Custom docker images for AML Pipelines

This is a basic guide with steps on how to create your custom docker image with your preferred libraries and use it for running your AML pipeline workloads.

Prerequisites

- Docker Cli
- Azure Cli

Create a docker file

- You can create your own docker file using one of the base AzureML images listed in Microsoft Container Registry(MCR) as reference, depending on your ML workload (CPU/GPU etc.). For this guide we will be using Azureml Base.

- We would need to install all the necessary drivers in our custom image that are not shipped with the mcr base image. In this specific example we want to write stuff to Azure SQL database from a python script, possibly using the pandas library so we need two packages and their associated drivers - `pyodbc` for writing to DB and `sqlalchemy` to enable pandas database operations and simpler DB syntax instead of cursors. You dockerfile should should therefore look like this:

```
# pull base image from Microsoft Container Registry
FROM mcr.microsoft.com/azureml/base:latest

# apt-get and system utilities
RUN apt-get update && apt-get install -y \
    curl apt-transport-https debconf-utils \
    && rm -rf /var/lib/apt/lists/*

# adding custom MS repository
RUN curl https://packages.microsoft.com/keys/microsoft.asc | apt-key add -
RUN curl https://packages.microsoft.com/config/ubuntu/16.04/prod.list >
/etc/apt/sources.list.d/mssql-release.list

# install SQL Server drivers and tools
RUN apt-get update && ACCEPT_EULA=Y apt-get install -y msodbcsql17 mssql-
tools
RUN echo 'export PATH="$PATH:/opt/mssql-tools/bin"' >> ~/.bashrc
RUN /bin/bash -c "source ~/.bashrc"

RUN apt-get -y install locales
RUN locale-gen en_US.UTF-8
RUN update-locale LANG=en_US.UTF-8

RUN apt-get install -y --reinstall build-essential

RUN apt-get install -y unixodbc-dev
```

```
# python stuff not shipped with base mcr image
RUN pip install pyodbc
RUN pip install sqlalchemy

CMD /bin/bash
```

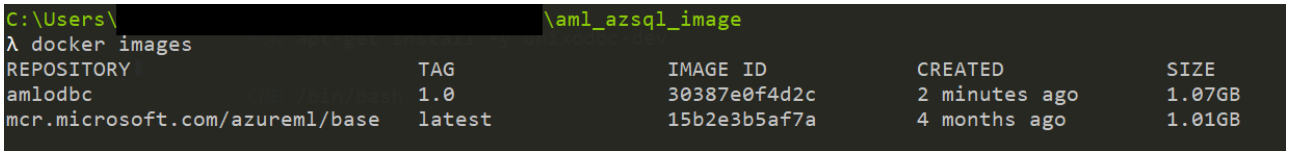
- Place the dockerfile into its own folder. We will use this folder as the context path for the next section.
- Start your command shell in the folder with our dockerfile

Build container image

- We will use docker build to create a new image named `amlodbc` with tag `1.0` using the supplied dockerfile as input and using current directory as build context. Note the `'.'` at the end of the command, specifying current directory as the docker context path.

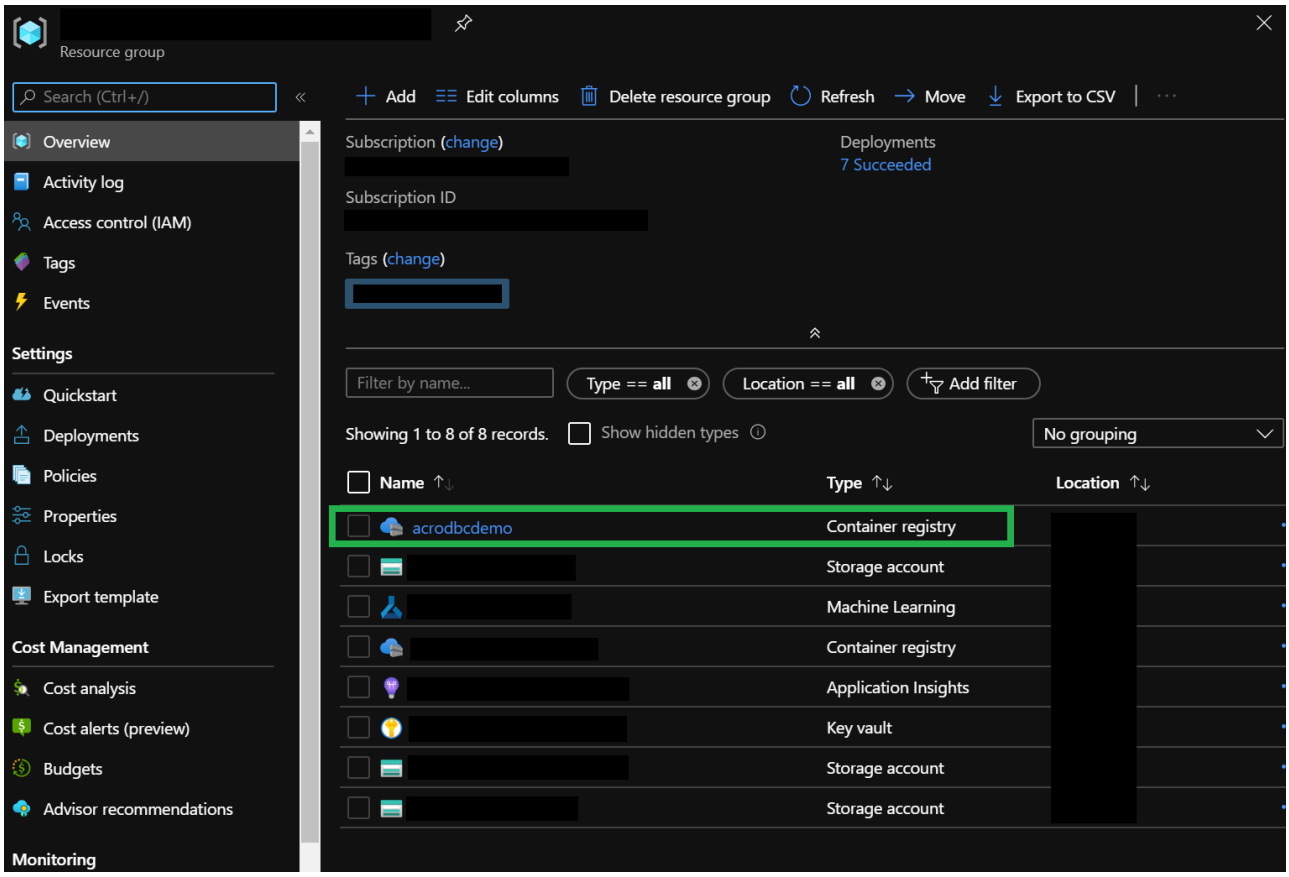
```
docker build -f dockerfile -t amlodbc:1.0 .
```

- To see a list of containers, use command `docker images`. You will notice the base mcr image that we pulled as well as our new `amlodbc` image:

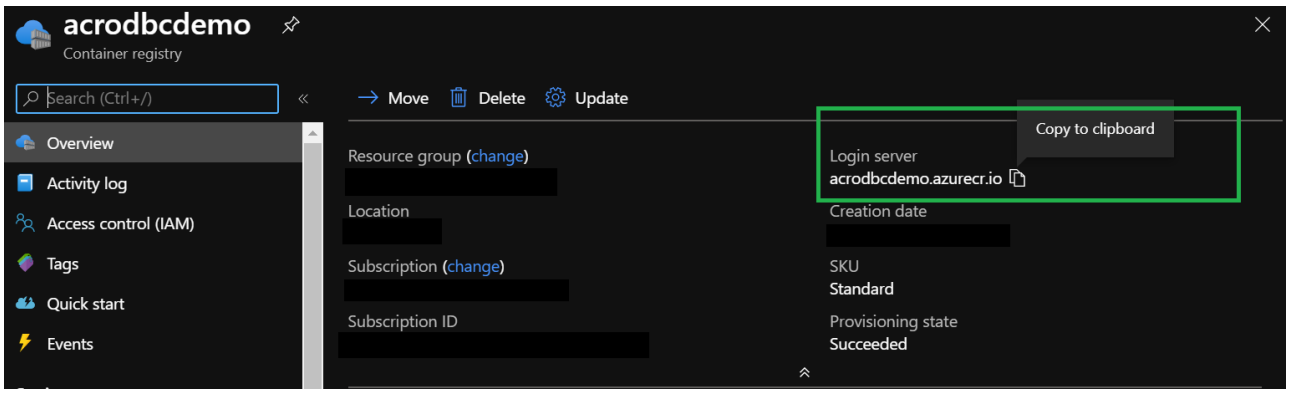


Push image to Azure Container Registry

- Go to azure portal and navigate to the resource group that has your workspace. Along with your AML workspace and default storage accounts, you'll see an item of type "Container Registry". If there are more than one registry resources you can select any one to register your image to. Lets select `acrodbcdemo` here:



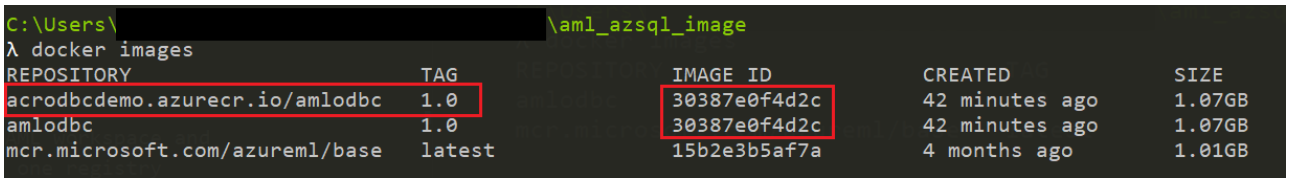
- Note the login server name from the registry details. It is usually of the form `[registry_name].azurecr.io`. In our case it will be `acrodbcdemo.azurecr.io` as can be seen in the below screenshot:



- Now we use docker tag to add ACR tag to our image:

```
docker tag amlodbc:1.0 acrodbcdemo.azurecr.io/amlodbc:1.0
```

- If you run `docker images` again you will see a new entry. Note how it has the same image id as `amlodbc`:



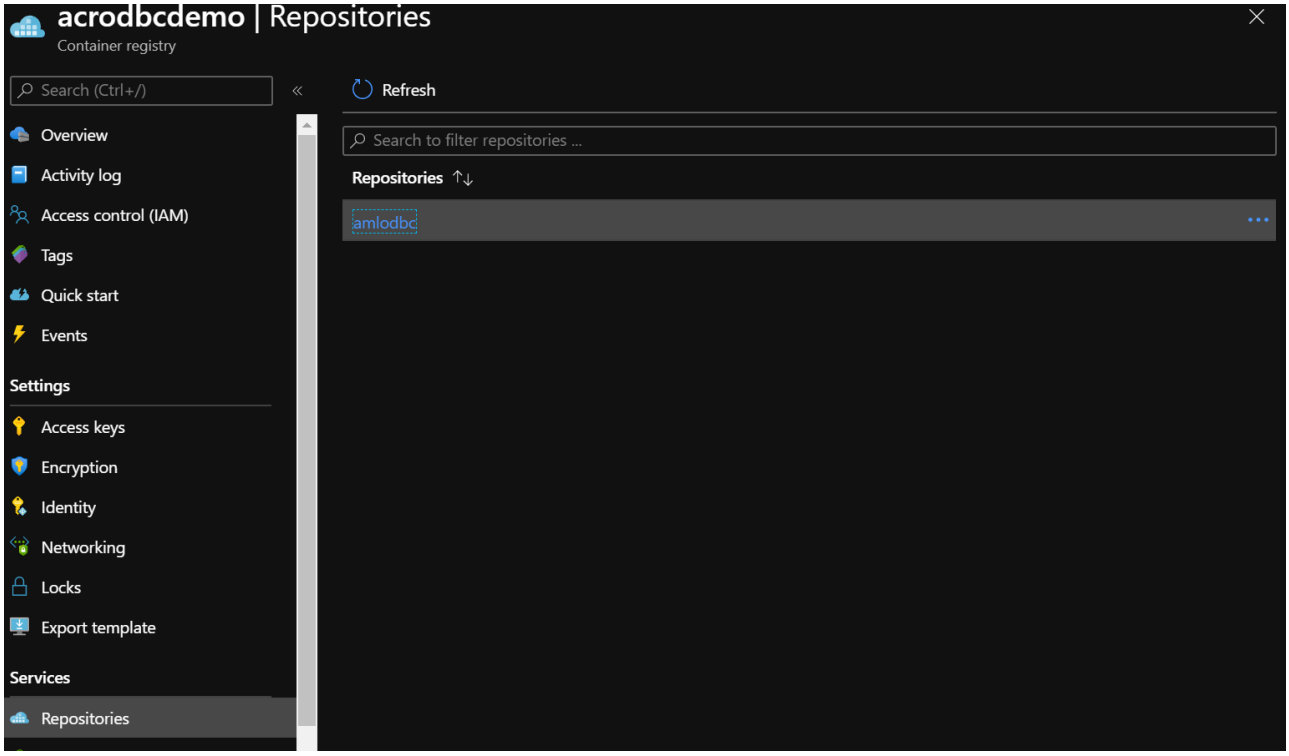
- Next, we log into our container registry using az acr login

```
az acr login --name acrodbcdemo
```

- Now we push to ACR using docker push

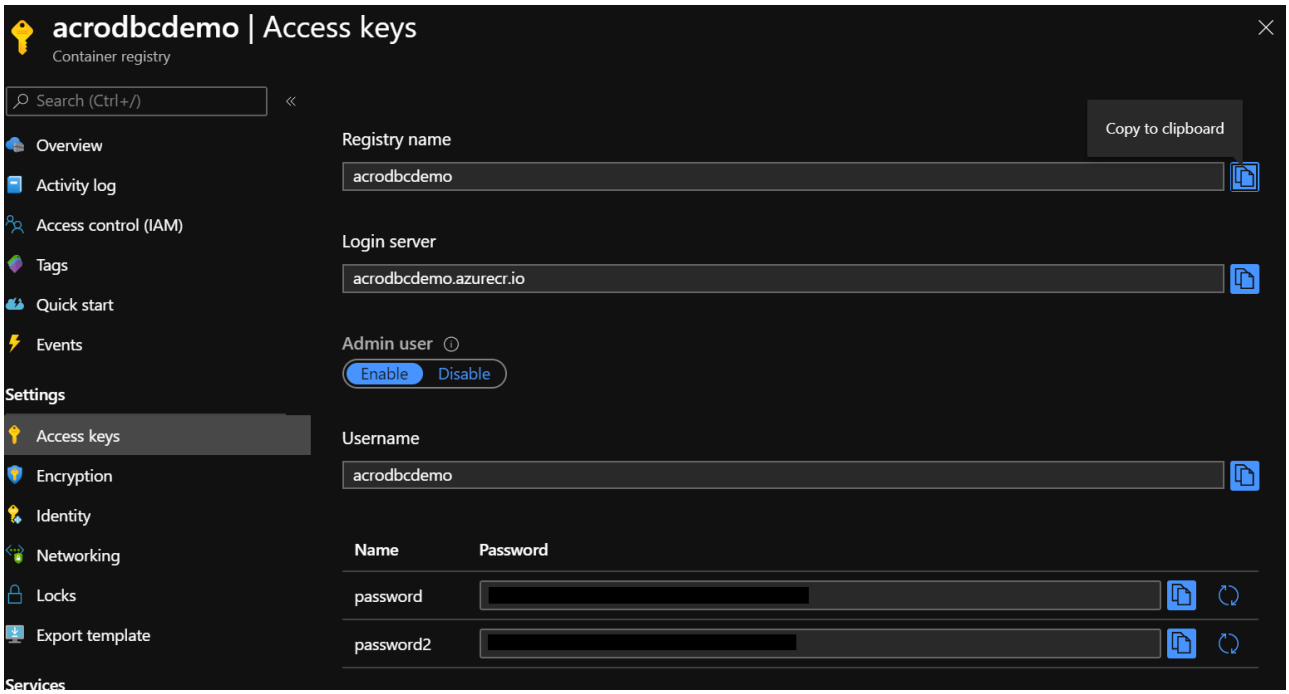
```
docker push acrodbcdemo.azurecr.io/amlodbc:1.0
```

- If everything went well, you should now see amlodbc appear as a new repository in azure portal:



Use the custom docker image in your AML pipeline

- Make sure your private ACR has 'Admin user' enabled under its Access keys section for this method to work



- Your custom docker image can be specified as a `ContainerRegistry` and passed to your pipeline step.

```
# Use a RunConfiguration to specify some additional requirements for this
step.
from azureml.core.runconfig import RunConfiguration
# from azureml.core.conda_dependencies import CondaDependencies
from azureml.core.container_registry import ContainerRegistry

# create a new runconfig object
run_config = RunConfiguration()

# enable Docker
run_config.environment.docker.enabled = True

# you can also point to an image in a private ACR
image_registry_details = ContainerRegistry()
image_registry_details.address = "acrodbcdemo.azurecr.io"
image_registry_details.username = "acrodbcdemo" # username is same as
registry name
image_registry_details.password = "<password>" # use any one of the two
passwords shown in portal
run_config.environment.docker.base_image_registry = image_registry_details

# this is an image in the image_registry
image_name = 'amlodbc:2.0'
run_config.environment.docker.base_image = image_name

# don't let the system build a new conda environment
run_config.environment.python.user_managed_dependencies = True

# specify CondaDependencies obj
# run_config.environment.python.conda_dependencies =
CondaDependencies.create(conda_packages=['pyodbc','sqlalchemy'])
```

```
# For this step, we use yet another source_directory that contains only the
things that need to be sent to our compute
source_directory = './steps'
print('Source directory for the step is
{}.'.format(os.path.realpath(source_directory)))

sql_demo_step = PythonScriptStep(name="sql_step",
                         script_name="pyodbc_pipeline_step.py",
                         compute_target=aml_compute,
                         source_directory=source_directory,
                         runconfig=run_config)

print("sql_demo_step created")
```

Further Reading

- Dockerfile reference
- Microsoft ODBC driver installation guide for Linux
- Microsoft Container Registry github
- AML containers repository
- Estimator demo with custom docker images
- Distributed CNTK using custom docker images