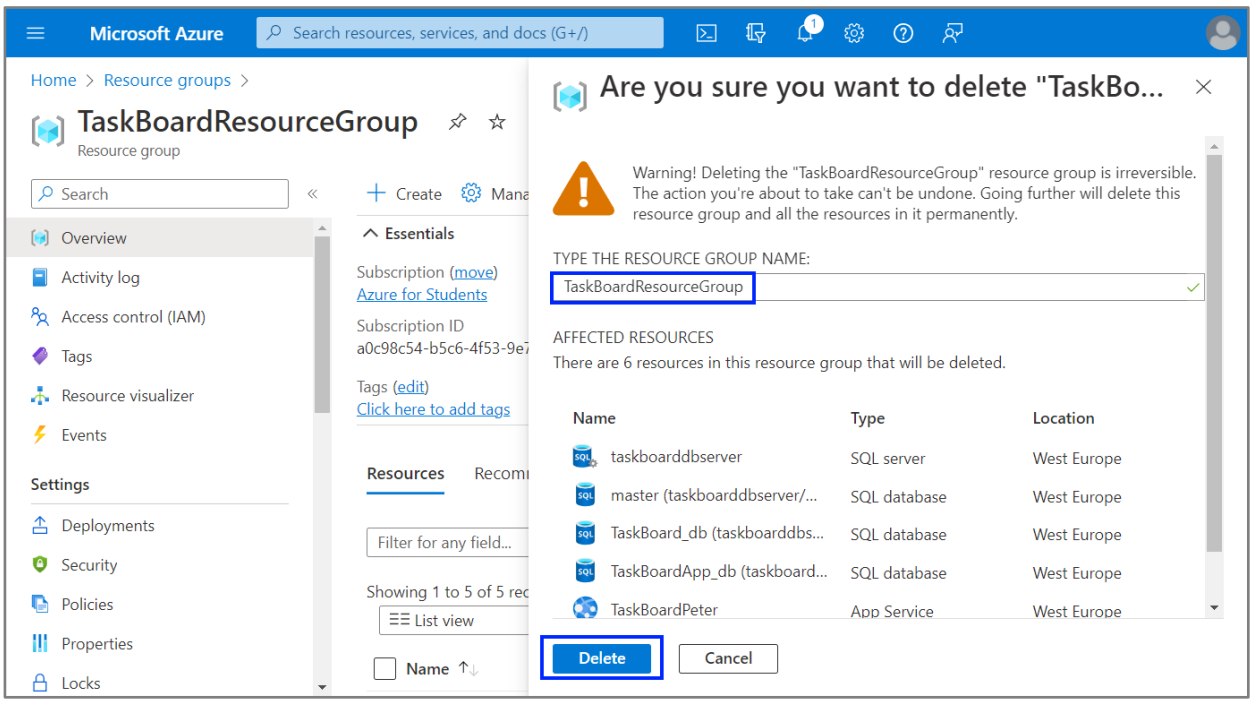




You have your "**WordPressResourceGroup**" **group**. Delete it by selecting **[Delete resource group]**:



Next, type the **resource group name** and click **[Delete]**:

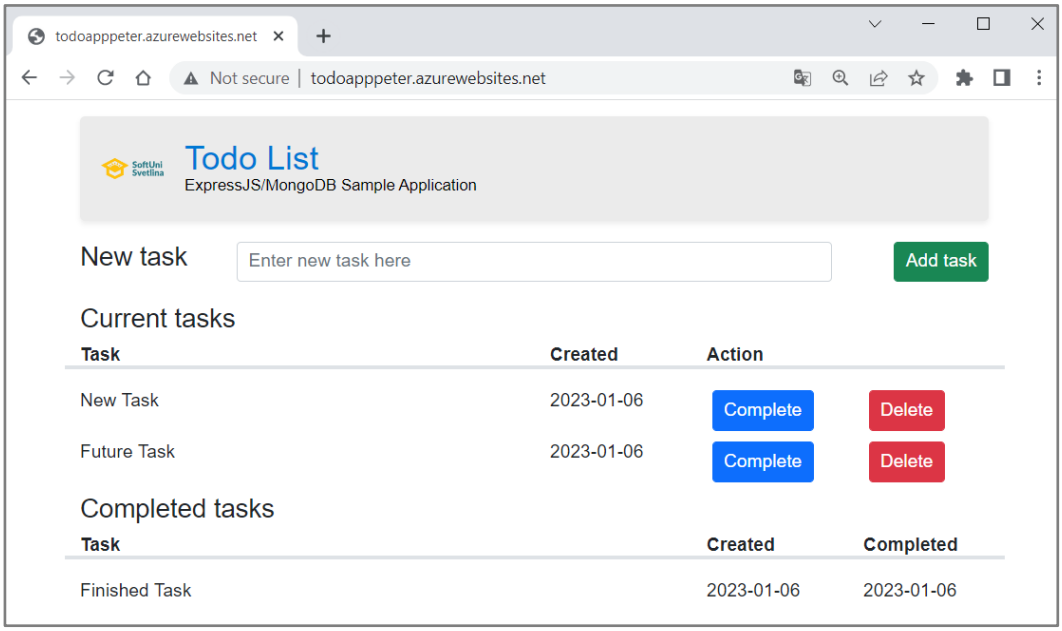


The **resource group** will be **deleted** after a while. All **resources of your app** will be **deleted** with it.

Now you have a **fully-functional `WordPress` site** in **`Azure`** and you know how to **manage it and its resources**.

2. Deploy a Node.js + MongoDB Web App to Azure

You are provided with a **`Node.js` app** with a **MongoDB database** called "**TODO App**" in the **resources**. It looks like this when **run**:



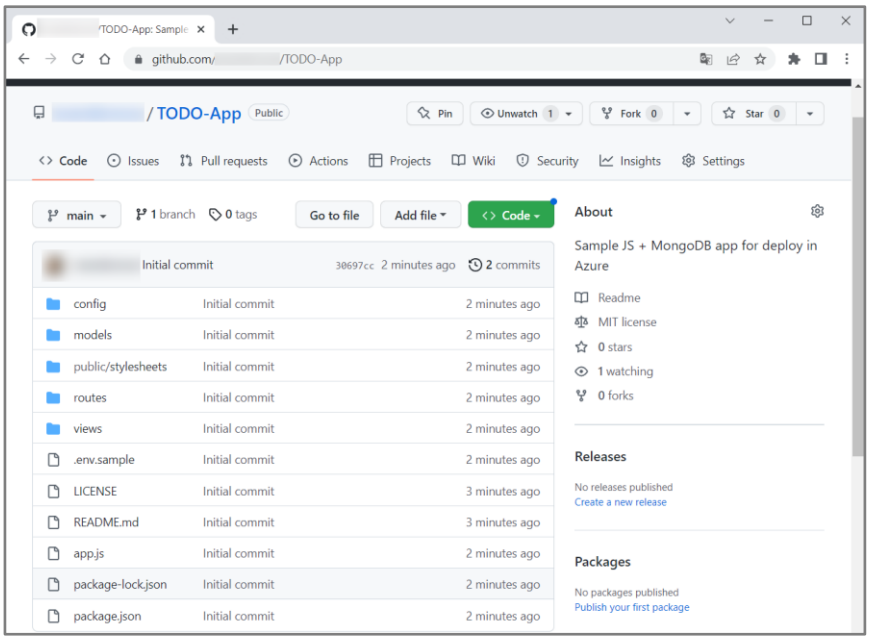
You should **upload the app to `GitHub`**, as a start, and then **deploy it to `Azure`**, using **`Azure App Service`** and **`Azure Cosmos DB for MongoDB`**.

The **process** is pretty similar to **deploying an ASP.NET app with a SQL database** – the only difference is the **settings of the app**.

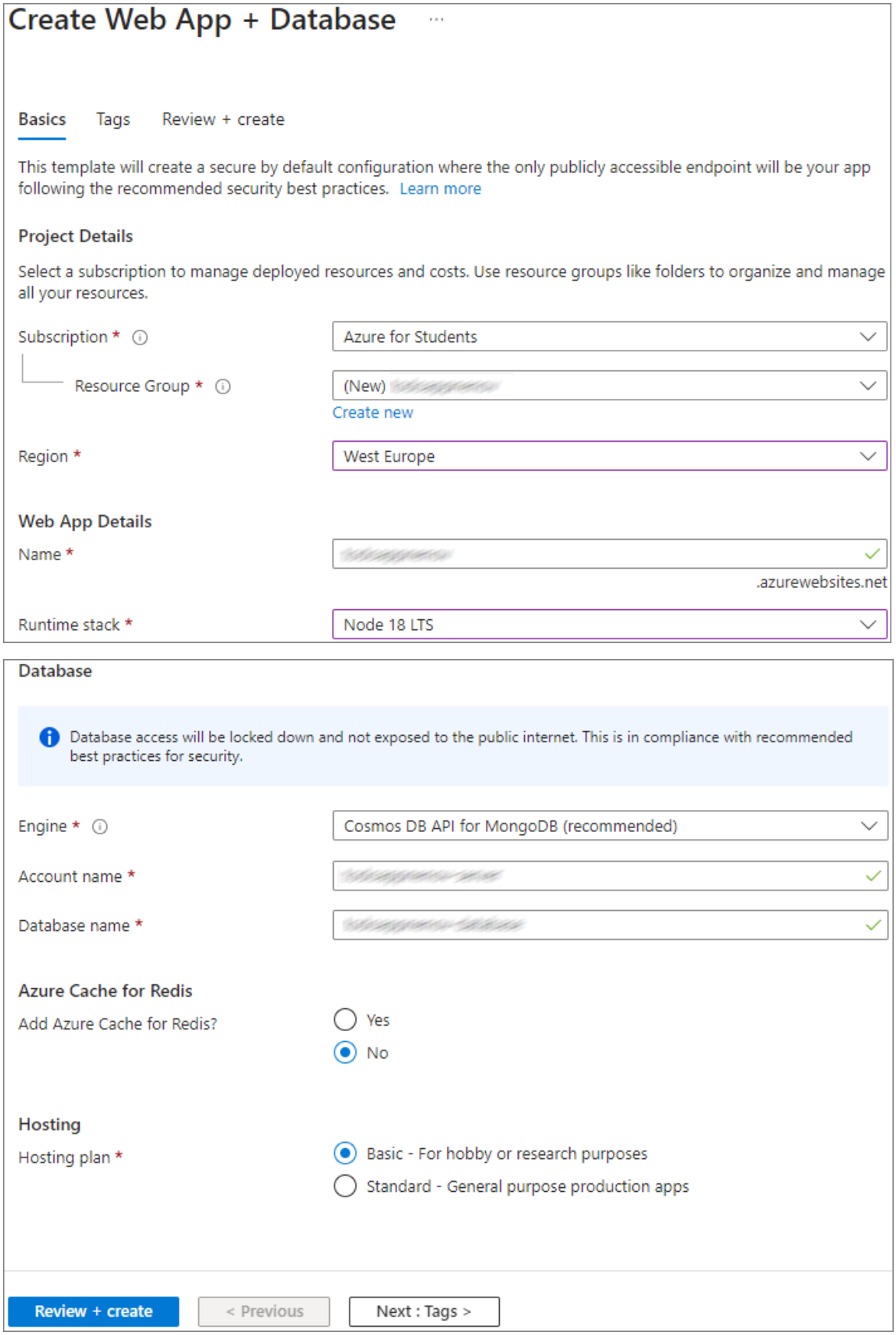
Hints

You should fulfill the below **steps** to **run the app in `Azure`**:

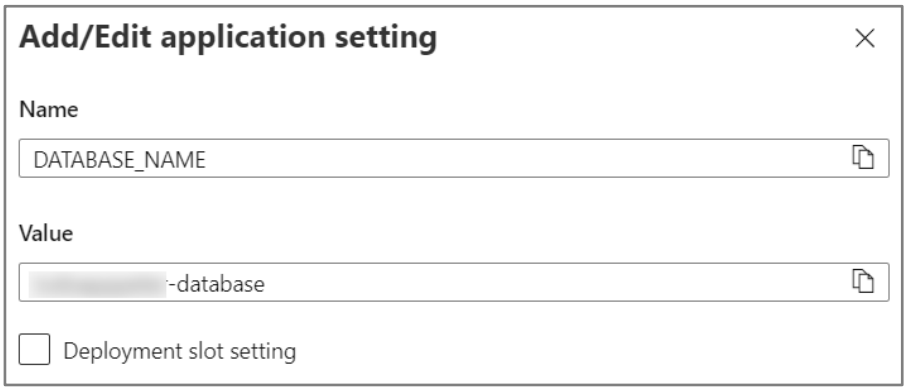
1. Upload the "**TODO App**" **project code** from the **resources** to a **`GitHub` repository**.



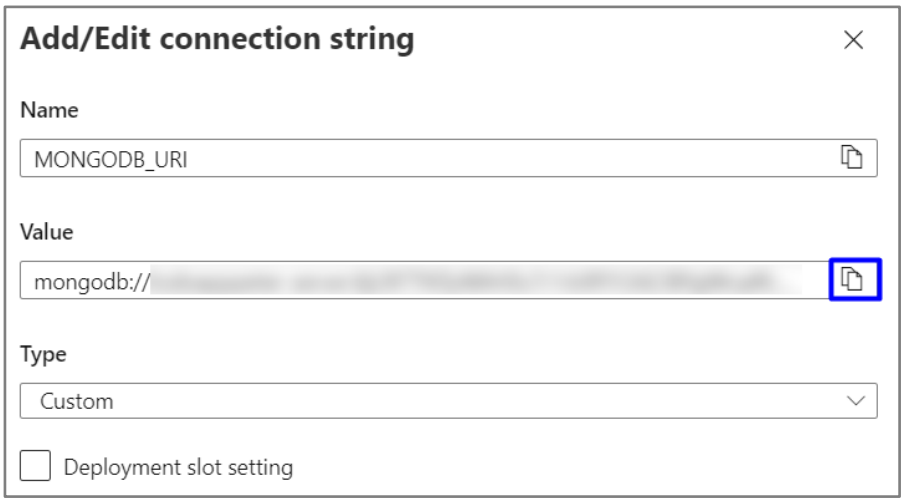
2. In **`Azure Portal`**, go to the "**`Create Web App + Database`**" **page** and **fill in the fields**. Create a **new resource group**. Give a **suitable name** to the Azure app. Choose **`[Node 18 LTS]`** as **runtime stack**. Don't change the **default selected database engine** (**`Cosmos DB API for MongoDB`**) and **copy the generated database name** because you will need it later.



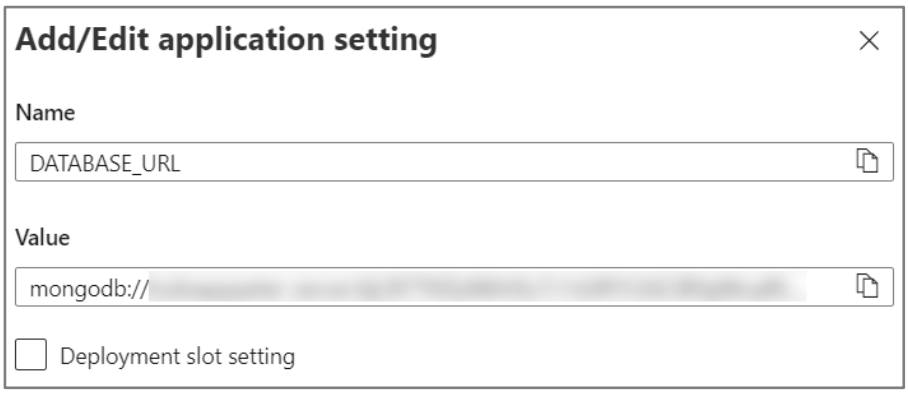
3. Go to the "**Configuration**" **page** of the **App Service app** and create a **[New application setting]** with:
    - **Name**: "**DATABASE_NAME**"
    - **Value**: the automatically **generated database name** you copied earlier (i.e. **<app-name>-database**)



4. Next, select the "**MONGODB_URI**" **connection string** on the same page and **copy its value**



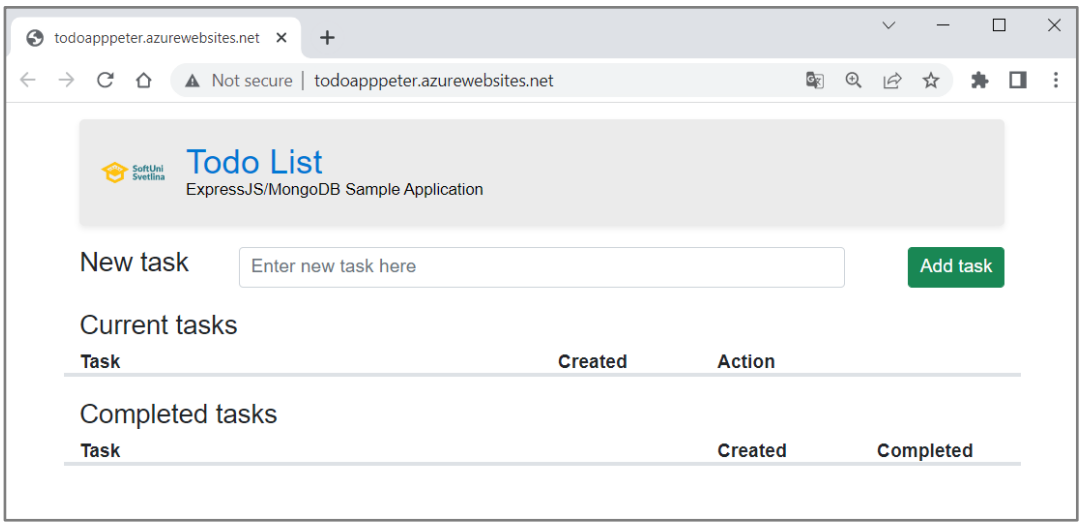
5. Create one more **new application setting** with:
    - **Name**: "**DATABASE_URL**"
    - **Value**: the "**MONGODB_URI**" **connection string** you copied earlier (i.e., **mongodb://...**)



Don't forget to **save the settings**.

6. Your app is configured to work with the **Azure database**, so you should just go to the "**Deployment Center**" **page** and **deploy the app** from the **GitHub repository**.
7. A **GitHub workflow** should be created and it should **show a status of "Complete"**. It takes about 15-30 minutes.

8. You should be able to **access the app** on https://<app-name>.azurewebsites.net and **work with it**.

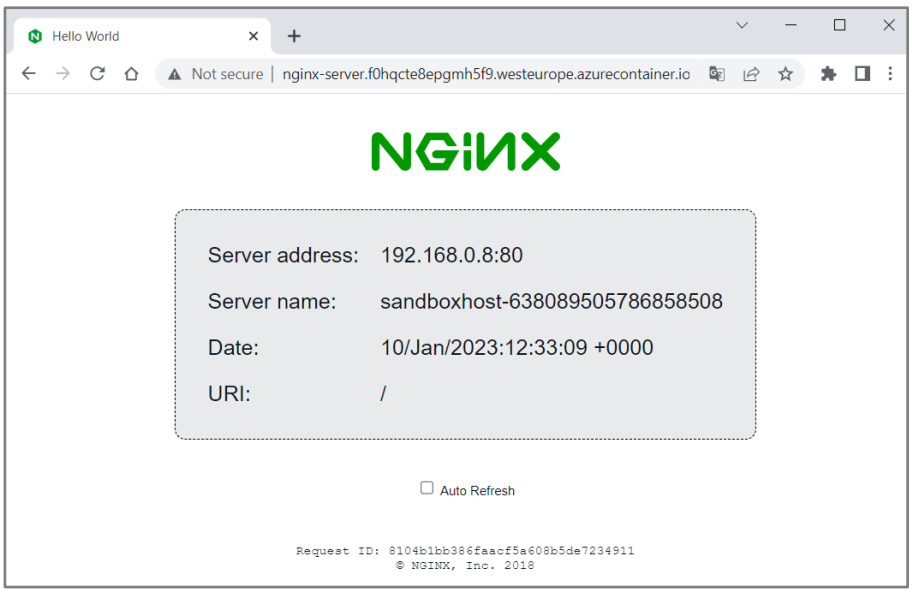


NOTE: Don't forget to delete the resources in your Azure account.

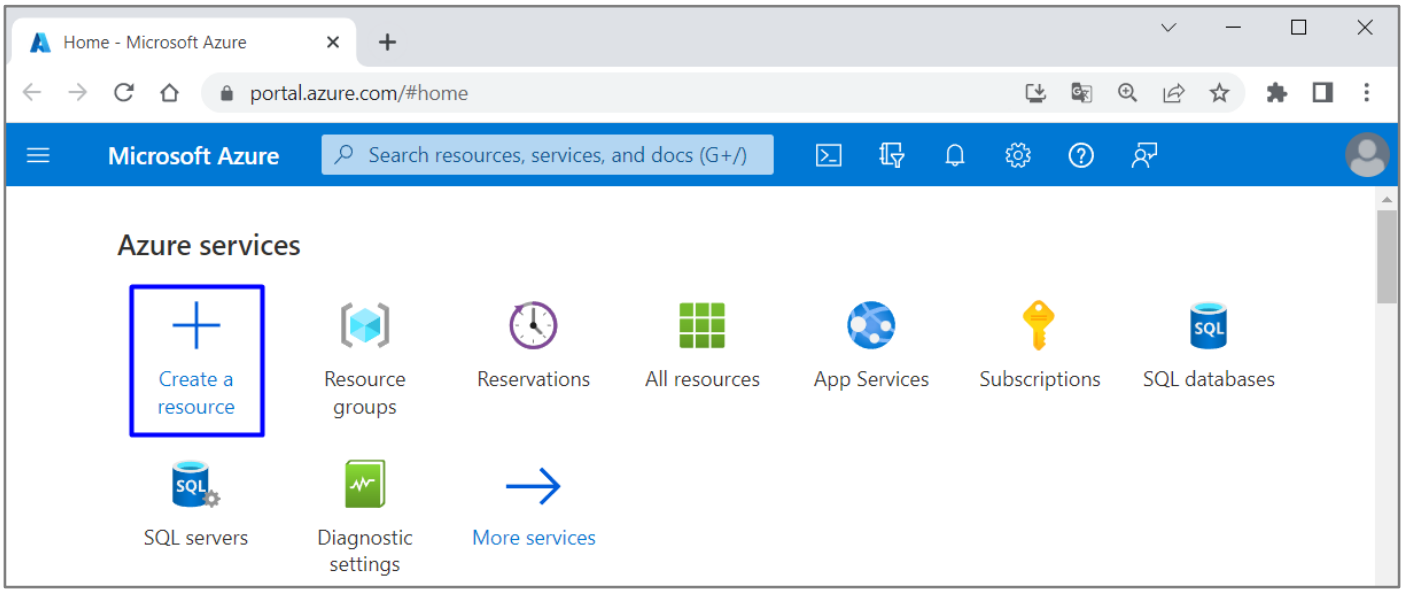
3. Deploy NGINX Server Container to Azure using Azure Portal

In this task, we will **deploy a container instance** to **`Azure Container Instances`** using the **`Azure Portal`**. **`Azure Container Instances`** allows us to **run serverless and isolated Docker containers** in **Azure** and make its application available with a **fully qualified domain name** (**FQDN**).

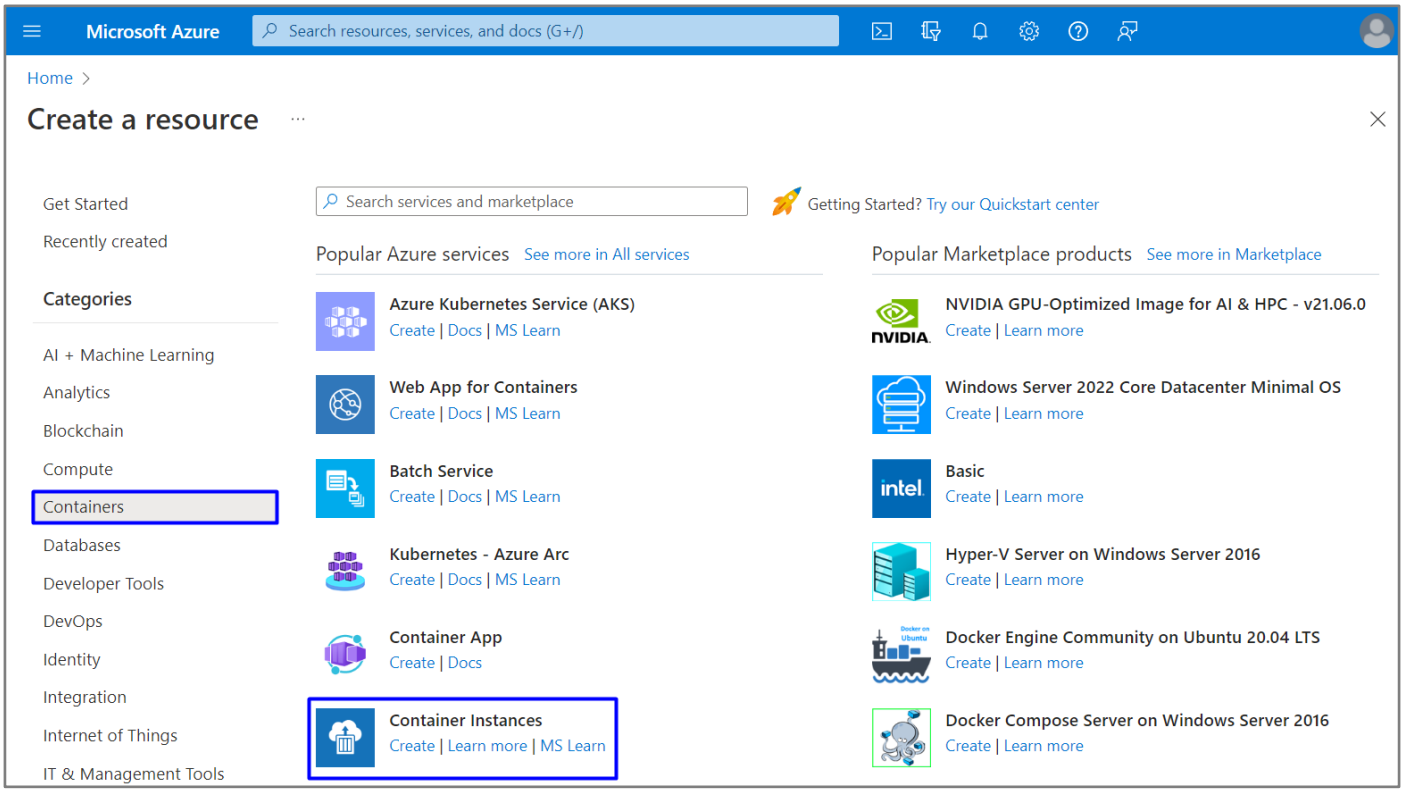
We will use the **NGINX server image** from **DockerHub**: https://hub.docker.com/r/nginxdemos/hello. You are already familiar with the **server**. When **deployed to `Azure`**, it will look like this:



Let's see how to do this. As a first step, open **`Azure Portal`** (https://portal.azure.com) and **click on `[Create a resource]`**:

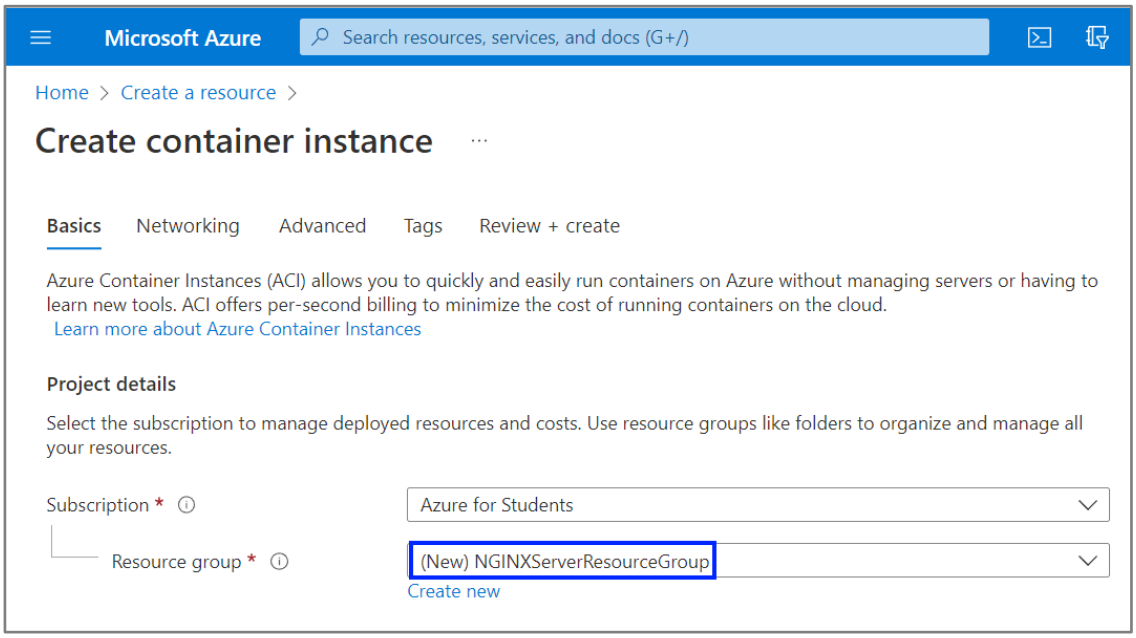


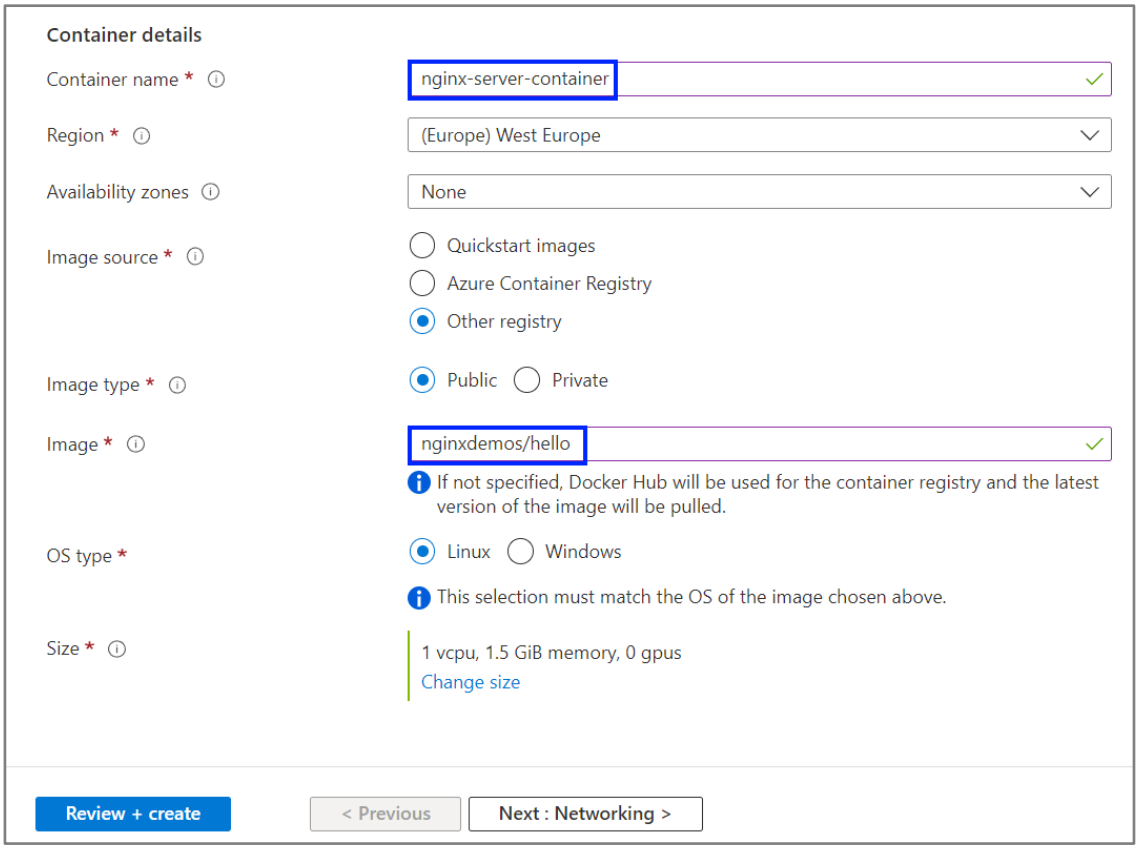
Next, choose **[Containers]** → **[Container Instances]**:



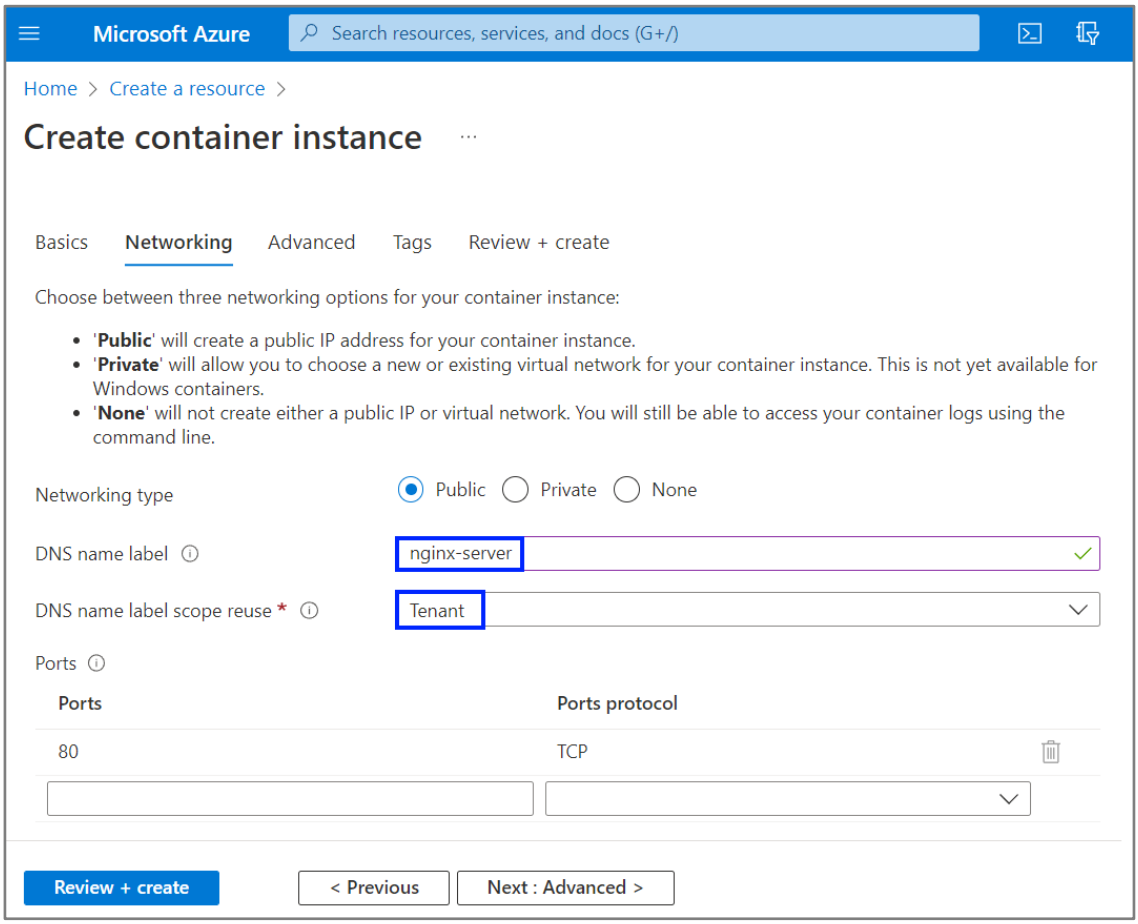
On the "**Basic**" **tab** of the "**Create container instance**" **page** you should **fill in the fields** as follows:

- Use your "**Azure for Students**" **subscription**
- Create a **new resource group** with a suitable name
- Create a **name for your container**
- Choose a **region** near you
- Leave the "**Availability zones**" to **[None]**
- For the **image source**, choose **[Other registry]** (to use an **image from DockerHub**, which is the **default registry** for this **option**) and **fill in the image name**
- Leave the "**OS type**" to **[Linux]** and "**Size**" field with the **given options**





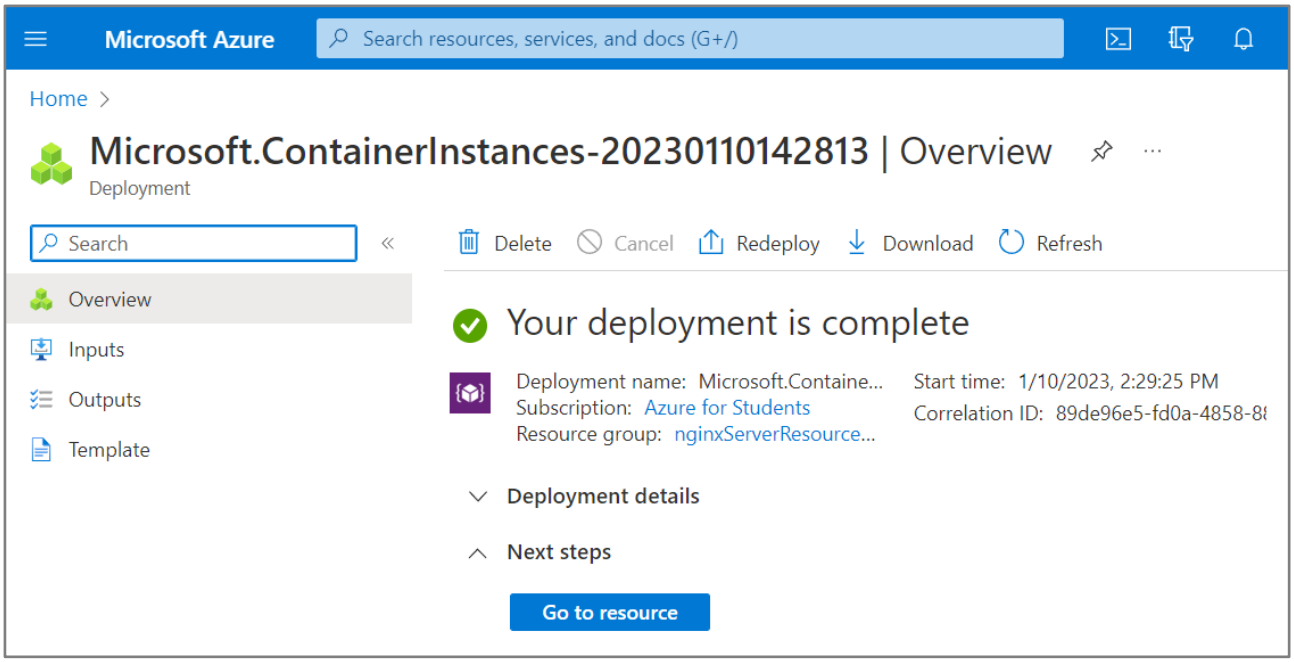
Click on **`[Next]`** to go to the "**`Networking`**" **tab**. There you should **fill in a DNS name for your container** and **choose `[Tenant]`** for **DNS scope reuse**:



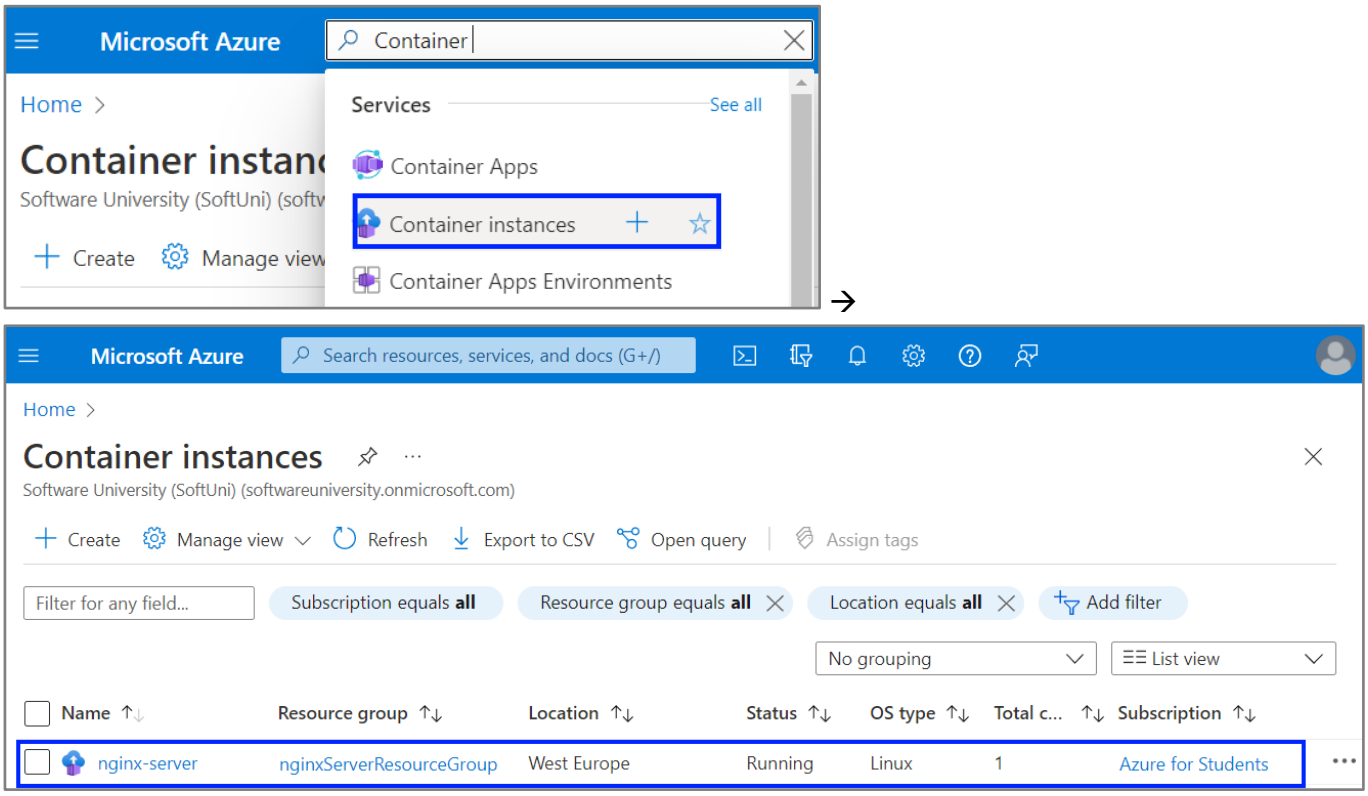
The **name must be unique** within the Azure region where you create the container instance. Your container will be **publicly reachable** at **`<dns-name-label>.<region>.azurecontainer.io`**. An **auto-generated hash** is added as a **DNS name label** to your container instance's **fully qualified domain name** (**FQDN**).

If you receive a "**DNS name `label not available`" error message**, try a **different DNS name label**.

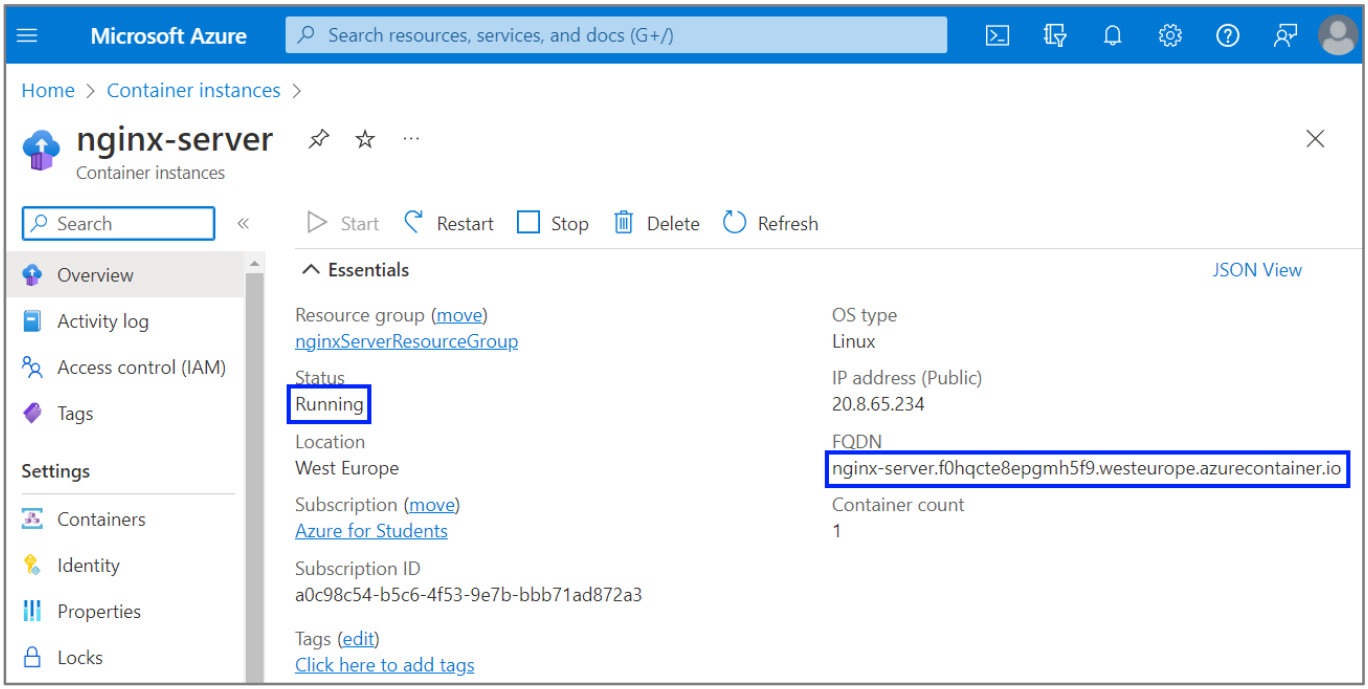
Leave all other settings as their defaults and select **`[Review + create]`**, then **`[Create]`**. Wait for the **deployment to complete**:



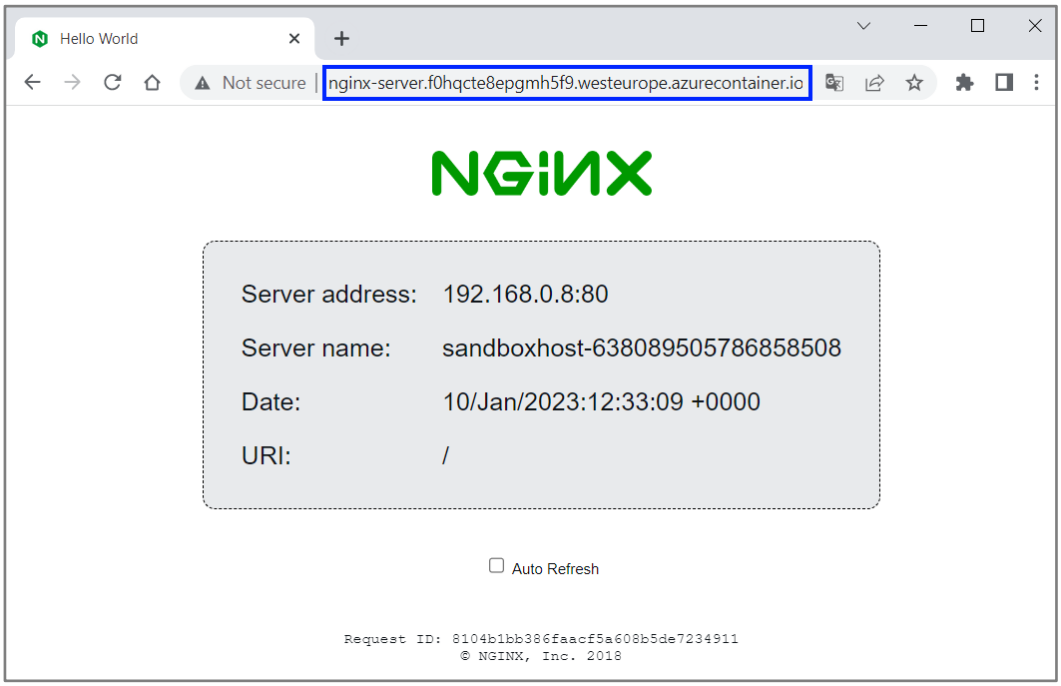
Then go to **`nginx-server` container instance** from the "**`Container instances`" page**:



Look at the **FQDN** and the **status of the container** on the "**`Overview`**" **page**:

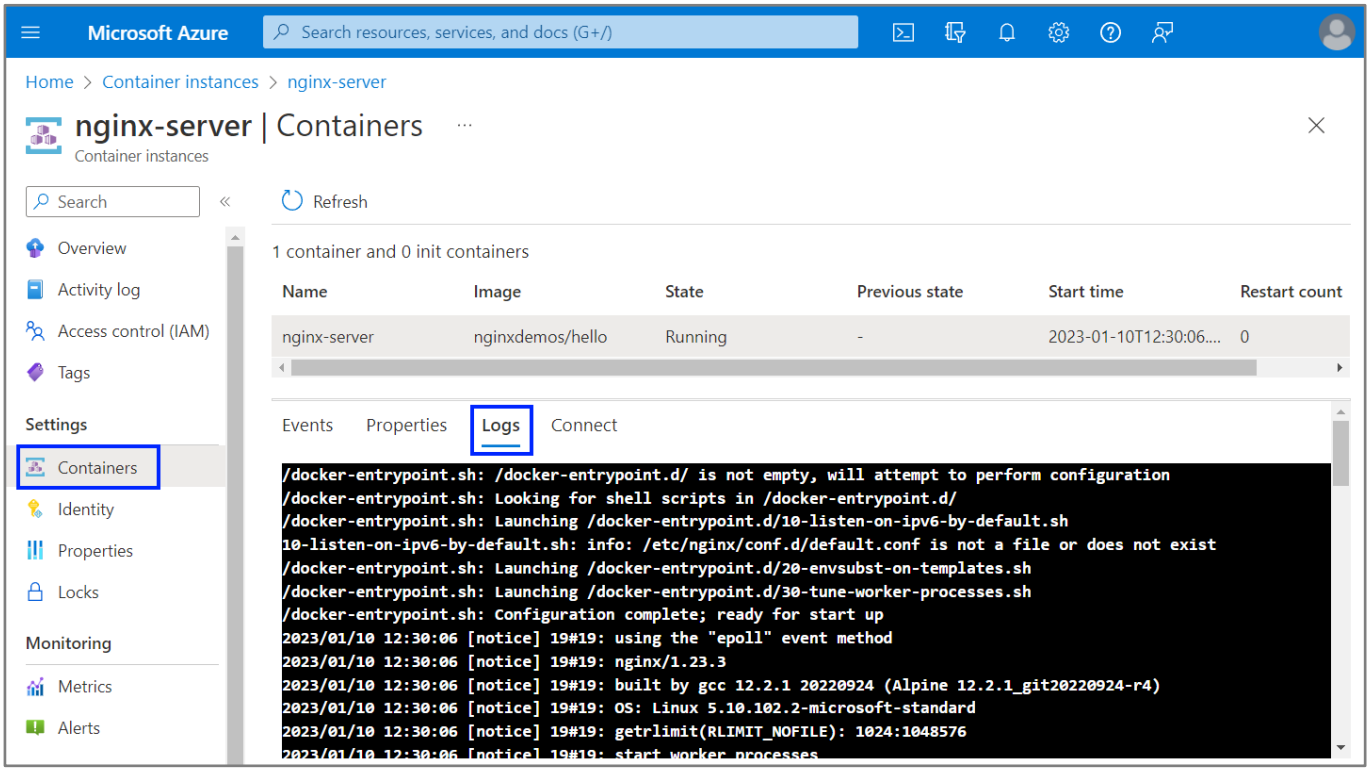


When the **status is** "**`Running`**", navigate to the **container's FQDN in your browser** and you should see your **NGINX server**:

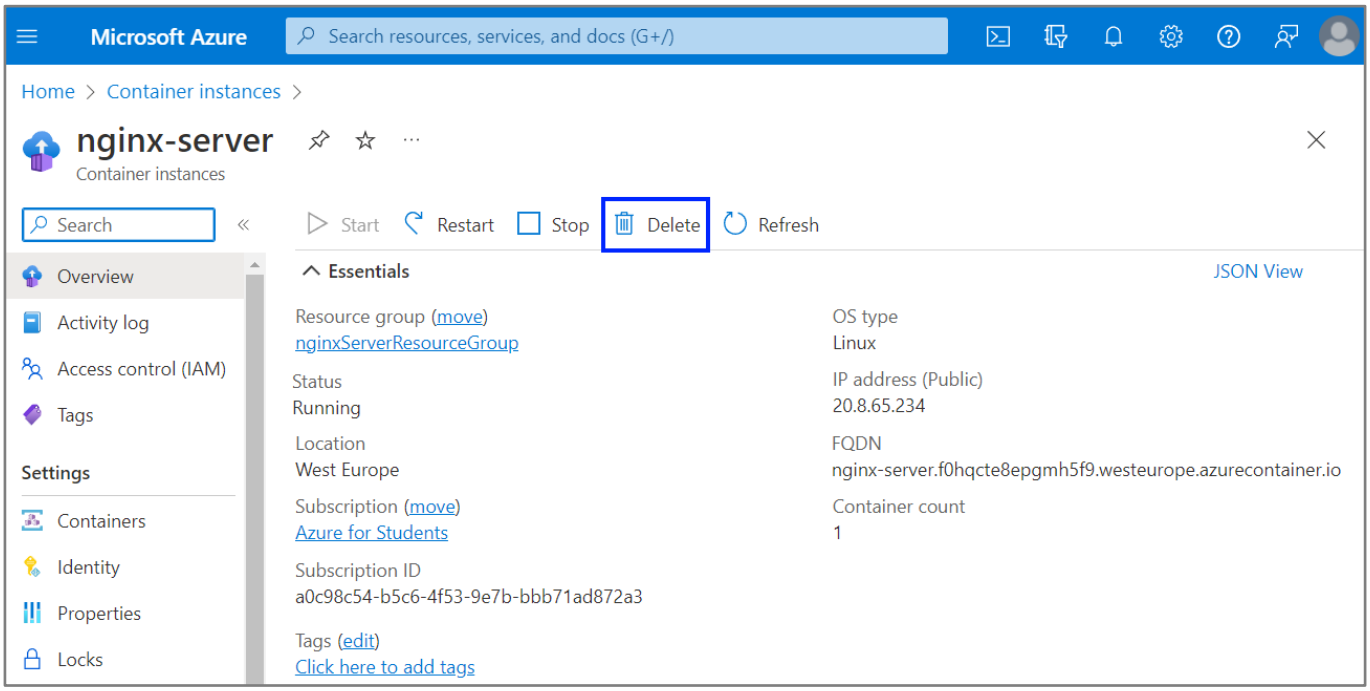


NOTE: if you **receive an error**, **wait for the container** a little bit more. After **up to 5 minutes**, it should be **loading successfully**.

If you have **any other problems**, you can look at the **container logs** in **`[Containers]`** → **`[Logs]`**:



You can **delete the container** by **deleting its resource group** in the familiar to you way. You can also **delete only the container** by going to **`[Overview]`** and clicking on **`[Delete]`**:



4. Deploy NGINX Server Container to Azure using Azure CLI

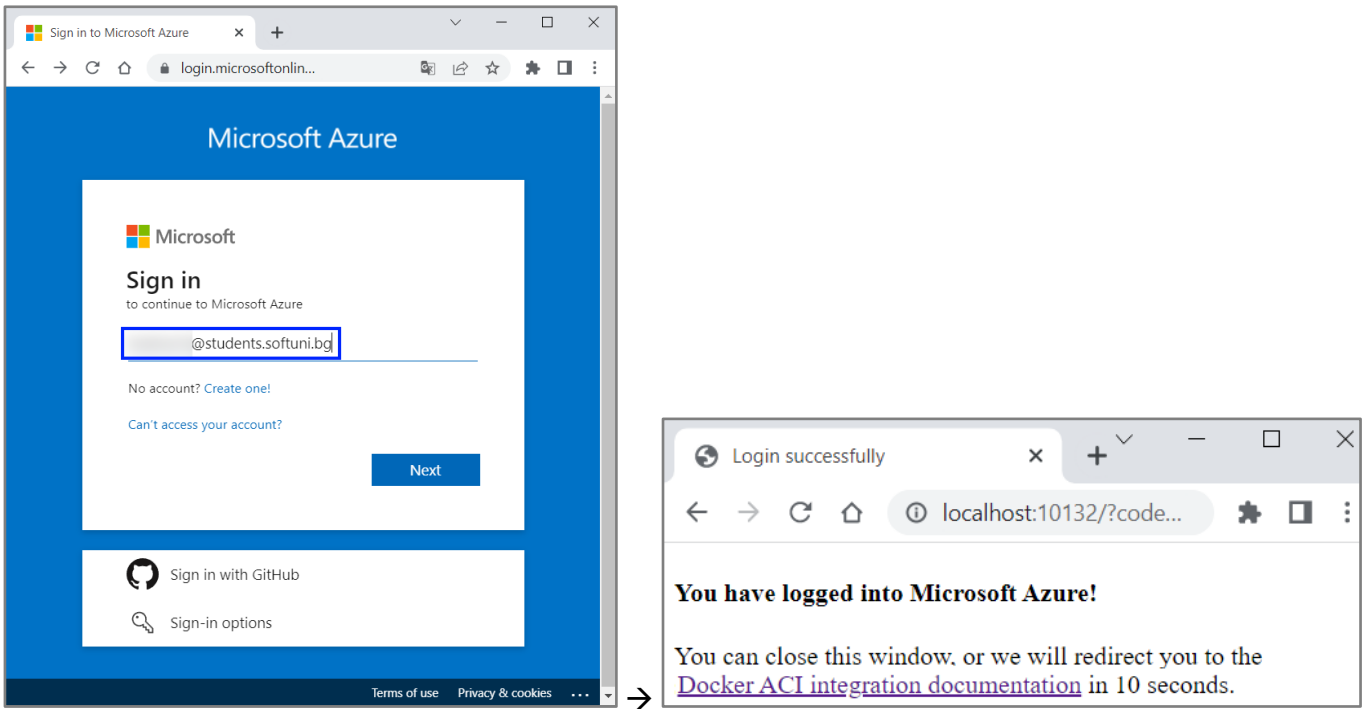
Now we will see how to **deploy a `NGINX` server container to `Azure`** but using **`Azure CLI` commands**.

NOTE: **`Docker Desktop`** should be **running** in order for the commands to be executed successfully. Also, you should **open a `CLI`** to execute commands, for example **`PowerShell`**.

First, **log in to Azure** with the following command:

```
PS C:\Users\PC> docker login azure
login succeeded
```

A **browser window for login to Azure** will appear. Enter your **credentials** and you should be **successfully logged in**:



You can **close the above browser window** and **return to `PowerShell`**.

Next, we should **create an ACI context**, which **associates Docker with an Azure subscription and resource group** so you can create and manage container instances. Our **context** will be called "**`nginxacicontext`**":

```
PS C:\Users\PC> docker context create aci nginxacicontext
Using only available subscription : Azure for Students (a0c98c54-b5c6-4f53-9e7b-bbb71ad872a3)
? Select a resource group  [Use arrows to move, type to filter]
> create a new resource group
```

Now you are prompted to **select your subscription** and a **resource group**. You should **choose the "`Azure for Students`" subscription** and **create a new resource group**, using the **arrow keys** and the **`[Enter]` key** on your keyboard.

In our case we have **only one subscription option** and **no resource groups**, so hitting **`[Enter]`** is enough:

```
PS C:\Users\PC> docker context create aci nginxacicontext
Using only available subscription : Azure for Students (a0c98c54-b5c6-4f53-9e7b-bbb71ad872a3)
? Select a resource group create a new resource group
Resource group "6c71f2b8-547e-2cf3-ab83-4336e4556bc8" (eastus) created
Successfully created aci context "nginxacicontext"
```

A **resource group** and an **ACI context** were successfully created. Note that the **new resource group** is created with a **system-generated name**.

Confirm that you **added the ACI context** to your **Docker contexts** like this:

```
PS C:\Users\PC> docker context ls
NAME                TYPE                DESCRIPTION
default *           moby                Current DOCKER_HOST based configuration
desktop-linux       moby
nginxacicontext     aci                 6c71f2b8-547e-2cf3-ab83-4336e4556bc8@eastus
```

After **creating a Docker context**, you can **create a container in Azure**. First **switch to the ACI context** we created, so that Docker commands run in it:

```
PS C:\Users\PC> docker context use nginxacicontext
nginxacicontext
```

Run a **`docker run` command** to **run a NGINX server container instance** in **Azure** with **exposed port 80**:

```
PS C:\Users\PC> docker run -p 80:80 nginxdemos/hello
[+] Running 2/2
 - Group pedantic-brahmagupta  Created                                3.7s
 - pedantic-brahmagupta        Created                               26.1s
/docker-entrypoint.sh: /docker-entrypoint.d/ is not empty, will attempt to perform
configuration
/docker-entrypoint.sh: Looking for shell scripts in /docker-entrypoint.d/
/docker-entrypoint.sh: Launching /docker-entrypoint.d/10-listen-on-ipv6-by-default.sh
10-listen-on-ipv6-by-default.sh: info: /etc/nginx/conf.d/default.conf is not a file or
 does not exist
/docker-entrypoint.sh: Launching /docker-entrypoint.d/20-envsubst-on-templates.sh
/docker-entrypoint.sh: Launching /docker-entrypoint.d/30-tune-worker-processes.sh
/docker-entrypoint.sh: Configuration complete; ready for start up
2023/01/11 08:48:34 [notice] 19#19: using the "epoll" event method
2023/01/11 08:48:34 [notice] 19#19: nginx/1.23.3
2023/01/11 08:48:34 [notice] 19#19: built by gcc 12.2.1 20220924 (Alpine 12.2.1_git20
220924-r4)
2023/01/11 08:48:34 [notice] 19#19: OS: Linux 5.10.102.2-microsoft-standard
```

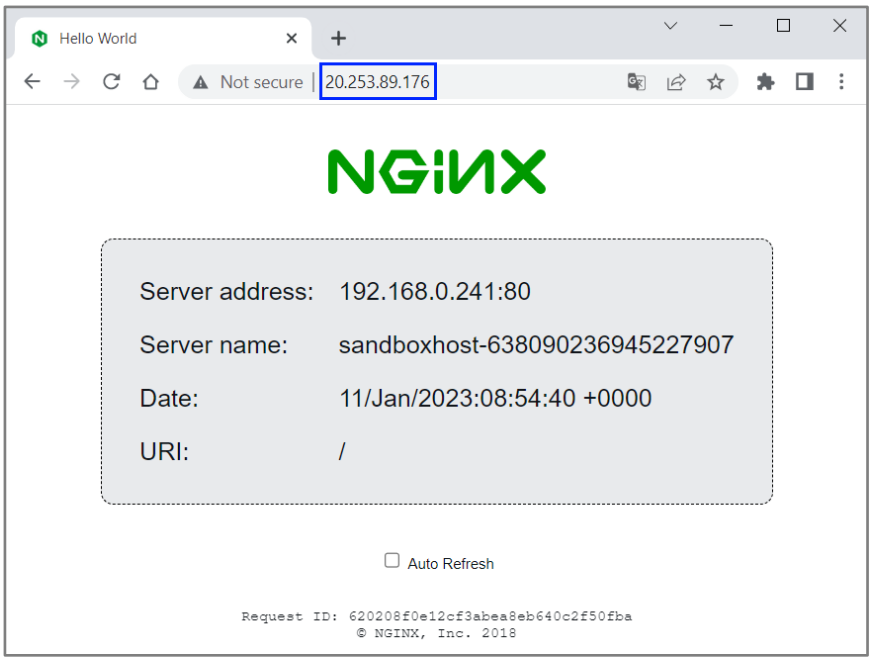
```
2023/01/11 08:48:34 [notice] 19#19: getrlimit(RLIMIT_NOFILE): 1024:1048576
2023/01/11 08:48:34 [notice] 19#19: start worker processes
2023/01/11 08:48:34 [notice] 19#19: start worker process 37
```

As you can see, the **name of the container** here is **`pedantic-brahmagupta`** (yours may be different). You can press **`[Ctrl]`** + **`[C]`** to **exit the logs**.

Then, use the following command to **see all containers** and get details about your **running container**, including its **public IP address**:

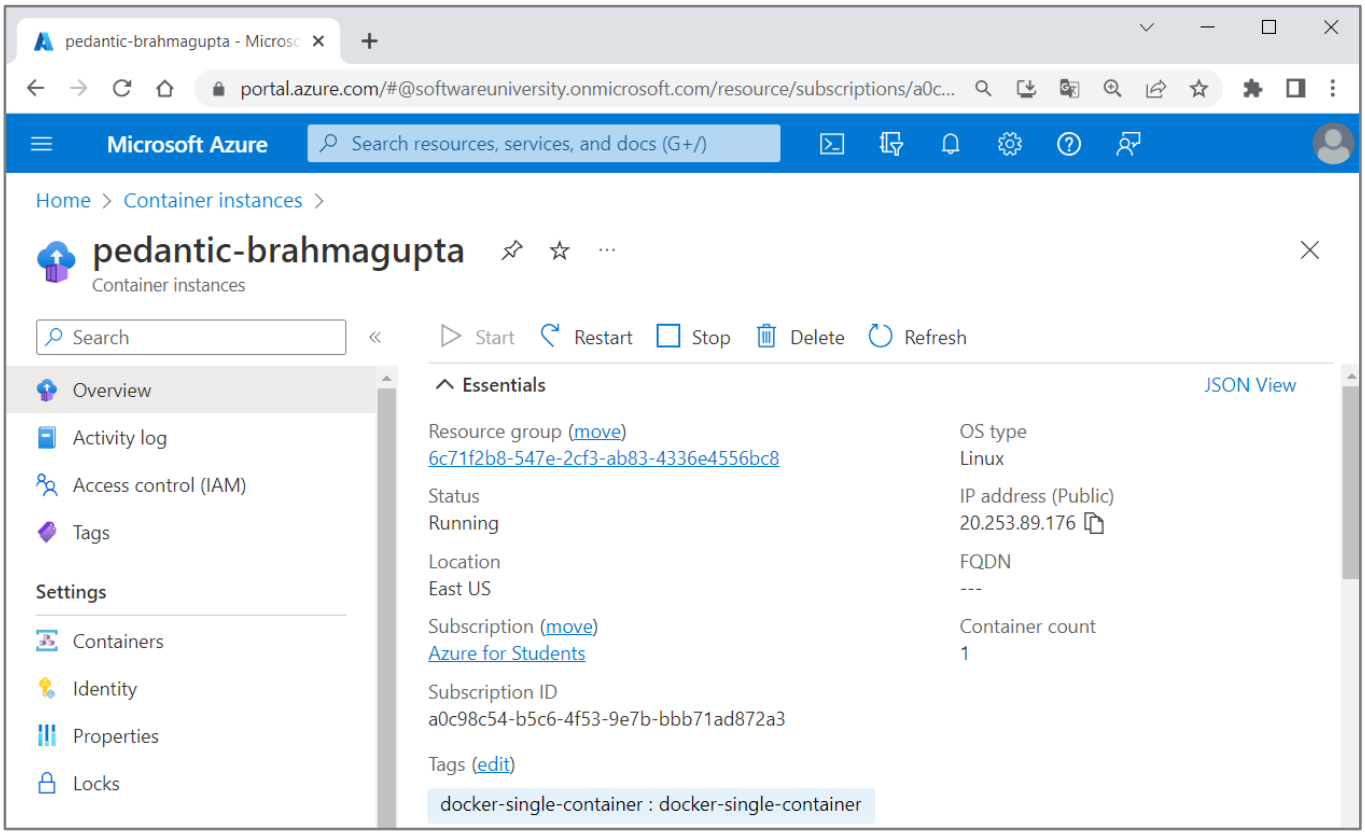
```
PS C:\Users\PC> docker ps
CONTAINER ID   IMAGE              COMMAND   STATUS    PORTS
pedantic-brahmagupta   nginxdemos/hello           Running   20.253.89.176:80->80/tcp
```

Get this address and **paste it in the browser** to **access your app** (its **status** should be "**`Running`**"):



NOTE: it may be necessary that you **wait a few minutes** for the **container app to load**.

You can also **look at your container instance** in **`Azure Portal`**:



Note that in this case we **have an IP address**, not a **FQDN**.

Also, you can **pull the container logs** if you need them like this:

```
PS C:\Users\PC> docker logs pedantic-brahmagupta
/docker-entrypoint.sh: /docker-entrypoint.d/ is not empty, will attempt to perform
configuration
/docker-entrypoint.sh: Looking for shell scripts in /docker-entrypoint.d/
/docker-entrypoint.sh: Launching /docker-entrypoint.d/10-listen-on-ipv6-by-default.
sh
10-listen-on-ipv6-by-default.sh: info: /etc/nginx/conf.d/default.conf is not a file
 or does not exist
/docker-entrypoint.sh: Launching /docker-entrypoint.d/20-envsubst-on-templates.sh
/docker-entrypoint.sh: Launching /docker-entrypoint.d/30-tune-worker-processes.sh
/docker-entrypoint.sh: Configuration complete; ready for start up
2023/01/11 08:48:34 [notice] 19#19: using the "epoll" event method
2023/01/11 08:48:34 [notice] 19#19: nginx/1.23.3
2023/01/11 08:48:34 [notice] 19#19: built by gcc 12.2.1 20220924 (Alpine 12.2.1_git
20220924-r4)
2023/01/11 08:48:34 [notice] 19#19: OS: Linux 5.10.102.2-microsoft-standard
2023/01/11 08:48:34 [notice] 19#19: getrlimit(RLIMIT_NOFILE): 1024:1048576
2023/01/11 08:48:34 [notice] 19#19: start worker processes
2023/01/11 08:48:34 [notice] 19#19: start worker process 37
10.92.0.11 - - [11/Jan/2023:08:54:40 +0000] "GET / HTTP/1.1" 200 7252 "-" "Mozilla/
5.0 (Windows NT 10.0; Win64; x64) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/108
.0.0.0 Safari/537.36" "-"
10.92.0.9 - - [11/Jan/2023:09:02:57 +0000] "\x16\x03\x01\x00\x85\x01\x00\x00\x81\x0
3\x03\x1Df\xD2\xFD\xE1\xA5Q\x09\x19\x17iX\x01\x88\xAC\xB2T\x83\xA98}I\xAD\x9C/\x02\
xA5" 400 157 "-" "-" "-"
```

You can also **stop** and **delete the container**:

```
PS C:\Users\PC> docker stop pedantic-brahmagupta
pedantic-brahmagupta
```

```
PS C:\Users\PC> docker rm pedantic-brahmagupta
pedantic-brahmagupta
```

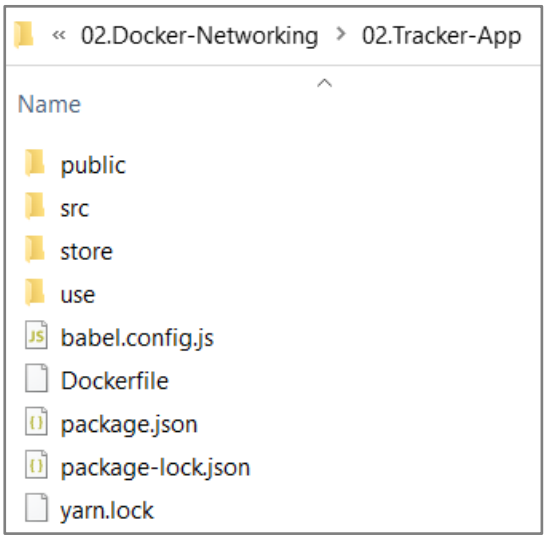
However, the **resource group should be deleted** from **Azure Portal**.

After this **first two tasks** you know **how to create Azure Container Instances** using **Azure Portal** and **Docker CLI**. You could also **do it through Azure CLI**, which we will **show you in the next task**.

5. Deploy the "Tracker" App to Azure

Your task now is to **run a simple JavaScript front-end app based on Vue.js** for keeping track of daily duties in a **Docker container**. It does not need **anything but an image** to run. It does not use a database or any other storage.

You're provided with **its files** it in the **resources**, together with a **Dockerfile** which runs the **app on NGINX server** (on the right):



You should **deploy the app** to **Azure Container Instances**.

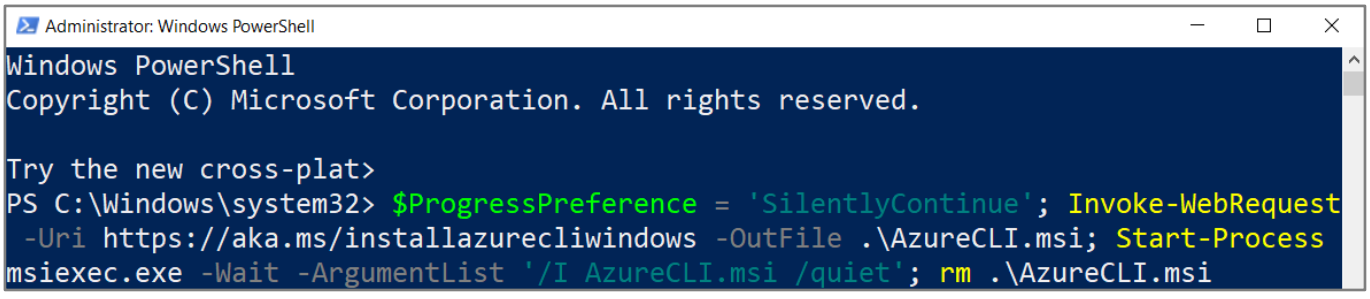
Install Azure CLI on Your Local Computer

The **Azure Command-Line Interface** (**CLI**) is a cross-platform **command-line tool**, which can be used to **connect to Azure** and **execute administrative commands** on **Azure resources**. It can be run from **inside a Docker container**.

Because the **Azure Cloud Shell** does not include the **Docker daemon**, you must **install both** the **Azure CLI** and **Docker Engine** on your **local computer** for this task. We will **use it**, as well, but later when we are done with Docker.

You already have **Docker**, so let's **install Azure CLI**. This can be done **through PowerShell** with the following **command**:

```
$ProgressPreference = 'SilentlyContinue'; Invoke-WebRequest -Uri
https://aka.ms/installazurecliwindows -OutFile .\AzureCLI.msi; Start-Process
msiexec.exe -Wait -ArgumentList '/I AzureCLI.msi /quiet'; rm .\AzureCLI.msi
```



NOTE: **PowerShell** must be **run as administrator** for the **installation**. After that, run a **new PowerShell instance** in the standard way and **work with it**.

You can check your **Azure CLI version** with:

```
PS C:\Users\PC> az --version
azure-cli                         2.44.1

core                              2.44.1
telemetry                          1.0.8

Dependencies:
msal                              1.20.0
azure-mgmt-resource              21.1.0b1

Python location 'C:\Program Files (x86)\Microsoft SDKs\Azure\CLI2\python.exe'
Extensions directory 'C:\Users\EVELINA-PC\.azure\cliextensions'

Python (Windows) 3.10.8 (tags/v3.10.8:aaaf517, Oct 11 2022, 16:37:59) [MSC v.1933 32
 bit (Intel)]

Legal docs and information: aka.ms/AzureCliLegal


Your CLI is up-to-date.
```

Now you can go on with **creating a container image**.

Step 1: Create a Container Image for Deployment

In this step, you will **package the "Tracker App" into a container image** that can be **run using Azure Container Instances**.

You are provided with a **Dockerfile**, so you should just **create the image**, for example "**tracker-app-image**". You should know how to do it:

```
PS D:\SoftUni\03.Tracker-App> [redacted] tracker-app-image
[+] Building 0.7s (14/14) FINISHED
...
Use 'docker scan' to run Snyk tests against images to find vulnerabilities and learn
 how to fix them
```

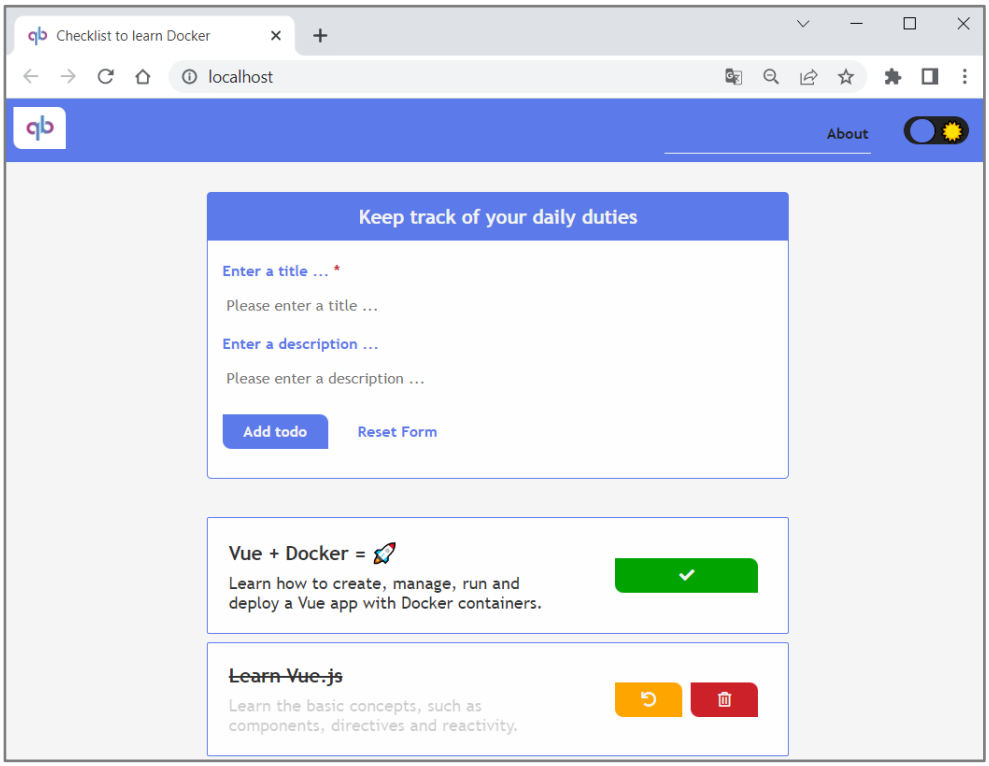
The **newly created image** should appear:

```
PS D:\SoftUni\03.Tracker-App> docker images
REPOSITORY          TAG       IMAGE ID       CREATED         SIZE
tracker-app-image   latest    19749ad7ccaa   5 minutes ago   143MB
```

You can now use this **image to run a container locally** to see if it works:

```
PS D:\SoftUni\03.Tracker-App> docker [redacted]
10a7c7ae15f24f2de40e0f2923a4917597a8269e75db51390e664b1e9a50fc07
```

↓



We have verified that the **container image runs locally**, so let's see how to **push it to Azure Container Registry**.

Step 2: Create an Azure Container Registry and Push a Container Image

An **Azure Container Registry** is a **managed registry service**. It stores and manages **private container images** and other artifacts, similar to the way **Docker Hub stores public Docker container images**.

Now we should **create an Azure container registry** and **push our image** to it.

First, **login to Azure** through **Azure CLI** with the **az login command**. A **web browser will be opened** and you should **enter your credentials**. Then **login** should be successful:

```
PS D:\SoftUni\03.Tracker-App> az login
A web browser has been opened at https://login.microsoftonline.com/organizations/oau
th2/v2.0/authorize. Please continue the login in the web browser. If no web browser
is available or if the web browser fails to open, use device code flow with `az logi
n --use-device-code`.
[
  {
    "cloudName": "AzureCloud",
    "homeTenantId": "[redacted]",
    "id": "[redacted]",
    "isDefault": true,
    "managedByTenants": [],
    "name": "Azure for Students",
    "state": "Enabled",
    "tenantId": "[redacted]",
    "user": {
      "name": "[redacted]",
      "type": "user"
    }
  }
]
```

Create Azure Container Registry

Now you need a **resource group** to **deploy the container registry** that we will create to.

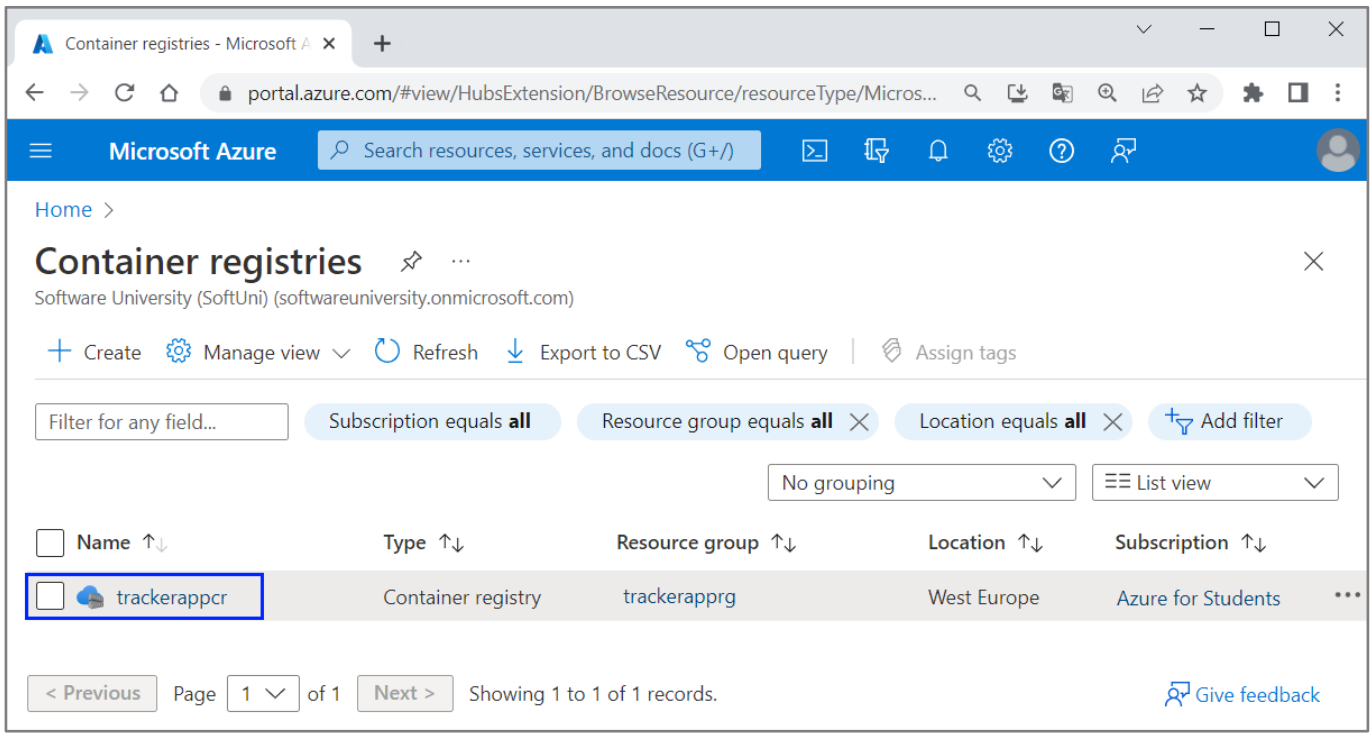
Create a new resource group in Azure with the **`az group create`** command. **Name the group** in a way you want and set it in the "**`westeurope`**" **region**:

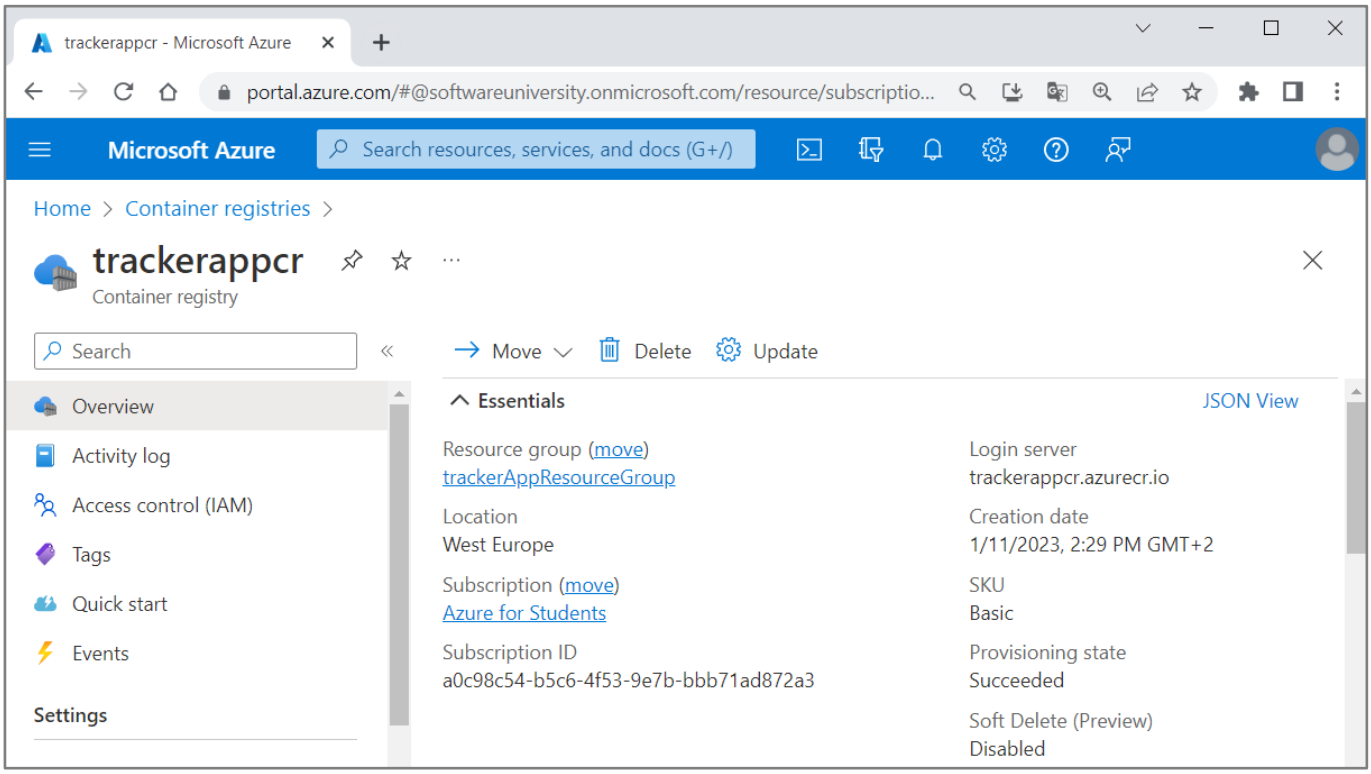
```
PS D:\SoftUni\03.Tracker-App> az group create --name trackerapprg --location westeurope


{
  "id": "/subscriptions/a0c98c54-b5c6-4f53-9e7b-bbb71ad872a3/resourceGroups/trackerapprg",
  "location": "westeurope",
  "managedBy": null,
  "name": "trackerapprg",
  "properties": {
    "provisioningState": "Succeeded"
  },
  "tags": null,
  "type": "Microsoft.Resources/resourceGroups"
}
```

Once you've created the resource group, **create an Azure container registry** with the **`az acr create`** command. The **container registry name** must be **unique within Azure**, and contain **5-50 alphanumeric characters**:

```
PS D:\SoftUni\03.Tracker-App> az acr create --resource-group trackerapprg --name trackerappcr --sku Basic
Resource provider 'Microsoft.ContainerRegistry' used by this operation is not registered. We are registering for you.
Registration succeeded.
{
  "adminUserEnabled": false,
  ...
  "zoneRedundancy": "Disabled"
}
```

You can also **see the container registry** in **`Azure Portal`** by going to the "**`Container Registries`**" **page**:





Next, you need to **log in to the container registry** you created, so that you can **push images** to it. You should use the **`az acr login` command** and **provide the name of the registry** you created:

```
PS D:\SoftUni\03.Tracker-App> az acr login --name trackerappcr
Login Succeeded
```

Login should be **successful**.

Tag Container Image

To **push a container image** to a **private registry** like **`Azure Container Registry`**, you must first **tag the image** with the **full name of the registry's login server**.

Get the **full login server name** for your **Azure container registry**:

```
PS D:\SoftUni\03.Tracker-App> az acr show --name trackerappcr --query loginServer --
output table
Result
----------------------
trackerappcr.azurecr.io ←——
```

Now you should **tag the container image** we created in the previous step with the **login server of your container registry**. Also, add the **`:v1` tag** to the **end of the image name** to indicate the **image version number**. Do it like this:

```
                                          local image name    login server name
PS D:\SoftUni\03.Tracker-App> docker tag tracker-app-image trackerappcr.azurecr.io/
tracker-app-image:v1
new image name    image version
```

You can look and see that the **new image is created**:

```
PS D:\SoftUni\03.Tracker-App> docker images
REPOSITORY                                  TAG       IMAGE ID       CREATED
tracker-app-image                           latest    19749ad7ccaa   2 hours ago
trackerappcr.azurecr.io/tracker-app-image   v1        19749ad7ccaa   2 hours ago
```

Now you **have your image**.

Push image to Azure Container Registry

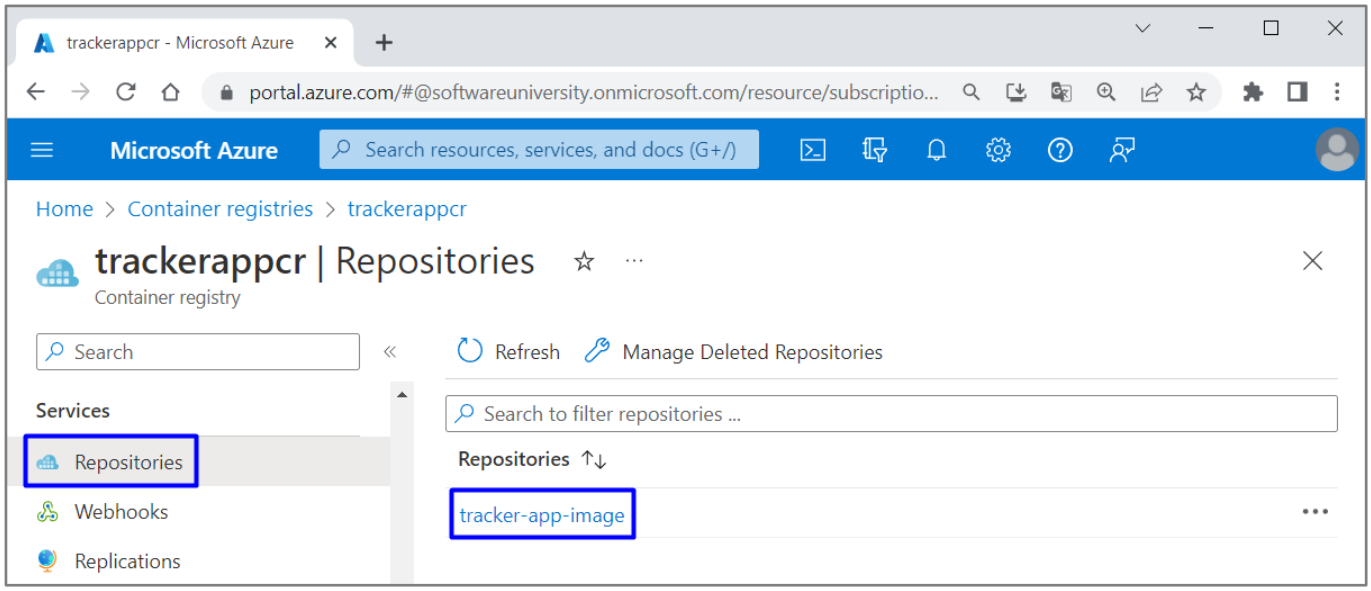
Now you can finally **push your new image** to **`Azure Container Registry`**. Do it as shown below:

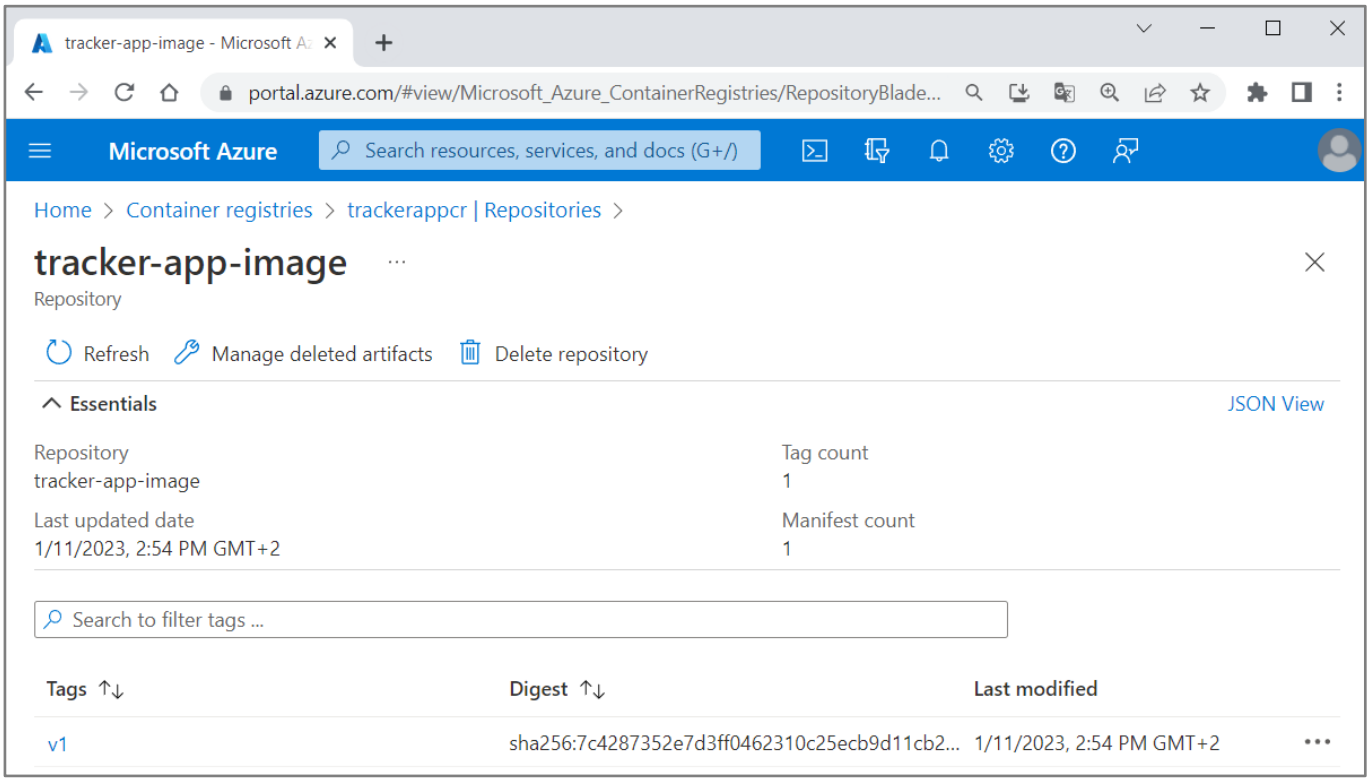
```
PS D:\SoftUni\03.Tracker-App> docker push trackerappcr.azurecr.io/tracker-app-image
:v1
The push refers to repository [trackerappcr.azurecr.io/tracker-app-image]
309d25d04ced: Pushed
80115eeb30bc: Pushed
049fd3bdb25d: Pushed
ff1154af28db: Pushed
8477a329ab95: Pushed
7e7121bf193a: Pushed
67a4178b7d47: Pushed
v1: digest: sha256:7c4287352e7d3ff0462310c25ecb9d11cb284d4fc9dc85887aabc15428340abf
 size: 1780
```

Your **image should be pushed successfully**. To verify this, **list the images** in your **container registry**:

```
PS D:\SoftUni\03.Tracker-App> az acr repository list --name trackerappcr
[
  "tracker-app-image"
]
```

You have you **image in `Azure Container Registry`**. You can also **check in `Azure Portal`** when you select the **container registry → `[Repositories]`**:





In this step you **prepared an Azure container registry** for use with **Azure Container Instances**, and **pushed a container image** to the registry.

Step 3: Deploy a Container Application

Finally, we have everything needed to **deploy a container to Azure Container Instances**.

Get Registry Credentials

When you **deploy an image** that's **hosted in a private Azure container registry** like the one created, you must **supply credentials** to access the registry. For this to happen, you shall **create and configure** an **Azure Active Directory** (**AD**) **service principal** with **pull permissions** to your **registry**.

To do this, you will need the **following commands**:

```
$ACR_NAME='$containerRegistry'
$SERVICE_PRINCIPAL_NAME='$servicePrincipal'


# Obtain the full registry ID
$ACR_REGISTRY_ID=$(az acr show --name $ACR_NAME --query "id" --output tsv)


# Create and configure the service principal with pull permissions to your registry
$PASSWORD=$(az ad sp create-for-rbac --name $SERVICE_PRINCIPAL_NAME --scopes
$ACR_REGISTRY_ID --role acrpull --query "password" --output tsv)
$USER_NAME=$(az ad sp list --display-name $SERVICE_PRINCIPAL_NAME --query
"[].appId" --output tsv)


# Output the service principal's credentials
echo "Service principal ID: $USER_NAME"
```

```
echo "Service principal password: $PASSWORD"
```

You should **modify them** for your environment:

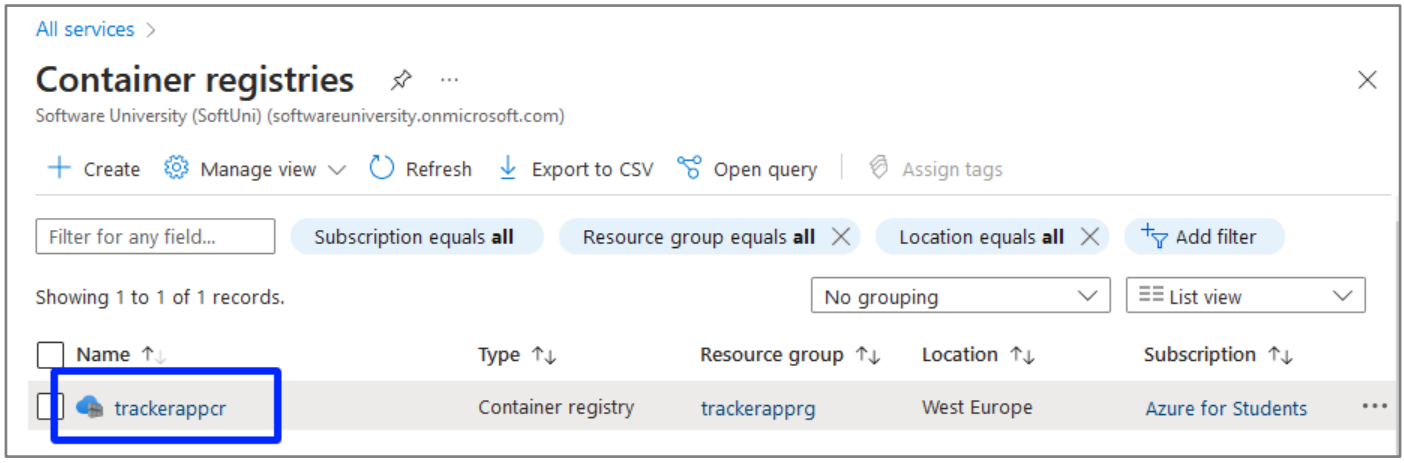
- **ACR_NAME** should keep the **name of your Azure container registry**, which you already created
- **SERVICE_PRINCIPAL_NAME** should keep a **new name for your service principal**, which should be unique within your Active Directory tenant

Execute the commands one by one with the changes:

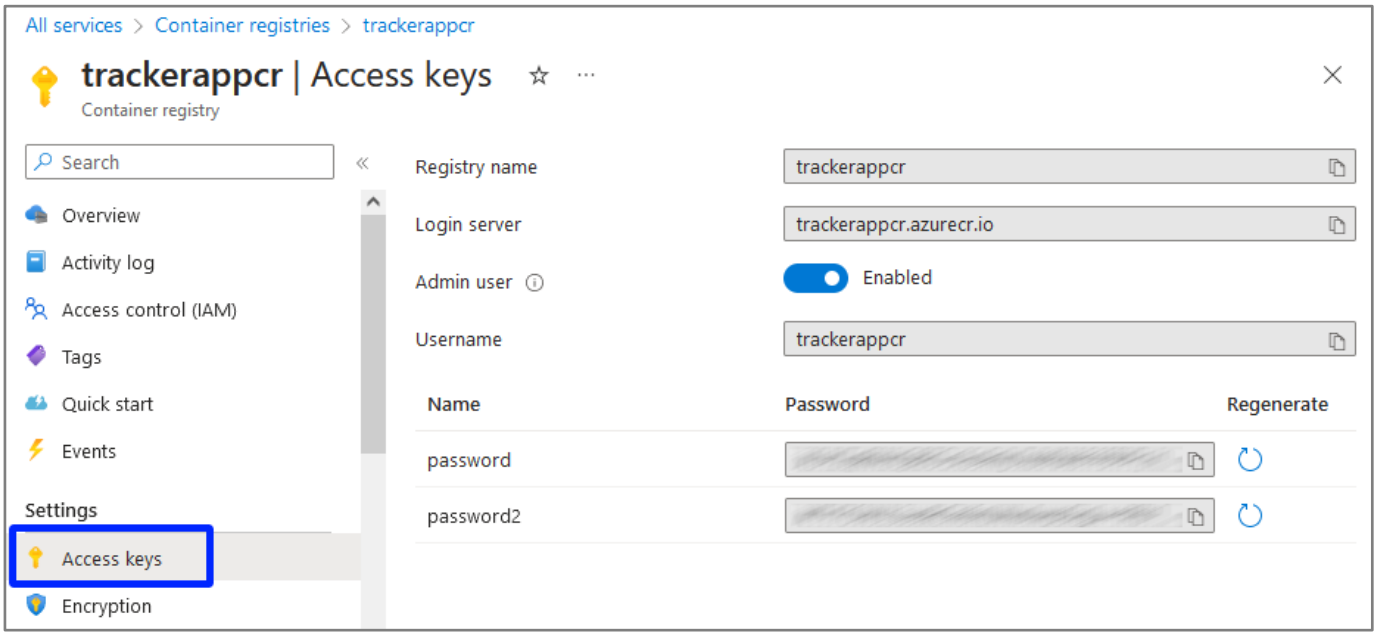
```
PS D:\SoftUni\03.Tracker-App> $ACR_NAME='trackerappcr'
PS D:\SoftUni\03.Tracker-App> $SERVICE_PRINCIPAL_NAME='trackerappsp'
PS D:\SoftUni\03.Tracker-App> $ACR_REGISTRY_ID=$(az acr show --name $ACR_NAME --query "id" --output tsv)
PS D:\SoftUni\03.Tracker-App> $PASSWORD=$(az ad sp create-for-rbac --name $SERVICE_PRINCIPAL_NAME --scopes $ACR_REGISTRY_ID --role acrpull --query "password" --output tsv)
WARNING: Found an existing application instance: (id) a830c596-47a5-4dff-9b58-56b9b319ee59. We will patch it.
WARNING: Creating 'acrpull' role assignment under scope '/subscriptions/a0c98c54-b5c6-4f53-9e7b-bbb71ad872a3/resourceGroups/trackerapprg/providers/Microsoft.ContainerRegistry/registries/trackerappcr'
WARNING: The output includes credentials that you must protect. Be sure that you do not include these credentials in your code or check the credentials into your source control. For more information, see https://aka.ms/azadsp-cli
PS D:\SoftUni\03.Tracker-App> echo "Service principal ID: $USER_NAME"
Service principal ID: [redacted]
PS D:\SoftUni\03.Tracker-App> echo "Service principal password: $PASSWORD"
Service principal password: [redacted]
```

You should **have no errors** and finally you should have your **service principal id and password**. Once you have these **credentials**, you can **configure your applications and services** to authenticate to your container registry as the service principal. **Copy them** because you will need them.

NOTE: If you get the "**`Insufficient privileges to complete the operation.`**" error message, go to "Container registries" in the **Azure Portal** and select the **`trackerapp`** container registry**:**



After that, select **`Access keys`** and enable the **`Admin user`:**



Deploy Container

Now use the **az container create command** to **deploy a container in Azure**. Use this command and **replace <resource-group-name>**, **<image-name>**, **<acrLoginServer>**, **<service-principal-ID>** and **<service-principal-password>** with **your corresponding values**. Also, **replace <container-name>** with a **name for your container** and **<aciDnsLabel>** with a **new DNS name** that you like:

```
az container create --resource-group <resource-group-name> --name <container-name>
--image <acrLoginServer>/<image-name>:v1 --cpu 1 --memory 1 --registry-login-
server <acrLoginServer> --registry-username <service-principal-ID> --registry-
password <service-principal-password> --ip-address Public --dns-name-label
<aciDnsLabel> --ports 80
```

NOTE: If you have enabled the **Admin user** in the previous step, just replace **<service-principal-ID> with <username>** and **<service-principal-password>** with **<password>**

Container deployment should be **successful**:

```
PS D:\SoftUni\03.Tracker-App> az container create --resource-group trackerapprg --
name trackerapp --image trackerappcr.azurecr.io/tracker-app-image:v1 --cpu 1 --mem
ory 1 --registry-login-server trackerappcr.azurecr.io --registry-username
                              --registry-password
          --ip-address Public --dns-name-label trackerappdns --ports 80
{
  "containers": [
    {
      "command": null,
      ...
  "volumes": null,
  "zones": null
}
```

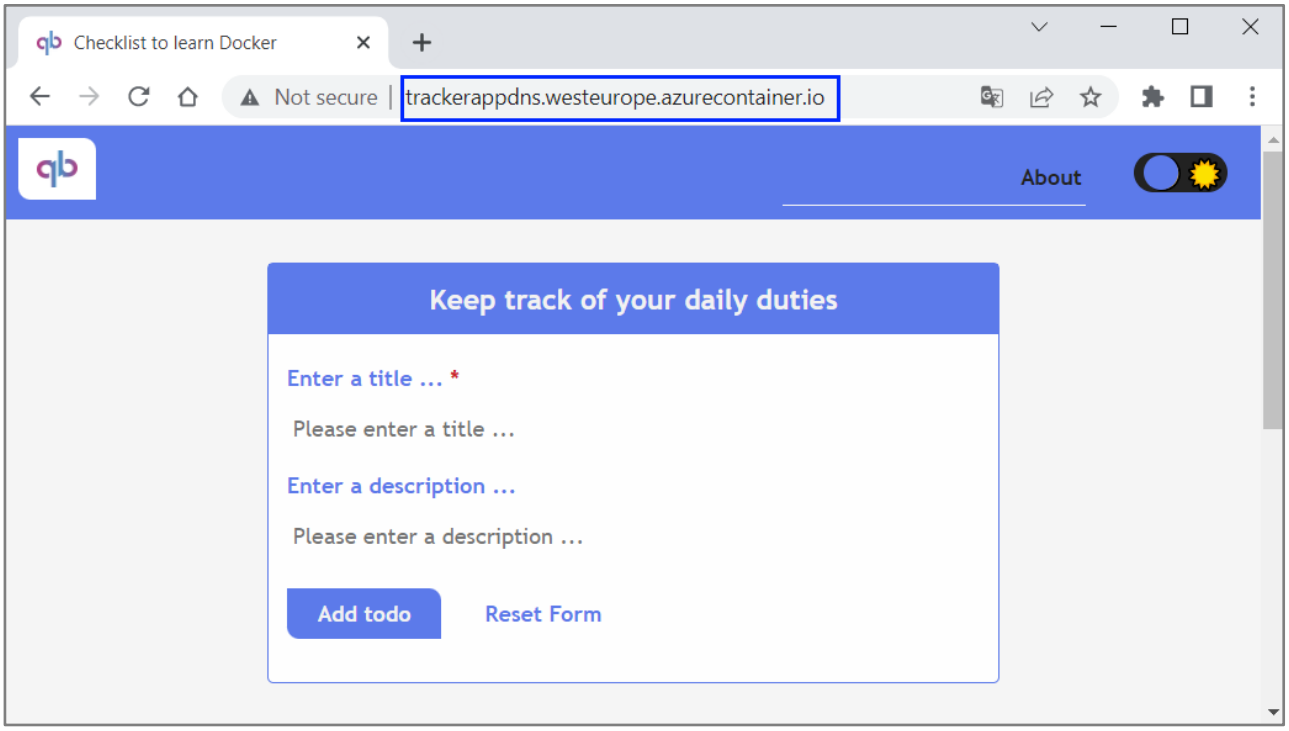
To **view the container state of deployment**, use:

```
PS D:\SoftUni\03.Tracker-App> az container show --resource-group trackerapprg --na
me trackerapp --query instanceView.state
"Running"
```

Once the **deployment succeeds**, display the **container's fully qualified domain name** (**FQDN**):

```
PS D:\SoftUni\03.Tracker-App> az container show --resource-group trackerapprg --na
me trackerapp --query ipAddress.fqdn
"trackerappdns.westeurope.azurecontainer.io"
```

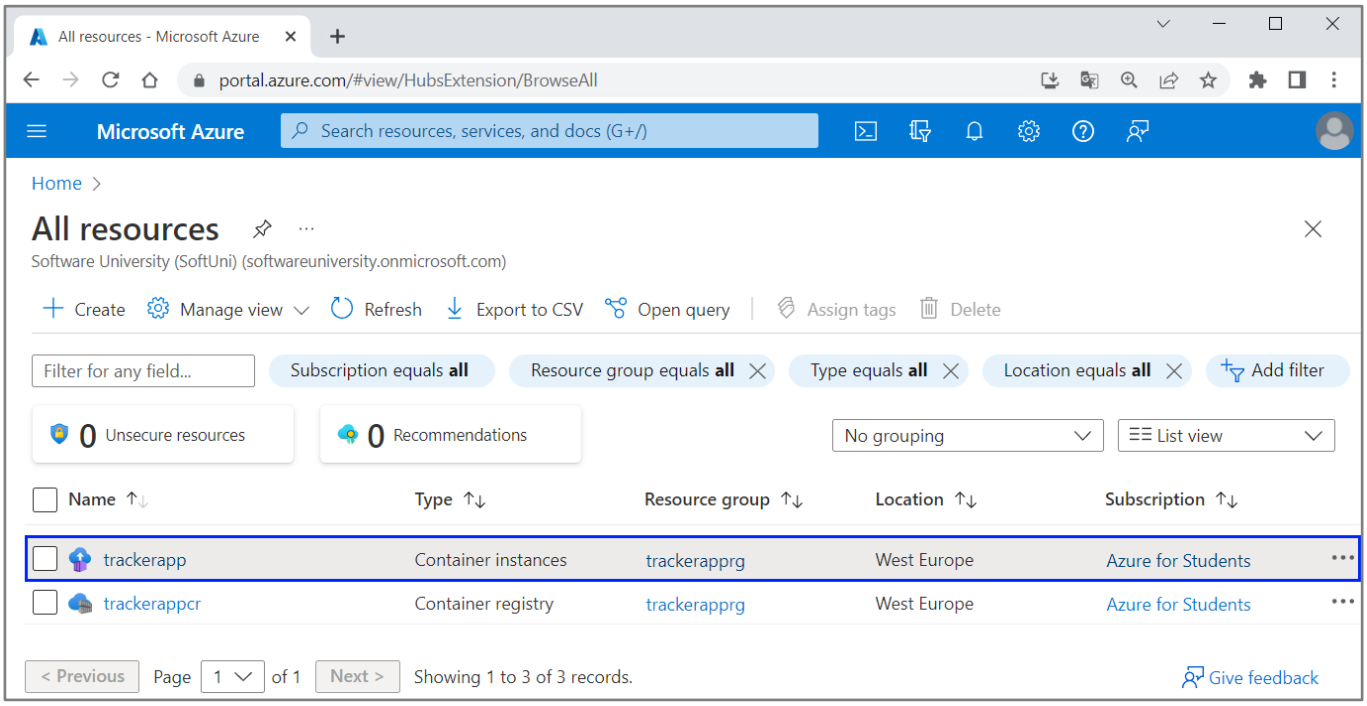
Use the **FQDN** to **access your app in the browser** (it contains the **DNS label** you chose):

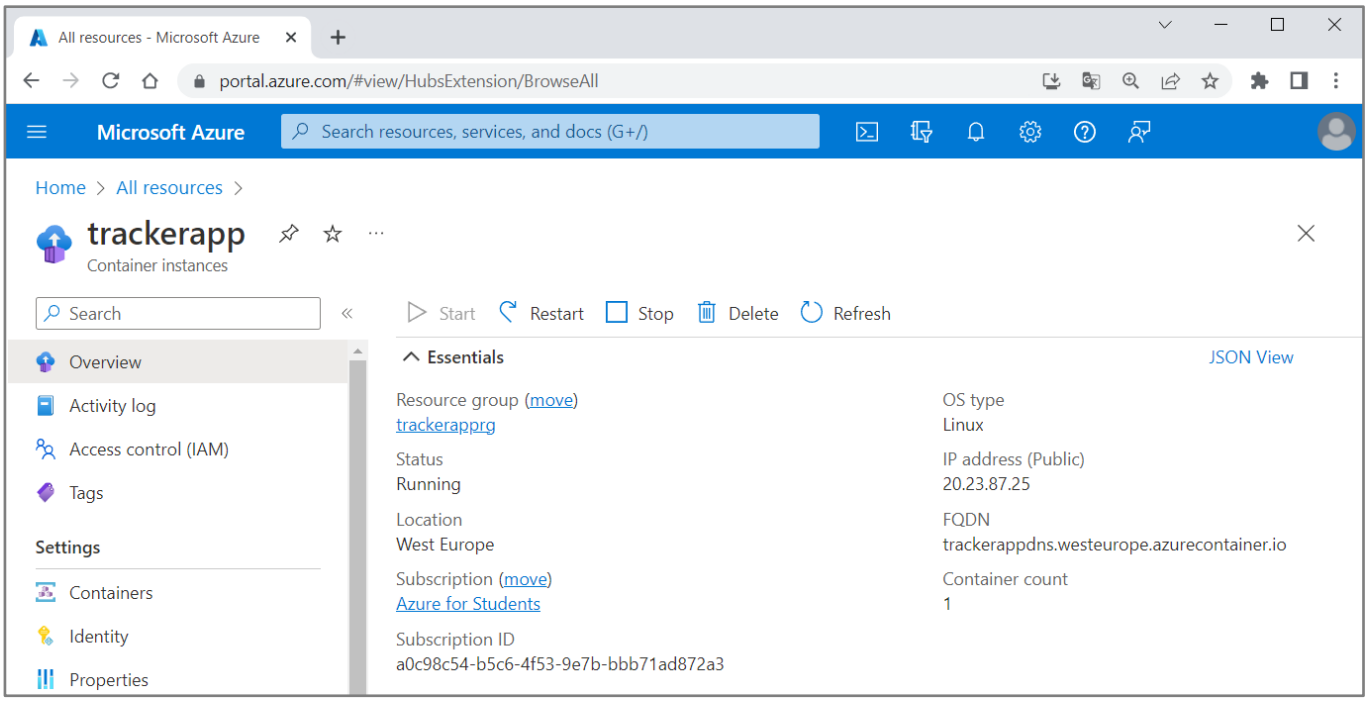


It should be **fully working**.

Explore and Remove Container

You can look at the **created container instance** in **`Azure Portal`** too:





You can also view the **log output of the container** from **`Azure CLI`**:

```
PS D:\SoftUni\03.Tracker-App> az container logs --resource-group trackerapprg --na
me trackerapp
/docker-entrypoint.sh: /docker-entrypoint.d/ is not empty, will attempt to perform
 configuration
/docker-entrypoint.sh: Looking for shell scripts in /docker-entrypoint.d/
/docker-entrypoint.sh: Launching /docker-entrypoint.d/10-listen-on-ipv6-by-default
.sh
10-listen-on-ipv6-by-default.sh: info: Getting the checksum of /etc/nginx/conf.d/d
efault.conf
10-listen-on-ipv6-by-default.sh: info: Enabled listen on IPv6 in /etc/nginx/conf.d
/default.conf
```

And finally, **clear all resources** by **deleting the resource group** with **`az group delete`**:

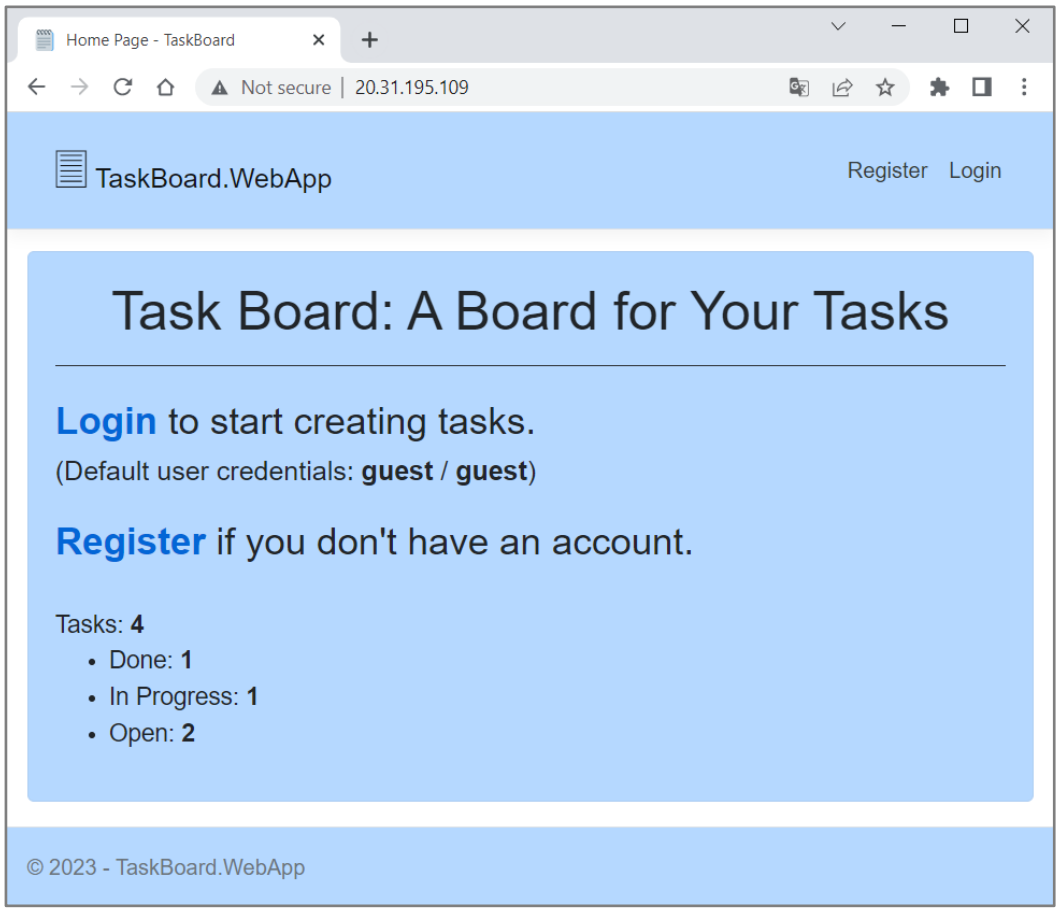
```
PS D:\SoftUni\03.Tracker-App> az group delete --name trackerapprg
Are you sure you want to perform this operation? (y/n): y
```

Now we know how to **create resource groups**, **container registries**, **container instances**, etc. and **deploy a container app** in **Azure**.

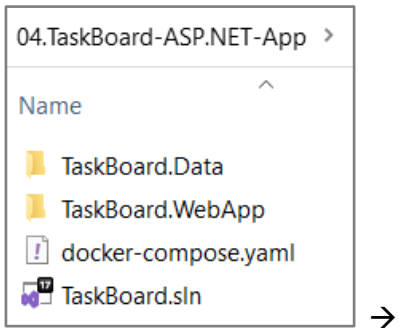
6. Deploy the "TaskBoard" App using Docker Compose

In this task, we will **deploy** the **TaskBoard multi-container app** as a **container group** in **Azure Container Instances**, using **Docker Compose**. This is a way to easily switch from local to cloud deployment.

When successfully **deployed to Azure**, the app will look like this on its **provided IP address**:



You have the **TaskBoard app** with a **docker-compose.yaml file** for it in the **resources**:



docker-compose.yaml

```yaml
version: "3.8"

services:
    sqlserver:
        container_name: sqlserver
        image: mcr.microsoft.com/mssql/server
        ports:
            - "1433:1433"
        environment:
            - ACCEPT_EULA=Y
            - MSSQL_SA_PASSWORD=yourStrongPassword12#
        volumes:
            - sqldata:/var/opt/mssql
    web-app:
        container_name: web-app
        build:
            dockerfile: ./TaskBoard.WebApp/Dockerfile
        ports:
            - "5000:80"
        restart: on-failure

volumes:
    sqldata:
```

To create and use a **volume in Azure**, we will use the **Azure File Share service**. As you can see, **we haven't defined a custom network**, as **Azure will create a default one**. If you want, however, you can search and create a **custom network in Azure** for your containers.

Let's see how to **deploy the app** in **ACI**.

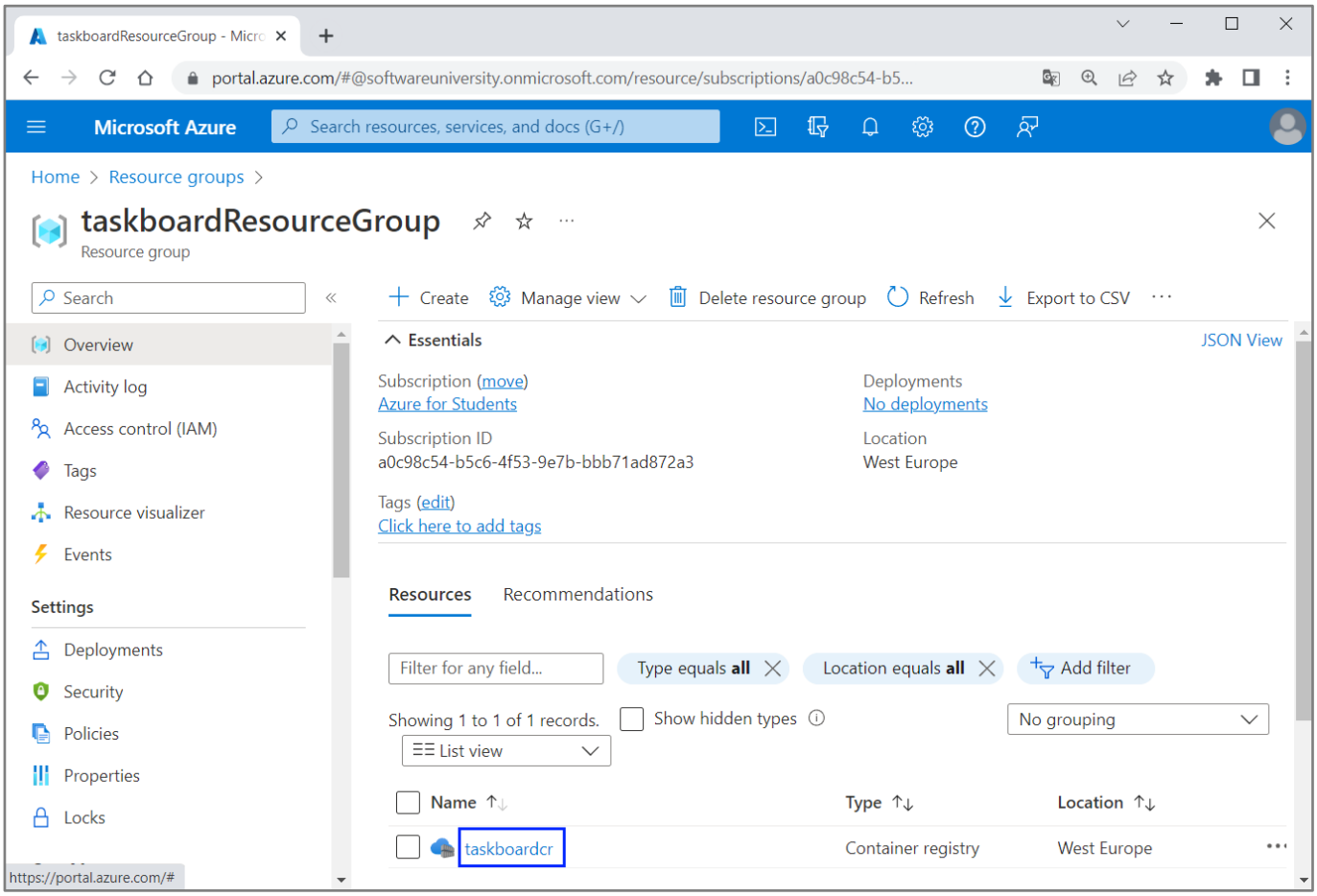
Step 1: Create Azure Container Registry

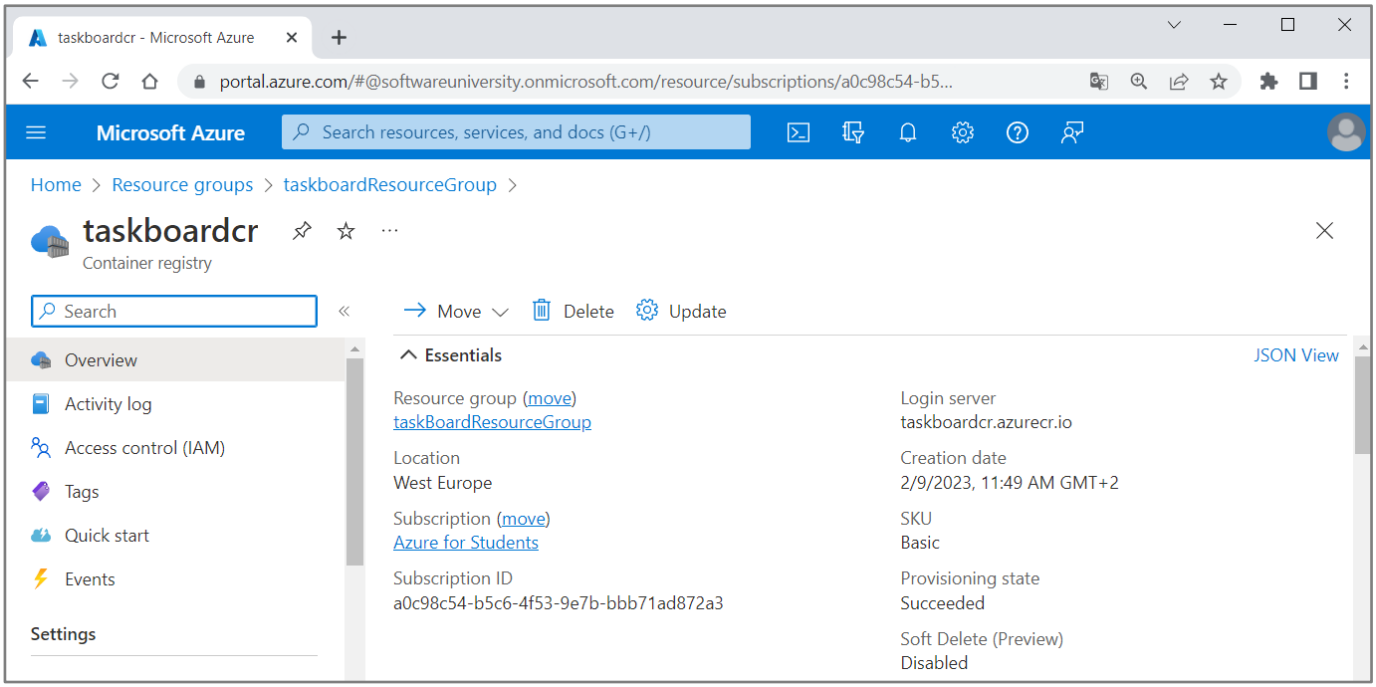
The first thing we should do is to **create a container registry** in Azure, using the **CLI**. We will **create a resource group** named "**taskBoardResourceGroup**" and a **container registry** with name "**taskboardcr**". You can do this by yourself:

```
PS D:\SoftUni\TaskBoard-ASP.NET-App> [redacted]
{
  "id": "/subscriptions/a0c98c54-b5c6-4f53-9e7b-bbb71ad872a3/resourceGroups/taskboardResourceGroup",
  "location": "westeurope",
  "managedBy": null,
  "name": "taskboardResourceGroup",
  "properties": {
    "provisioningState": "Succeeded"
  },
  "tags": null,
  "type": "Microsoft.Resources/resourceGroups"
}
```

```
PS D:\SoftUni\TaskBoard-ASP.NET-App> [redacted]
{
  "adminUserEnabled": false,
  "anonymousPullEnabled": false,
  ...
  "location": "westeurope",
  "loginServer": "taskboardcr.azurecr.io",
  "name": "taskboardcr",
  ...
  "resourceGroup": "taskBoardResourceGroup",
  "sku": {
    "name": "Basic",
  ...
}
```

You can also look at them in **Azure Portal**:





Then you should **log in** to the **`taskboardcr` container registry** that you have just created:

```
PS D:\SoftUni\TaskBoard-ASP.NET-App> az acr login --name taskboardcr
Login Succeeded
```

Step 2: Modify Docker Compose File

Now you should make some **modifications to the provided `docker-compose.yaml` file**, so that it works in **Azure** later.

First, you should make sure that in **each container** the **default container port** and the **exposed port are the same**:

```yaml
version: "3.8"

services:
    sqlserver:
        container_name: sqlserver
        image: mcr.microsoft.com/mssql/server
        ports:
            - "1433:1433"
        environment:...
        volumes: ...
    web-app:
        container_name: web-app
        build:...
        ports:
            - "80:80"
        restart: on-failure

volumes:...
```

This is because **port mapping** is **not supported** with **ACI**.

Next, you should **add an image property** to the **`web-app` service**. It should **contain the login service name** of your container registry (**`taskboardcr.azurecr.io`**) + **`/`** + **your image name**:

```yaml
version: "3.8"

services:
    sqlserver:...
    web-app:
        container_name: web-app
        build:...
        image: taskboardcr.azurecr.io/taskboard-image
        ports: ...
        restart: on-failure

volumes:...
```

These were the **changes** we needed to make for now. Because of these changes, the **`taskboard-image`** will be **tagged** for your **Azure container registry** on the next step. Then it can be **pulled to run in Azure Container Instances**.

Finally, you should **set deployment options** for **resources to be reserved** for the **`sqlserver`** container:

```yaml
version: "3.8"

services:
    sqlserver:
        container_name: sqlserver
        image: mcr.microsoft.com/mssql/server
        ports: ...
        deploy:
            resources:
                reservations:
                    cpus: '2'
                    memory: 2GB
        environment: ...
        volumes: ...
    web-app: ...

volumes: ...
```

The **SQL container** needs **2 CPU** and **2GB memory** at least to work properly. If it is **missing resources**, it would not be able to **create all database tables** it needs and this would result in **errors**.

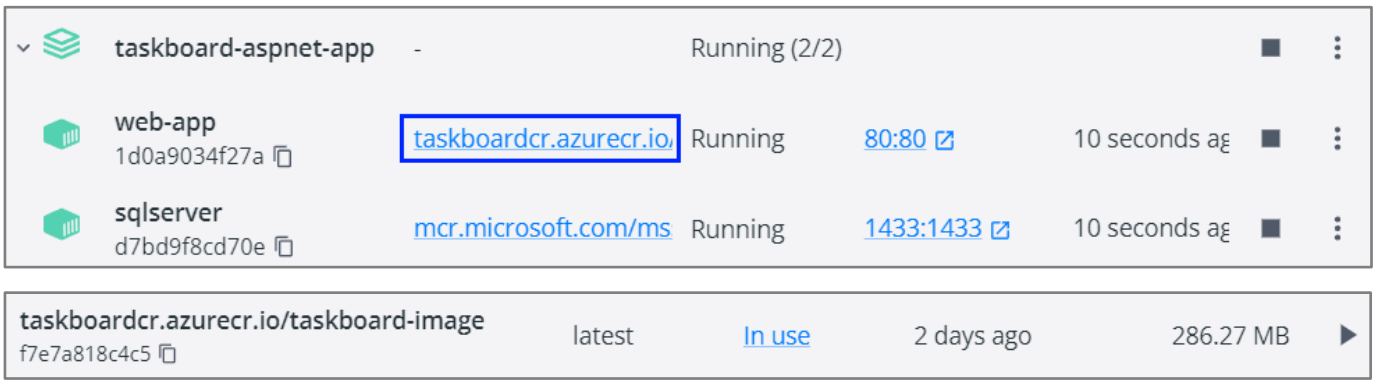
NOTE: it is important to know that **services names** should contain only lowercase letters, numbers and hyphens and the **password** should not contain symbols like "**$**". If you have **any problems** with the **`docker-compose up` command** later, **return to this step** and think about a **possible problem** in the **`docker-compose.yaml` file**.

Step 3: Run Multi-Container App Locally

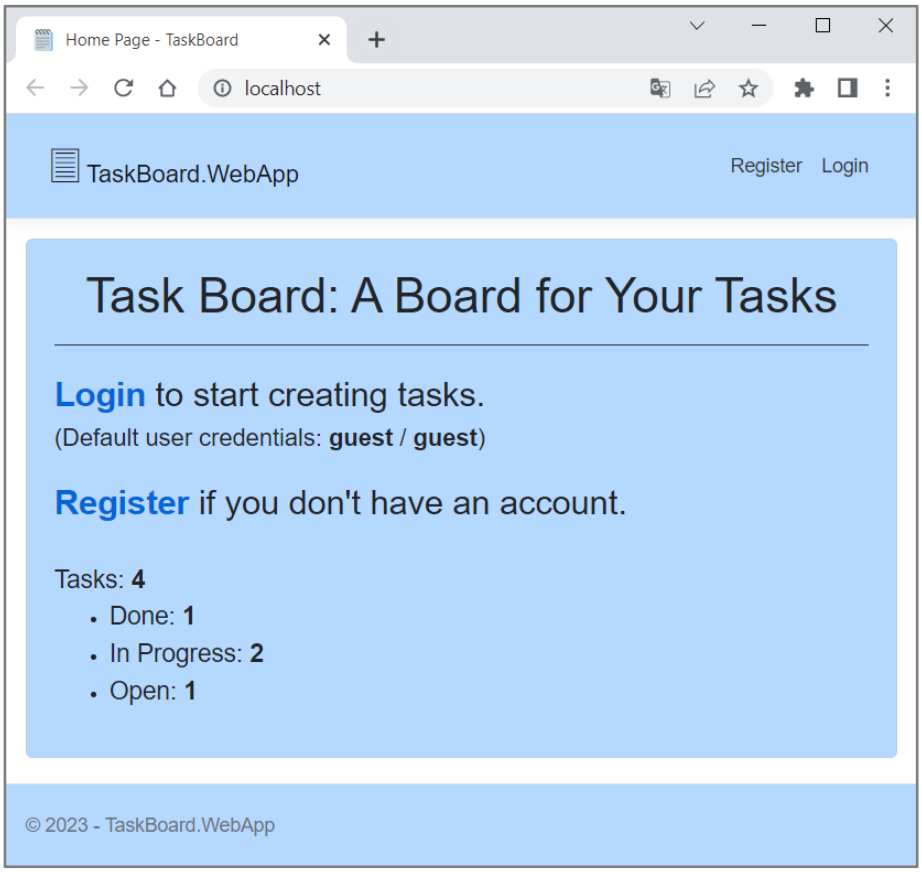
Use the **`docker-compose.yaml` file** we modified to **build the container image** and **start the `TaskBoard` application locally**:

```
PS D:\SoftUni\TaskBoard-ASP.NET-App> docker-compose up --build -d
[+] Building 14.6s (19/19) FINISHED
 => [internal] load build definition from Dockerfile                0.1s
 ...
[+] Running 3/3
 - Network taskboard-aspnet-app_default  Created                     0.8s
 - Container web-app                     Started                    2.1s
 - Container sqlserver                   Started                    2.1s
```

When completed, you will have the **Docker containers** and the **tagged `web-app` service image**:



Make sure that the **app is working correctly** with the database:



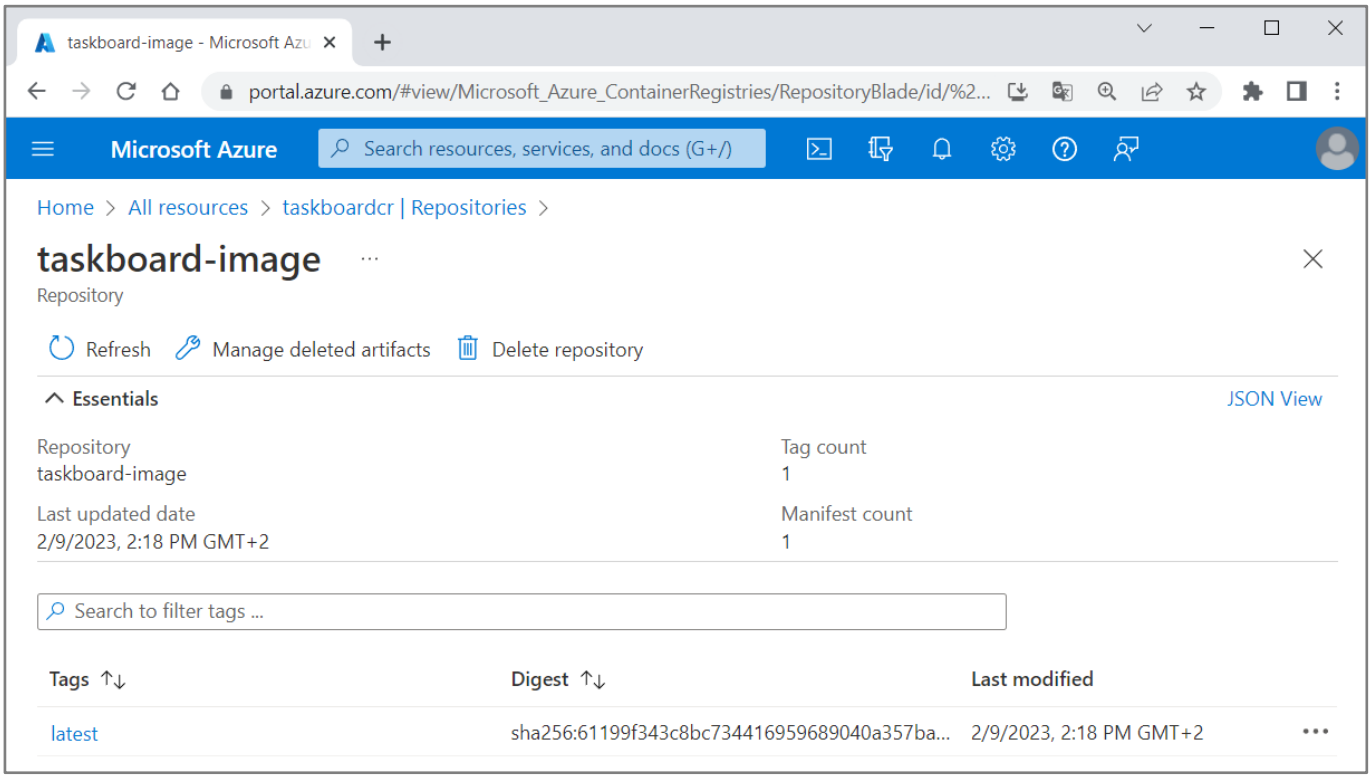
Then you can **stop the app** and **remove the containers**.

You can see in Docker that we have the **container image** and it is **tagged:**

Name	Tag	Status	Created	Size
taskboardcr.azurecr.io/taskboard-image 258a7aa9c675	latest	In use	less than a minute a	285.51 MB

So now we should **push it to our Azure container registry**. Use the **`docker-compose push`** command and the **image should be available in the registry**:

```
PS D:\SoftUni\TaskBoard-ASP.NET-App> az acr repository show --name taskboardcr --
repository taskboard-image
{
  "changeableAttributes": {
    "deleteEnabled": true,
    "listEnabled": true,
    "readEnabled": true,
    "teleportEnabled": false,
    "writeEnabled": true
  },
  "createdTime": "2023-02-09T12:18:36.9712859Z",
  "imageName": "taskboard-image",
  "lastUpdateTime": "2023-02-09T12:18:37.073611Z",
  "manifestCount": 1,
  "registry": "taskboardcr.azurecr.io",
  "tagCount": 1
}
```



Later we will **use this image**.

Step 4: Set up Azure File Share Storage

As you know, a **SQL Server container** needs a **volume to persist data**. **`Azure File Share`** is used to support **volumes** for **ACI containers**. We should **create a file share** and use it in our **`docker-compose.yaml` file**.

Azure file shares are deployed into **storage accounts**. An **`Azure storage account`** contains all of your **`Azure Storage data objects`**: blobs, files, queues, and tables. Azure supports multiple types of storage accounts.

Azure can create a **file share** by itself when you add it in the **`Docker Compose` file**. **Mount the volume** to the SQL Server container's **directory** and **specify the volume driver** (**`azure_file`**) and its **options** (**file share** and **storage account names**) like this:

docker-compose.yaml

```
version: "3.8"

services:
    sqlserver:
        container_name: sqlserver
        image: mcr.microsoft.com/mssql/server
        ports: ...
        deploy: ...
        environment: ...
        volumes:
            - sqldata:/var/opt/mssql
    web-app: ...

volumes:
    sqldata:
      driver: azure_file
      driver_opts:
        share_name: sql-volume
        storage_account_name: taskboardstorageacc
```

We set the **name of the volume** to "**`sql-volume`**" and the **storage account name** to "**`taskboardstorageacc`**" but you can **use different names**.

Your app is **fully prepared** for **deployment to ACI**.

Step 5: Create Azure Context

You should **create an ACI context** to associate **Docker with an Azure subscription and resource group** so you can **create and manage container instances**. You know how to **create a context**, so create the **`taskboardcontext aci` context** in the **`taskBoardResourceGroup` resource group** by yourself:

```
PS D:\SoftUni\TaskBoard-ASP.NET-App> [redacted]
Using only available subscription : Azure for Students (a0c98c54-b5c6-4f53-9e7b-b
bb71ad872a)
? Select a resource group taskboardResourceGroup (westeurope)
Successfully created aci context "taskboardcontext"
```

Then use the **created context**:

```
PS D:\SoftUni\TaskBoard-ASP.NET-App> [redacted]
taskboardcontext
```

This will make the **subsequent commands executed in this context**, e.g., in **Azure**.

Step 6: Deploy App to Azure Container Instances

Finally, you should **run the `docker compose up` command** in the **`aci` context** to **start the application in `Azure Container Instances`**:

```
PS D:\SoftUni\TaskBoard-ASP.NET-App> docker compose up
[+] Running 5/5
 - taskboardstorageacc            Created                                21.5s
 - sql-volume                     Created                                 1.2s
 - Group taskboard-aspnet-app     Created                                 7.8s
 - web-app                        Created                                93.1s
 - sqlserver                      Created                                93.1s
```

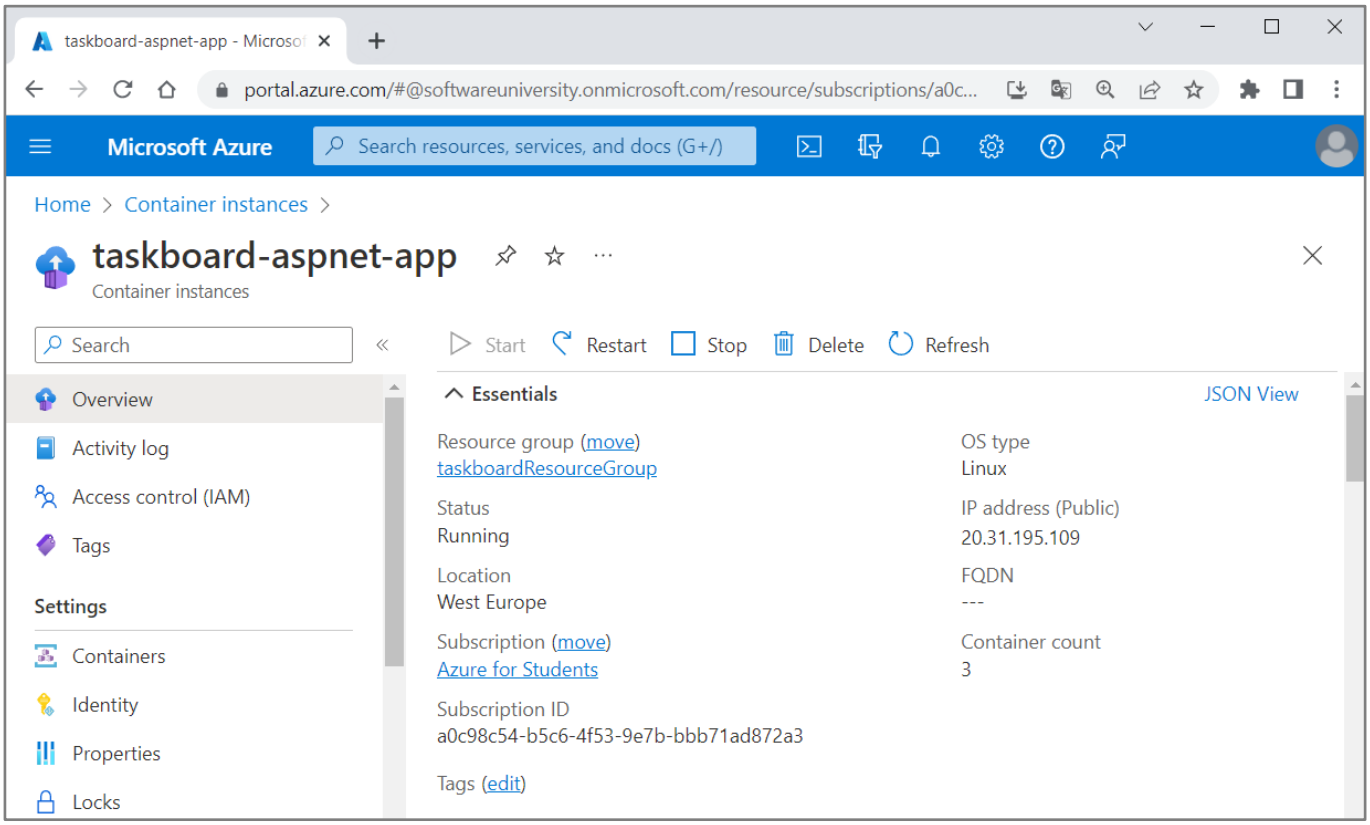
The **`taskboard-image` image** will be **pulled from your container registry**. After a while, **storage account** and **file share are created** and will be used for **volume** in the container. Then, **containers are deployed as a group in ACI**.

NOTE: if **any errors occur** or the **command does not run the containers**, think about what you may have done wrong in the previous steps. Especially, you may have **problems with your `docker-compose.yaml` file**. Try to solve the problems and **run the app in Azure successfully**.

To see the **running containers** and the **IP address** assigned to the **container group**, execute the following command:

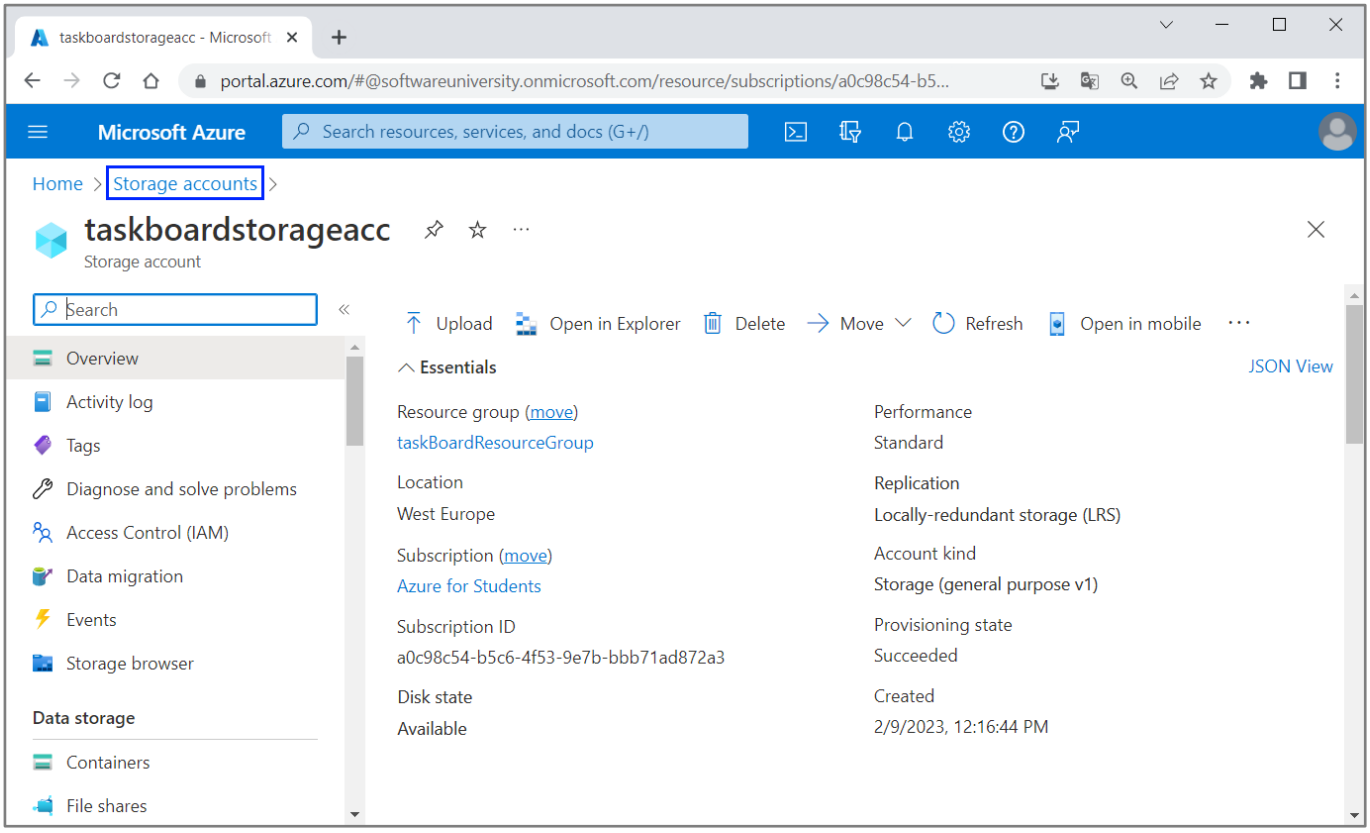
```
PS D:\SoftUni\TaskBoard-ASP.NET-App> docker ps
CONTAINER ID                  IMAGE                     STATUS    PORTS
taskboard-aspnet-app_sqlserver mcr.microsoft.com/m...Running  20.23.53.217:1433->1433/tcp
taskboard-aspnet-app_web-app   taskboardcr.azurecr...Running  20.23.53.217:80->80/tcp
```

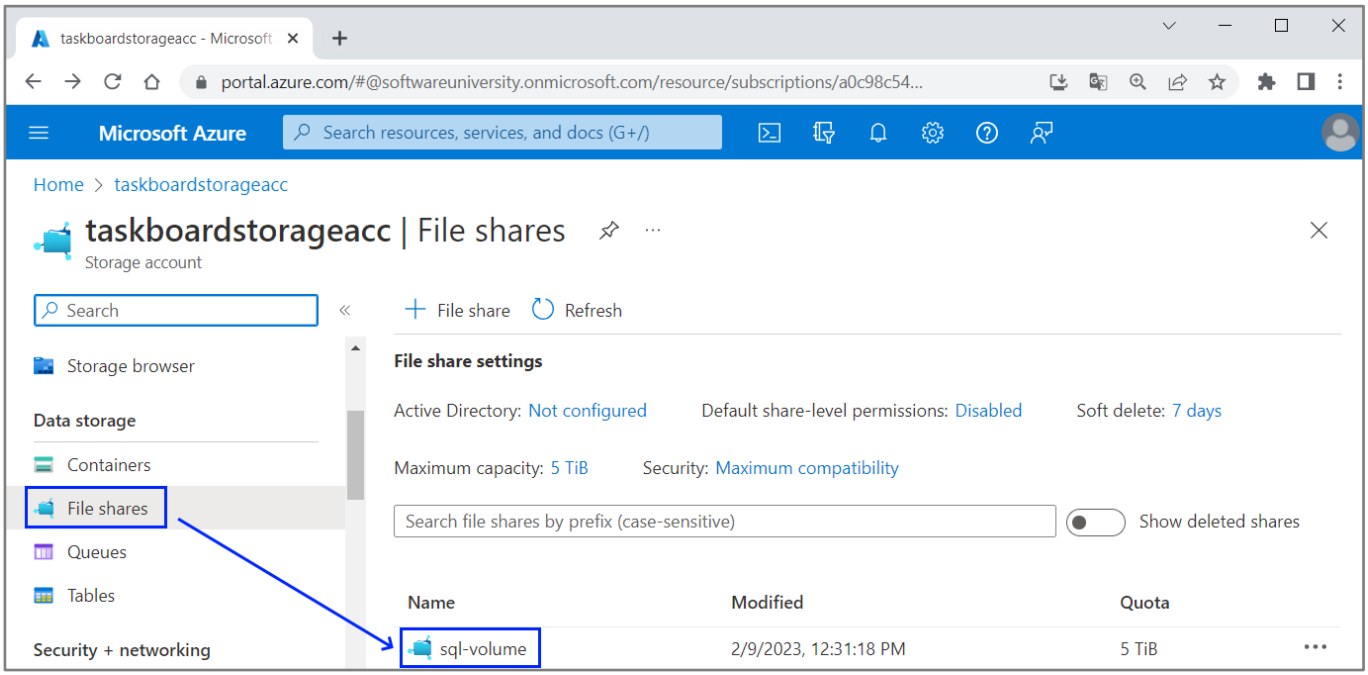
You can also look at them in **`Azure Portal`**:



You can also look at **each container's logs** in **`[Settings]` → `[Containers]`**.

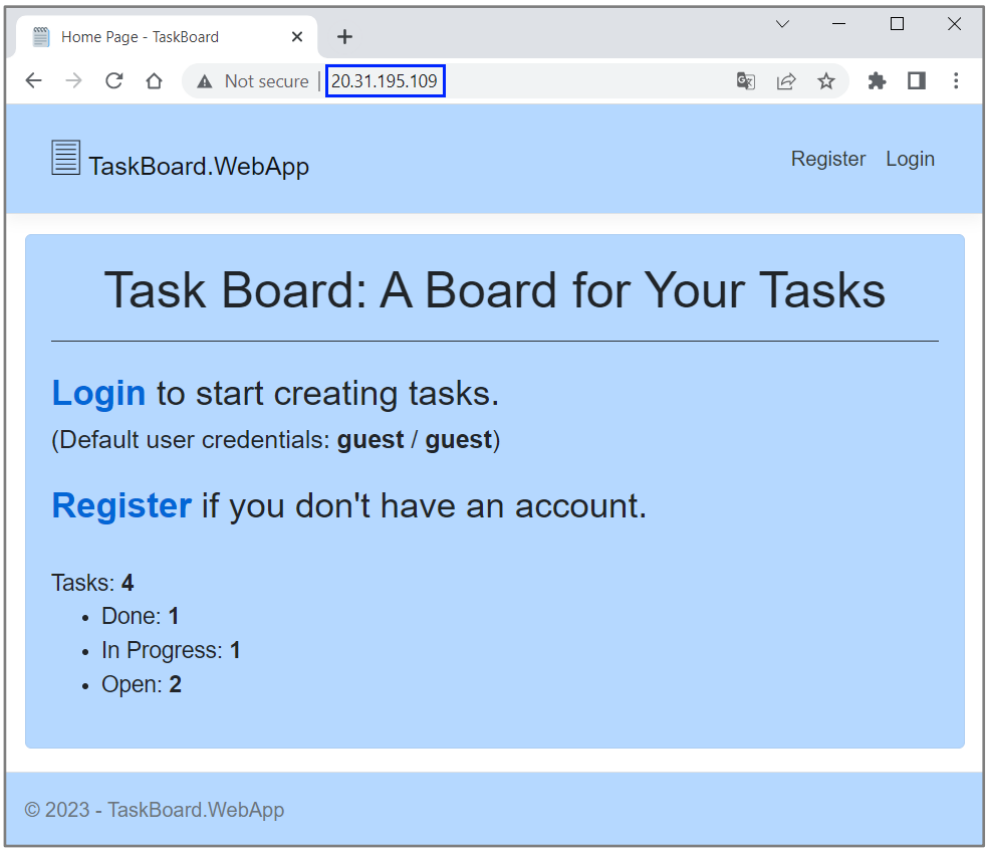
And here are the **storage account** and the **file share** that were created:





Step 7: Run the App in Azure

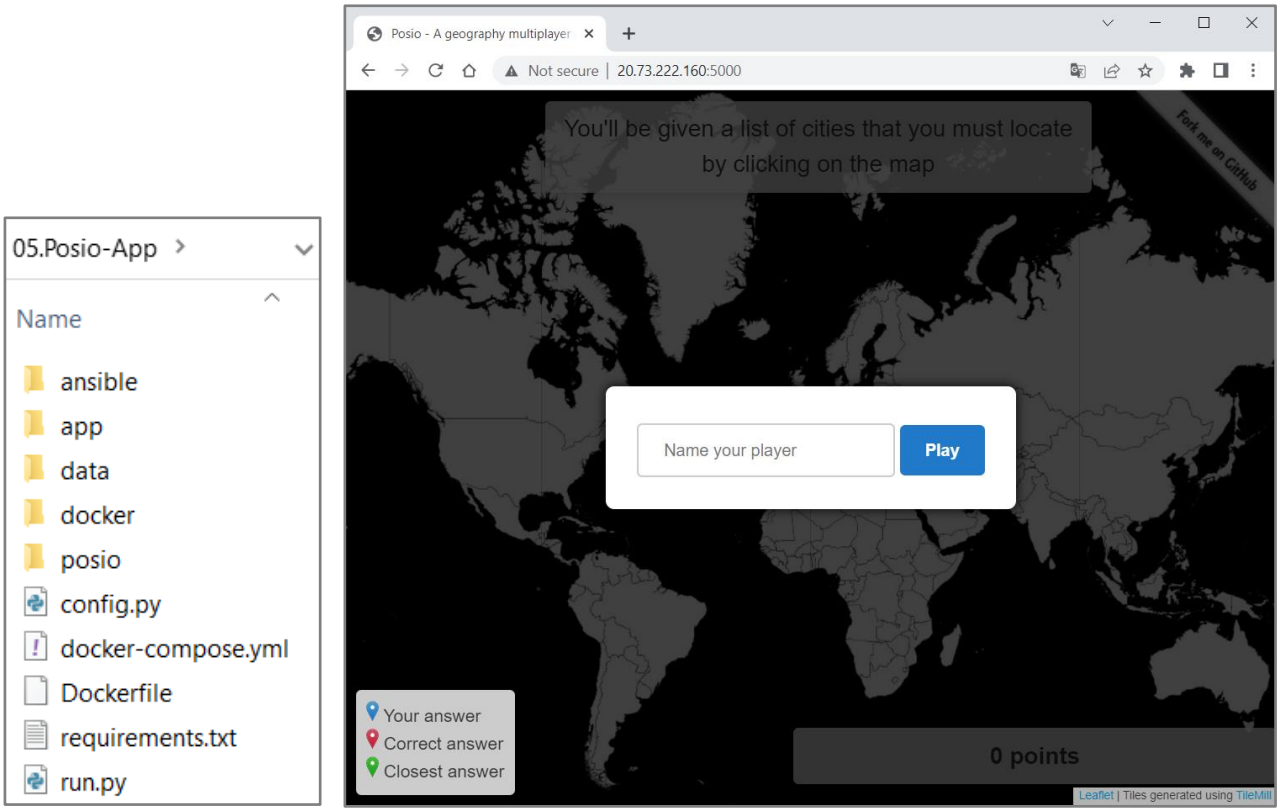
At the end, use the **IP address of the app** to **navigate to it**. Wait for **several minutes**, **refresh the browser** several times and your **TaskBoard app** should be **up and working**:

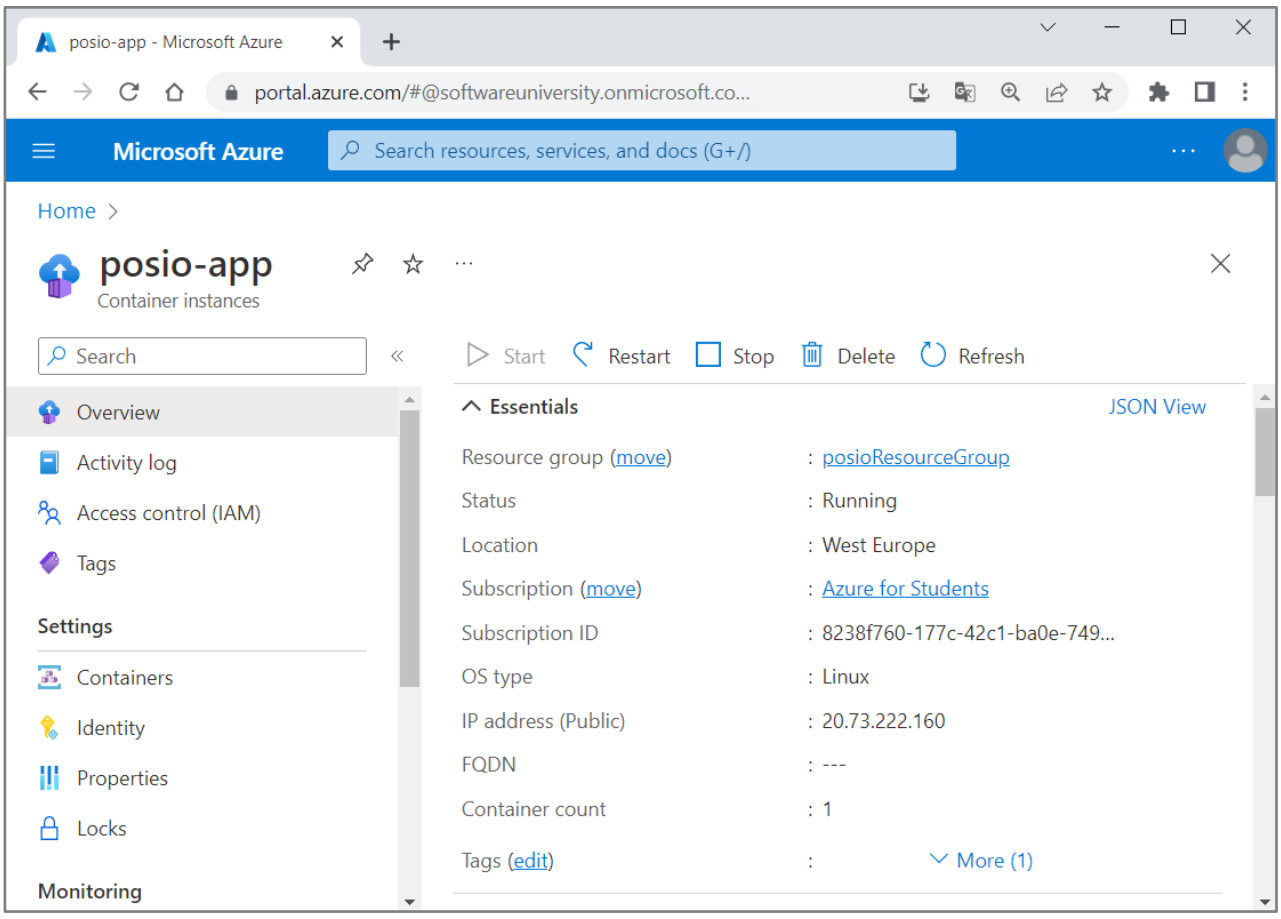


NOTE: you may have **multiple errors in the container logs** because the **SQL database takes time to be created** and the **web app fails to connect to it** several times. However, if this **behavior doesn't stop** or **any of your containers is terminated**, then you should **search for a problem with the app or its deployment**.

7. Deploy the "Posio" App

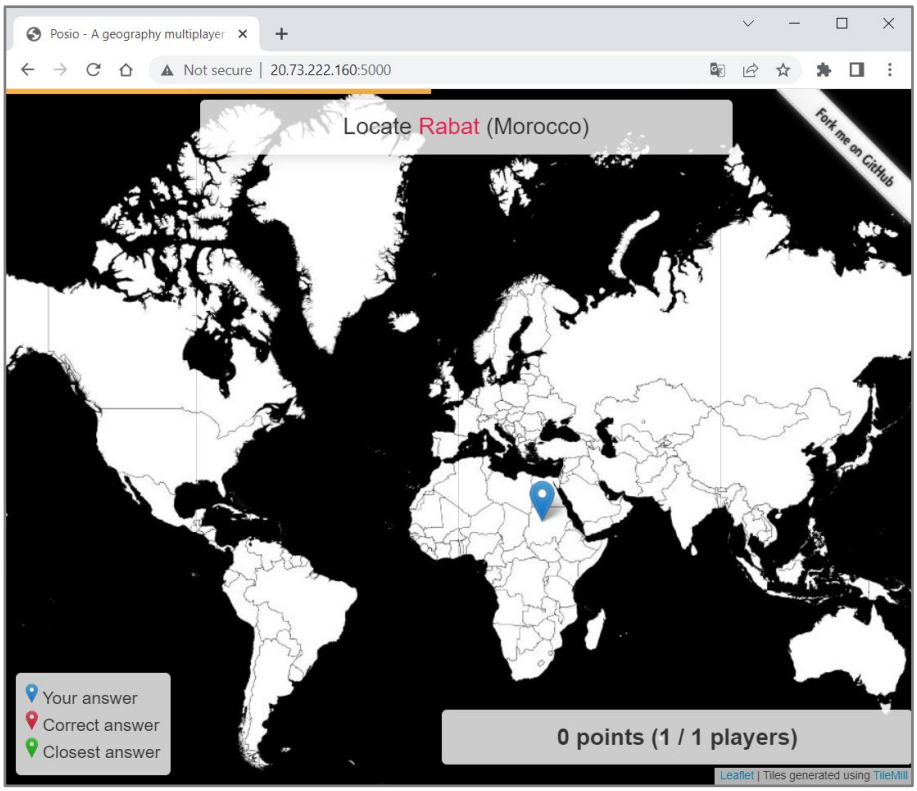
Here is one more task for you to try and **deploy a simple app** to **`Azure Container Instances`** using a **`Docker Compose file`**. The "**`Posio`**" **app** is a **simple multiplayer geography game** using Websockets. You have it in the **resources** and it should look like this when **deployed**:

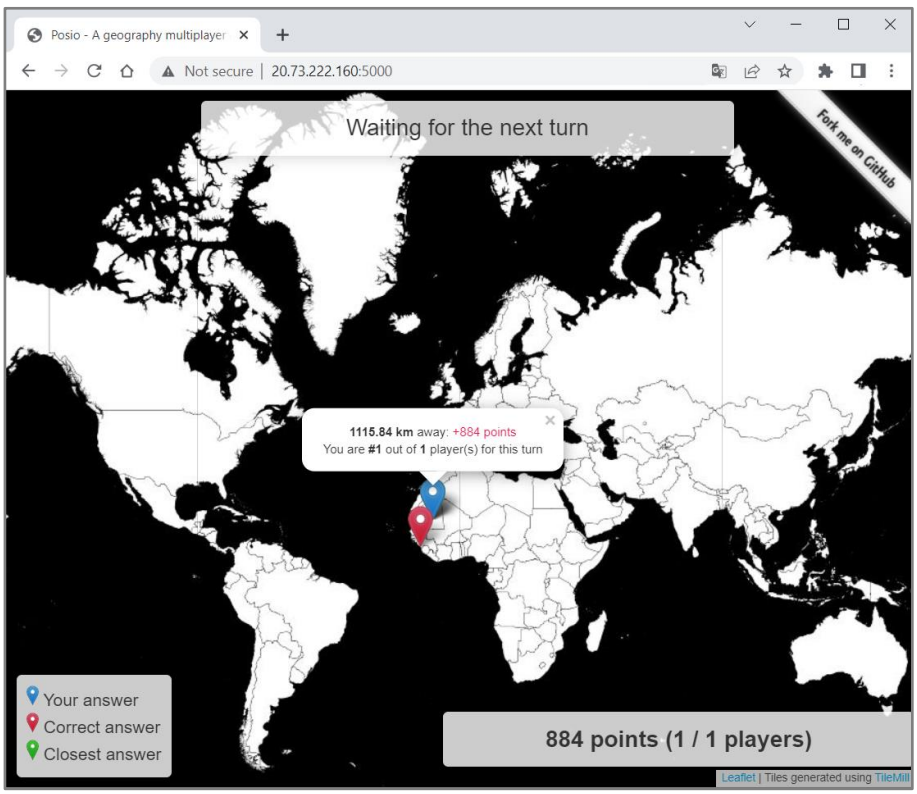




To **deploy the app**, follow the steps from the **previous task**: create a container registry and push the app image, set up a file share to be created, create context and deploy the app to ACI.

When done, the **app should be accessed** on **`{IP Address}:5000`** and you should be able to **play the game**:





You can play with friends – there is a **rank of players**.