Run Docker containers with Azure Container Instances

Learn how to run containerized apps using Docker containers with Azure Container Instances (ACI).

In this module, you will:

- Run containers in Azure Container Instances
- Control what happens when your container exits
- Use environment variables to configure your container when it starts
- Attach a data volume to persist data when your container exits

Important
You need your own Azure subscription to run the exercises in this lab, and you may incur charges. If you don't already have an Azure subscription, create a **free account** before you begin.

Introduction to Azure Container Instances

Containers offer a standardized and repeatable way to package, deploy and manage cloud applications. Azure Container Instances let you run a container in Azure without managing virtual machines and without a higher-level service.

Exercise - Run Azure Container Instances

Here, you create a container in Azure and expose it to the Internet with a fully qualified domain name (FQDN).

Why use Azure Container Instances?

Azure Container Instances is useful for scenarios that can operate in isolated containers, including simple applications, task automation, and build jobs. Here are some of the benefits:

- **Fast startup**: Launch containers in seconds.
- **Per second billing**: Incur costs only while the container is running.
- **Hypervisor-level security**: Isolate your application as completely as it would be in a VM.
- **Custom sizes**: Specify exact values for CPU cores and memory.
- **Persistent storage**: Mount Azure Files shares directly to a container to retrieve and persist state.
- **Linux and Windows**: Schedule both Windows and Linux containers using the same API.

For scenarios where you need full container orchestration, including service discovery across multiple containers, automatic scaling, and coordinated application upgrades, we recommend Azure Kubernetes Service (AKS).

Create a container

1. Sign into the Azure portal with your Azure subscription.
2. Open the Azure Cloud Shell from the Azure portal using the Cloud Shell icon.

3. Create a new resource group with the name **learn-deploy-aci-rg** so that it will be easier to clean up these resources when you are finished with the module. If you choose a different resource group name, remember it for the rest of the exercises in this module. You also need to choose a region in which you want to create the resource group, for example **East US**.

```
az group create --name learn-deploy-aci-rg --location eastus
```

You create a container by providing a name, a Docker image, and an Azure resource group to the `az container create` command. You can optionally expose the container to the Internet by specifying a DNS name label. In this example, you deploy a container that hosts a small web app. You can also select the location to place the image - you'll use the **East US** region, but you can change it to a location close to you.

4. You provide a DNS name to expose your container to the Internet. Your DNS name must be unique. For learning purposes, run this command from Cloud Shell to create a Bash variable that holds a unique name.

```
DNS_NAME_LABEL=aci-demo-$RANDOM
```

5. Run the following `az container create` command to start a container instance.

```
az container create \
  --resource-group learn-deploy-aci-rg \
  --name mycontainer \
  --image microsoft/aci-helloworld \
  --ports 80 \
  --dns-name-label $DNS_NAME_LABEL \
  --location eastus
```

`$DNS_NAME_LABEL` specifies your DNS name. The image name, **microsoft/aci-helloworld**, refers to a Docker image hosted on Docker Hub that runs a basic Node.js web application.

6. When the `az container create` command completes, run `az container show` to check its status.

```
az container show \
  --resource-group learn-deploy-aci-rg \
  --name mycontainer \
  --query "{FQDN:ipAddress.fqdn,ProvisioningState:provisioningState}" \
  --out table
```

You see your container's fully qualified domain name (FQDN) and its provisioning state. Here's an example, your's will likely be different.

```
FQDN                                    ProvisioningState
--------------------------------------  -------------------
aci-demo.eastus.azurecontainer.io       Succeeded
```

If your container is in the **Creating** state, wait a few moments and run the command again until you see the **Succeeded** state.

7. From a browser, navigate to your container's FQDN to see it running. You see this.

Summary

Here, you created an Azure container instance to run a web server and application. You also accessed this application using the FQDN of the container instance.

Exercise - Control restart behavior

The ease and speed of deploying containers in Azure Container Instances makes it a great fit for executing run-once tasks like image rendering or building and testing applications.

With a configurable restart policy, you can specify that your containers are stopped when their processes have completed. Because container instances are billed by the

second, you're charged only for the compute resources used while the container executing your task is running.

What are container restart policies?

Azure Container Instances has three restart-policy options:

Restart policy	Description
Always	Containers in the container group are always restarted. This policy makes sense for long-running tasks such as a web server. This is the **default** setting applied when no restart policy is specified at container creation.
Never	Containers in the container group are never restarted. The containers run one time only.
OnFailure	Containers in the container group are restarted only when the process executed in the container fails (when it terminates with a nonzero exit code). The containers are run at least once. This policy works well for containers that run short-lived tasks.

Run a container to completion

To see the restart policy in action, create a container instance from the **microsoft/aci-wordcount** Docker image and specify the **OnFailure** restart policy. This container runs a Python script that analyzes the text of Shakespeare's Hamlet, writes the 10 most common words to standard output, and then exits.

1. Run this `az container create` command to start the container.

```
az container create \
  --resource-group learn-deploy-aci-rg \
  --name mycontainer-restart-demo \
  --image microsoft/aci-wordcount:latest \
  --restart-policy OnFailure \
  --location eastus
```

Azure Container Instances starts the container and then stops it when its process (a script, in this case) exits. When Azure Container Instances stops a container whose restart policy is **Never** or **OnFailure**, the container's status is set to **Terminated**.

2. Run `az container show` to check your container's status.

```
az container show \
  --resource-group learn-deploy-aci-rg \
  --name mycontainer-restart-demo \
  --query containers[0].instanceView.currentState.state
```

   Repeat the command until it reaches the **Terminated** status.

3. View the container's logs to examine the output. To do so, run `az container logs` like this.

```
az container logs \
  --resource-group learn-deploy-aci-rg \
  --name mycontainer-restart-demo
```

   You should see this.

```
 [('the', 990),
 ('and', 702),
 ('of', 628),
 ('to', 610),
 ('I', 544),
 ('you', 495),
 ('a', 453),
 ('my', 441),
 ('in', 399),
 ('HAMLET', 386)]
```

Exercise - Set environment variables

Environment variables enable you to dynamically configure the application or script the container runs. You can use the Azure CLI, PowerShell, or the Azure portal to set variables when you create the container. Secured environment variables enable you to prevent sensitive information from displaying in the container's output.

Here, you'll create an Azure Cosmos DB instance and use environment variables to pass the connection information to an Azure container instance. An application in the container uses the variables to write and read data from Azure Cosmos DB. You will create both an environment variable and a secured environment variable so you can see the difference between them.

Deploy Azure Cosmos DB

1. When you deploy Azure Cosmos DB, you provide a unique database name. For learning purposes, run this command from Cloud Shell to create a Bash variable that holds a unique name.

   ```
   COSMOS_DB_NAME=aci-cosmos-db-$RANDOM
   ```

2. Run this `az cosmosdb create` command to create your Azure Cosmos DB instance.

   ```
   COSMOS_DB_ENDPOINT=$(az cosmosdb create \
     --resource-group learn-deploy-aci-rg \
     --name $COSMOS_DB_NAME \
     --query documentEndpoint \
     --output tsv)
   ```

   This command can take a few minutes to complete.

`$COSMOS_DB_NAME` specifies your unique database name. The command prints the endpoint address for your database. Here, the command saves this address to the Bash variable `COSMOS_DB_ENDPOINT`.

3. Run `az cosmosdb keys list` to get the Azure Cosmos DB connection key and store it in a Bash variable named `COSMOS_DB_MASTERKEY`.

```
COSMOS_DB_MASTERKEY=$(az cosmosdb keys list \
  --resource-group learn-deploy-aci-rg \
  --name $COSMOS_DB_NAME \
  --query primaryMasterKey \
  --output tsv)
```

Deploy a container that works with your database

Here you'll create an Azure container instance that can read from and write records to your Azure Cosmos DB instance.

The two environment variables you created in the last part, `COSMOS_DB_ENDPOINT` and `COSMOS_DB_MASTERKEY`, hold the values you need to connect to the Azure Cosmos DB instance.

1. Run the following `az container create` command to create the container.

```
az container create \
  --resource-group learn-deploy-aci-rg \
  --name aci-demo \
  --image microsoft/azure-vote-front:cosmosdb \
  --ip-address Public \
  --location eastus \
  --environment-variables \
    COSMOS_DB_ENDPOINT=$COSMOS_DB_ENDPOINT \
    COSMOS_DB_MASTERKEY=$COSMOS_DB_MASTERKEY
```

microsoft/azure-vote-front:cosmosdb refers to a Docker image that runs a fictitious voting app.

Note the `--environment-variables` argument. This argument specifies environment variables that are passed to the container when the container starts. The container image is configured to look for these environment variables. Here, you pass the name of the Azure Cosmos DB endpoint and its connection key.

2. Run `az container show` to get your container's public IP address.

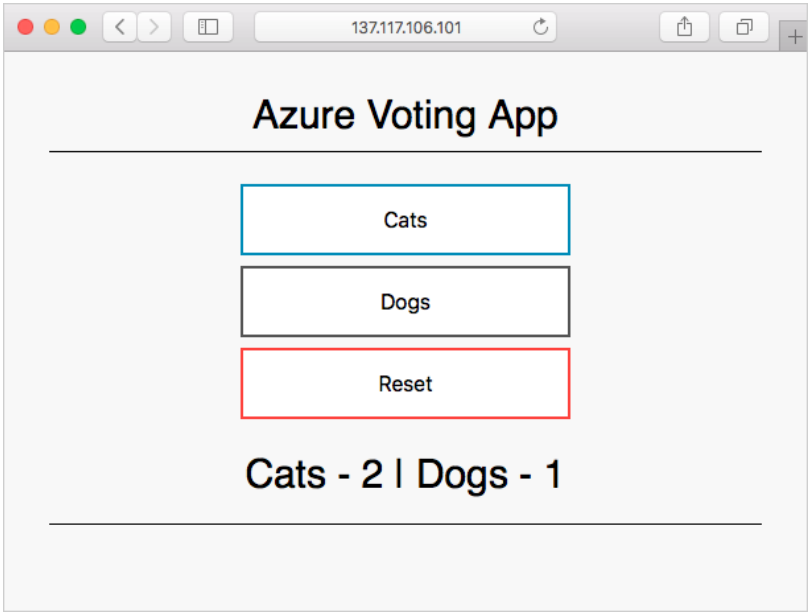
```
az container show \
  --resource-group learn-deploy-aci-rg \
  --name aci-demo \
  --query ipAddress.ip \
  --output tsv
```

3. From a browser, navigate to your container's IP address.

   Important

   Sometimes containers take a minute or two to fully start up and be able to receive connections. If there's no response when you navigate to the IP address in your browser, wait a few moments and refresh the page.

   Once the app is available, you see this.



Try casting a vote for cats or dogs. Each vote is stored in your Azure Cosmos DB instance.

Use secured environment variables to hide connection information

In the previous part, you used two environment variables to create your container. By default, these environment variables are accessible through the Azure portal and command-line tools in plain text.

In this part, you'll learn how to prevent sensitive information, such as connection keys, from being displayed in plain text.

1. Let's start by seeing the current behavior in action. Run the following `az container show` command to display your container's environment variables.

   ```
   az container show \
     --resource-group learn-deploy-aci-rg \
     --name aci-demo \
     --query containers[0].environmentVariables
   ```

   You see that both values appear in plain text. Here's an example.

   ```
   [
     {
       "name": "COSMOS_DB_ENDPOINT",
       "secureValue": null,
       "value": "https://aci-cosmos.documents.azure.com:443/"
     },
     {
       "name": "COSMOS_DB_MASTERKEY",
       "secureValue": null,
       "value":
   "Xm5BwdLlCllBvrR26V00000000S2uOusuglhzwkE7dOPMBQ3oA30n3rKd8PKA137000000
   00095ynys863Ghgw=="
     }
   ]
   ```

Although these values don't appear to your users through the voting application, it's a good security practice to ensure that sensitive information, such as connection keys, are not stored in plain text.

Secure environment variables prevent clear text output. To use secure environment variables, you use the `--secure-environment-variables` argument instead of the `--environment-variables` argument.

2. Run the following command to create a second container, named **aci-demo-secure**, that makes use of secured environment variables.

```
az container create \
  --resource-group learn-deploy-aci-rg \
  --name aci-demo-secure \
  --image microsoft/azure-vote-front:cosmosdb \
  --ip-address Public \
  --location eastus \
  --secure-environment-variables \
    COSMOS_DB_ENDPOINT=$COSMOS_DB_ENDPOINT \
    COSMOS_DB_MASTERKEY=$COSMOS_DB_MASTERKEY
```

Note the use of the `--secure-environment-variables` argument.

3. Run the following `az container show` command to display your container's environment variables.

```
az container show \
  --resource-group learn-deploy-aci-rg \
  --name aci-demo-secure \
  --query containers[0].environmentVariables
```

This time, you see that your environment variables do not appear in plain text.

```
[
  {
    "name": "COSMOS_DB_ENDPOINT",
    "secureValue": null,
    "value": null
  },
  {
```

```
    "name": "COSMOS_DB_MASTERKEY",
    "secureValue": null,
    "value": null
  }
]
```

In fact, the values of your environment variables do not appear at all. That's OK because these values refer to sensitive information. Here, all you need to know is that the environment variables exist.

Exercise - Use data volumes

By default, Azure Container Instances are stateless. If the container crashes or stops, all of its state is lost. To persist state beyond the lifetime of the container, you must mount a volume from an external store.

Here, you'll mount an Azure file share to an Azure container instance to you can store data and access it later.

Create an Azure file share

Here you'll create a storage account and a file share that you'll later make accessible to an Azure container instance.

1. Your storage account requires a unique name. For learning purposes, run the following command to store a unique name in a Bash variable.

```
STORAGE_ACCOUNT_NAME=mystorageaccount$RANDOM
```

2. Run the following `az storage account create` command to create your storage account.

```
az storage account create \
  --resource-group learn-deploy-aci-rg \
  --name $STORAGE_ACCOUNT_NAME \
  --sku Standard_LRS \
  --location eastus
```

3. Run the following command to place the storage account connection string into an environment variable named `AZURE_STORAGE_CONNECTION_STRING`.

```
export AZURE_STORAGE_CONNECTION_STRING=$(az storage account show-
connection-string \
  --resource-group learn-deploy-aci-rg \
  --name $STORAGE_ACCOUNT_NAME \
  --output tsv)
```

`AZURE_STORAGE_CONNECTION_STRING` is a special environment variable that's understood by the Azure CLI. The `export` part makes this variable accessible to other CLI commands you'll run shortly.

4. Run this command to create a file share, named **aci-share-demo**, in the storage account.

```
az storage share create --name aci-share-demo
```

Get storage credentials

To mount an Azure file share as a volume in Azure Container Instances, you need these three values:

- The storage account name
- The share name
- The storage account access key

You already have the first two values. The storage account name is stored in the `STORAGE_ACCOUNT_NAME` Bash variable. You specified **aci-share-demo** as the share name in the previous step. Here you'll get the remaining value — the storage account access key.

1. Run the following command to get the storage account key.

   ```
   STORAGE_KEY=$(az storage account keys list \
     --resource-group learn-deploy-aci-rg \
     --account-name $STORAGE_ACCOUNT_NAME \
     --query "[0].value" \
     --output tsv)
   ```

   The result is stored in a Bash variable named `STORAGE_KEY`.

2. As an optional step, print the storage key to the console.

   ```
   echo $STORAGE_KEY
   ```

Deploy a container and mount the file share

To mount an Azure file share as a volume in a container, you specify the share and volume mount point when you create the container.

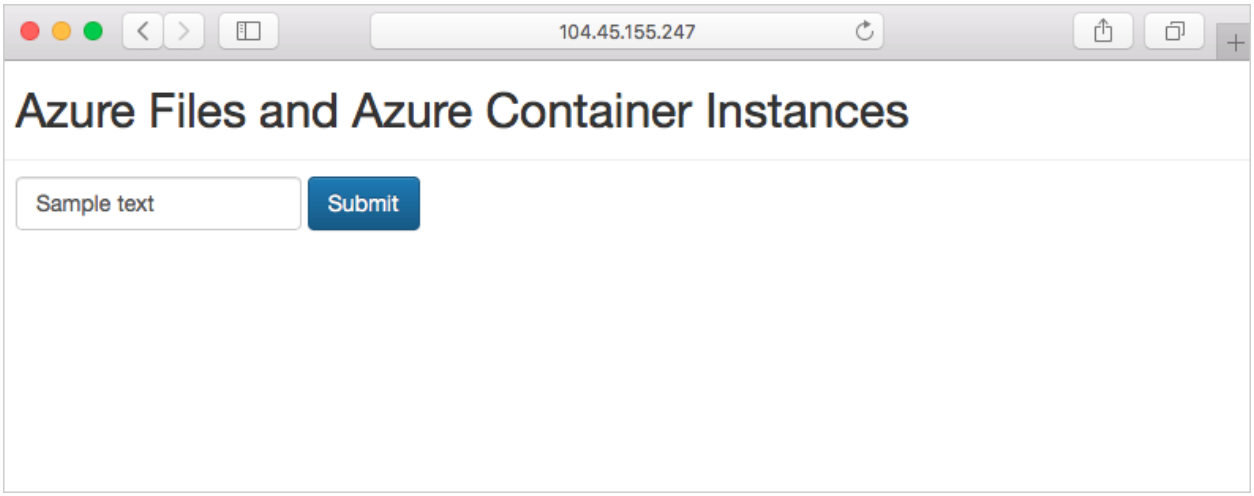
1. Run this `az container create` command to create a container that mounts `/aci/logs/` to your file share.

   ```
   az container create \
     --resource-group learn-deploy-aci-rg \
     --name aci-demo-files \
     --image microsoft/aci-hellofiles \
     --location eastus \
     --ports 80 \
     --ip-address Public \
     --azure-file-volume-account-name $STORAGE_ACCOUNT_NAME \
     --azure-file-volume-account-key $STORAGE_KEY \
     --azure-file-volume-share-name aci-share-demo \
     --azure-file-volume-mount-path /aci/logs/
   ```

2. Run `az container show` to get your container's public IP address.

```
az container show \
  --resource-group learn-deploy-aci-rg \
  --name aci-demo-files \
  --query ipAddress.ip \
  --output tsv
```

3. From a browser, navigate to your container's IP address. You see this.



4. Enter some text into the form and click **Submit**. This action creates a file that contains the text you entered in the Azure file share.
5. Run this `az storage file list` command to display the files that are contained in your file share.

```
az storage file list -s aci-share-demo -o table
```

6. Run `az storage file download` to download a file to your Cloud Shell session. Replace **<filename>** with one of the files that appeared in the previous step.

```
az storage file download -s aci-share-demo -p <filename>
```

7. Run the `cat` command to print the contents of the file.

```
cat <filename>
```

Remember that your data persists when your container exits. You can mount your file share to other container instances to make that data available to them.