# Microsoft Cloud Workshop

Containers and DevOps
Hands-on lab step-by-step
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# Containers and DevOps hands-on lab step-by-step

## Abstract and learning objectives

This hands-on lab is designed to guide you through the process of building and deploying Docker images to the Kubernetes platform hosted on Azure Kubernetes Services (AKS), in addition to learning how to work with dynamic service discovery, service scale-out, and high-availability.

At the end of this lab you will be better able to build and deploy containerized applications to Azure Kubernetes Service and perform common DevOps procedures.

## Overview

Fabrikam Medical Conferences (FabMedical) provides conference website services tailored to the medical community. They are refactoring their application code, based on node.js, so that it can run as a Docker application, and want to implement a POC that will help them get familiar with the development process, lifecycle of deployment, and critical aspects of the hosting environment. They will be deploying their applications to Azure Kubernetes Service and want to learn how to deploy containers in a dynamically load-balanced manner, discover containers, and scale them on demand.

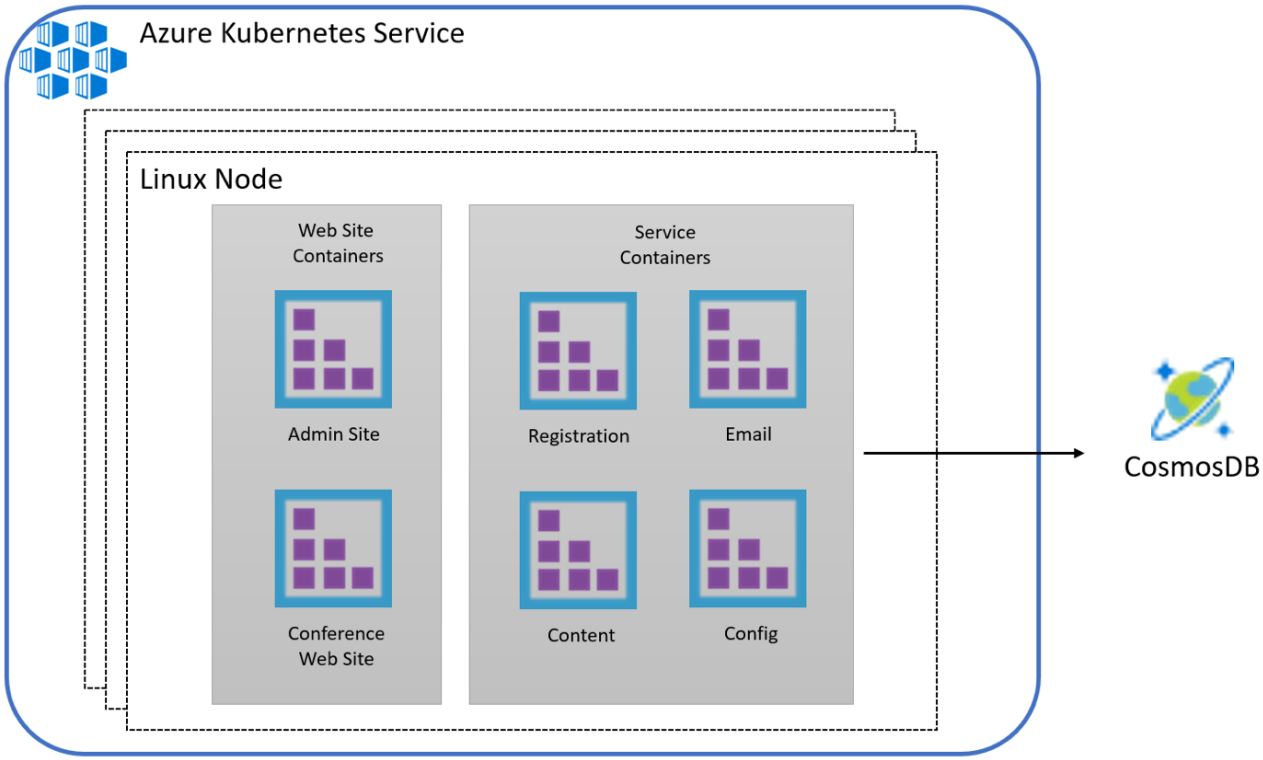
In this hands-on lab, you will assist with completing this POC with a subset of the application code base. You will create a build agent based on Linux, and an Azure Kubernetes Service cluster for running deployed applications. You will be helping them to complete the Docker setup for their application, test locally, push to an image repository, deploy to the cluster, and test load-balancing and scale.

**IMPORTANT: Most Azure resources require unique names. Throughout these steps you will see the word "SUFFIX" as part of resource names. You should replace this with your Microsoft email prefix to ensure the resource is uniquely named.**

## Solution architecture

Below is a diagram of the solution architecture you will build in this lab. Please study this carefully, so you understand the whole of the solution as you are working on the various components.

The solution will use Azure Kubernetes Service (AKS), which means that the container cluster topology is provisioned according to the number of requested nodes. The proposed containers deployed to the cluster are illustrated below with CosmosDb as a managed service:




Each tenant will have the following containers:

- **Conference Web site**: the SPA application that will use configuration settings to handle custom styles for the tenant
- **Admin Web site**: the SPA application that conference owners use to manage conference configuration details, manage attendee registrations, manage campaigns and communicate with attendees
- **Registration service**: the API that handles all registration activities creating new conference registrations with the appropriate package selections and associated cost

- **Email service**: the API that handles email notifications to conference attendees during registration, or when the conference owners choose to engage the attendees through their admin site
- **Config service**: the API that handles conference configuration settings such as dates, locations, pricing tables, early bird specials, countdowns, and related
- **Content service**: the API that handles content for the conference such as speakers, sessions, workshops, and sponsors

## Requirements

1. Microsoft Azure subscription must be pay-as-you-go or MSDN
    - Trial subscriptions will *not* work
    - You must have rights to create a service principal as discussed in Task 9: Create a Service Principal --- and this typically requires a subscription owner to log in. You may have to ask another subscription owner to login to the portal and execute that step ahead of time if you do not have the rights.
    - You must have enough cores available in your subscription to create the build agent and Azure Kubernetes Service cluster in Task 5: Create a build agent VM and Task 10: Create an Azure Kubernetes Service cluster. You'll need eight cores if following the exact instructions in the lab, or more if you choose additional agents or larger VM sizes. If you execute the steps required before the lab, you will be able to see if you need to request more cores in your sub.
2. Local machine or a virtual machine configured with:
    - A browser, preferably Chrome for consistency with the lab implementation tests
    - Command prompt
        - On Windows, you will be using Bash on Ubuntu on Windows, hereon referred to as WSL
        - On Mac, all instructions should be executed using bash in Terminal
3. You will be asked to install other tools throughout the exercises.

**VERY IMPORTANT: You should be typing all of the commands as they appear in the guide, except where explicitly stated in this document. Do not try to copy and paste from Word to your command windows or other documents where you are instructed to enter information shown in this document. There can be issues with Copy and Paste from Word that result in errors, execution of instructions, or creation of file content.**

## Exercise 1: Create and run a Docker application

**Duration**: 40 minutes

In this exercise, you will take the starter files and run the node.js application as a Docker application. You will create a Dockerfile, build Docker images, and run containers to execute the application.

**NOTE: Complete these tasks from the WSL window with the build agent session.**

## Task 1: Test the application

The purpose of this task is to make sure you can run the application successfully before applying changes to run it as a Docker application.

1. From the WSL window, connect to your build agent if you are not already connected
2. Type the following command to create a Docker network named "fabmedical"

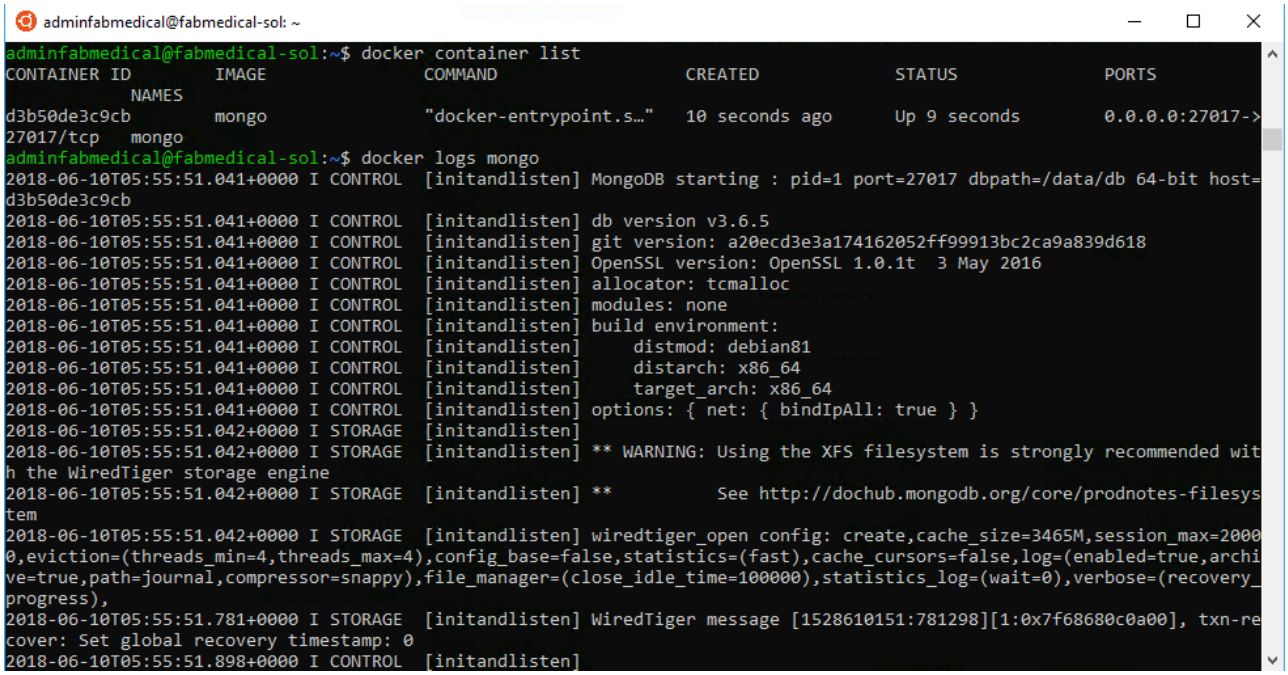
```
docker network create fabmedical
```

3. Run an instance of mongodb to use for local testing

```
docker run --name mongo --net fabmedical -p 27017:27017 -d mongo
```

4. Confirm that the mongo container is running and ready

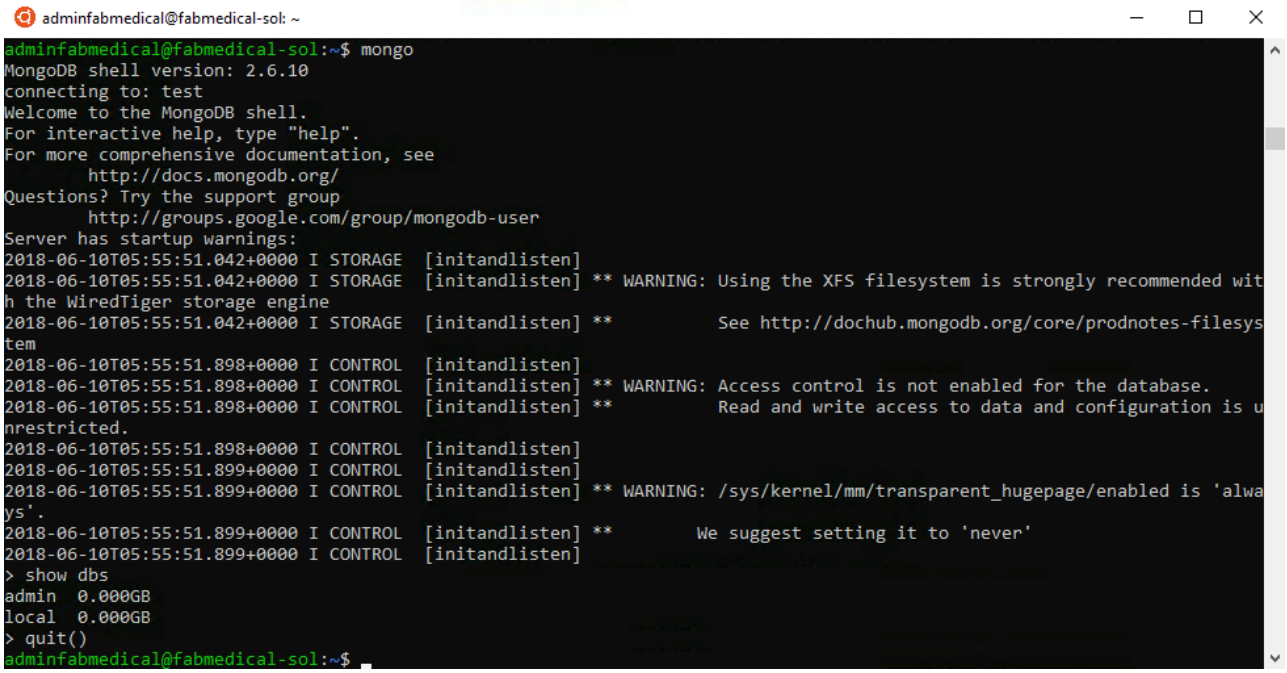
```
docker container list
docker logs mongo
```




5. Connect to the mongo instance using the mongo shell and test some basic commands

```
mongo
```

```
show dbs
quit()
```

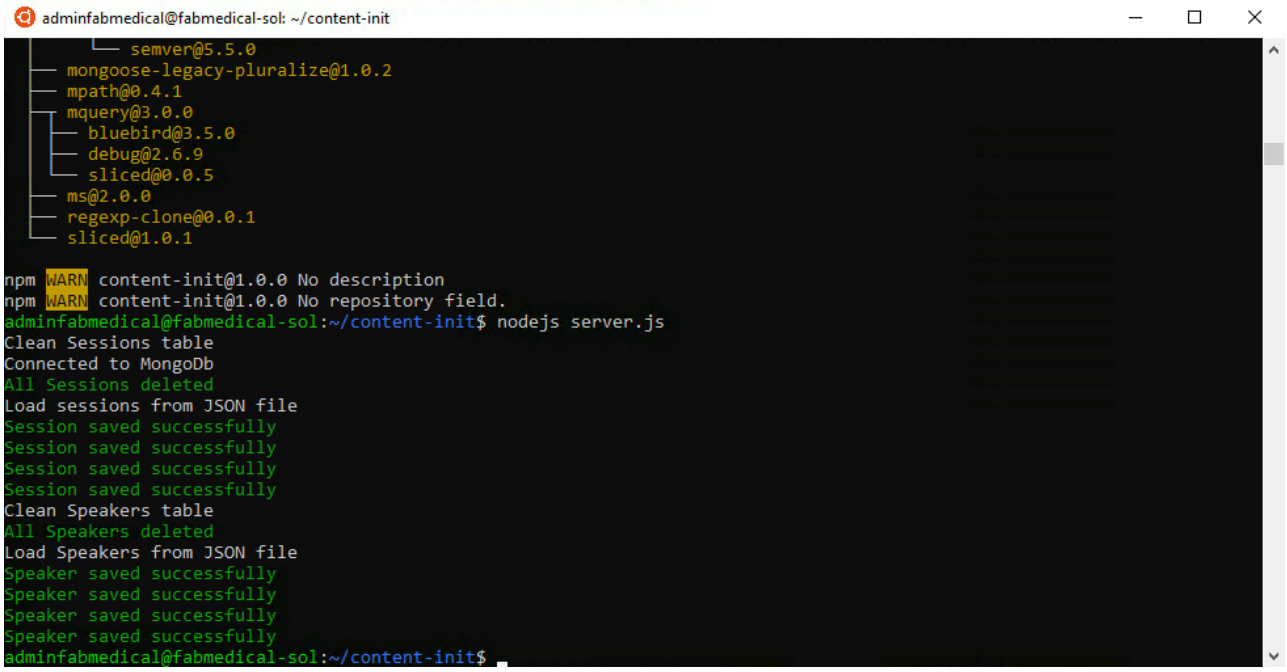



6. To initialize the local database with test content, first navigate to the content-init directory and run npm install

```
cd content-init
npm install
```

7. Initialize the database

```
nodejs server.js
```

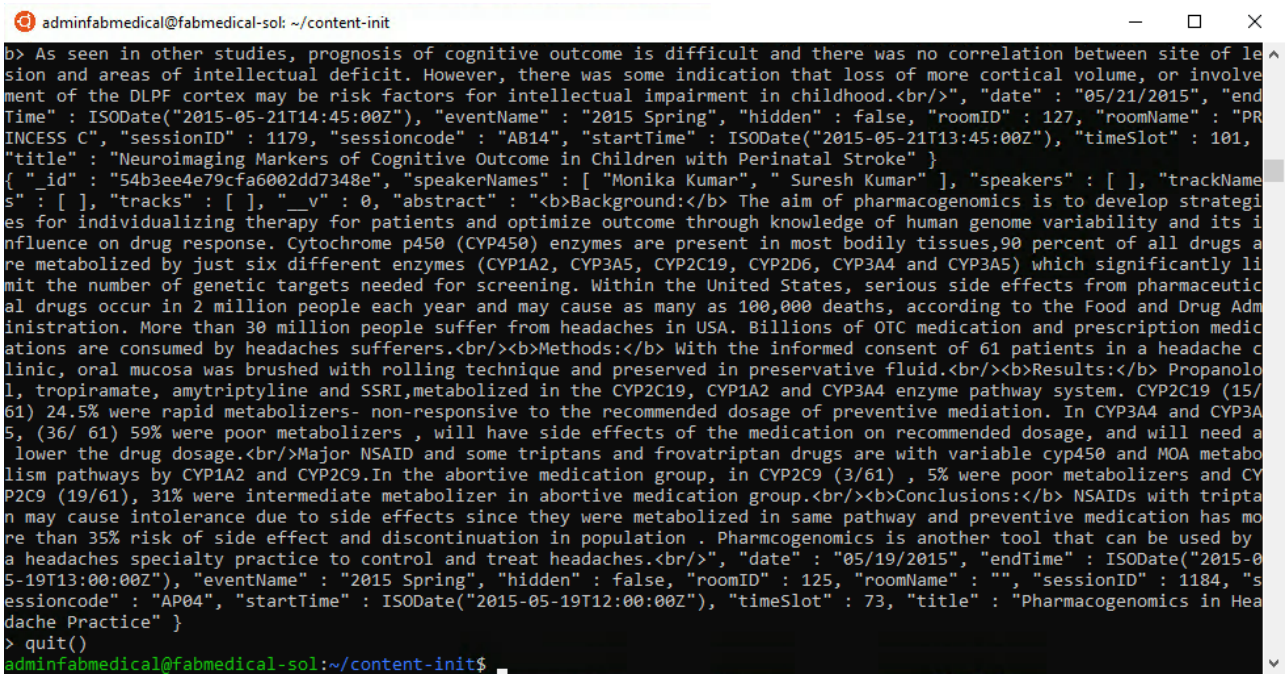



8. Confirm that the database now contains test data

```
mongo
```

```
show dbs
use contentdb
show collections
db.speakers.find()
db.sessions.find()
quit()
```

This should produce output similar to the following:



9. Now navigate to the content-api directory and run npm install

```
cd ../content-api
npm install
```

10. Start the API as a background process

```
nodejs ./server.js &
```

```
adminfabmedical@fabmedical-[redacted]:~/FabMedical/content-api$ nodejs ./server.js &
[1] 73302
adminfabmedical@fabmedical-[redacted]:~/FabMedical/content-api$ Listening on port 3001
```

11. Press ENTER again to get to a command prompt for the next step

12. Test the API using curl. You will request the speakers content, and this will return a JSON result.

```
curl http://localhost:3001/speakers
```

13. Navigate to the web application directory, run npm install and bower install, and then run the application as a background process as well. Ignore any warnings you see in the output; this will not affect running the application.

```
cd ../content-web
npm install
bower install
nodejs ./server.js &
```

```
adminfabmedical@fabmedical-[redacted]:~/FabMedical/content-web$ nodejs ./server.js &
[2] 73785
adminfabmedical@fabmedical-[redacted]:~/FabMedical/content-web$ === Using development environment ===
Express server listening on port 3000
```

14. Press ENTER again to get a command prompt for the next step

15. Test the web application using curl. You will see HTML output returned without errors.

```
curl http://localhost:3000
```

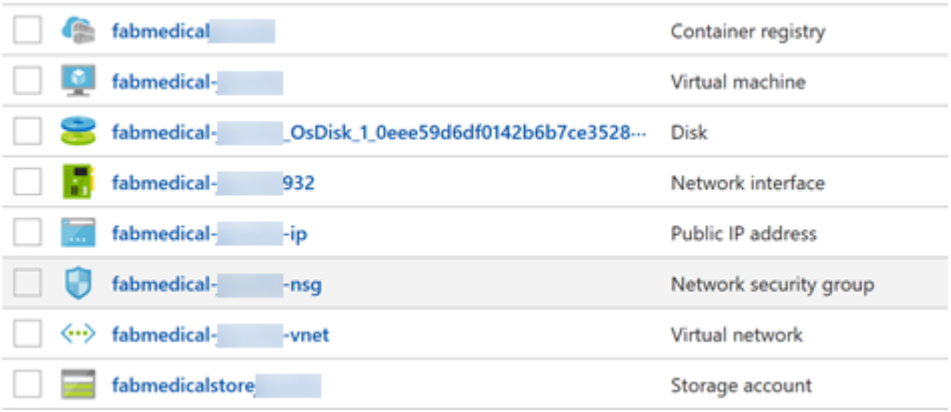
16. Leave the application running for the next task

17. If you received a JSON response to the /speakers content request and an HTML response from the web application, your environment is working as expected

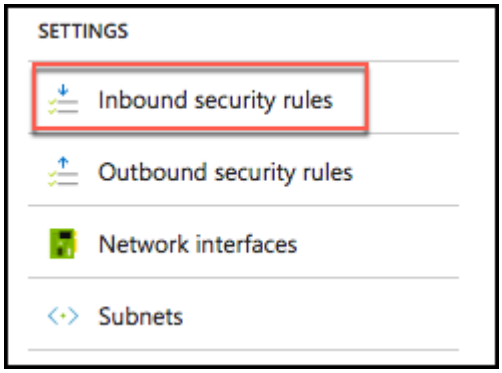
## Task 2: Enable browsing to the web application

In this task, you will open a port range on the agent VM so that you can browse to the web application for testing.

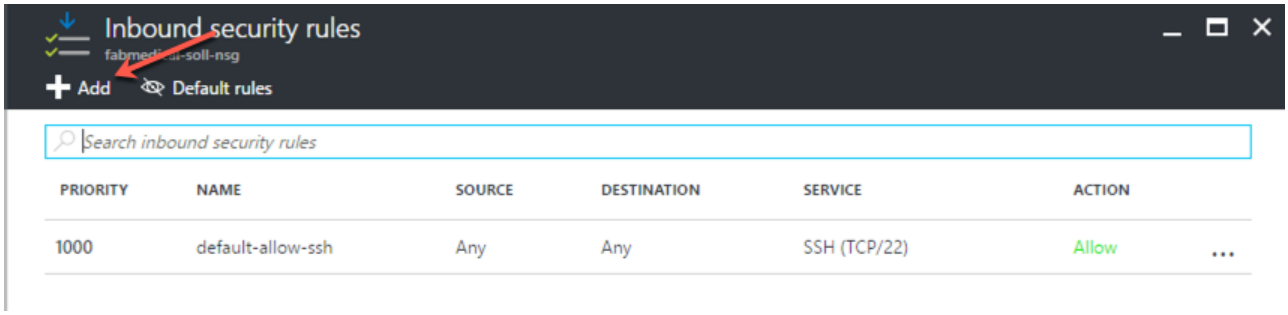
1. From the Azure portal select the resource group you created named fabmedical-SUFFIX
2. Select the Network Security Group associated with the build agent from your list of available resources




3. From the Network interface essentials blade, select **Inbound security rules**

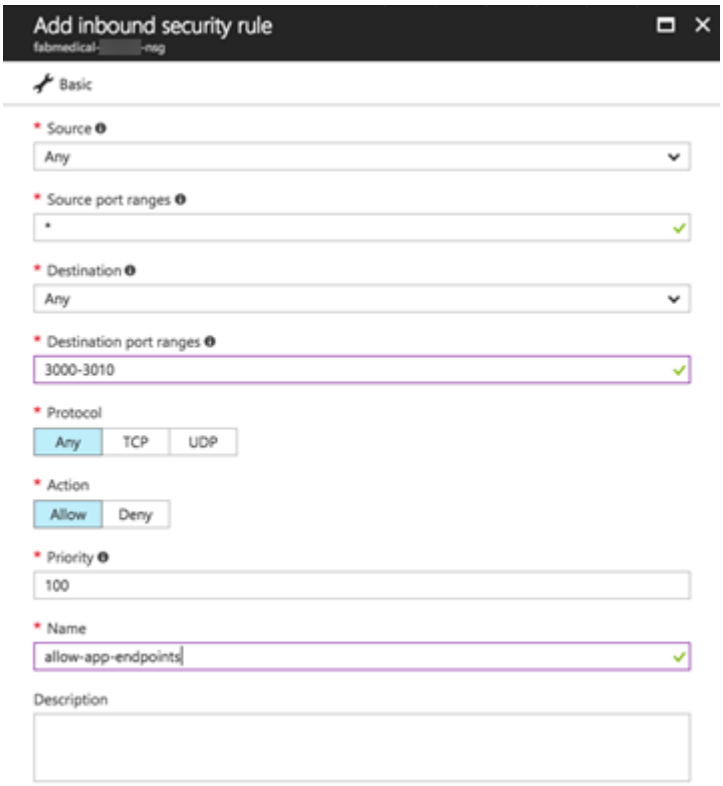



4. Select **Add** to add a new rule

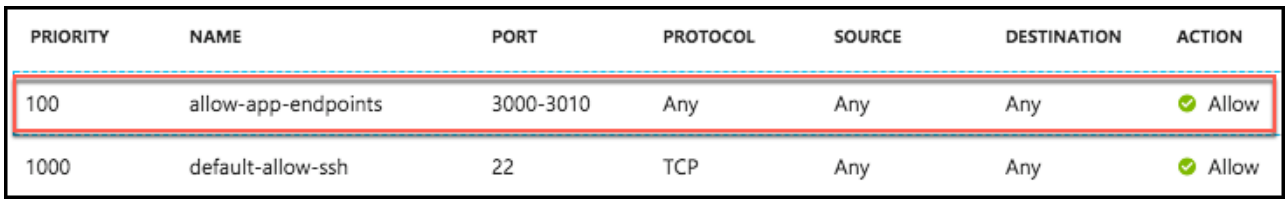



5. From the Add inbound security rule blade, enter the values as shown in the screenshot below:
   - **Source**: Any
   - **Source port ranges**:
   - **Destination**: Any
   - **Destination Port Ranges**: 3000-3010

- **Protocol**: Any
- **Action**: Allow
- **Priority**: Leave at the default priority setting
- **Name**: Enter "allow-app-endpoints"

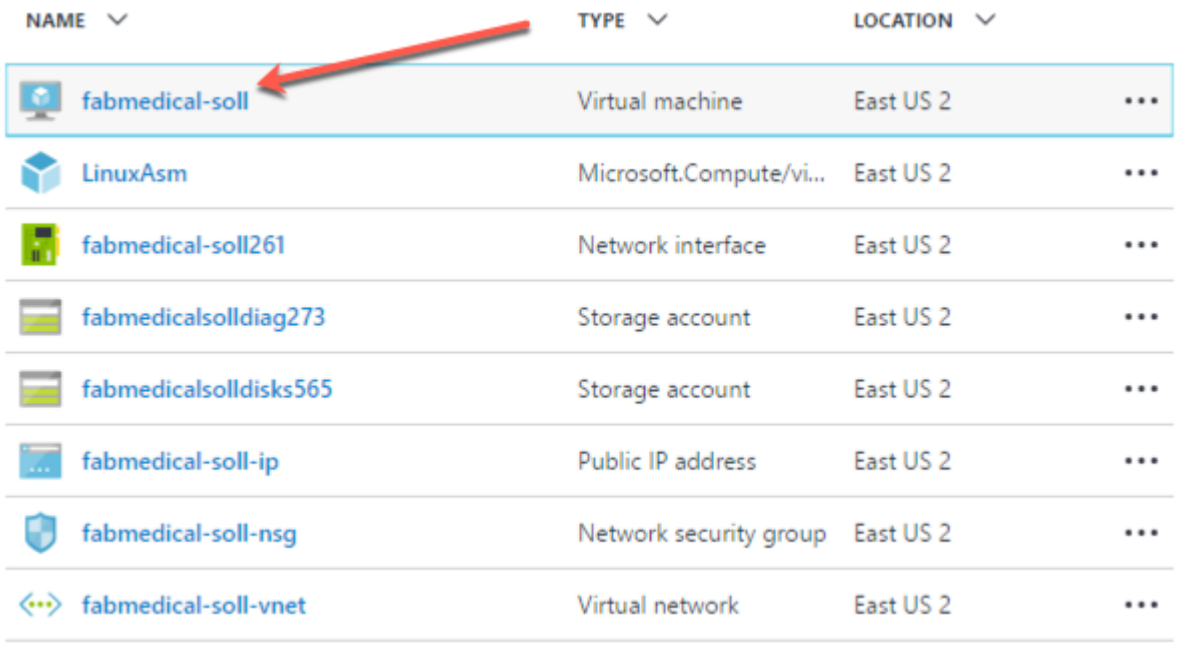



6. Select **OK** to save the new rule

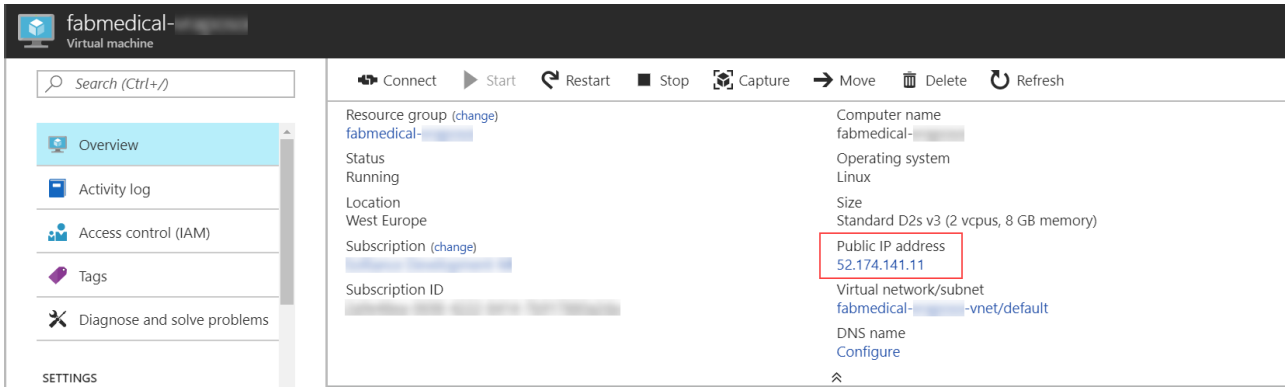


| PRIORITY | NAME | PORT | PROTOCOL | SOURCE | DESTINATION | ACTION |
|---|---|---|---|---|---|---|
| 100 | allow-app-endpoints | 3000-3010 | Any | Any | Any | Allow |
| 1000 | default-allow-ssh | 22 | TCP | Any | Any | Allow |

7. From the resource list shown in step 2, select the build agent VM named fabmedical-SUFFIX




8. From the Virtual Machine blade overview, find the IP address of the VM




9. Test the web application from a browser. Navigate to the web application using your build agent IP address at port 3000.

```
http://[BUILDAGENTIP]:3000

EXAMPLE: http://13.68.113.176:3000
```

10. Select the Speakers and Sessions links in the header. You will see the pages display the HTML version of the JSON content you curled previously.

11. Once you have verified the application is accessible through a browser, go to your WSL window and stop the running node processes.

```
killall nodejs
```

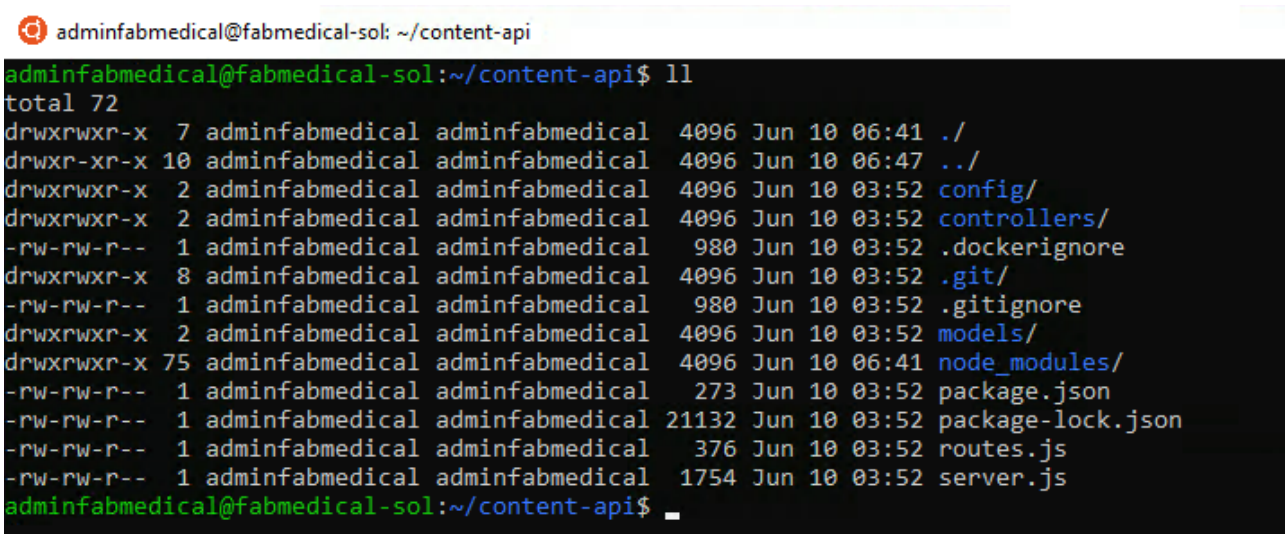
## Task 3: Create a Dockerfile

In this task, you will create a new Dockerfile that will be used to run the API application as a containerized application.

**NOTE: You will be working in a Linux VM without friendly editor tools. You must follow the steps very carefully to work with Vim for a few editing exercises if you are not already familiar with Vim.**

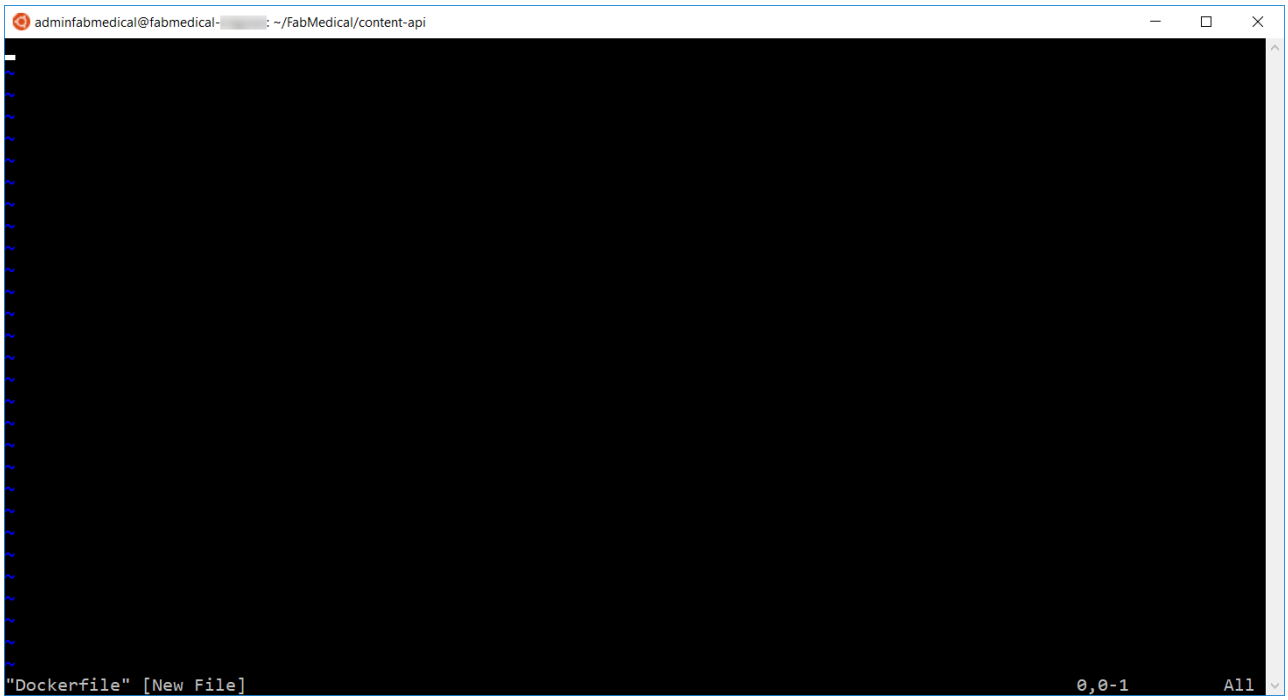
1. From WSL, navigate to the content-api folder. List the files in the folder with this command. The output should look like the screenshot below.

```
cd ../content-api
ll
```




2. Create a new file named "Dockerfile" and note the casing in the name. Use the following Vim command to create a new file. The WSL window should look as shown in the following screenshot.

```
vi Dockerfile
```




3. Select "i" on your keyboard. You'll see the bottom of the window showing INSERT mode.


4. Type the following into the file. These statements produce a Dockerfile that describes the following:

    - The base stage includes environment setup which we expect to change very rarely, if at all
        - Creates a new Docker image from the base image node:alpine. This base image has node.js on it and is optimized fro small size.
        - Add `curl` to the base image to support Docker health checks
        - Creates a directory on the image where the application files can be copied
        - Exposes application port 3001 to the container environment so that the application can be reached at port 3001
    - The build stage contains all the tools and intermediate files needed to create the application
        - Creates a new Docker image from node:argon
        - Creates a directory on the image where the application files can be copied.
        - Copies package.json to the working directory
        - Runs npm install to initialize the node application environment
        - Copies the source files for the application over to the image
    - The final stage combines the base image with the build output from the build stage

- Sets the working directory to the application file location
- Copies the app files from the build stage
- Indicates the command to start the node application when the container is run

**NOTE: Type the following into the editor, as you may have errors with copying and pasting.**

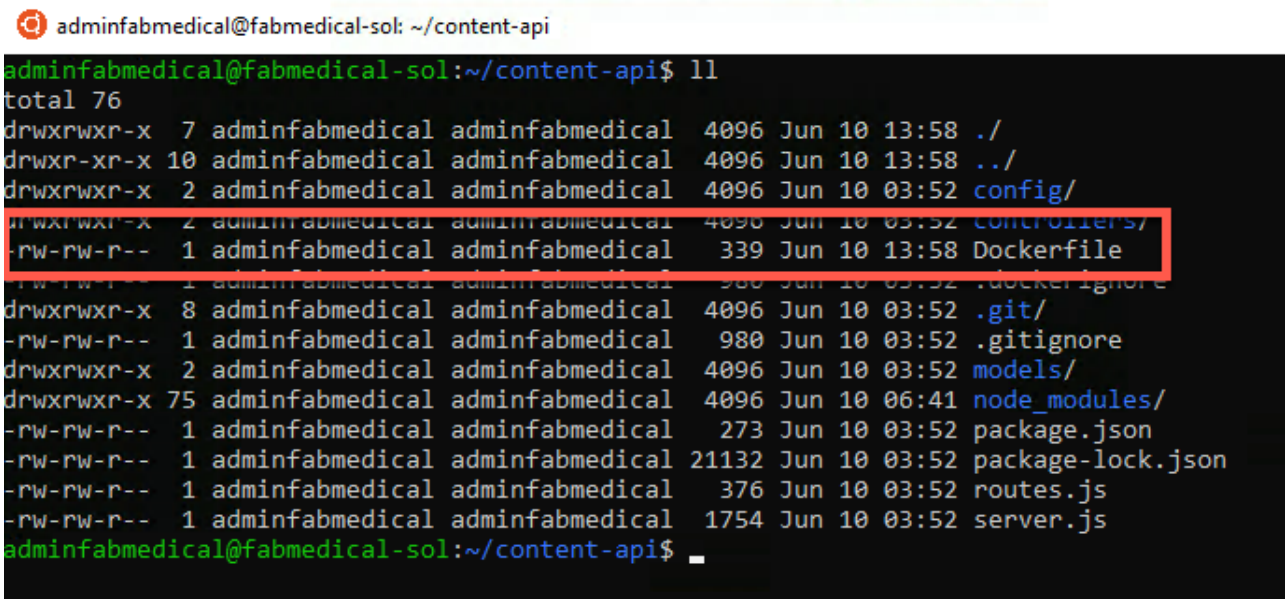
```
FROM node:alpine AS base
RUN apk -U add curl
WORKDIR /usr/src/app
EXPOSE 3001

FROM node:argon AS build
WORKDIR /usr/src/app

# Install app dependencies
COPY package.json /usr/src/app/
RUN npm install

# Bundle app source
COPY . /usr/src/app

FROM base AS final
WORKDIR /usr/src/app
COPY --from=build /usr/src/app .
CMD [ "npm", "start" ]
```

5. When you are finished typing, hit the Esc key and type ":wq" and hit the Enter key to save the changes and close the file

```
<Esc>
:wq
<Enter>
```

6. List the contents of the folder again to verify that the new Dockerfile has been created

```
ll
```




7. Verify the file contents to ensure it was saved as expected. Type the following command to see the output of the Dockerfile in the command window.

```
cat Dockerfile
```

## Task 4: Create Docker images

-In this task, you will create Docker images for the application --- one for the API application and another for the web application. Each image will be created via Docker commands that rely on a Dockerfile.

1. From WSL, type the following command to view any Docker images on the VM. The list will only contain the mongodb image downloaded earlier.

```
docker images
```

2. From the content-api folder containing the API application files and the new Dockerfile you created, type the following command to create a Docker image for the API application. This command does the following:

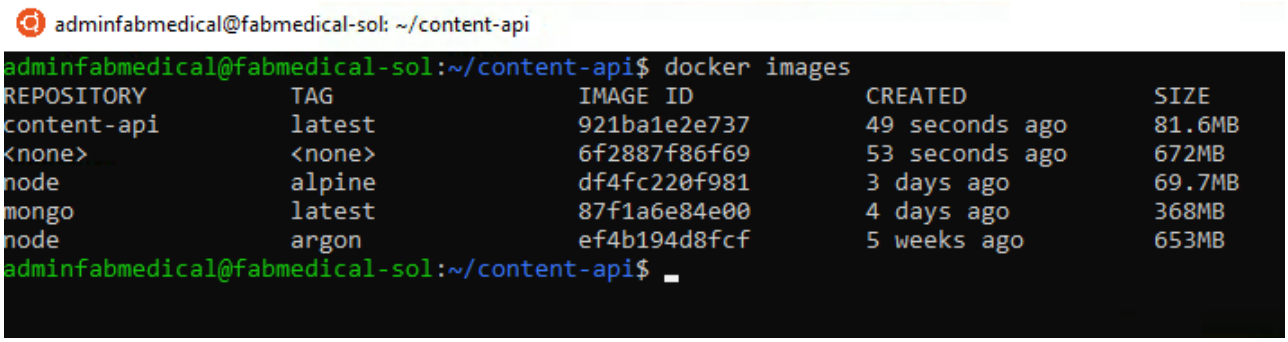
    - Executes the Docker build command to produce the image
    - Tags the resulting image with the name content-api (-t)
    - The final dot (".") indicates to use the Dockerfile in this current directory context. By default, this file is expected to have the name "Dockerfile" (case sensitive).

```
docker build -t content-api .
```

3. Once the image is successfully built, run the Docker images command again. You will see several new images: the node images and your container image.

```
docker images
```

Notice the untagged image. This is the build stage which contains all the intermediate files not need in your final image.




4. Commit and push the new Dockerfile before continuing.

   - `git add .`
   - `git commit -m "Added Dockerfile"`
   - `git push`
   - Enter credentials if prompted.

5. Navigate to the content-web folder again and list the files. Note that this folder already has a Dockerfile.

```
cd ../content-web
ll
```

6. View the Dockerfile contents -- which are similar to the file you created previously in the API folder. Type the following command:

```
cat Dockerfile
```

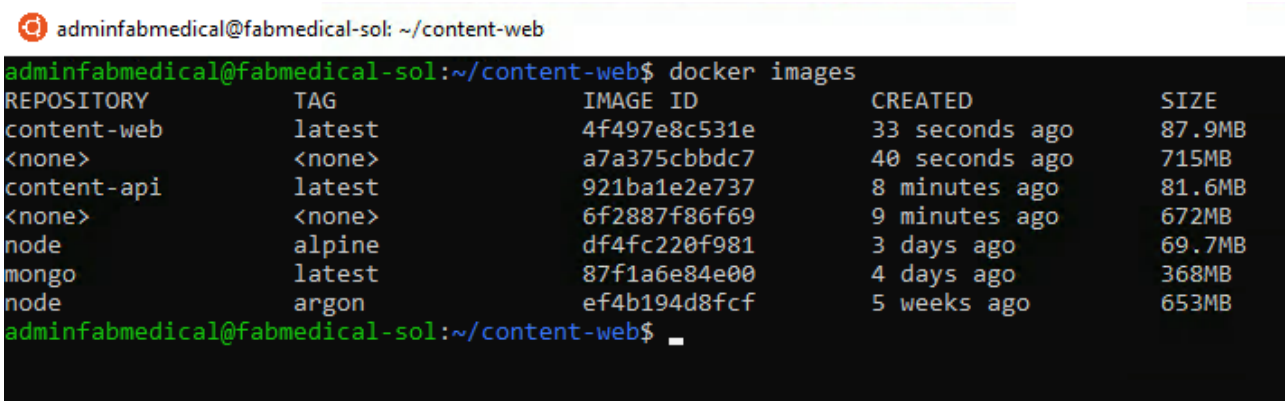
Notice that the content-web Dockerfile build stage includes additional tools to install bower packages in addition to the npm packages.

7. Type the following command to create a Docker image for the web application

```
docker build -t content-web .
```

8. When complete, you will see seven images now exist when you run the Docker images command

```
docker images
```




## Task 5: Run a containerized application

The web application container will be calling endpoints exposed by the API application container and the API application container will be communicating with mongodb. In this exercise, you will launch the images you created as containers on same bridge network you created when starting mongodb.

1. Create and start the API application container with the following command. The command does the following:

   -- Names the container "api" for later reference with Docker commands

   -- Instructs the Docker engine to use the "fabmedical" network

   -- Instructs the Docker engine to use port 3001 and map that to the internal container port 3001

   -- Creates a container from the specified image, by its tag, such as content-api

   ```
   docker run --name api --net fabmedical -p 3001:3001 content-api
   ```

2. The docker run command has failed because it is configured to connect to mongodb using a localhost url. However, now that content-api is isolated in a separate container, it cannot access mongodb via localhost even when running on the same docker host. Instead, the API must use the bridge network to connect to mongodb.

   ```
   > content-api@0.0.0 start /usr/src/app
   > node ./server.js

   Listening on port 3001
   Could not connect to MongoDB!
   MongoNetworkError: failed to connect to server [localhost:27017] on
   first connect [MongoNetworkError: connect ECONNREFUSED
   127.0.0.1:27017]
   npm ERR! code ELIFECYCLE
   npm ERR! errno 255
   ```

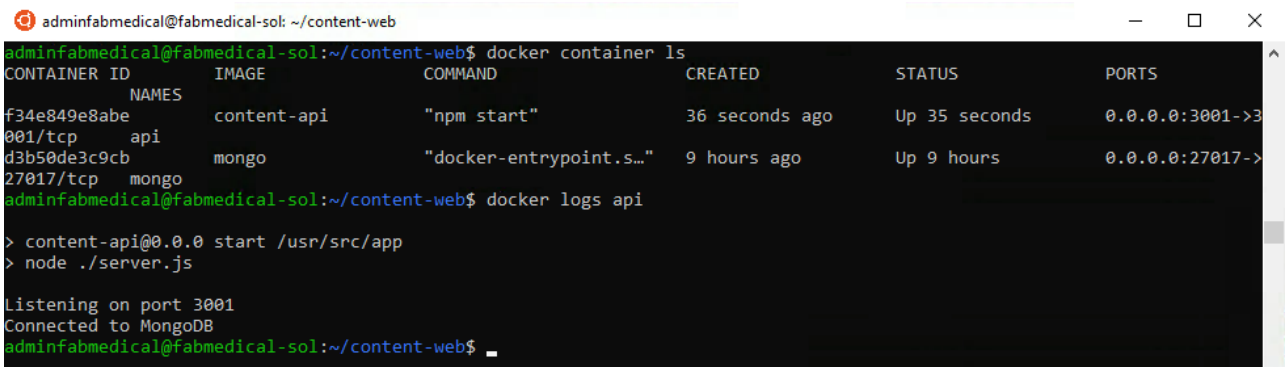
```
npm ERR! content-api@0.0.0 start: `node ./server.js`
npm ERR! Exit status 255
npm ERR!
npm ERR! Failed at the content-api@0.0.0 start script.
npm ERR! This is probably not a problem with npm. There is likely
additional logging output above.

npm ERR! A complete log of this run can be found in:
npm ERR!     /root/.npm/_logs/2018-06-08T13_36_52_985Z-debug.log
```

3. The content-api application allows an environment variable to configure the mongodb connection string. Remove the existing container, and then instruct the docker engine to set the environment variable by adding the `-e` switch to the docker run command. Also, use the `-d` switch to run the api as a daemon.

```
docker rm api
docker run --name api --net fabmedical -p 3001:3001 -e
MONGODB_CONNECTION=mongodb://mongo:27017/contentdb -d content-api
```

4. Enter the command to show running containers. You'll observe that the "api" container is in the list. Use the docker logs command to see that the API application has connected to mongodb.

```
docker container ls
docker logs api
```




5. Test the API by curling the URL. You will see JSON output as you did when testing previously.

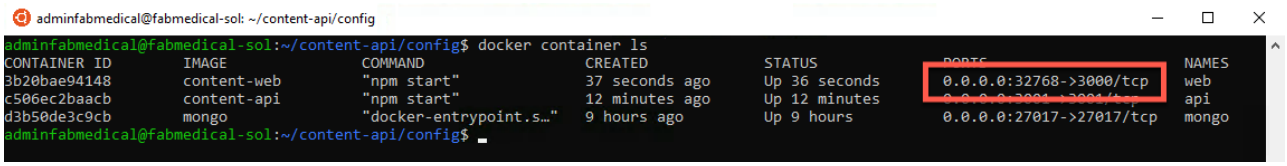
```
curl http://localhost:3001/speakers
```

6. Create and start the web application container with a similar Docker run command -- instruct the docker engine to use any port with the `-P` command.

```
docker run --name web --net fabmedical -P -d content-web
```

7. Enter the command to show running containers again and you'll observe that both the API and web containers are in the list. The web container shows a dynamically assigned port mapping to its internal container port 3000.

```
docker container ls
```




8. Test the web application by curling the URL. For the port, use the dynamically assigned port, which you can find in the output from the previous command. You will see HTML output, as you did when testing previously.

```
curl http://localhost:[PORT]/speakers.html
```

## Task 6: Setup environment variables

In this task, you will configure the "web" container to communicate with the API container using an environment variable, similar to the way the mongodb connection string is provided to the api. You will modify the web application to read the URL from the environment variable, rebuild the Docker image, and then run the container again to test connectivity.

1. From WSL, stop and remove the web container using the following commands.

```
docker stop web
docker rm web
```

2. Validate that the web container is no longer running or present by using the -a flag as shown in this command. You will see that the "web" container is no longer listed.

```
docker container ls -a
```

3. Navigate to the `content-web/data-access` directory. From there, open the index.js file for editing using Vim, and press the "i" key to go into edit mode.

```
cd data-access
vi index.js
<i>
```

4. Locate the following TODO item and modify the code to comment the first line and uncomment the second. The result is that the contentApiUrl variable will be set to an environment variable.

```
//TODO: Exercise 2 - Task 6 - Step 4

//const contentApiUrl = "http://localhost:3001";
const contentApiUrl = process.env.CONTENT_API_URL;
```

5. Press the Escape key and type ":wq". Then press the Enter key to save and close the file.

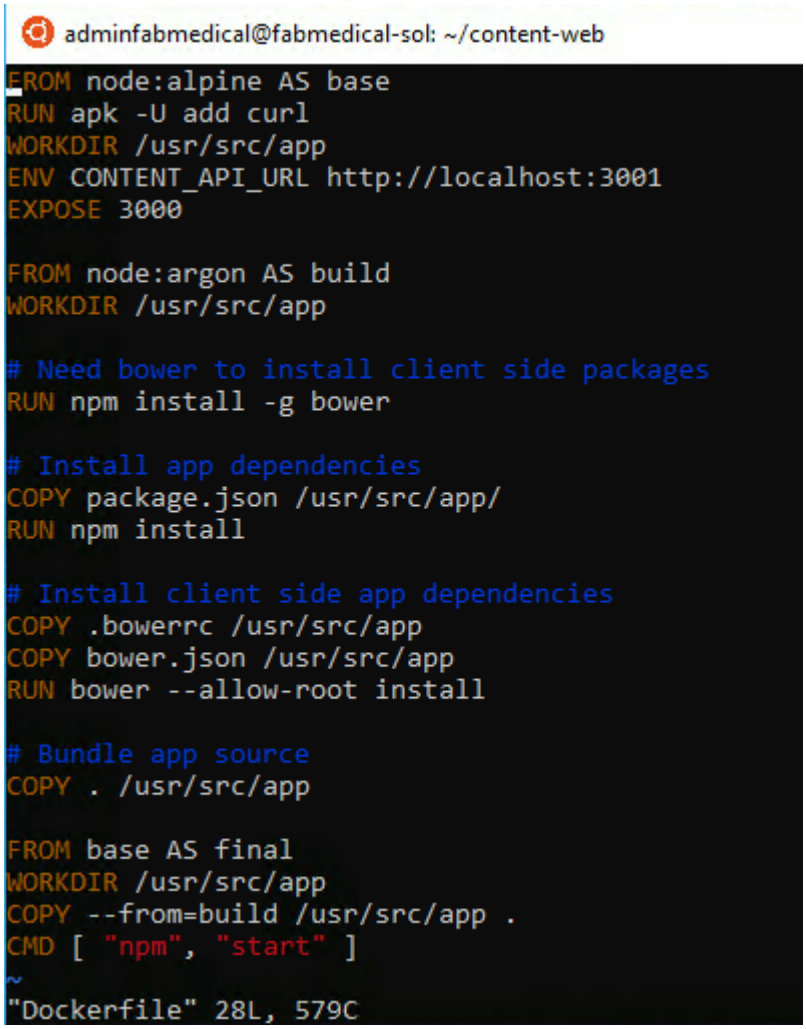
```
<Esc>
:wq
<Enter>
```

6. Navigate to the content-web directory. From there open the Dockerfile for editing using Vim and press the "i" key to go into edit mode.

```
cd ..
vi Dockerfile
<i>
```

7. Locate the EXPOSE line shown below, and add a line above it that sets the default value for the environment variable as shown in the screenshot

```
ENV CONTENT_API_URL http://localhost:3001
```




8. Press the Escape key and type ":wq" and then press the Enter key to save and close the file

```
<Esc>
:wq
<Enter>
```

9. Rebuild the web application Docker image using the same command as you did previously

```
docker build -t content-web .
```

10. Create and start the image passing the correct URI to the API container as an environment variable. This variable will address the API application using its container name over the Docker network you created. After running the container, check to see the container is running and note the dynamic port assignment for the next step.

```
docker run --name web --net fabmedical -P -d -e
CONTENT_API_URL=http://api:3001 content-web
docker container ls
```

11. Curl the speakers path again, using the port assigned to the web container. Again you will see HTML returned, but because curl does not process javascript, you cannot determine if the web application is communicating with the api application. You must verify this connection in a browser.

```
curl http://localhost:[PORT]/speakers.html
```

12. You will not be able to browse to the web application on the ephemeral port because the VM only exposes a limited port range. Now you will stop the web container and restart it using port 3000 to test in the browser. Type the following commands to stop the container, remove it, and run it again using explicit settings for the port.

```
docker stop web
docker rm web
docker run --name web --net fabmedical -p 3000:3000 -d -e
CONTENT_API_URL=http://api:3001 content-web
```

13. Curl the speaker path again, using port 3000. You will see the same HTML returned.

```
curl http://localhost:3000/speakers.html
```

14. You can now use a web browser to navigate to the website and successfully view the application at port 3000. Replace [BUILDAGENTIP] with the IP address you used previously.

```
http://[BUILDAGENTIP]:3000

EXAMPLE: http://13.68.113.176:3000
```

15. Managing several containers with all their command line options can become difficult as the solution grows. `docker-compose` allows us to declare options for several containers and run them together. First, cleanup the existing containers.

```
docker stop web && docker rm web
docker stop api && docker rm api
docker stop mongo && docker rm mongo
```

16. Commit your changes and push to the repository

```
git add .
git commit -m "Setup Environment Variables"
git push
```

17. Navigate to your home directory (where you checked out the content repositories) and create a docker compose file

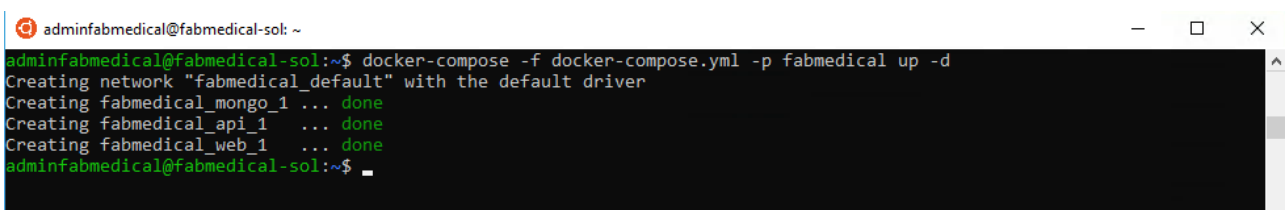
```
cd ~
vi docker-compose.yml
```

Type the following as the contents of `docker-compose.yml`

```
version: '3.4'

services:
  mongo:
    image: mongo
    restart: always

  api:
    build: ./content-api
    image: content-api
    depends_on:
      - mongo
    environment:
      MONGODB_CONNECTION: mongodb://mongo:27017/contentdb

  web:
    build: ./content-web
    image: content-web
    depends_on:
      - api
    environment:
      CONTENT_API_URL: http://api:3001
    ports:
      - "3000:3000"
```

18. Start the applications with the `up` command

```
docker-compose -f docker-compose.yml -p fabmedical up -d
```




19. Visit the website in the browser; notice that we no longer have any data on the speakers or sessions pages

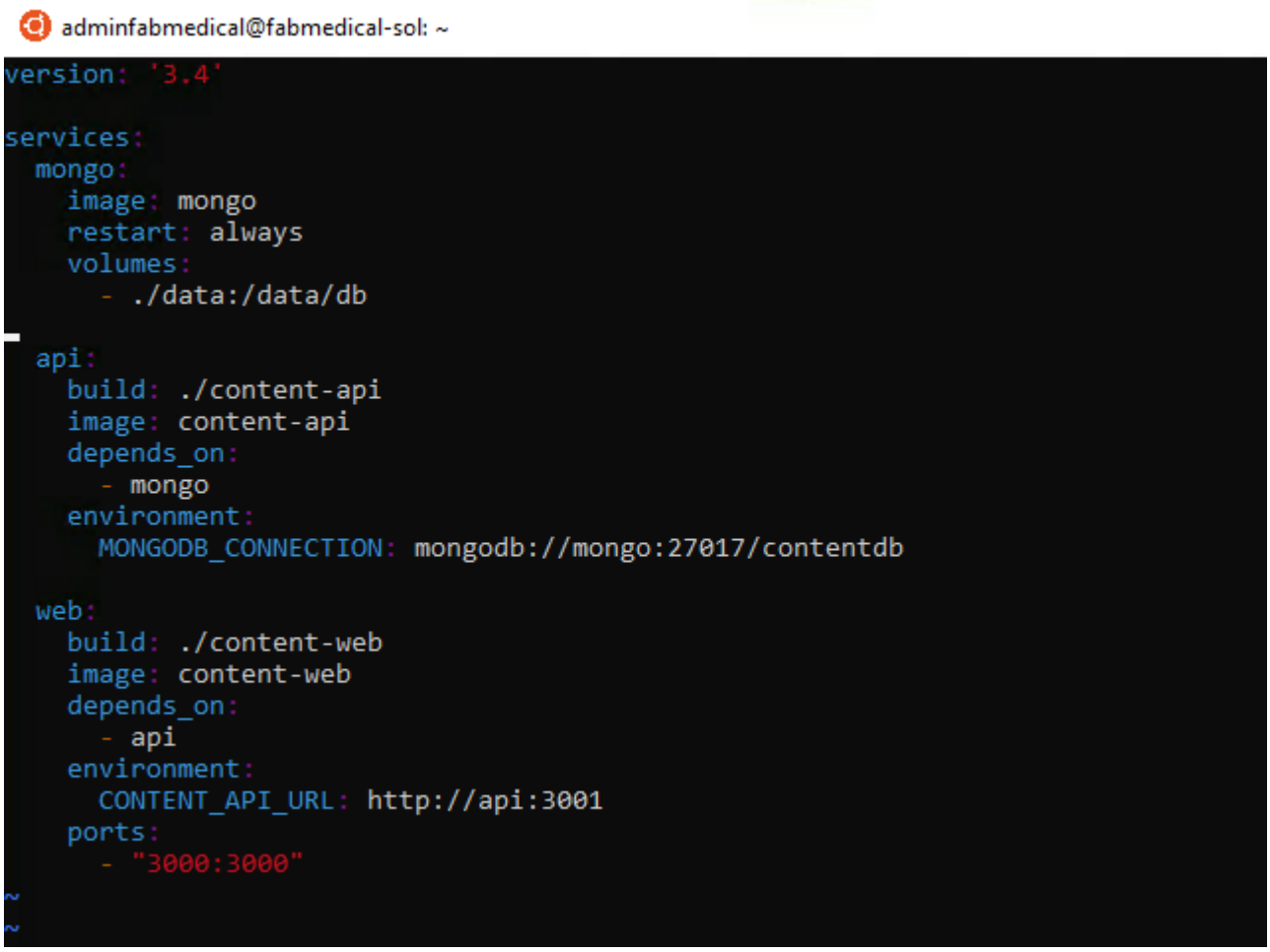

20. We stopped and removed our previous mongodb container; all the data contained in it has been removed. Docker compose has created a new, empty mongodb instance that must be reinitialized. If we care to persist our data between container instances, the docker has several mechanisms to do so. First we will update our compose file to persist mongodb data to a directory on the build agent.

```
mkdir data
vi docker-compose.yml
```

Update the mongo service to mount the local data directory onto to the `/data/db` volume in the docker container

```
mongo:
  image: mongo
  restart: always
  volumes:
    - ./data:/data/db
```

The result should look similar to the following screenshot




21. Next we will add a second file to our composition so that we can initialize the mongodb data when needed

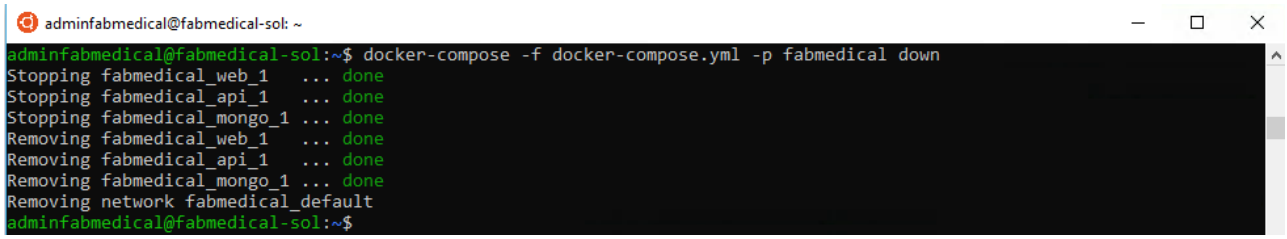
```
vi docker-compose.init.yml
```

Add the following as the content

```
version: '3.4'

services:
    init:
      build: ./content-init
      image: content-init
      depends_on:
        - mongo
      environment:
        MONGODB_CONNECTION: mongodb://mongo:27017/contentdb
```

22. To reconfigure the mongodb volume, we need to bring down the mongodb service first

```
docker-compose -f docker-compose.yml -p fabmedical down
```

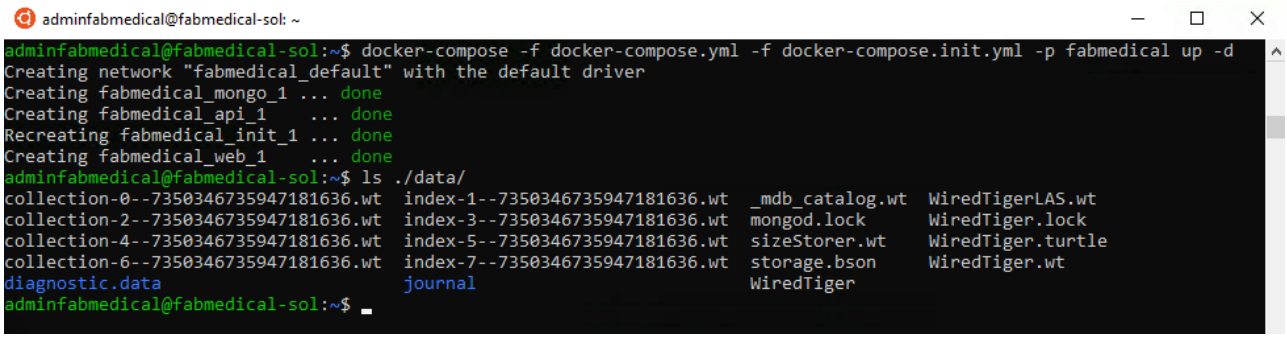



23. Now run `up` again with both files to update the mongodb configuration, and run the initialization script

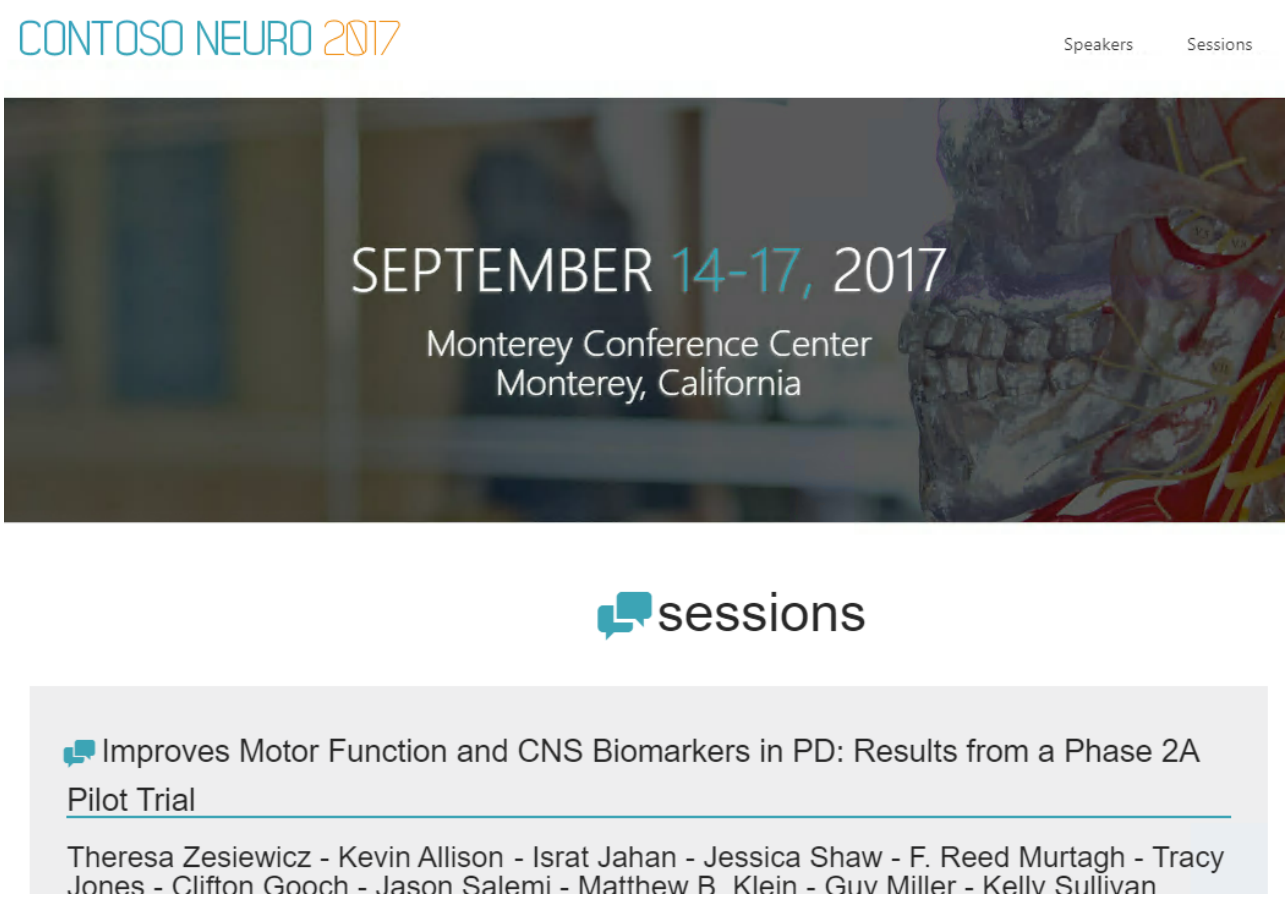
```
docker-compose -f docker-compose.yml -f docker-compose.init.yml -p
fabmedical up -d
```

24. Check the data folder to see that mongodb is now writing data files to the host

```
ls ./data/
```




25. Check the results in the browser. The speaker and session data are now available.



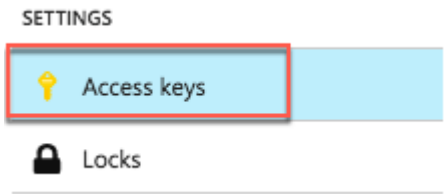

## Task 7: Push images to Azure Container Registry

To run containers in a remote environment, you will typically push images to a Docker registry, where you can store and distribute images. Each service will have a repository that can be pushed to and pulled from with Docker commands. Azure Container Registry (ACR) is a managed private Docker registry service based on Docker Registry v2.

In this task, you will push images to your ACR account, version images with tagging, and setup continuous integration (CI) to build future versions of your containers and push them to ACR automatically.

1. In the Azure Portal, navigate to the ACR you created in Before the hands-on lab

2. Select Access keys under Settings on the left-hand menu




3. The Access keys blade displays the Login server, username, and password that will be required for the next step. Keep this handy as you perform actions on the build VM.

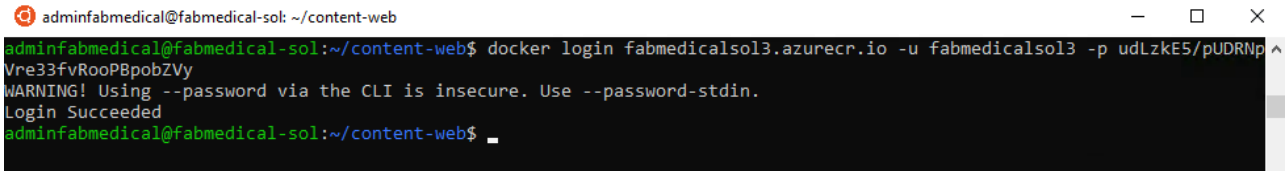
   **NOTE: If the username and password do not appear, select Enable on the Admin user option.**

4. From the WSL session connected to your build VM, login to your ACR account by typing the following command. Follow the instructions to complete the login.

```
docker login [LOGINSERVER] -u [USERNAME] -p [PASSWORD]
```

For example:

```
docker login fabmedicalsoll.azurecr.io -u fabmedicalsoll -p
+W/j=l+Fcze=n07SchxvGSlvsLRh/7ga
```



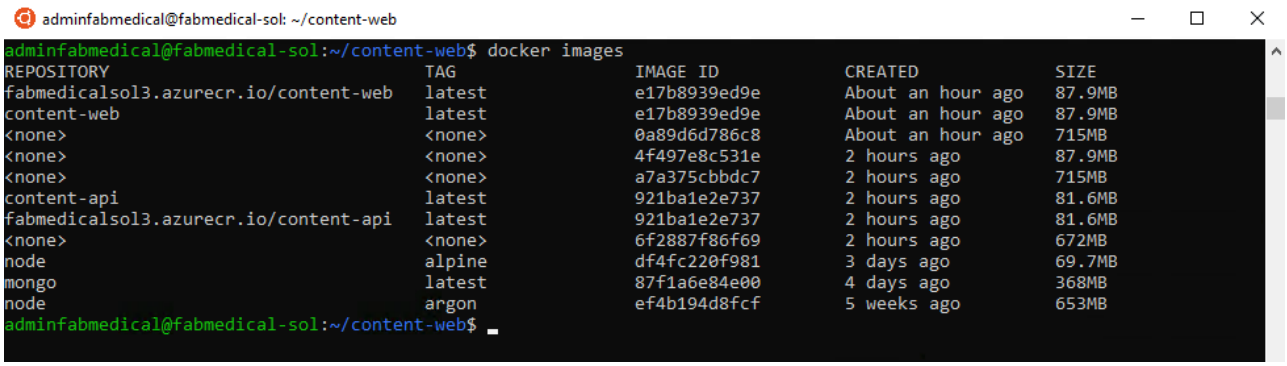

**Tip: Make sure to specify the fully qualified registry login server (all lowercase).**

5. Run the following commands to properly tag your images to match your ACR account name

```
docker tag content-web [LOGINSERVER]/content-web
docker tag content-api [LOGINSERVER]/content-api
```

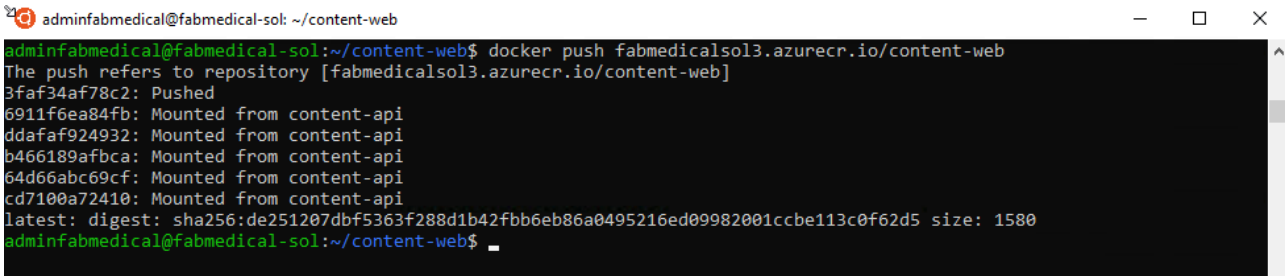
6. List your docker images and look at the repository and tag. Note that the repository is prefixed with your ACR login server name, such as the sample shown in the screenshot below.

```
docker images
```



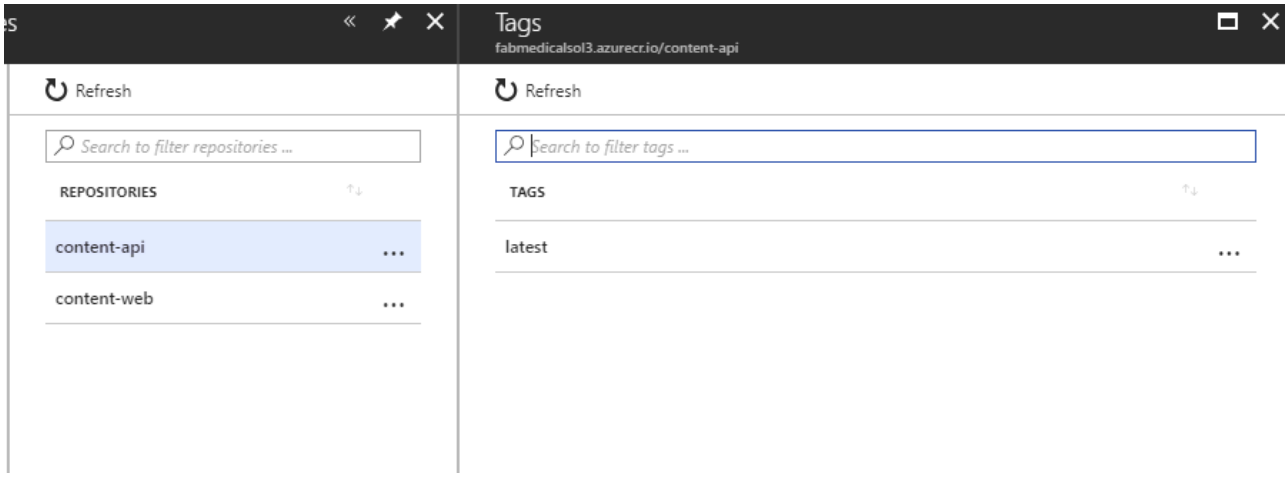

7. Push the images to your ACR account with the following command

```
docker push [LOGINSERVER]/content-web
docker push [LOGINSERVER]/content-api
```



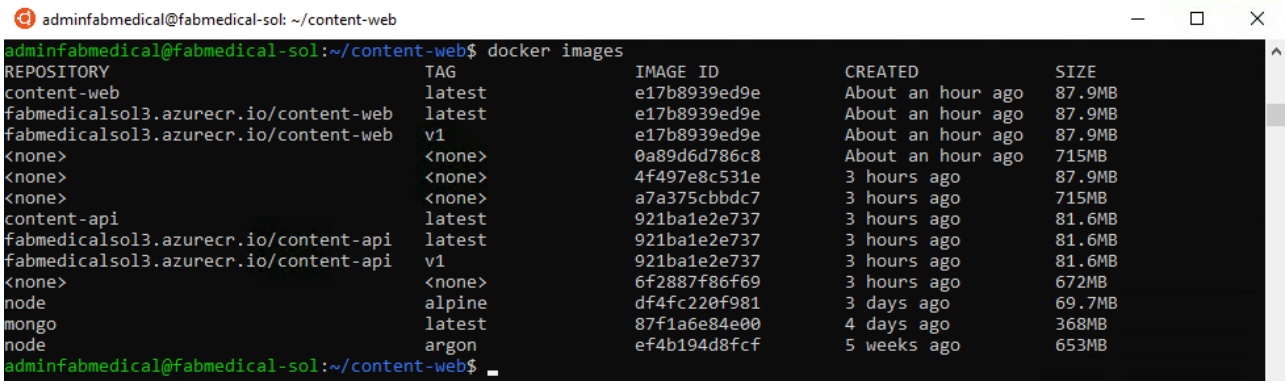

8. In the Azure Portal, navigate to your ACR account, and select Repositories under Services on the left-hand menu. You will now see two; one for each image.


9. Select content-api. You'll see the latest tag is assigned.

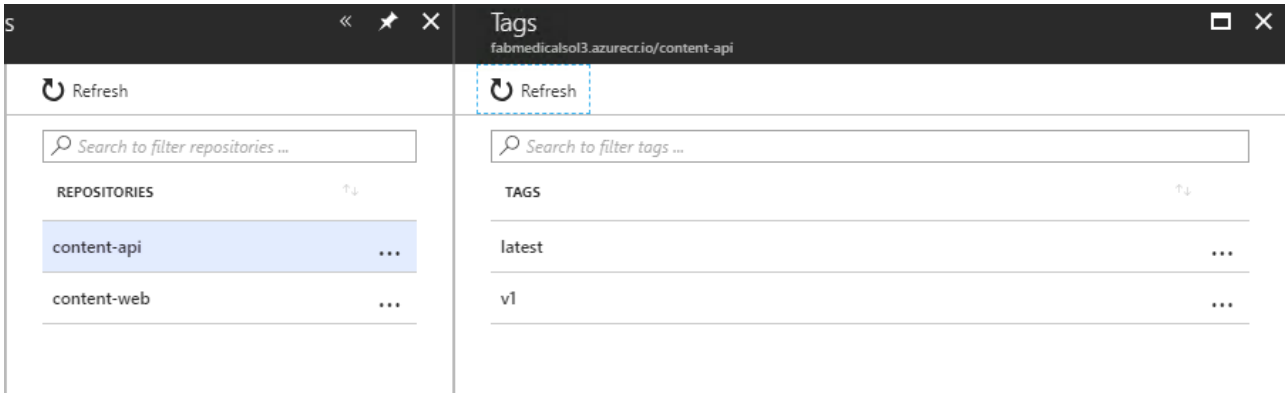



10. From WSL, assign the v1 tag to each image with the following commands. Then list the Docker images to note that there are now two entries for each image; showing the latest tag and the v1 tag. Also note that the image ID is the same for the two entries, as there is only one copy of the image.

```
docker tag [LOGINSERVER]/content-web:latest [LOGINSERVER]/content-web:v1
docker tag [LOGINSERVER]/content-api:latest [LOGINSERVER]/content-api:v1
docker images
```




11. Repeat Step 7 to push the images to ACR again so that the newly tagged v1 images are pushed. Then refresh one of the repositories to see the two versions of the image now appear.




12. Run the following commands to pull an image from the repository. Note that the default behavior is to pull images tagged with "latest." You can pull a specific version using the version tag. Also, note that since the images already exist on the build agent, nothing is downloaded.

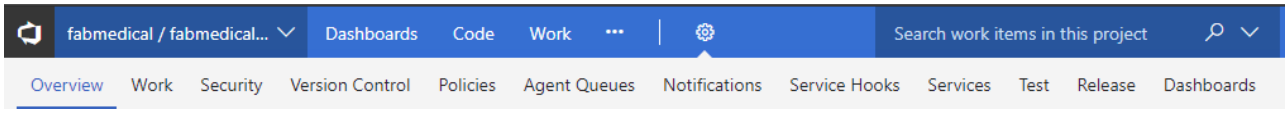
```
docker pull [LOGINSERVER]/content-web
docker pull [LOGINSERVER]/content-web:v1
```

--- **Azure subscription**: Choose "azurecloud-sol"

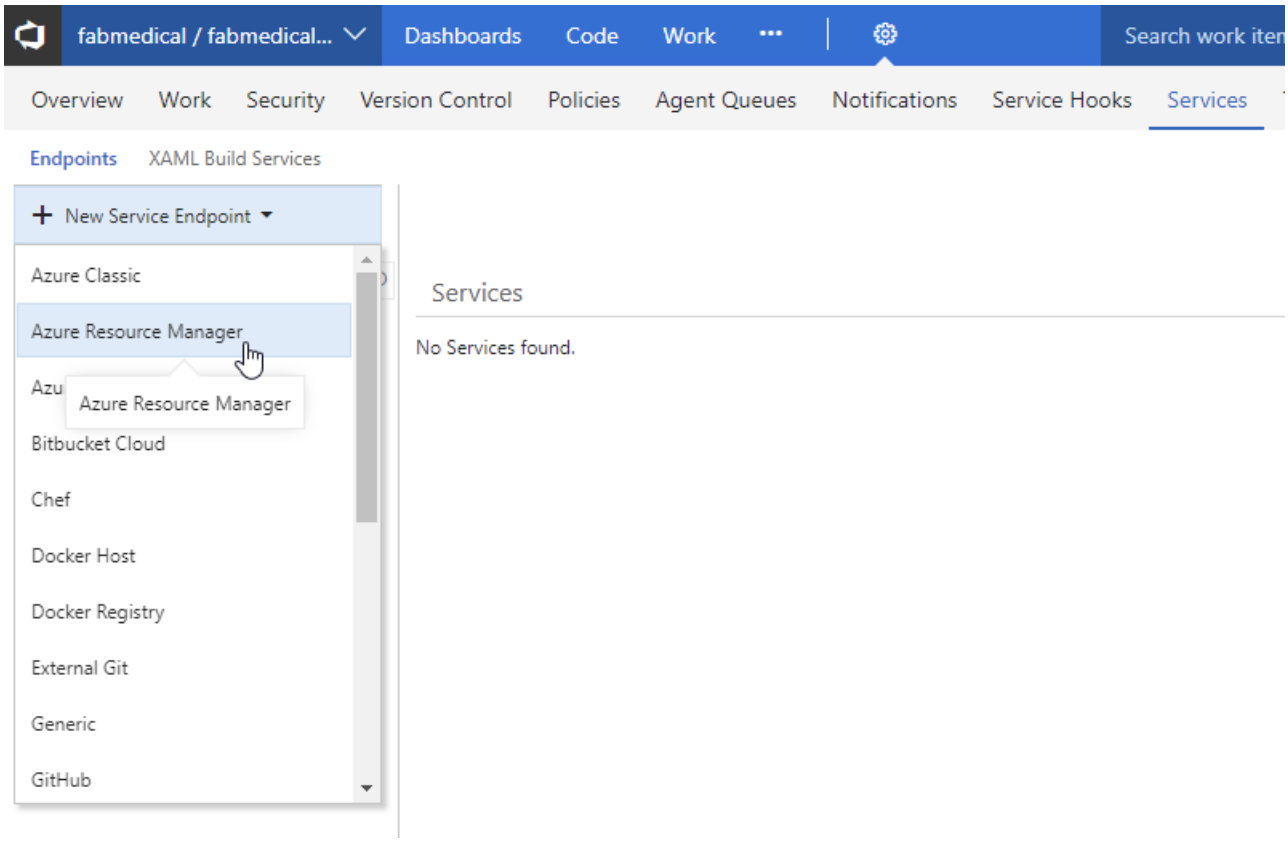
--- **Azure Container Registry**: Choose your ACR instance by name

--- **Include Latest Tag**: Checked

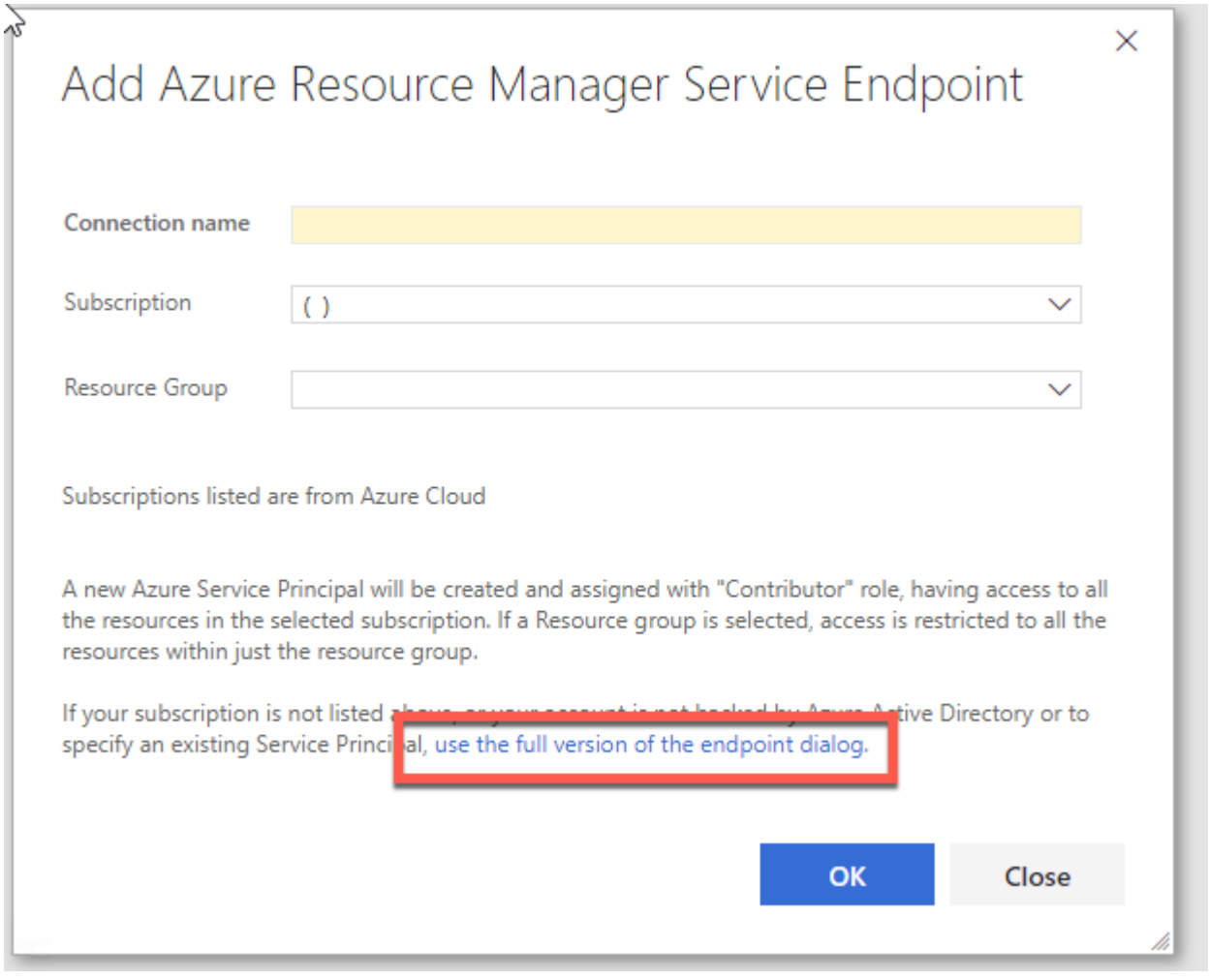
13. Next we will use VSTS to automate the process for creating images and pushing to ACR. First, you need to add an Azure Service Principal to your VSTS account. Login to your VisualStudio.com account and click the gear icon to access your settings. Then select Services.




14. Choose "+ New Service Endpoint". Then pick "Azure Resource Manager" from the menu.




15. Select the link indicated in the screenshot below to access the advanced settings




16. Enter the required information using the service principal information you created before the lab

> Note if you don't have your Subscription information handy you can view it using `az account show` on your **local** machine (not the build agent)

---- **Connection name**: azurecloud-sol

---- **Environment**: AzureCloud

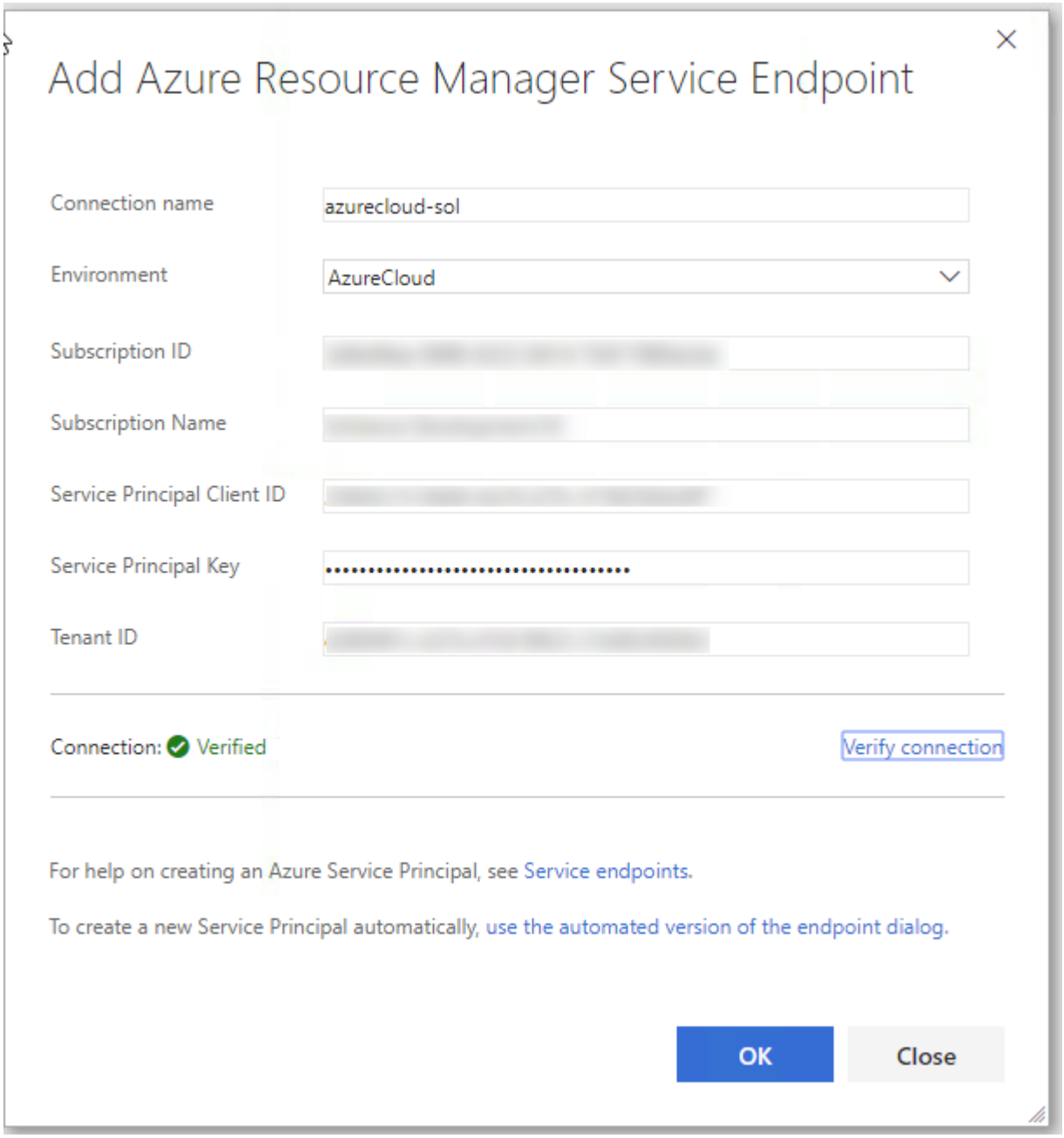
---- **Subscription ID**: `id` from `az account show` output

---- **Subscription Name**: `name` from `az account show` output

---- **Service Principal Client ID**: `appId` from service principal output.

---- **Service Principal Key**: `password` from service principal output.

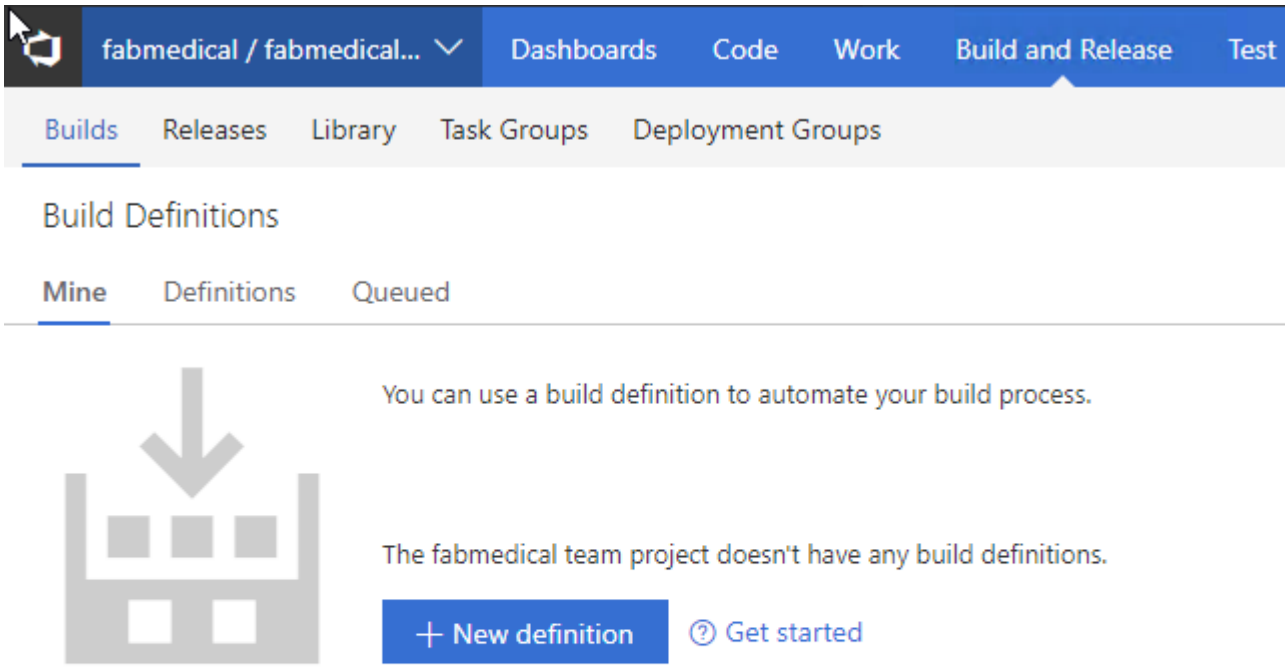
---- **Tenant ID**: `tenant` from service principal output.



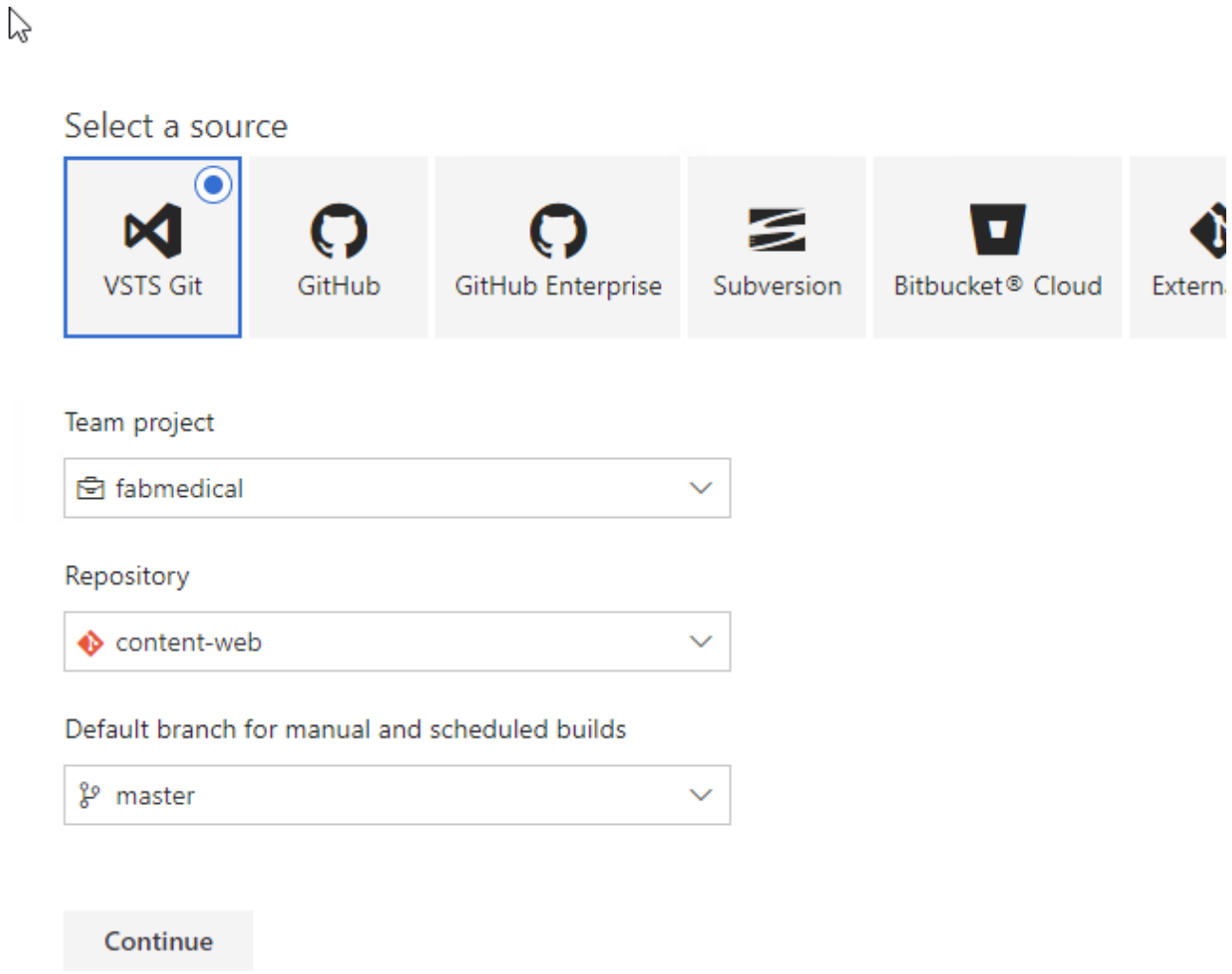

17. Select "Verify connection" then select "OK"

> If the connection does not verify, then recheck and reenter the required data.

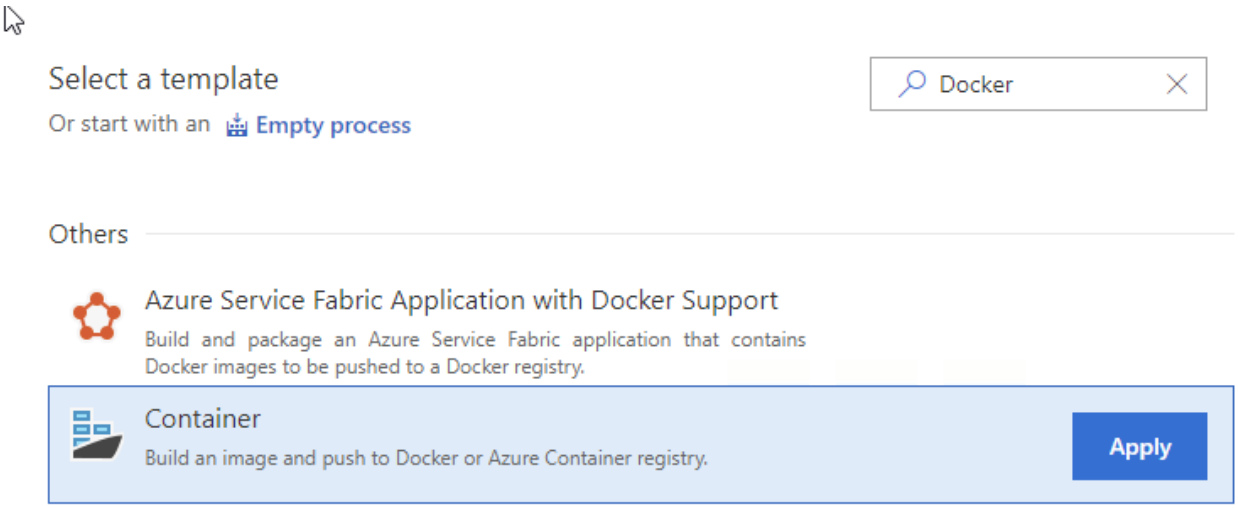
18. Now create your first build. Select "Build and Release"; then select "+ New definition."



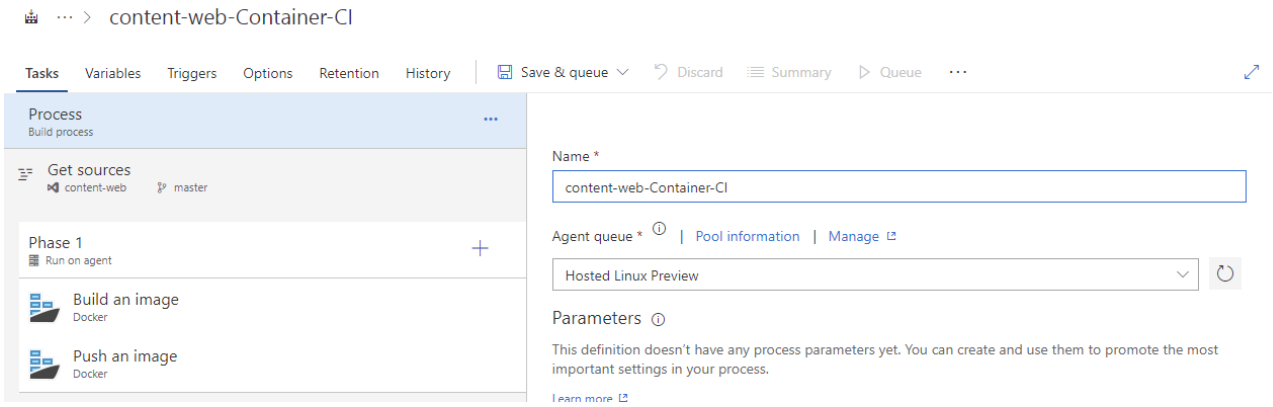

19. Choose the content-web repository and accept the other defaults




20. Next, search for "Docker" templates and choose "Container" then select "Apply"




21. Change the build name to "content-web-Container-CI"

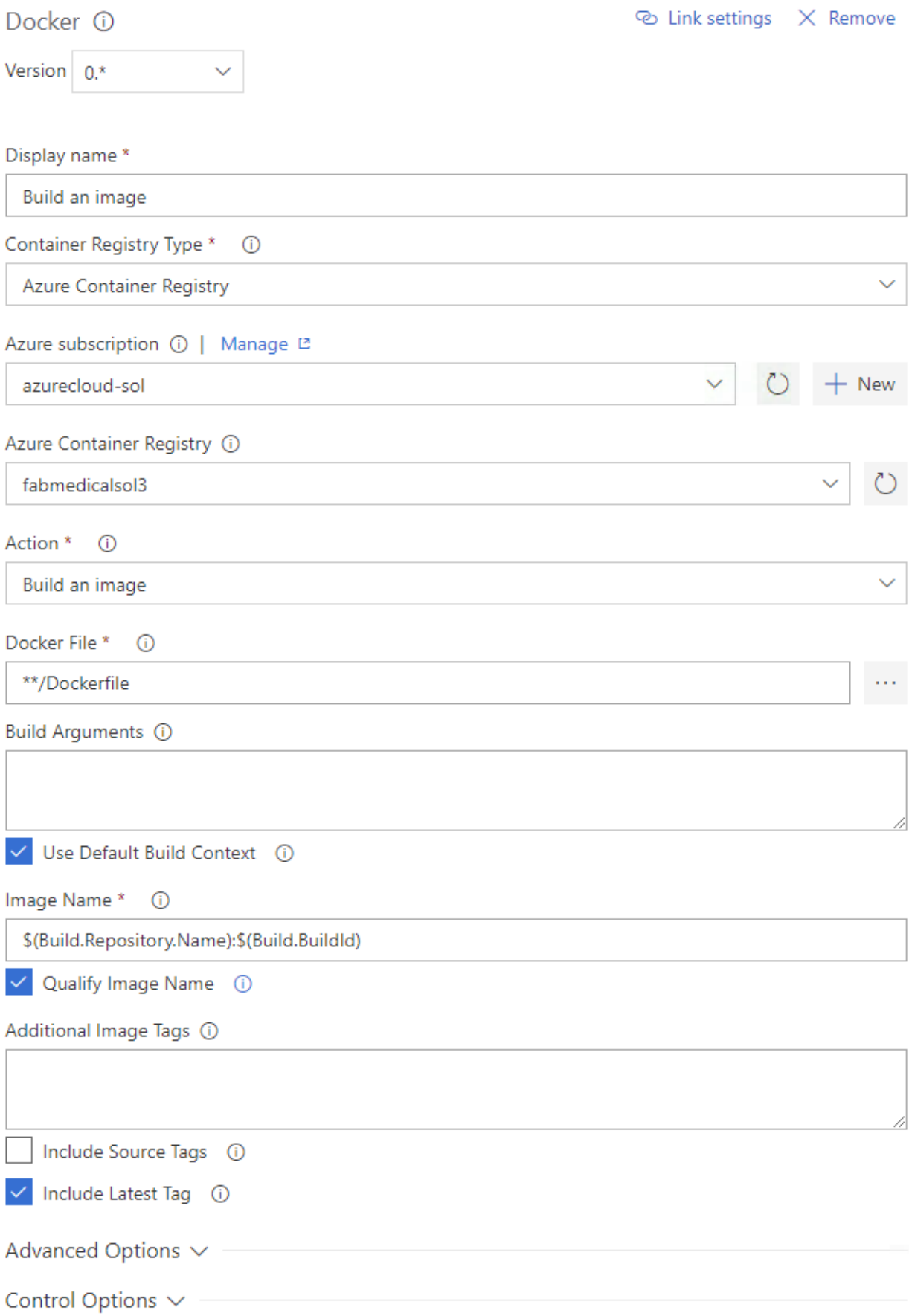



22. Select "Build an image"

    ----- **Azure subscription**: Choose "azurecloud-sol"

    ----- **Azure Container Registry**: Choose your ACR instance by name

    ----- **Include Latest Tag**: Checked

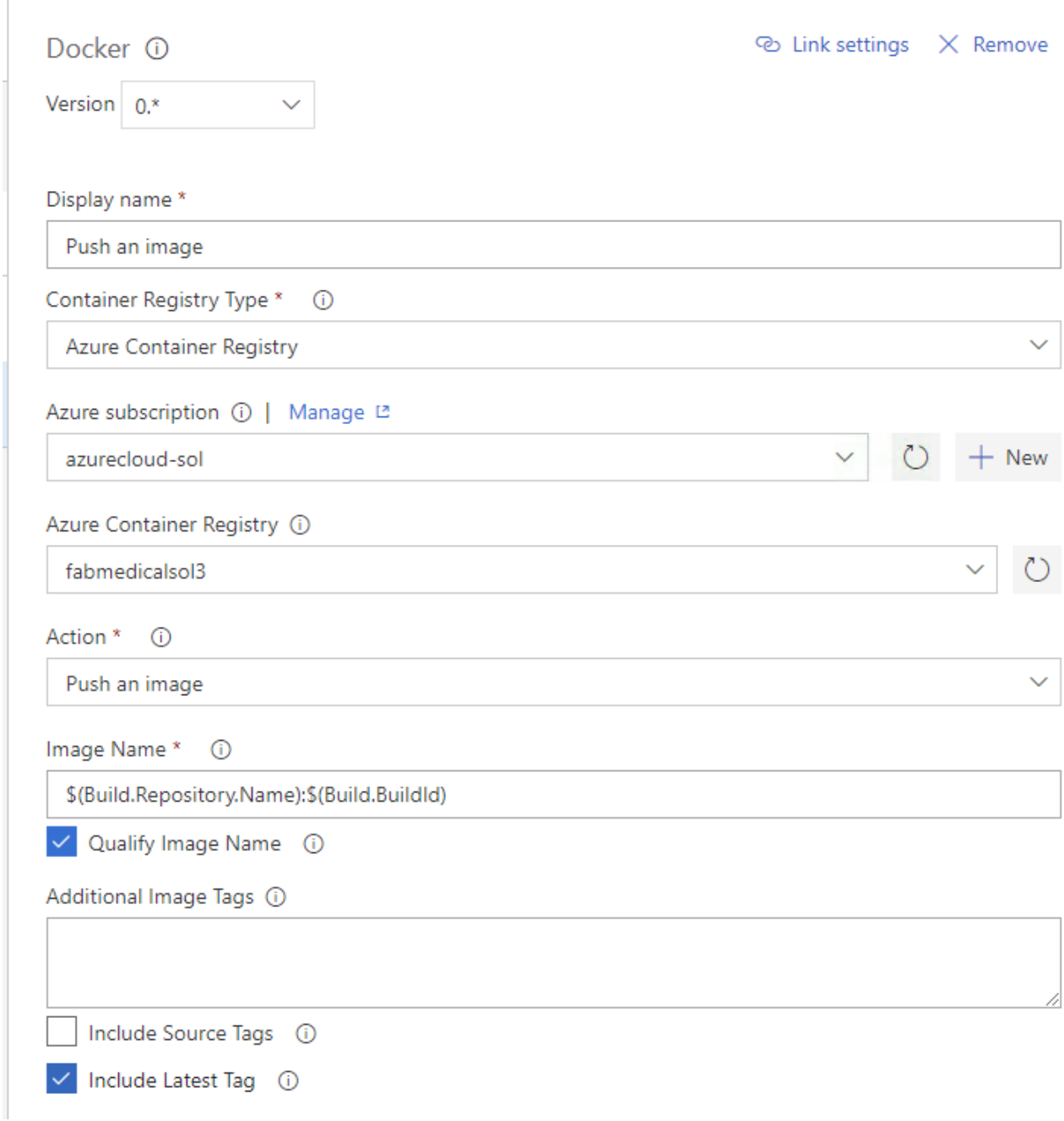



23. Select "Push an image"

----- **Azure subscription**: Choose "azurecloud-sol"

----- **Azure Container Registry**: Choose your ACR instance by name

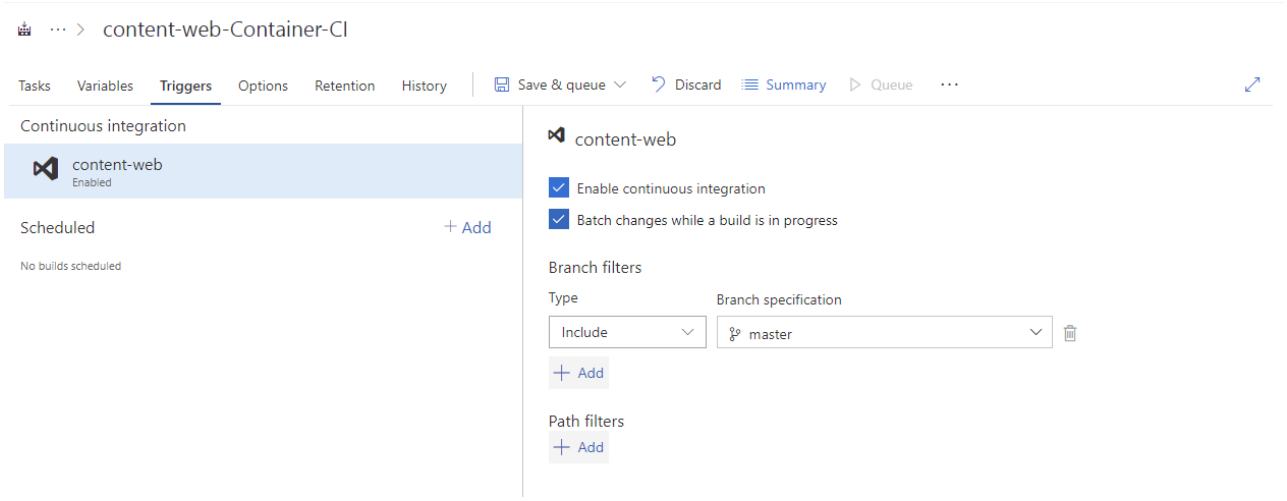
----- **Include Latest Tag**: Checked



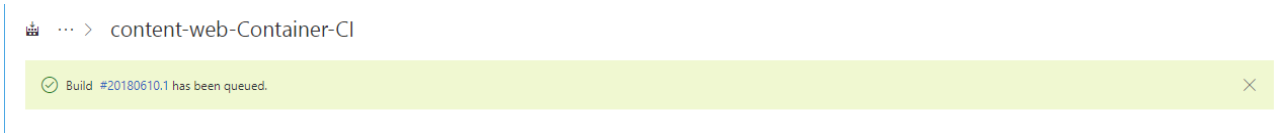

24. Select "Triggers"

----- **Enable continuous integration**: Checked

----- **Batch changes while a build is in progress**: Checked



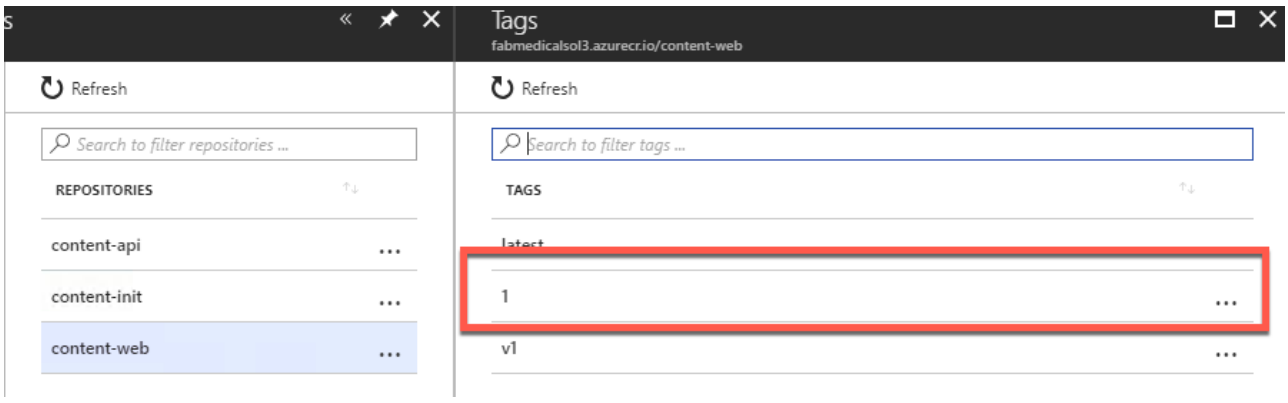

25. Select "Save & queue"; then select "Save & queue" two more times to kick off the first build




26. While that build runs, create the content-api build. Select "Builds", and then select "+ New". Configure content-api by following the same steps used to configure content-web.

27. While the content-api build runs, setup one last build for content-init by following the same steps as the previous two builds.

28. Visit your ACR instance in the Azure portal, you should see new containers tagged with the VSTS build number.




# Exercise 2: Deploy the solution to Azure Kubernetes Service

**Duration**: 30 minutes

In this exercise, you will connect to the Azure Kubernetes Service cluster you created before the hands-on lab and deploy the Docker application to the cluster using Kubernetes.

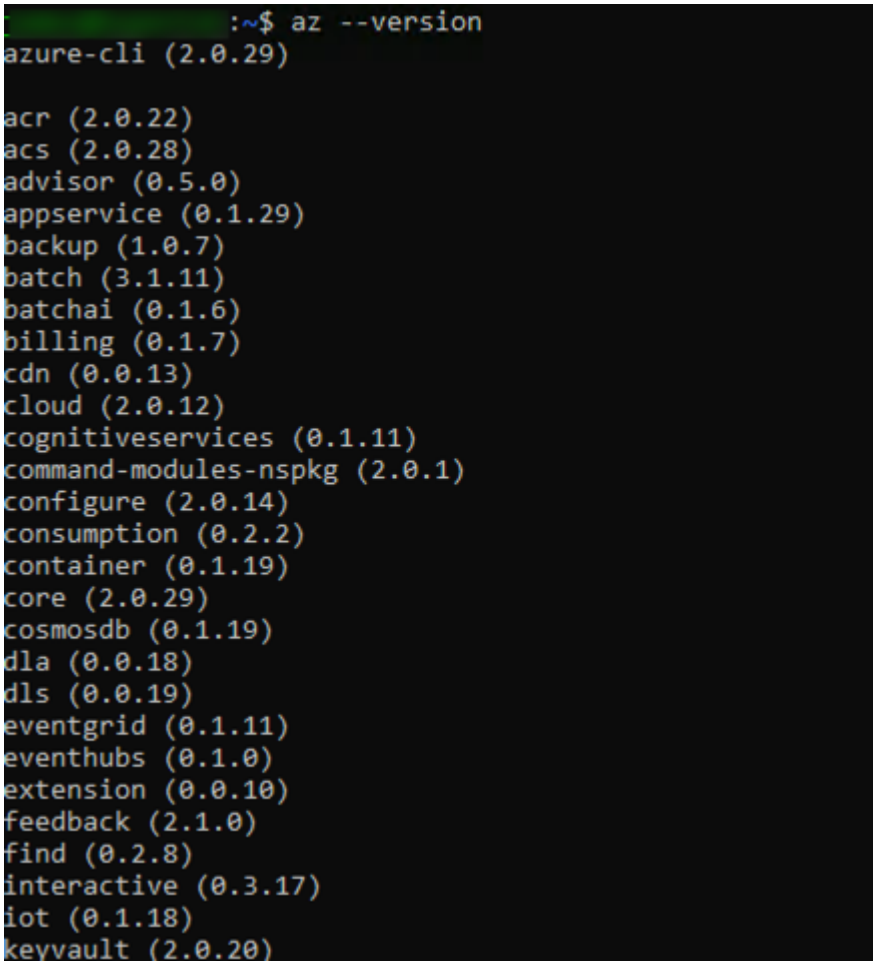
## Task 1: Tunnel into the Azure Kubernetes Service cluster

In this task, you will gather the information you need about your Azure Kubernetes Service cluster to connect to the cluster and execute commands to connect to the Kubernetes management dashboard from your local machine.

1. Open your WSL console (close the connection to the build agent if you are connected). From this WSL console, ensure that you installed the Azure CLI correctly by running the following command:

```
az --version
```

a. This should produce output similar to this:

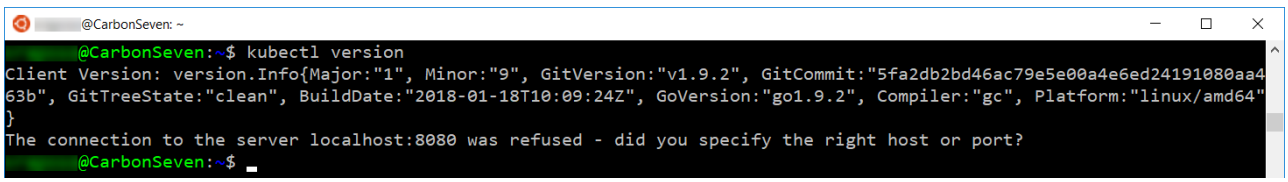



b. If the output is not correct, review your steps from the instructions in Task 11: Install Azure CLI from the instructions before the lab exercises.

2. Also, check the installation of the Kubernetes CLI (kubectl) by running the following command:

```
kubectl version
```

a. This should produce output similar to this:



b. If the output is not correct, review the steps from the instructions in Task 12: Install Kubernetes CLI from the instructions before the lab exercises.

3. Once you have installed and verified Azure CLI and Kubernetes CLI, login with the following command, and follow the instructions to complete your login as presented:

```
az login
```

4. Verify that you are connected to the correct subscription with the following command to show your default subscription:

```
az account show
```

a. If you are not connected to the correct subscription, list your subscriptions and then set the subscription by its id with the following commands (similar to what you did in cloud shell before the lab):

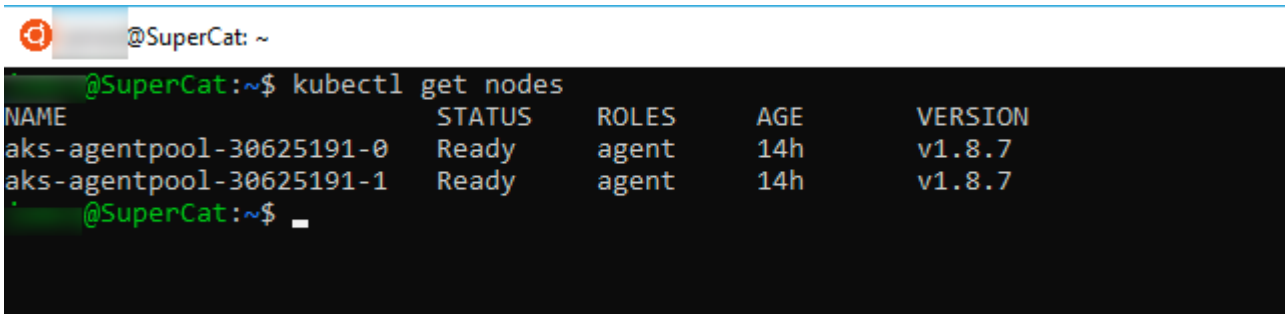
```
az account list
az account set --subscription {id}
```

5. Configure kubectl to connect to the Kubernetes cluster

```
az aks get-credentials --name fabmedical-SUFFIX --resource-group
fabmedical-SUFFIX
```

6. Test that the configuration is correct by running a simple kubectl command to produce a list of nodes:

```
kubectl get nodes
```

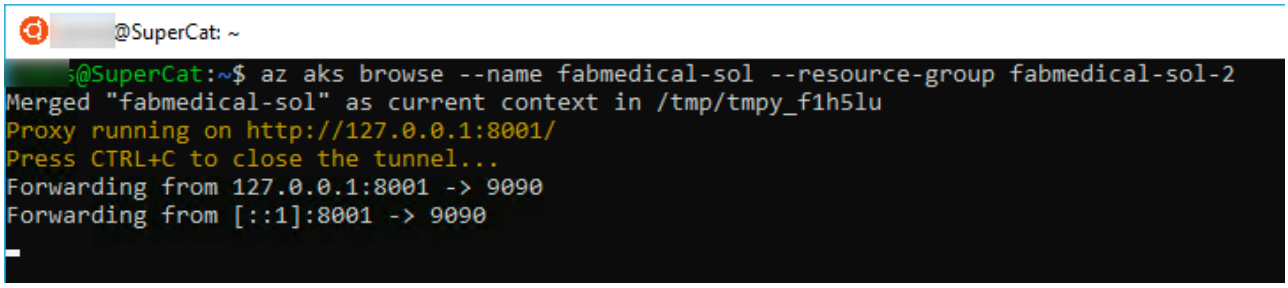



7. Create an SSH tunnel linking a local port (8001) on your machine to port 80 on the management node of the cluster. Execute the command below replacing the values as follows:

***NOTE:*** **After you run this command, it may work at first and later lose its connection, so you may have to run this again to reestablish the connection. If the Kubernetes dashboard becomes**

**unresponsive in the browser this is an indication to return here and check your tunnel or rerun the command.**

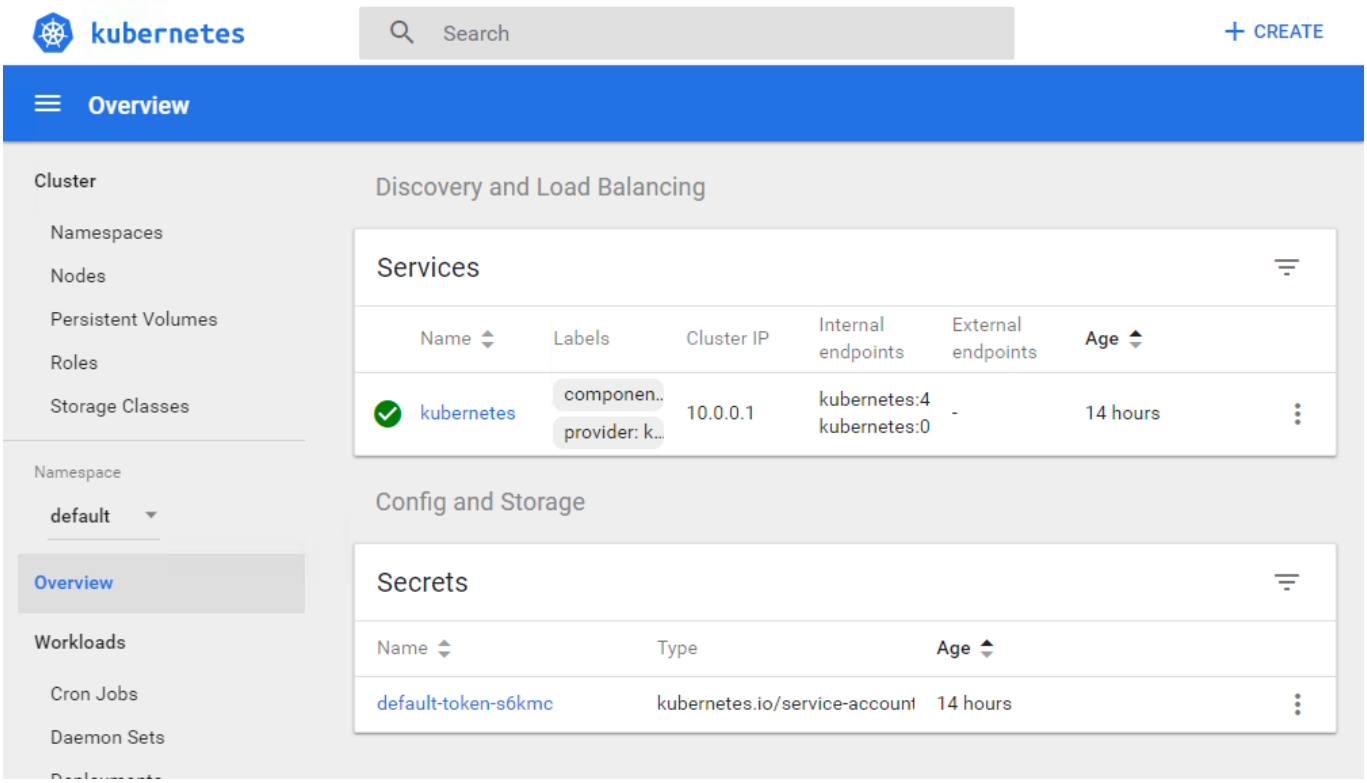
```
az aks browse --name fabmedical-SUFFIX --resource-group fabmedical-SUFFIX
```




8. Open a browser window and access the Kubernetes management dashboard at the Services view. To reach the dashboard, you must access the following address:

```
http://localhost:8001
```

9. If the tunnel is successful, you will see the Kubernetes management dashboard.

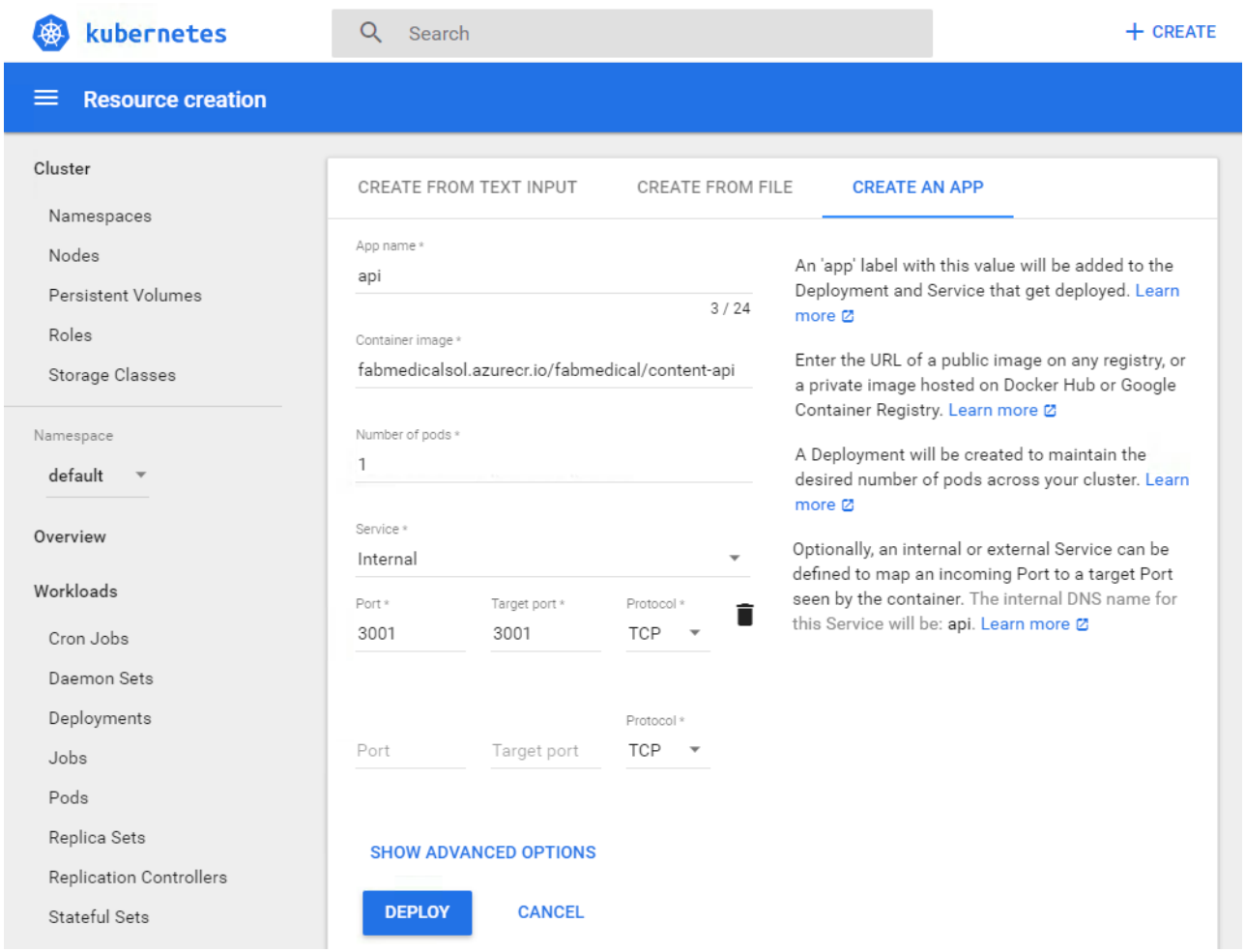



## Task 2: Deploy a service using the Kubernetes management dashboard

In this task, you will deploy the API application to the Azure Kubernetes Service cluster using the Kubernetes dashboard.

1. From the Kubernetes dashboard, select Create in the top right corner.

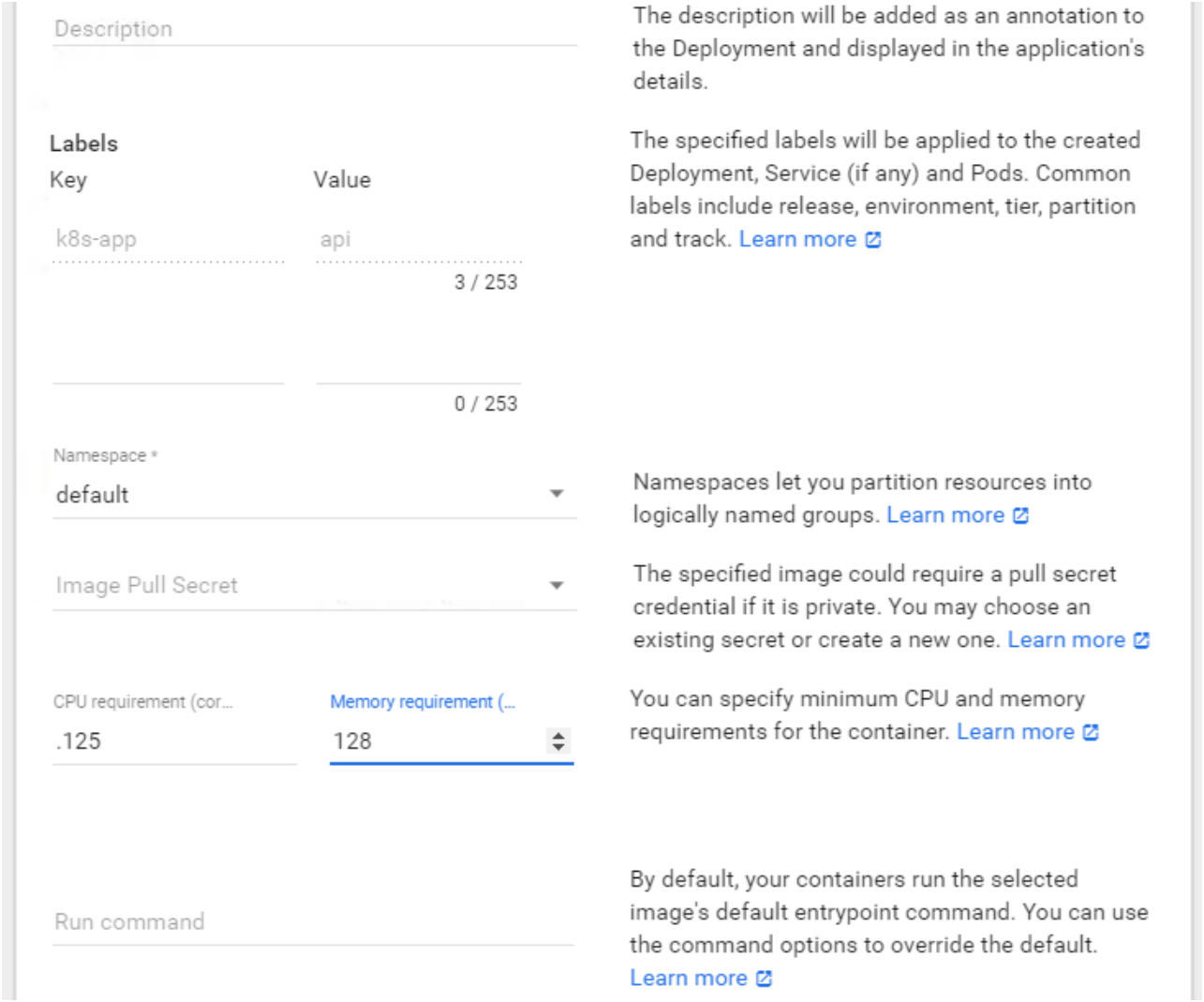
2. From the Resource creation view, select Create an App



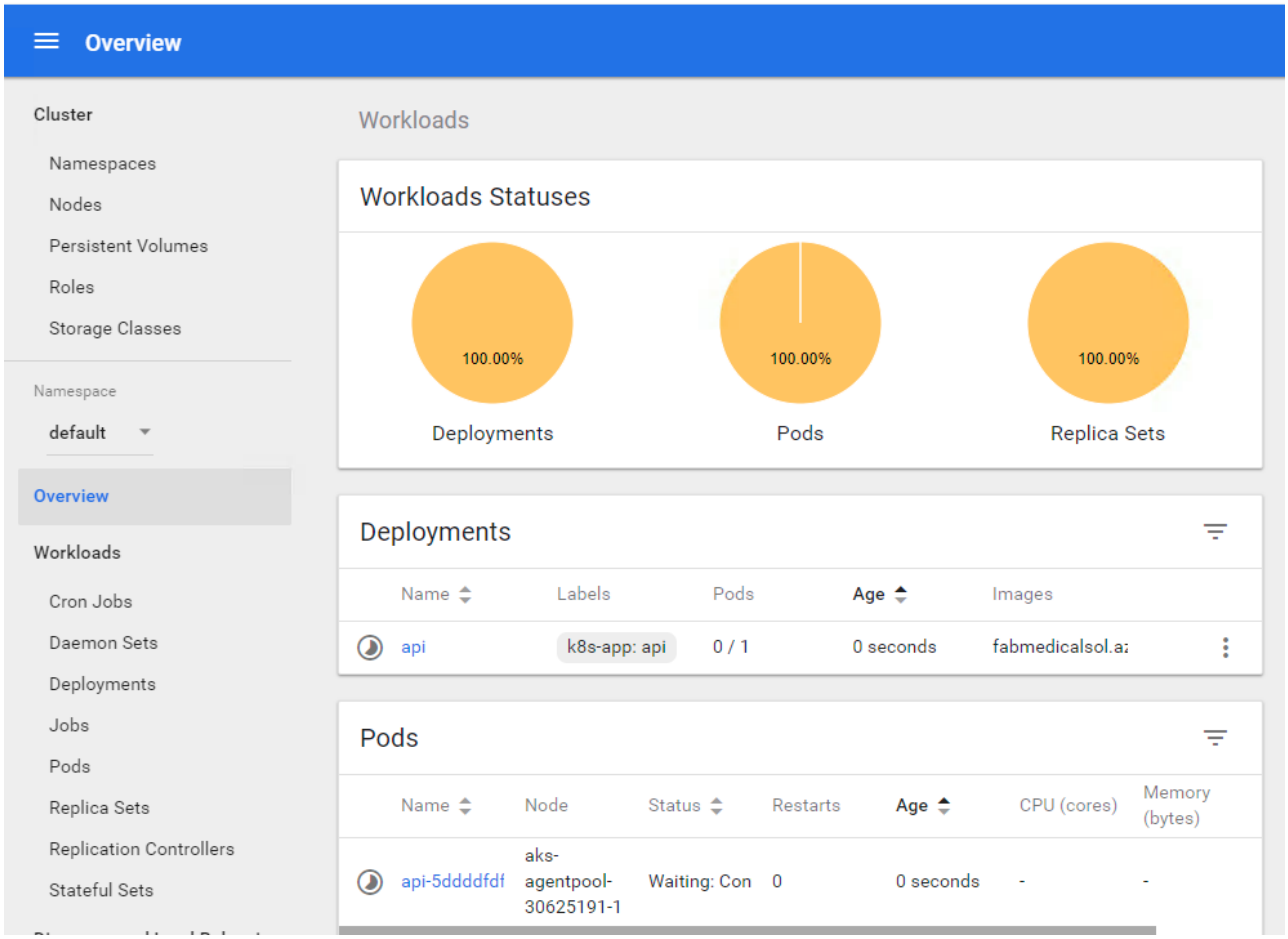

- Enter "api" for the App name
- Enter [LOGINSERVER]/content-api for the Container Image, replacing [LOGINSERVER] with your ACR login server, such as fabmedicalsol.azurecr.io
- Set Number of pods to 1
- Set Service to "Internal"
- Use 3001 for Port and 3001 for Target port

3. Select SHOW ADVANCED OPTIONS-----

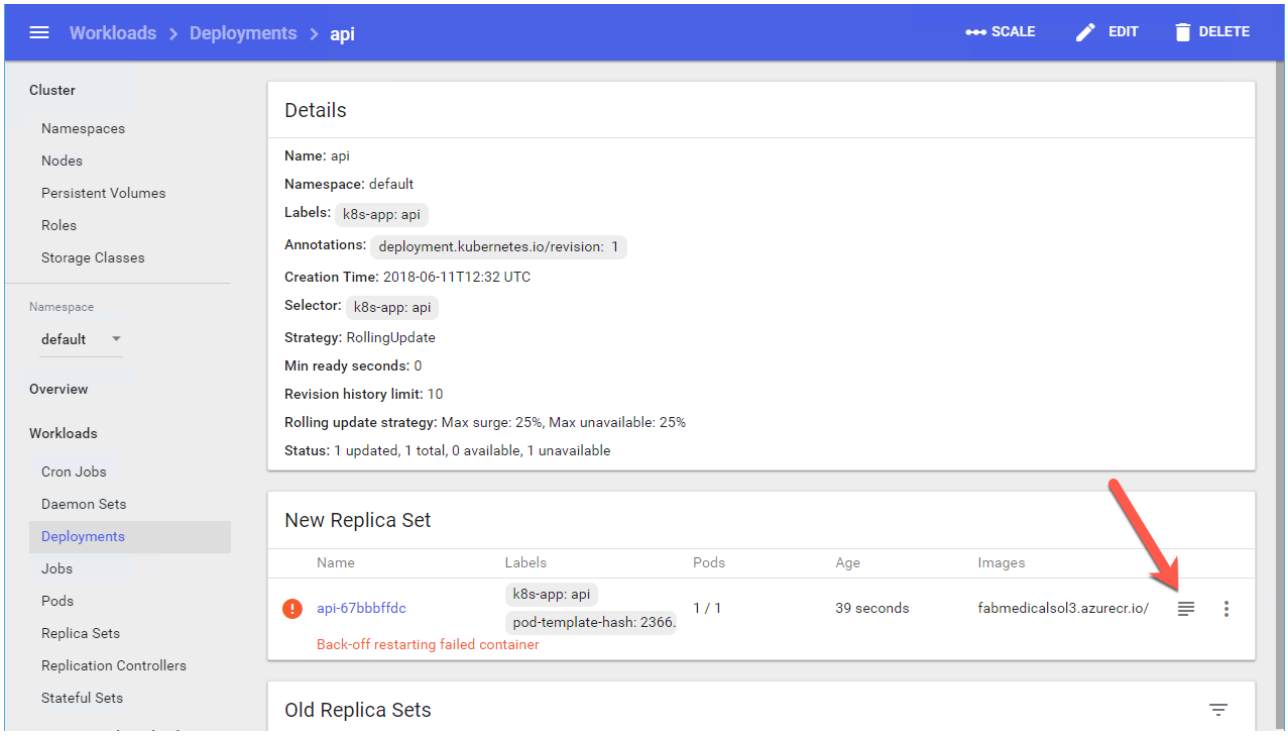
- Enter 0.125 for the CPU requirement
- Enter 128 for the Memory requirement



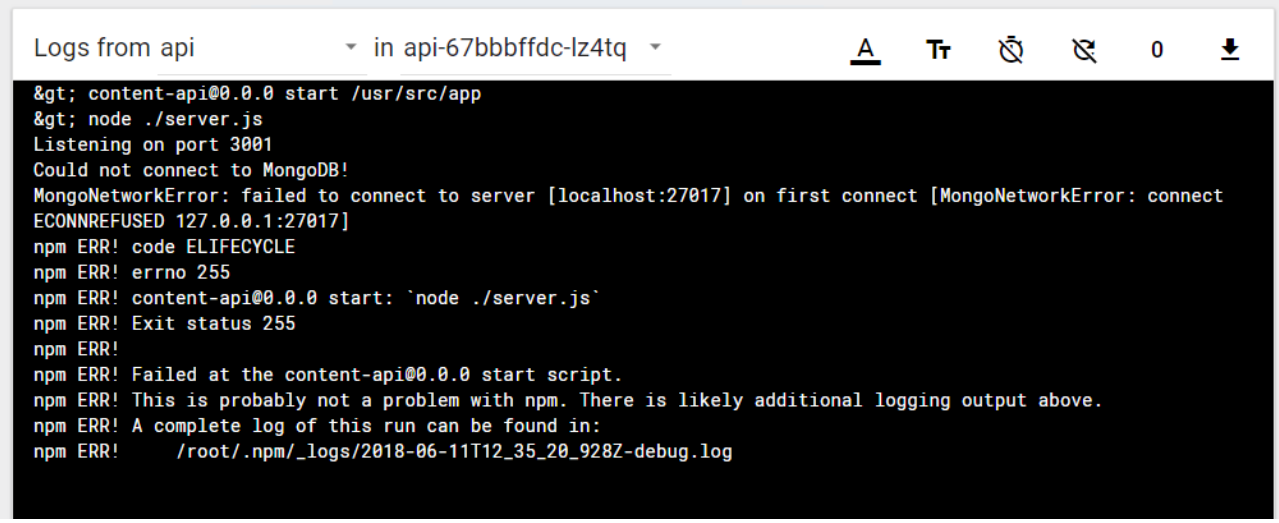

4. Select Deploy to initiate the service deployment based on the image. This can take a few minutes. In the meantime, you will be redirected to the Overview dashboard. Select the API deployment from the Overview dashboard to see the deployment in progress.



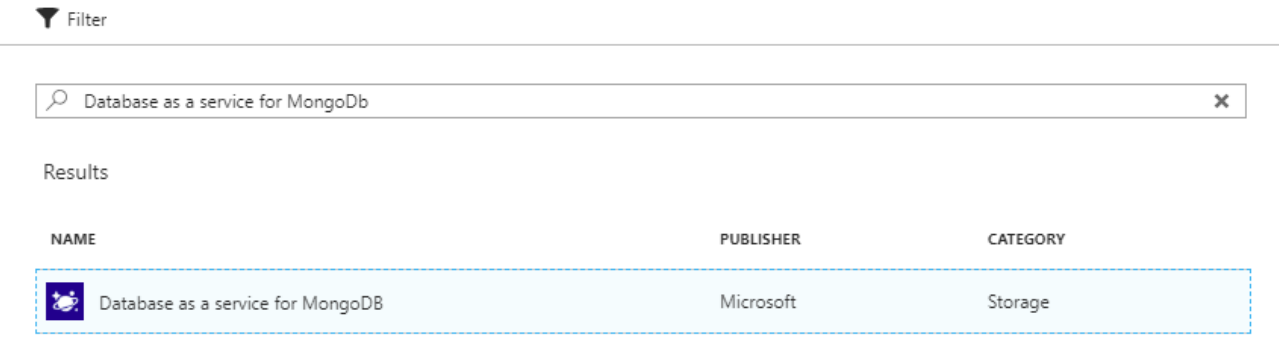

5. Kubernetes indicates a problem with the api Replica Set. Select the log icon to investigate.




6. The log indicates that the content-api application is once again failing because it cannot find a mongodb instance to communicate with. You will resolve this issue by migrating your data workload to CosmosDb.




7. Open the Azure portal in your browser and click "+ Create a resource". Search for "Database as a service for MongoDB", select the result and click "Create"



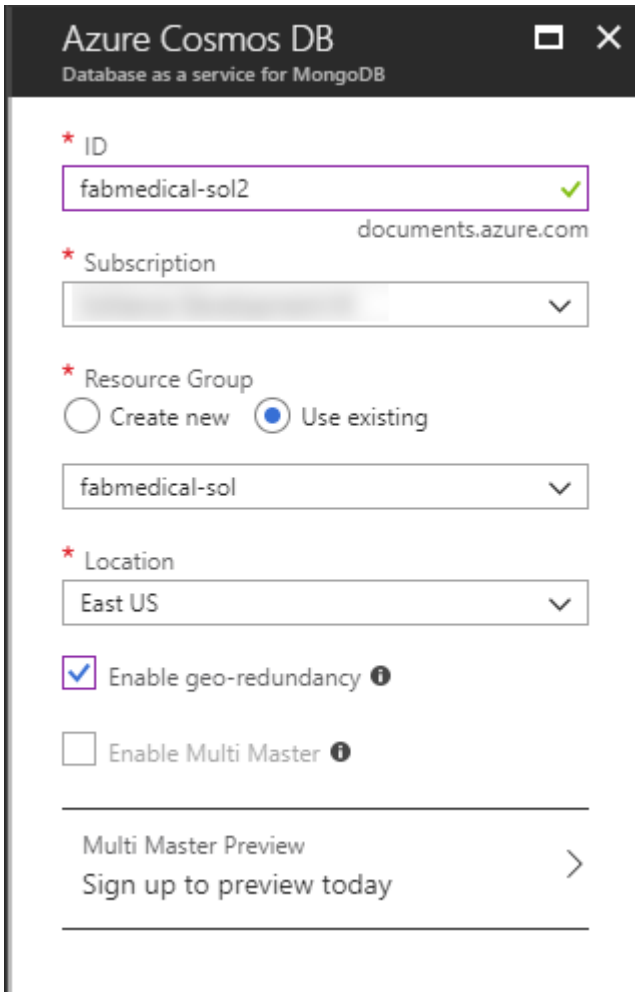

8. Configure Azure CosmosDb as follows and click "Create":

   -- **ID**: fabmedical-SUFFIX

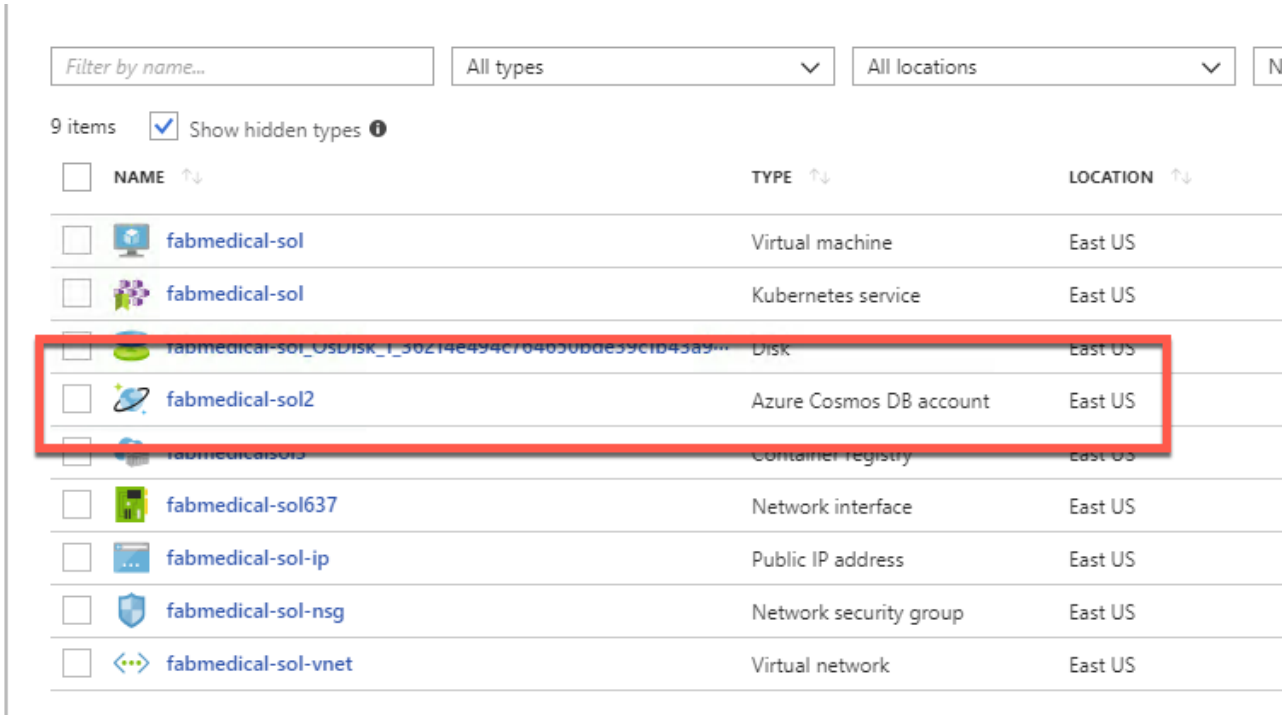
   -- **Subscription**: Use the same subscription you have used for all your other work.

   -- **Resource Group**: fabmedical-SUFFIX

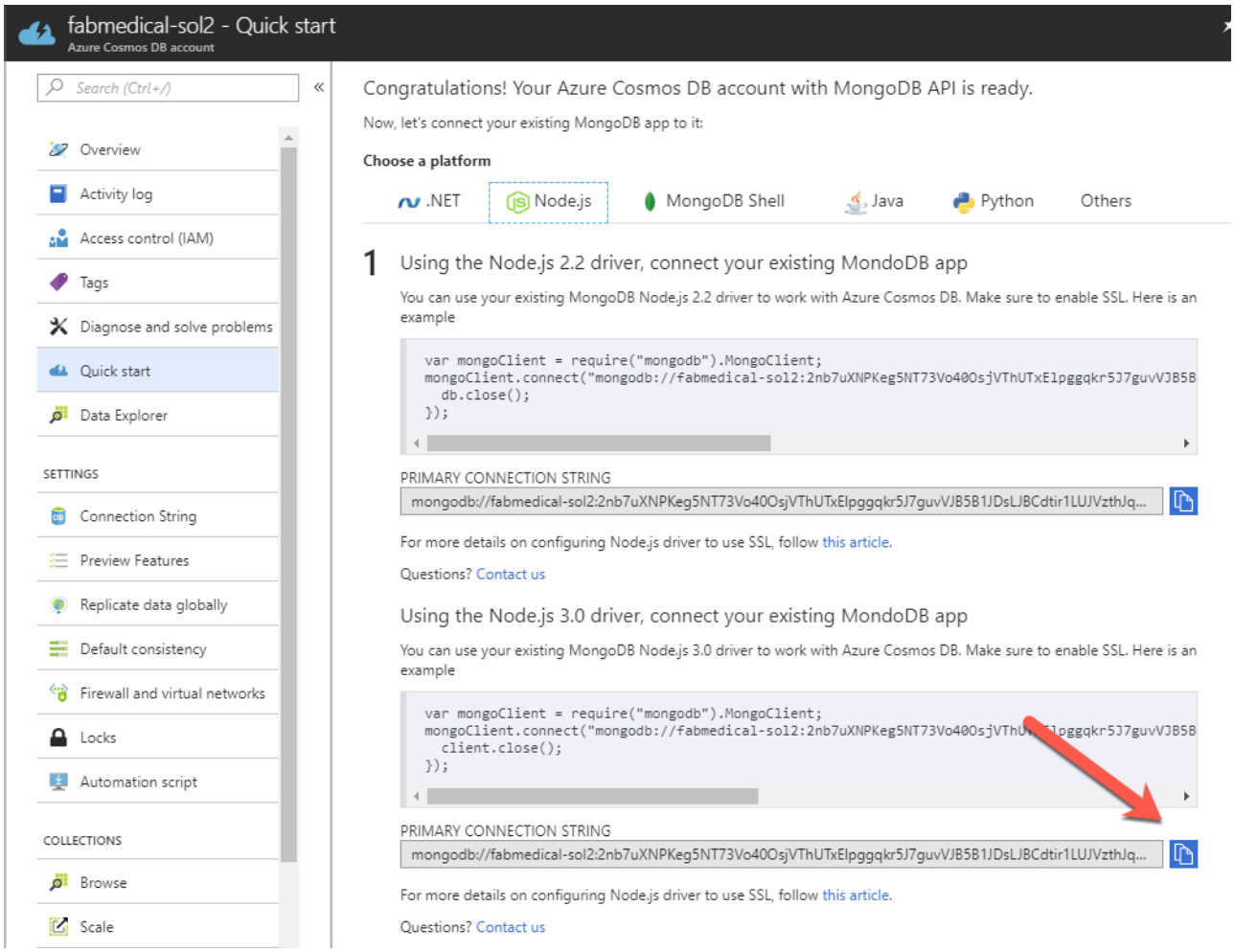
   -- **Geo-redundancy**: default (checked)




9. Navigate to your resource group and find your new CosmosDb resource. Click on the CosmosDb resource to view details.




10. Under "Quick Start" select the "Node.js" tab and copy the Node 3.0 connection string.




11. Update the provided connection string with a database "contentdb" and a replica set "globaldb"

> Note: User name and password redacted for brevity.

```
mongodb://<USERNAME>:<PASSWORD>@fabmedical-
sol2.documents.azure.com:10255/contentdb?ssl=true&replicaSet=globaldb
```

12. You will setup a Kubernetes secret to store the connection string, and configure the content-api application to access the secret. First, you must base64 encode the secret value. Open your WSL window and use the following command to encode the connection string and copy to your clipboard all in one step.

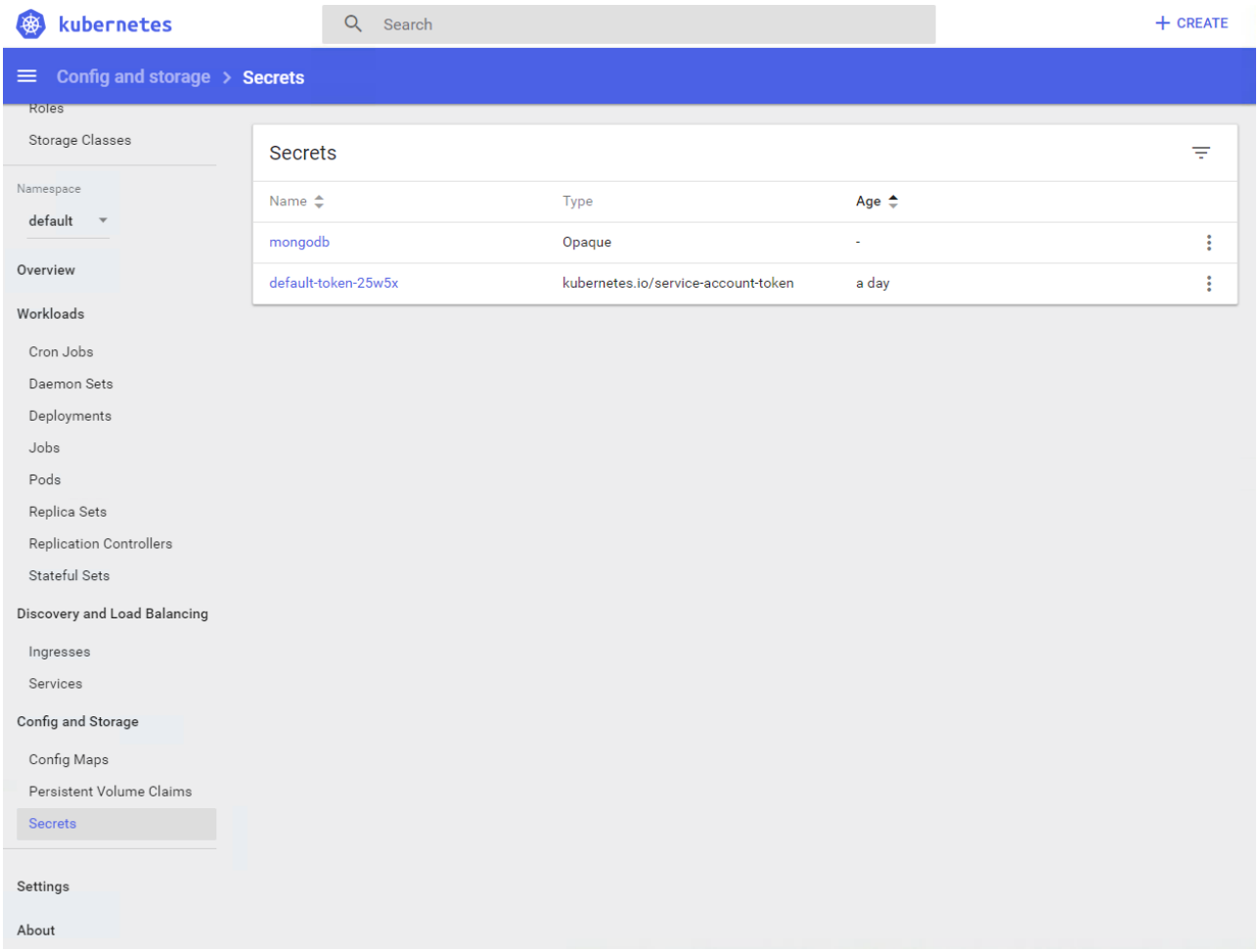
> If 'clip.exe' does not work, make sure your WSL window is not logged into the build agent over SSH.

```
echo -n "<connection string value>" | base64 -w 0 - | clip.exe
```

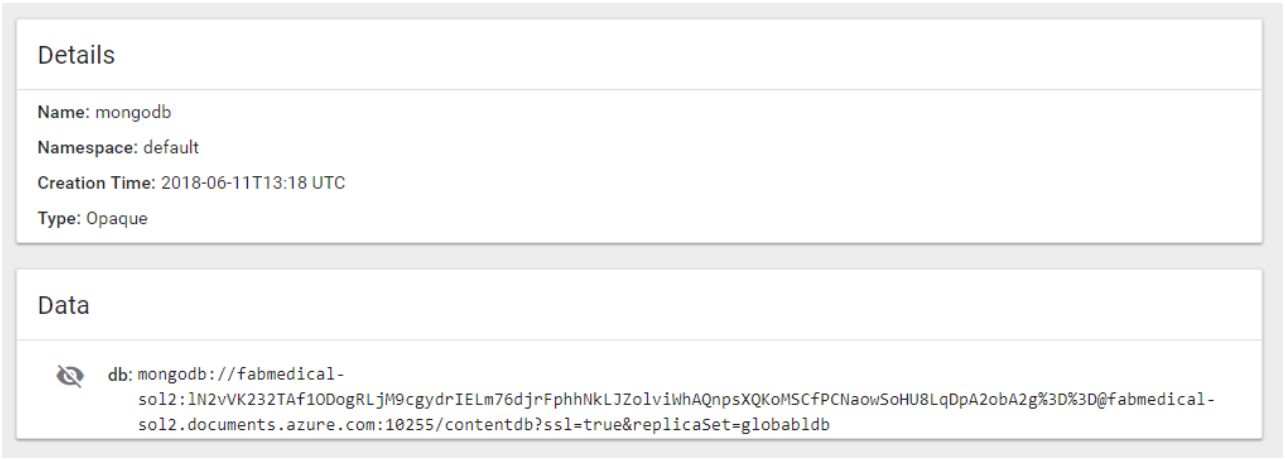
13. Return to the Kubernetes UI in your browser and click "+ Create". Update the following YAML with the encoded connection string from your clipboard, paste the YAML data into the create dialog and click "Upload".

```
apiVersion: v1
kind: Secret
metadata:
    name: mongodb
type: Opaque
data:
    db: <base64 encoded value>
```


14. Scroll down in the Kubernetes dashboard until you can see "Secrets" in the left hand menu. Click it.




15. View the details for the "mongodb" secret. Click the eyeball icon to show the secret.




16. Next, download the api deployment configuration using the following command in your WSL window:

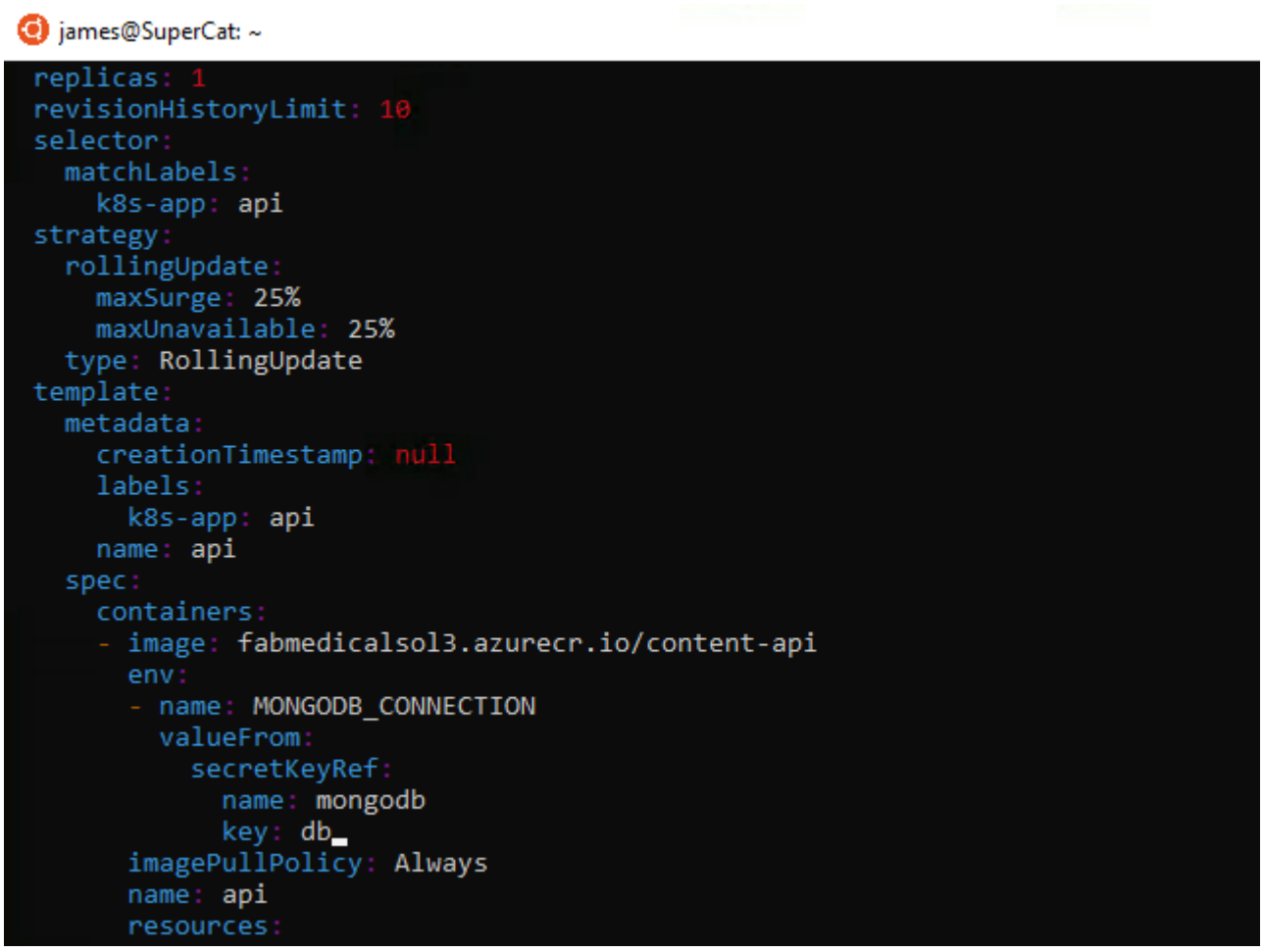
```
kubectl get -o=yaml --export=true deployment api > api.deployment.yml
```

17. Edit the downloaded file:

```
vi api.deployment.yml
```

a. Add the following environment configuration to the container spec, below the "image" property:

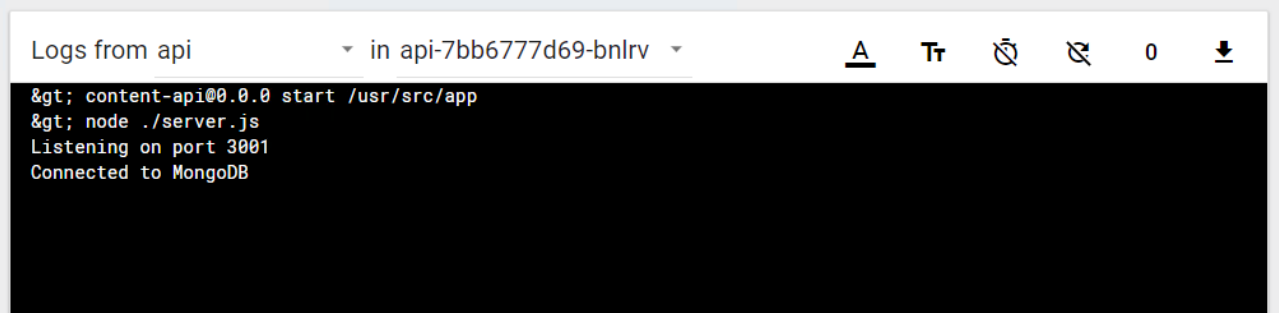
```
- image: fabmedicalsol2.azurecr.io/fabmedical/content-api
  env:
    - name: MONGODB_CONNECTION
      valueFrom:
        secretKeyRef:
          name: mongodb
          key: db
```




18. Update the api deployment by using `kubectl` to apply the new configuration

```
kubectl apply -f ./api.deployment.yml
```

19. Select "Deployments" then "api" to view the api deployment. It now has a healthy instance and the logs indicate it has connected to mongodb.




## Task 3: Deploy a service using kubectl

In this task, deploy the web service using `kubectl`.

1. Open a **new** WSL console
2. Create a text file called web.deployment.yml using Vim and press the "i" key to go into edit mode

```
vi web.deployment.yml
<i>
```

3. Copy and paste the following text into the editor:

   **NOTE: Be sure to copy and paste only the contents of the code block carefully to avoid introducing any special characters.**

```
apiVersion: extensions/v1beta1
kind: Deployment
metadata:
  labels:
      app: web
  name: web
spec:
  replicas: 1
  selector:
      matchLabels:
        app: web
  strategy:
      rollingUpdate:
        maxSurge: 1
        maxUnavailable: 1
      type: RollingUpdate
  template:
      metadata:
        labels:
            app: web
        name: web
      spec:
        containers:
        - image: [LOGINSERVER].azurecr.io/content-web
          env:
```

```
            - name: CONTENT_API_URL
              value: http://api:3001
          livenessProbe:
            httpGet:
                path: /
                port: 3000
            initialDelaySeconds: 30
            periodSeconds: 20
            timeoutSeconds: 10
            failureThreshold: 3
          imagePullPolicy: Always
          name: web
          ports:
            - containerPort: 3000
              hostPort: 80
              protocol: TCP
          resources:
            requests:
                cpu: 1000m
                memory: 128Mi
          securityContext:
            privileged: false
          terminationMessagePath: /dev/termination-log
          terminationMessagePolicy: File
        dnsPolicy: ClusterFirst
        restartPolicy: Always
        schedulerName: default-scheduler
        securityContext: {}
        terminationGracePeriodSeconds: 30
```

4. Edit this file and update the [LOGINSERVER] entry to match the name of your ACR login server

5. Press the Escape key and type ":wq". Then press the Enter key to save and close the file.

```
<Esc>
:wq
<Enter>
```

6. Create a text file called web.service.yml using Vim, and press the "i" key to go into edit mode

```
vi web.service.yml
```

7. Copy and paste the following text into the editor:

   **NOTE: Be sure to copy and paste only the contents of the code block carefully to avoid introducing any special characters.**

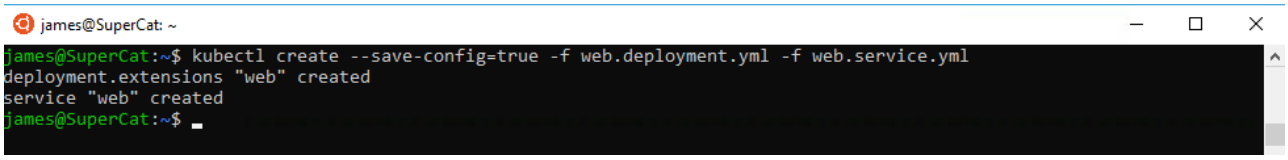
```

```

```
apiVersion: v1
kind: Service
metadata:
  labels:
      app: web
  name: web
spec:
  ports:
    - name: web-traffic
      port: 80
      protocol: TCP
      targetPort: 3000
  selector:
      app: web
  sessionAffinity: None
  type: LoadBalancer
```

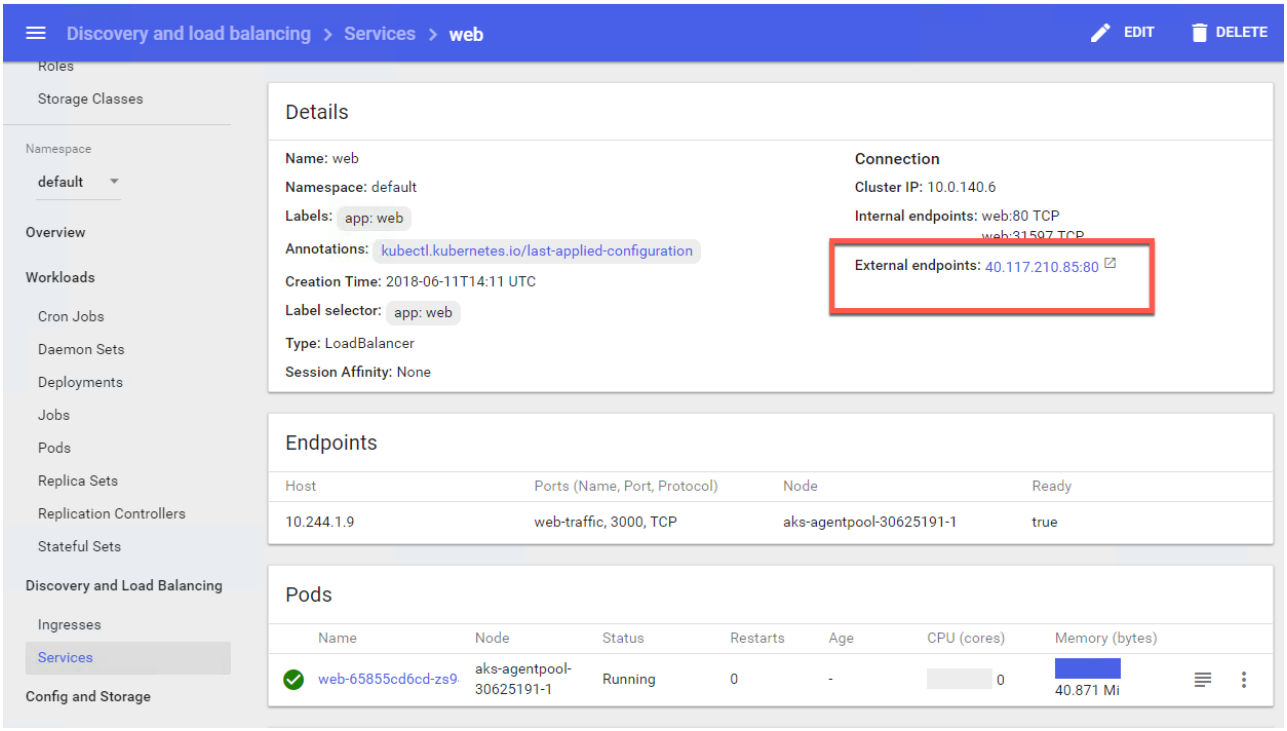
8. Press the Escape key and type ":wq"; then press the Enter key to save and close the file

9. Type the following command to deploy the application described by the YAML files. You will receive a message indicating the items kubectl has created a web deployment and a web service.

```
kubectl create --save-config=true -f web.deployment.yml -f
web.service.yml
```




10. Return to the browser where you have the Kubernetes management dashboard open. From the navigation menu, select Services view under Discovery and Load Balancing. From the Services view, select the web service and from this view, you will see the web service deploying. This deployment can take a few minutes. When it completes you should be able to access the website via an external endpoint.




11. Select the speakers and sessions links. Note that no data is displayed, although we have connected to our CosmosDb instance, there is no data loaded. You will resolve this by running the content-init application as a Kubernetes Job.


## Task 4: Initialize database with a Kubernetes Job

In this task, you will use a Kubernetes Job to run a container that is meant to execute a task and terminate, rather than run all the time.

1. In your WSL window create a text file called web.service.yml using Vim, and press the "i" key to go into edit mode

```
vi init.job.yml
```

2. Copy and paste the following text into the editor:

   **NOTE: Be sure to copy and paste only the contents of the code block carefully to avoid introducing any special characters.**

```
apiVersion: batch/v1
kind: Job
metadata:
  name: init
spec:
  template:
    spec:
      containers:
      - name: init
        image: [LOGINSERVER]/content-init
        env:
          - name: MONGODB_CONNECTION
            valueFrom:
              secretKeyRef:
                name: mongodb
                key: db
      restartPolicy: Never
  backoffLimit: 4
```

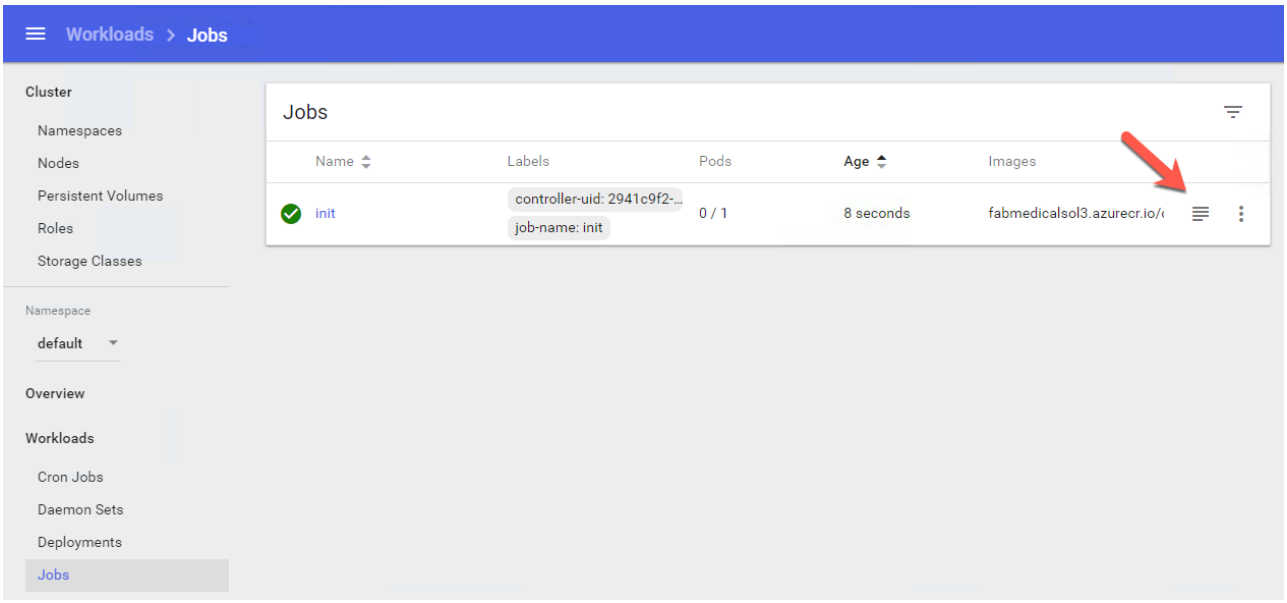
3. Edit this file and update the [LOGINSERVER] entry to match the name of your ACR login server

4. Press the Escape key and type ":wq". Then press the Enter key to save and close the file.

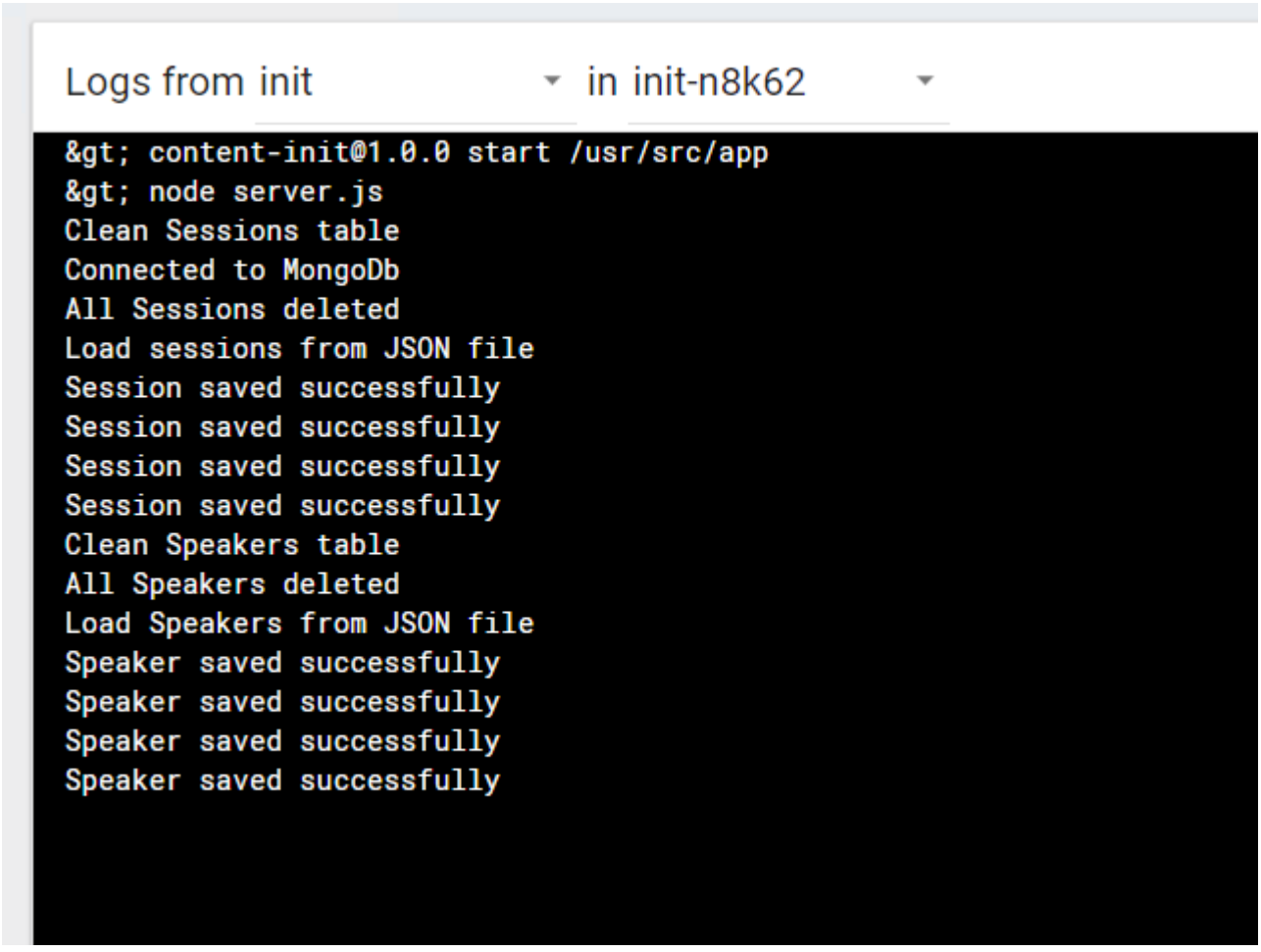
5. Type the following command to deploy the job described by the YAML. You will receive a message indicating the kubectl has created an init "job.batch".

```
kubectl create --save-config=true -f init.job.yml
```

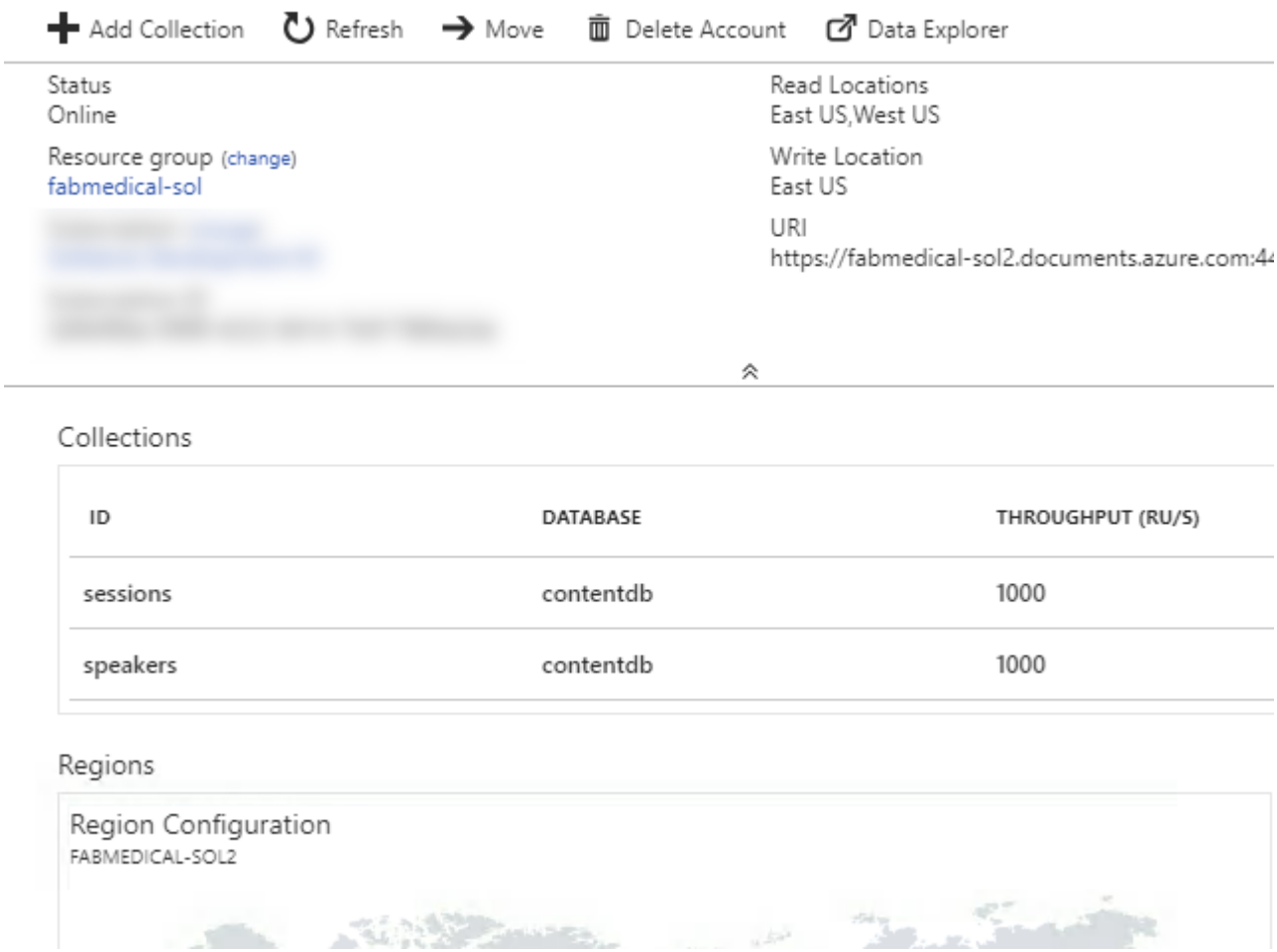
6. View the Job by selecting "Jobs" under "Workloads" in the Kubernetes UI




7. Select the log icon to view the logs




8. Next view your CosmosDb instance in the Azure portal and see that it now contains two collections

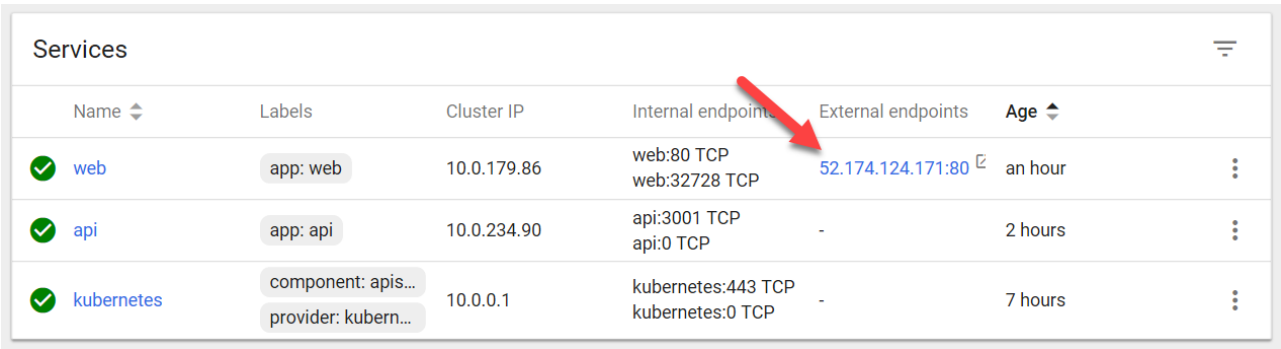



## Task 5: Test the application in a browser

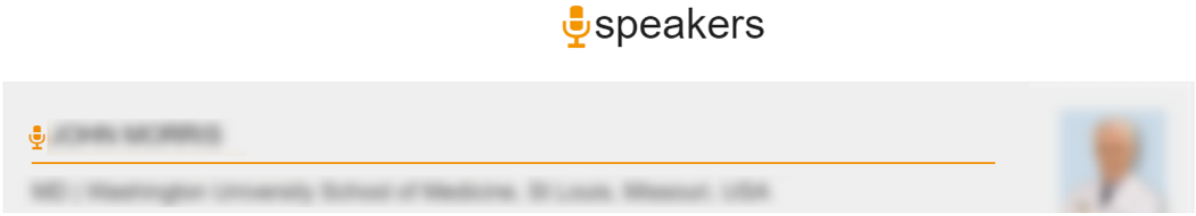
In this task, you will verify that you can browse to the web service you have deployed and view the speaker and content information exposed by the API service.

1. From the Kubernetes management dashboard, in the navigation menu, select the Services view under Discovery and Load Balancing

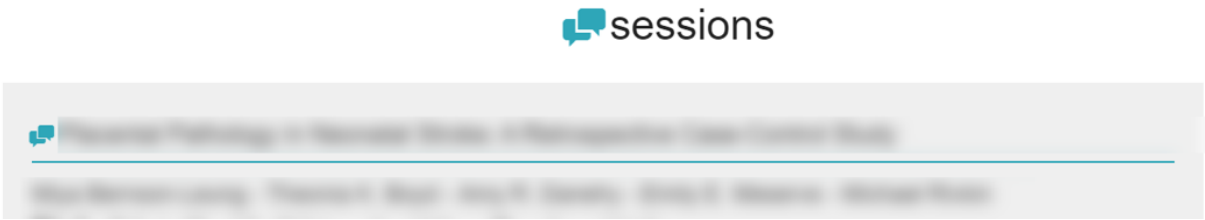
2. In the list of services, locate the external endpoint for the web service and select this hyperlink to launch the application




3. You will see the web application in your browser and be able to select the Speakers and Sessions links to view those pages without errors. The lack of errors means that the web application is correctly calling the API service to show the details on each of those pages.






## Exercise 3: Scale the application and test HA

**Duration**: 20 minutes

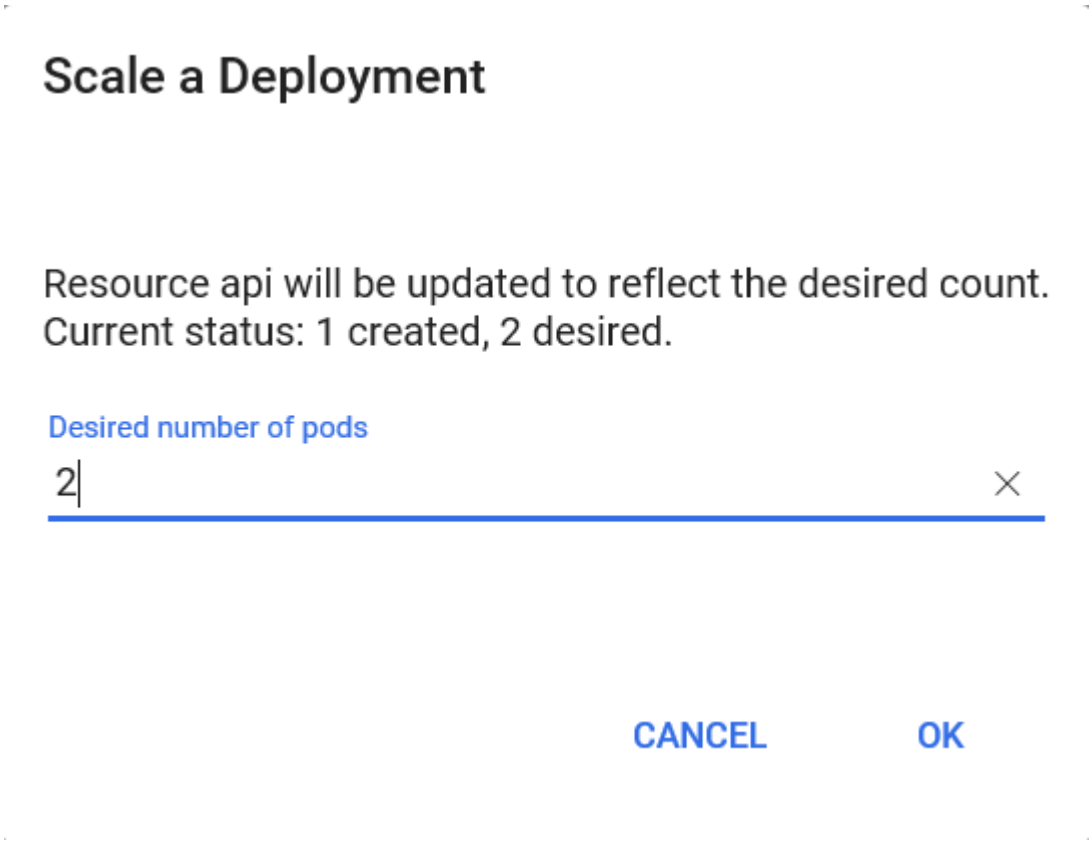
At this point you have deployed a single instance of the web and API service containers. In this exercise, you will increase the number of container instances for the web service and scale the front end on the existing cluster.

### Task 1: Increase service instances from the Kubernetes dashboard

In this task, you will increase the number of instances for the API deployment in the Kubernetes management dashboard. While it is deploying, you will observe the changing status.

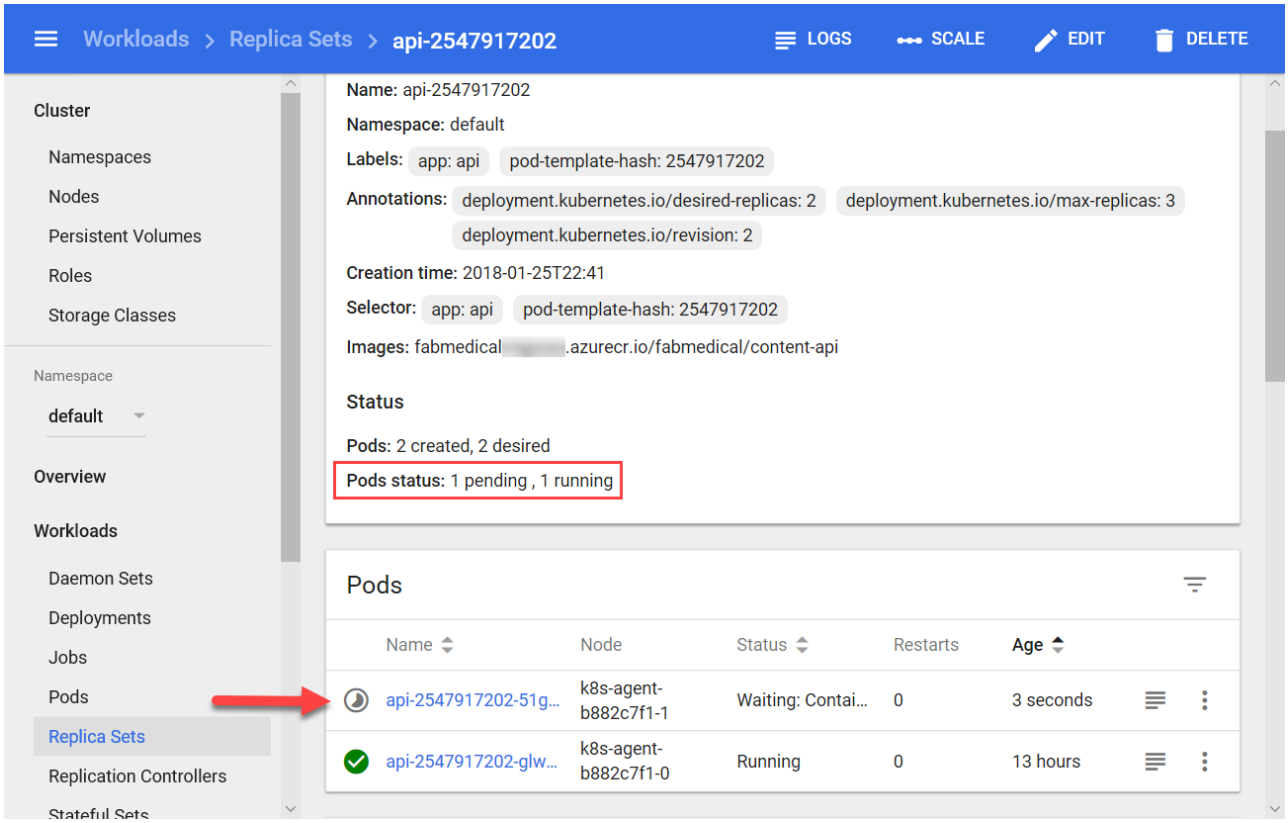
1. From the navigation menu, select Workloads>Deployments, and then select the API deployment
2. Select SCALE


3. Change the number of pods to 2, and then select **OK**

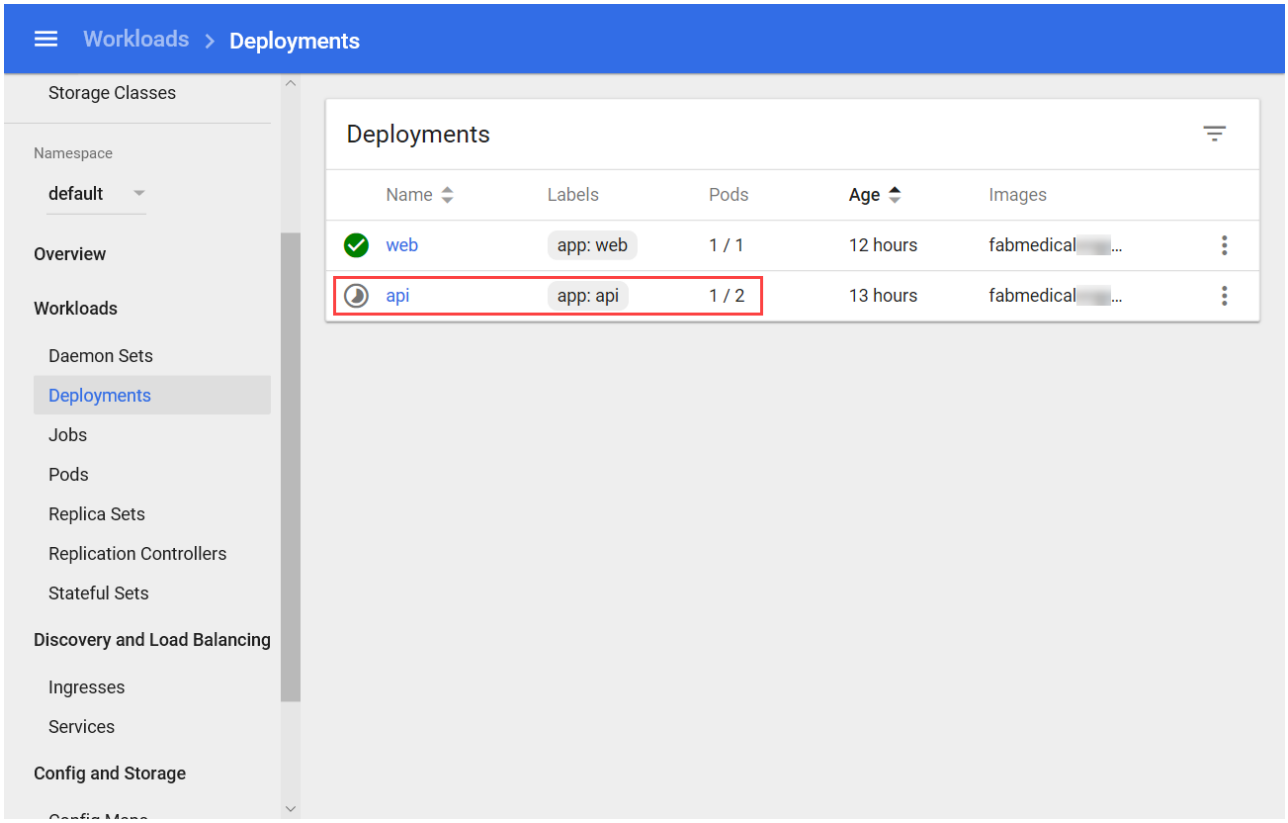



**NOTE: If the deployment completes quickly, you may not see the deployment Waiting states in the dashboard as described in the following steps**.

4. From the Replica Set view for the API, you'll see it is now deploying and that there is one healthy instance and one pending instance




5. From the navigation menu, select Deployments from the list. Note that the api service has a pending status indicated by the grey timer icon and it shows a pod count 1 of 2 instances (shown as "1/2").




6. From the Navigation menu, select Workloads. From this view, note that the health overview in the right panel of this view. You'll see the following:

    - One deployment and one replica set are each healthy for the api service
    - One replica set is healthy for the web service

    - Three pods are healthy

7. Navigate to the web application from the browser again. The application should still work without errors as you navigate to Speakers and Sessions pages

    - Navigate to the /stats.html page. You'll see information about the environment including:

        - webTaskId: the task identifier for the web service instance
        - taskId: the task identifier for the API service instance
        - hostName: the hostname identifier for the API service instance
        - pid: the process id for the API service instance
        - mem: some memory indicators returned from the API service instance
        - counters: counters for the service itself, as returned by the API service instance
        - uptime: the up time for the API service

    - Refresh the page in the browser, and you can see the hostName change between the two API service instances. The letters after "api-{number}-" in the hostname will change.

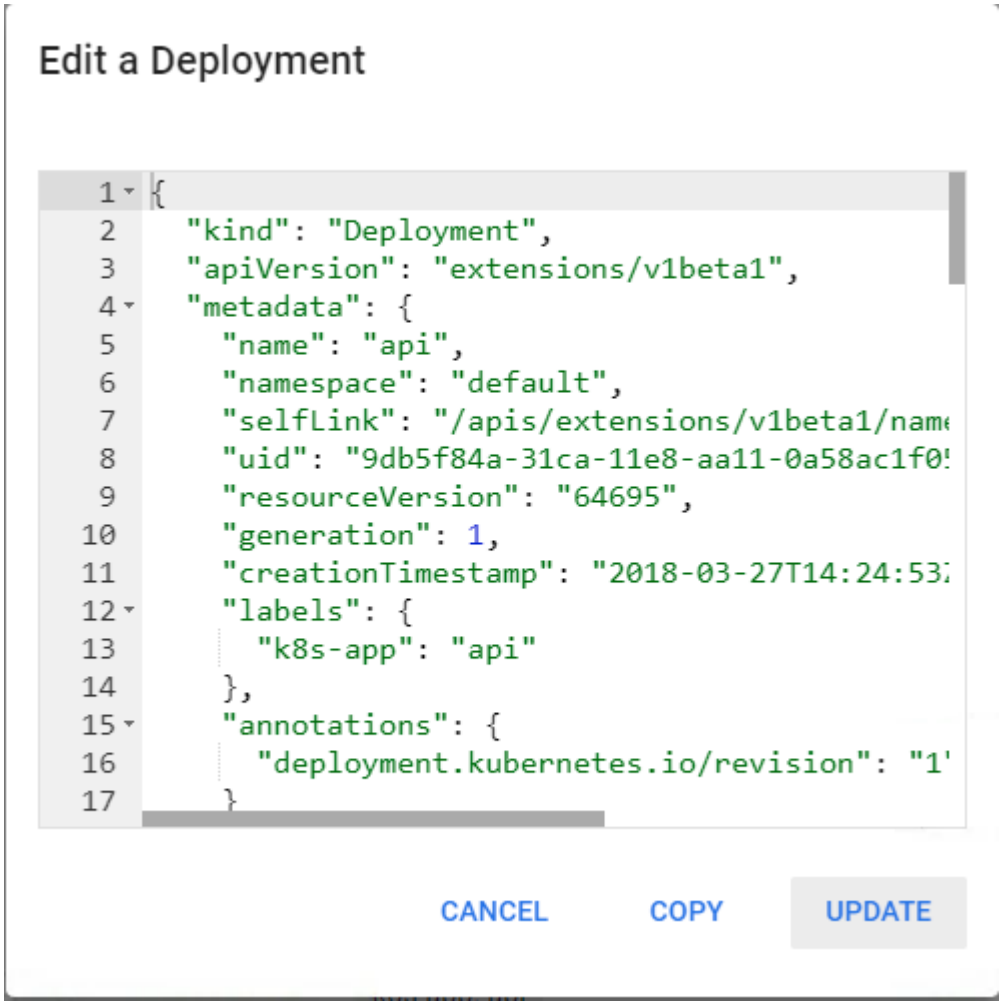
## Task 2: Increase service instances beyond available resources

In this task, you will try to increase the number of instances for the API service container beyond available resources in the cluster. You will observe how Kubernetes handles this condition and correct the problem.

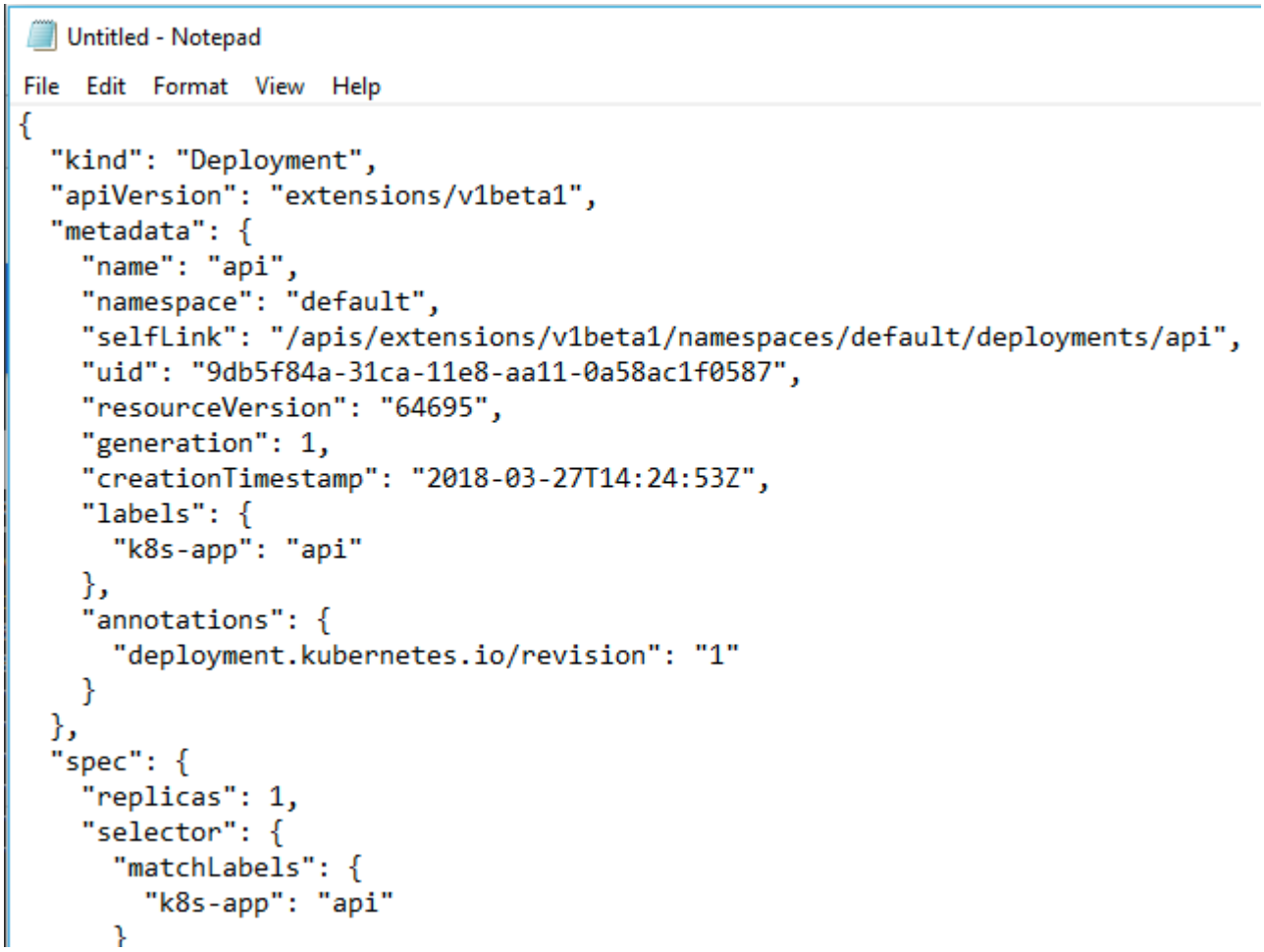
1. From the navigation menu, select Deployments. From this view, select the API deployment.

2. Configure the deployment to use a fixed host port for initial testing. Select Edit.


3. In the Edit a Deployment dialog, you will see a list of settings shown in JSON format. Use the copy button to copy the text to your clipboard.




4. Paste the contents into the text editor of your choice (notepad is shown here, MacOS users can use TextEdit)




5. Scroll down about half way to find the node "$.spec.template.spec.containers[0]", as shown in the screenshot below

```
{
  "kind": "Deployment",
  "apiVersion": "extensions/v1beta1",
  "metadata": {
    "name": "api",
    "namespace": "default",
    "selfLink": "/apis/extensions/v1beta1/namespaces/default/deployments/api",
    "uid": "9db5f84a-31ca-11e8-aa11-0a58ac1f0587",
    "resourceVersion": "64695",
    "generation": 1,
    "creationTimestamp": "2018-03-27T14:24:53Z",
    "labels": {
      "k8s-app": "api"
    },
    "annotations": {
      "deployment.kubernetes.io/revision": "1"
    }
  },
  "spec": {
    "replicas": 1,
    "selector": {
      "matchLabels": {
        "k8s-app": "api"
      }
    },
    "template": {
      "metadata": {
        "name": "api",
        "creationTimestamp": null,
        "labels": {
          "k8s-app": "api"
        }
      }
    "spec": {
      "containers": [
        {
          "name": "api",
          "image": "fabmedicalsol.azurecr.io/fabmedical/content-api",
          "resources": {
            "requests": {
              "cpu": "125m",
              "memory": "128Mi"
            }
```

6. The containers spec has a single entry for the API container at the moment. You'll see that the name of the container is "api" - this is how you know you are looking at the correct container spec.

    - Add the following JSON snippet below the "name" property in the container spec

```
"ports": [
    {
    "containerPort": 3001,
    "hostPort": 3001
    }
],
```

- Your container spec should now look like this:

```
"spec": {
  "containers": [
    {
      "name": "api",
      "ports": [
        {
          "containerPort": 3001,
          "hostPort": 3001
        }
      ],
      "image": "fabmedicalcsel.azurecr.io/fabmedical/content-api",
      "resources": {
        "requests": {
          "cpu": "125m",
          "memory": "128Mi"
        }
      },
      "terminationMessagePath": "/dev/termination-log",
      "terminationMessagePolicy": "File",
      "imagePullPolicy": "Always",
      "securityContext": {
        "privileged": false
      }
    }
  ],
  "restartPolicy": "Always",
  "terminationGracePeriodSeconds": 30
```

7. Copy the updated JSON document from notepad into the clipboard. Return to the Kubernetes dashboard, which should still be viewing the "api" deployment.

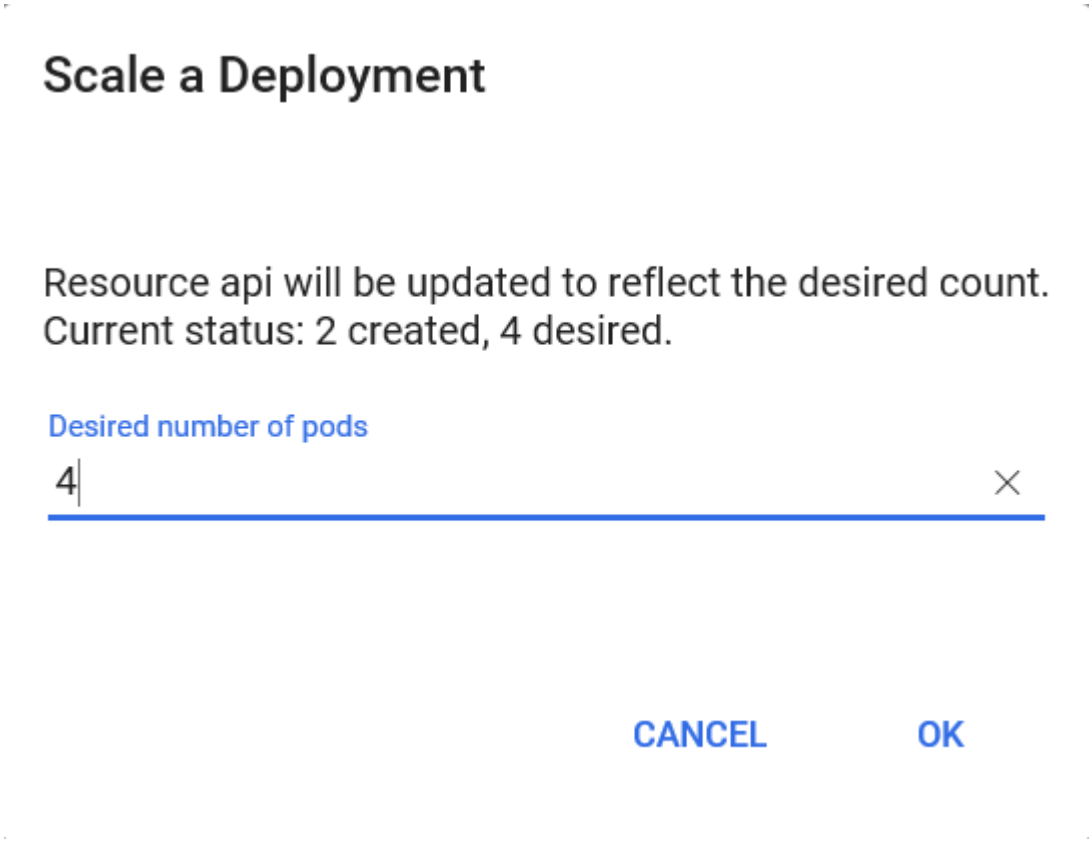
   -- Select Edit


   -- Paste the updated JSON document

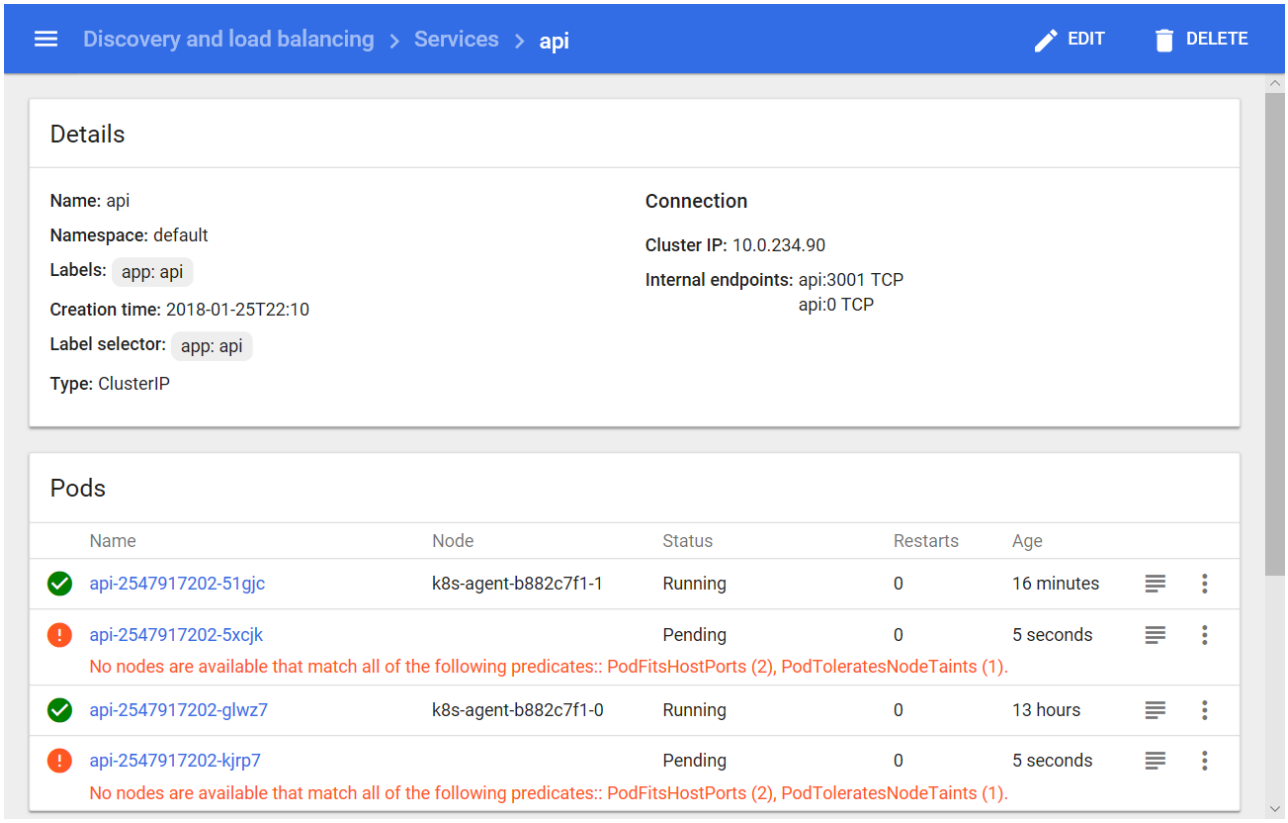
   -- Select Update


8. From the API deployment view, select **Scale**

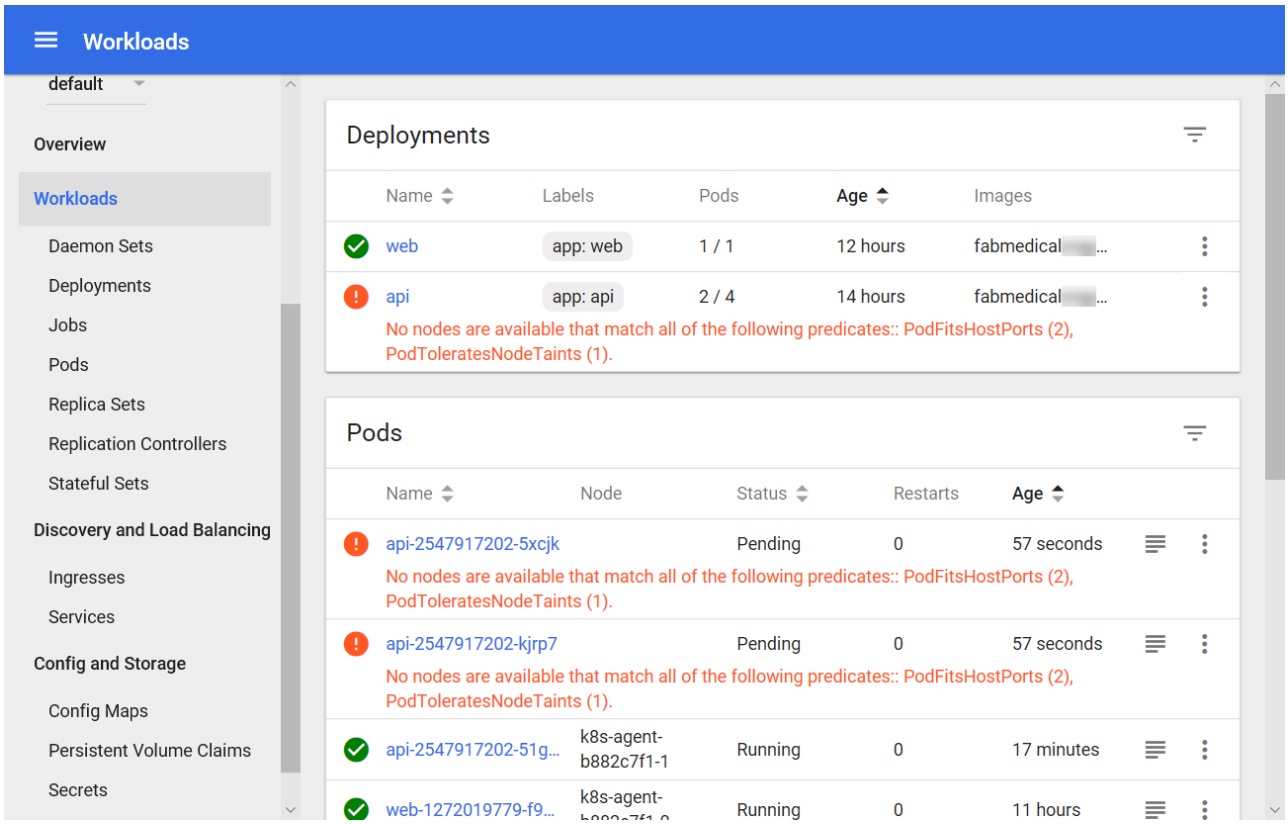

9. Change the number of pods to 4 and select **OK**




10. From the navigation menu, select Services view under Discovery and Load Balancing. Select the api service from the Services list. From the api service view, you'll see it has two healthy instances and two unhealthy (or possibly pending depending on timing) instances.



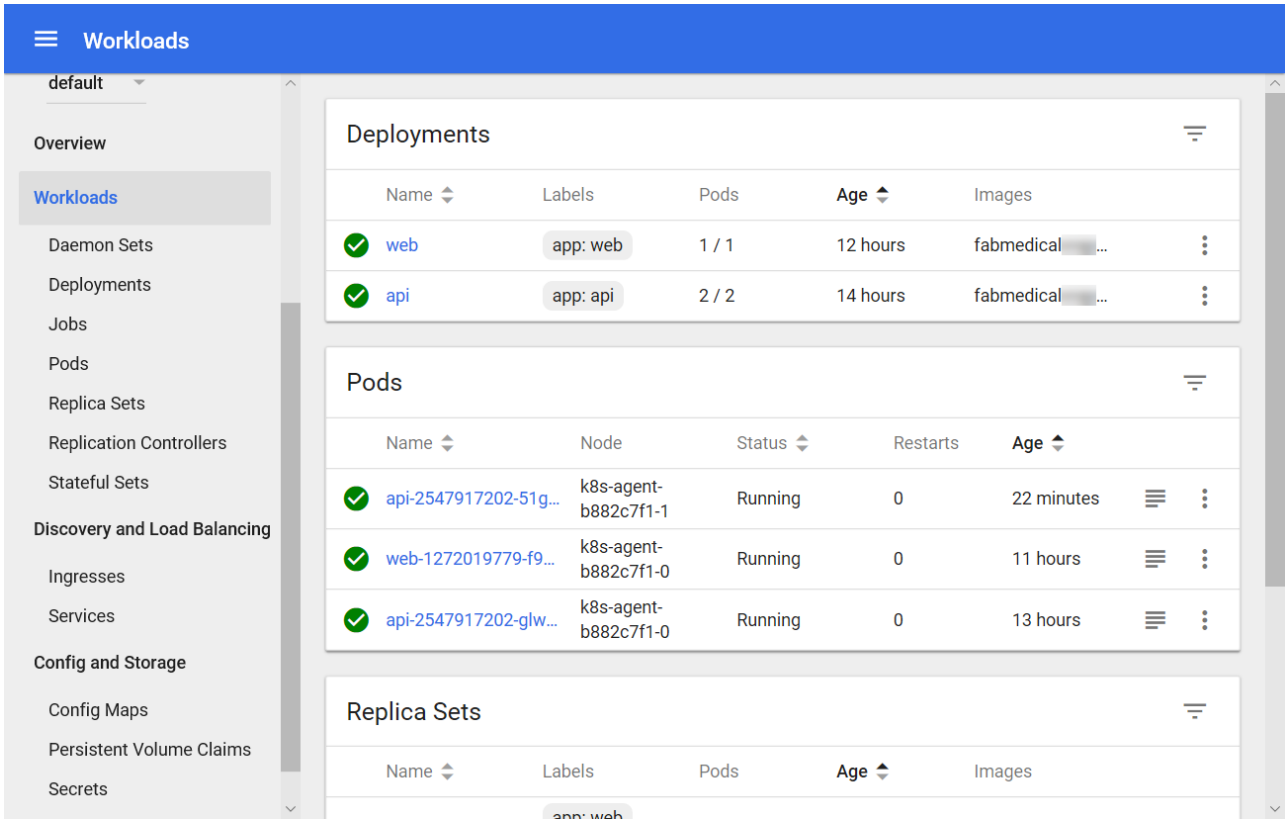

11. After a few minutes, select Workloads from the navigation menu. From this view, you should see an alert reported for the api deployment.




**NOTE: This message indicates that there weren't enough available resources to match the requirements for a new pod instance. In this case, this is because the instance requires port 3001, and since there are only 2 nodes available in the cluster, only two api instances can be scheduled. The third and fourth pod instances will wait for a new node to be available that can run another instance using that port.**

12. Reduce the number of requested pods to 2 using the Scale button

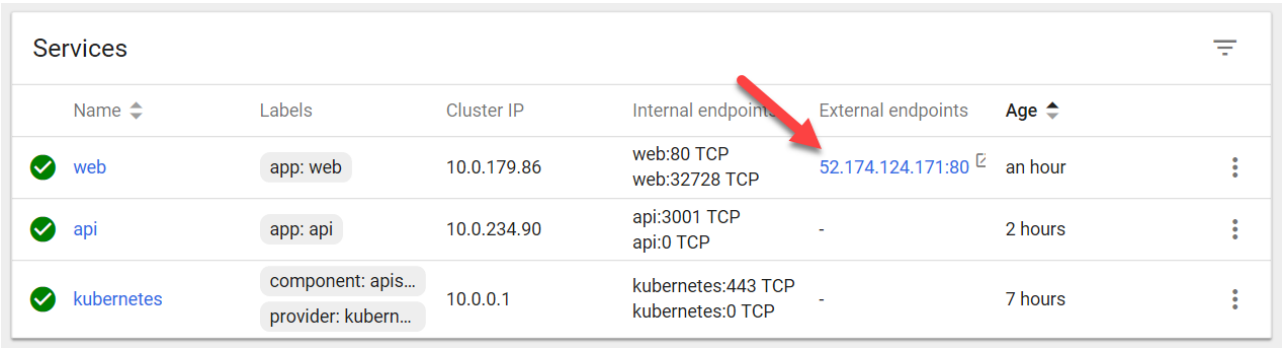
13. Almost immediately, the warning message from the Workloads dashboard should disappear, and the API deployment will show 2/2 pods are running



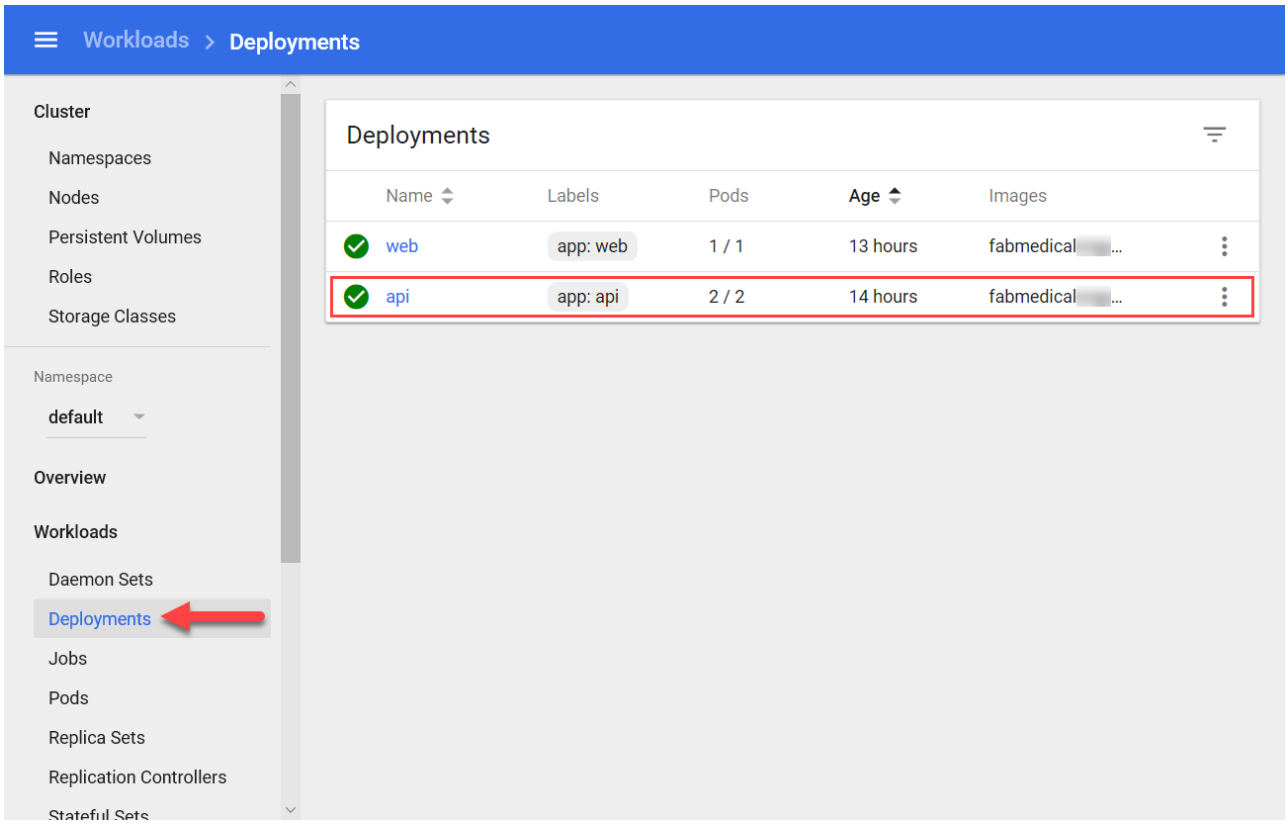

## Task 3: Restart containers and test HA

In this task, you will restart containers and validate that the restart does not impact the running service.

1. From the navigation menu on the left, select Services view under Discovery and Load Balancing. From the Services list, select the external endpoint hyperlink for the web service, and visit the stats page by adding /stats.html to the URL. Keep this open and handy to be refreshed as you complete the steps that follow.

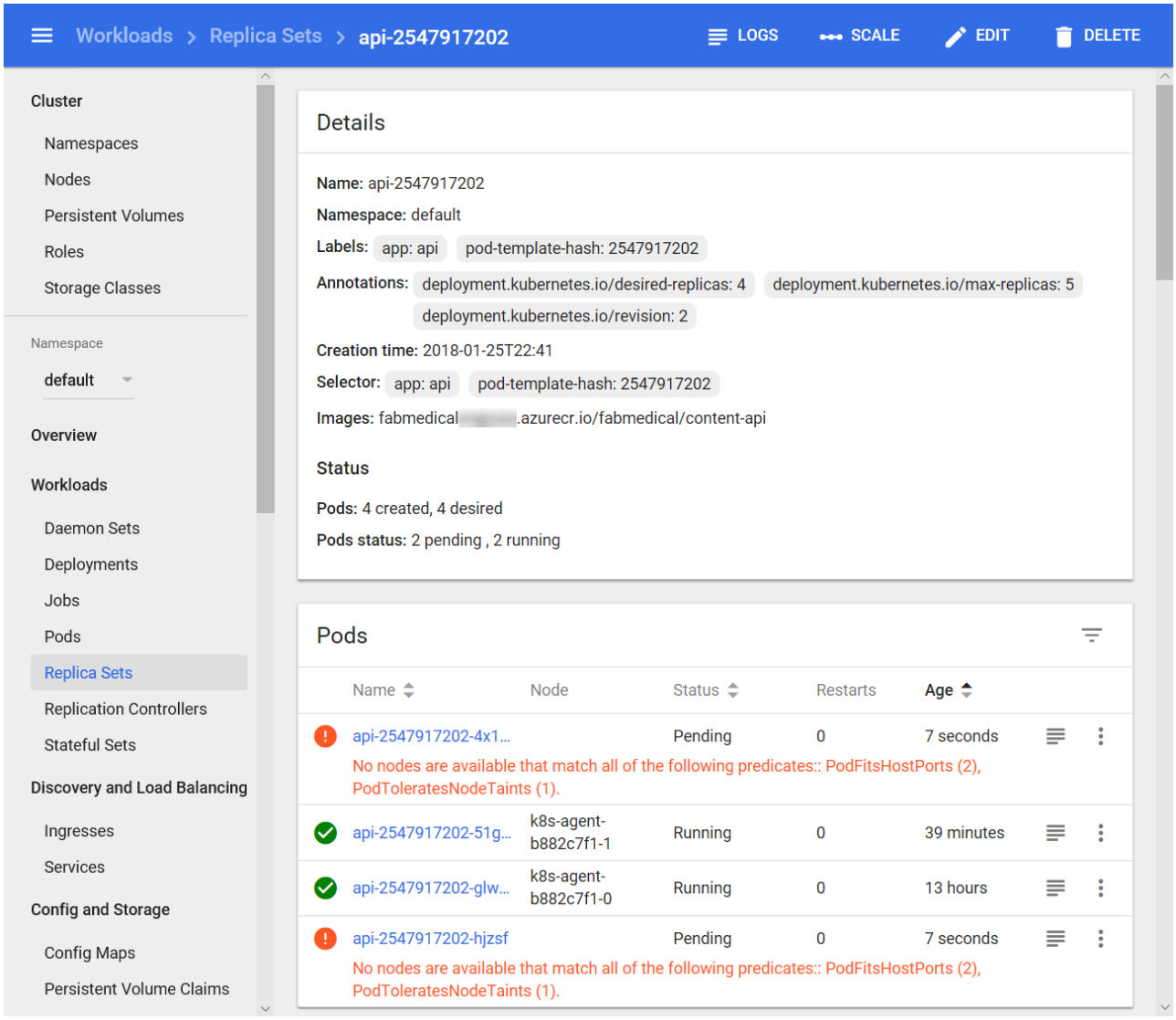



2. From the navigation menu, select Workloads>Deployments. From Deployments list, select the API deployment.

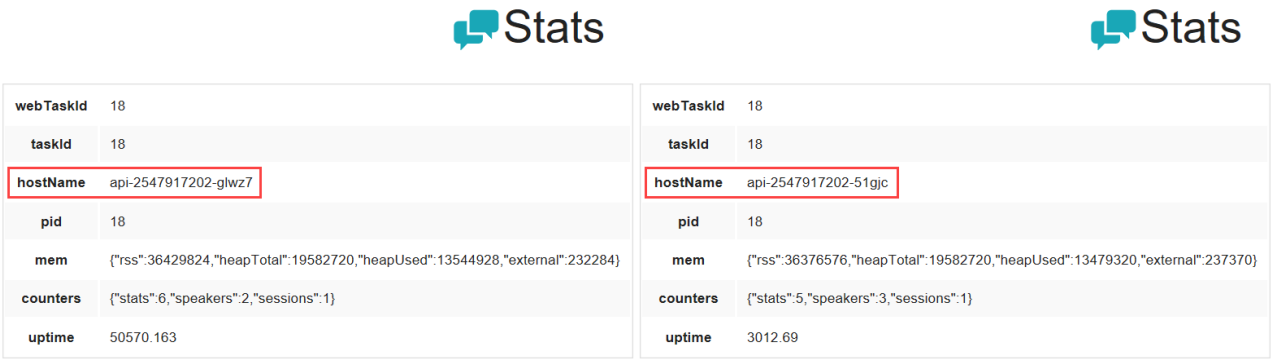



3. From the API deployment view, select **Scale** and from the dialog presented, and enter 4 for the desired number of pods. Select **OK**.

4. From the navigation menu, select Workloads>Replica Sets. Select the api replica set and, from the Replica Set view, you will see that two pods cannot deploy.

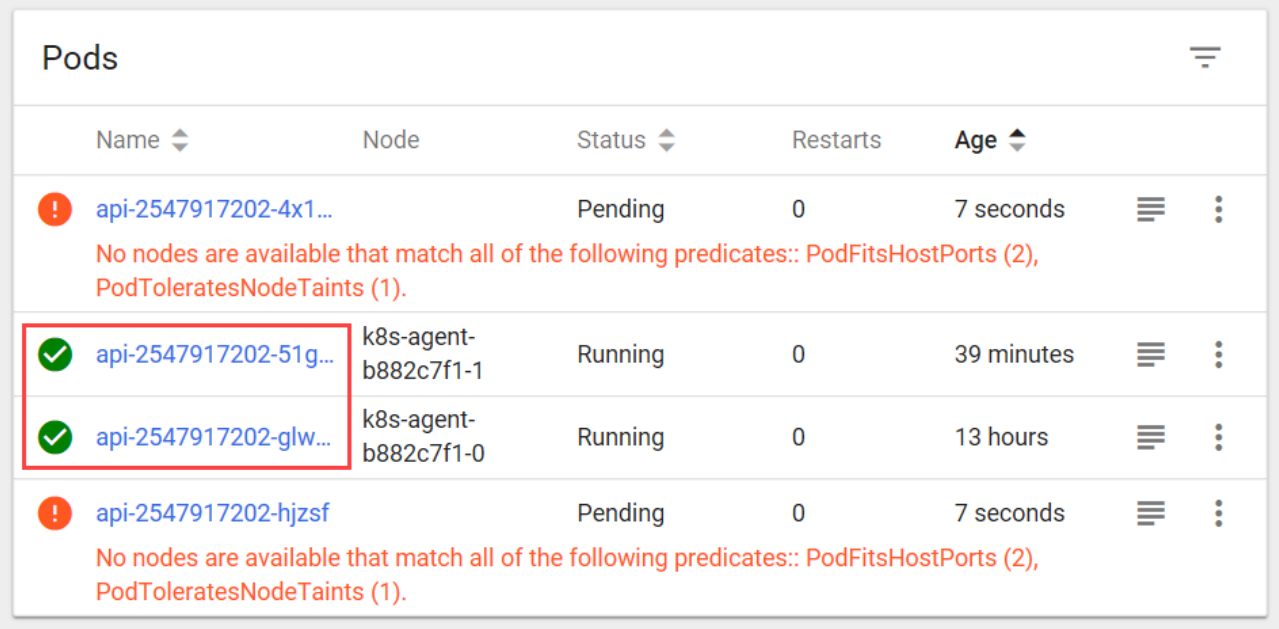



5. Return to the browser tab with the web application stats page loaded. Refresh the page over and over. You will not see any errors, but you will see the api host name change between the two api pod instances periodically. The task id and pid might also change between the two api pod instances.

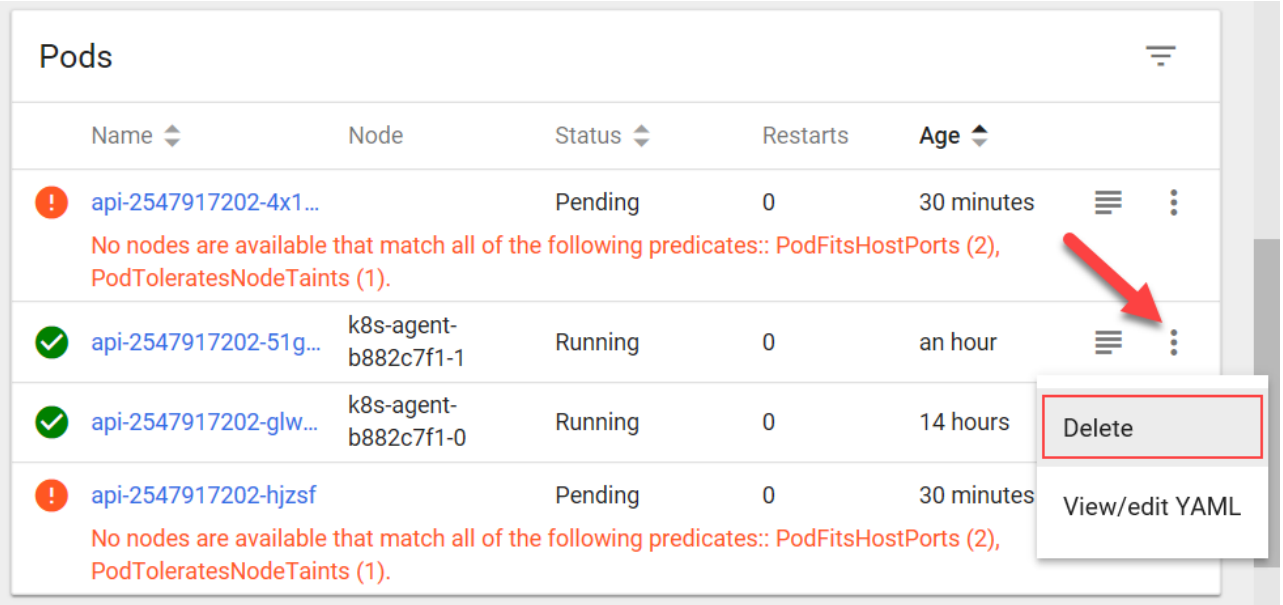



6. After refreshing enough times to see that the hostName value is changing and the service remains healthy, return to the Replica Sets view for the API. From the navigation menu, select Replica Sets under Workloads and select the API replica set.

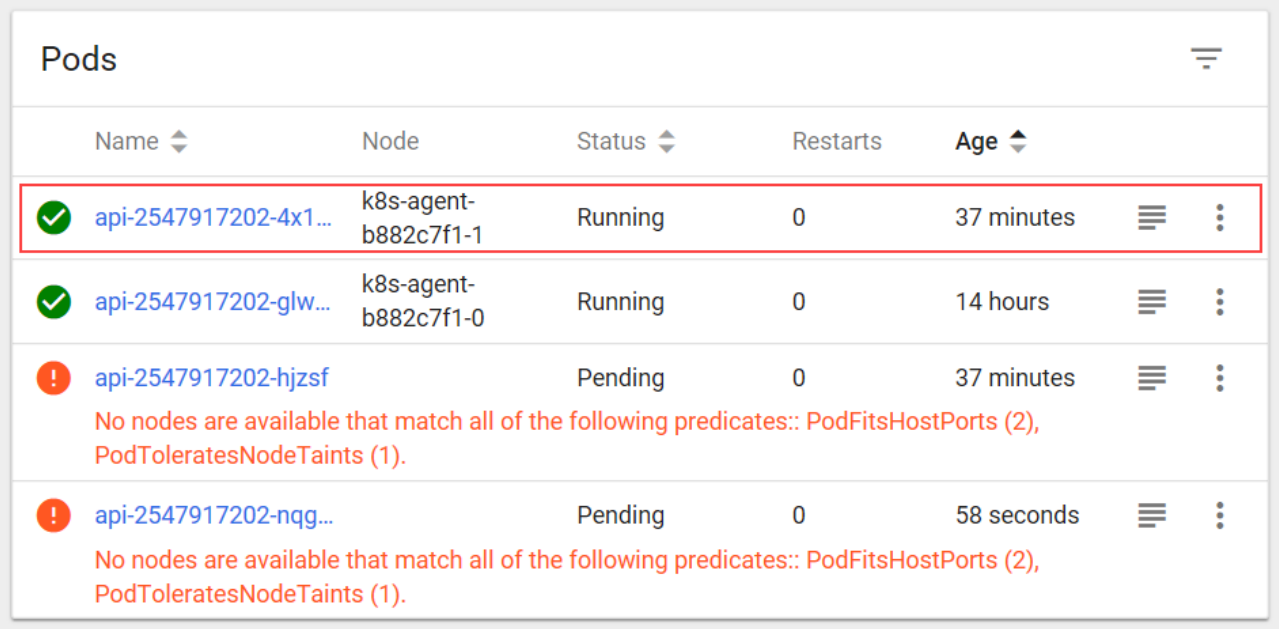
7. From this view, take note that the hostName value shown in the web application stats page matches the pod names for the pods that are running.




8. Note the remaining pods are still pending, since there are not enough port resources available to launch another instance. Make some room by deleting a running instance. Select the context menu and choose Delete for one of the healthy pods.

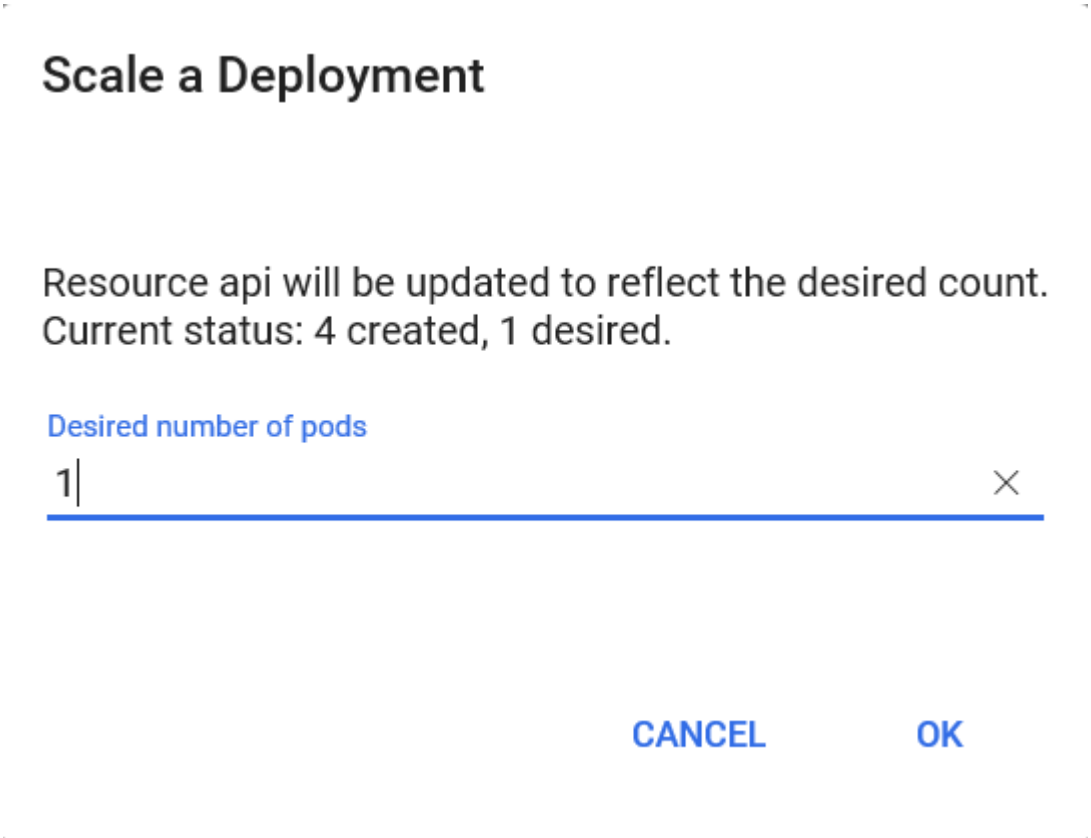



9. Once the running instance is gone, Kubernetes will be able to launch one of the pending instances. However, because you set the desired size of the deploy to 4, Kubernetes will add a new pending instance. Removing a running instance allowed a pending instance to start, but in the end, the number of pending and running instances is unchanged.

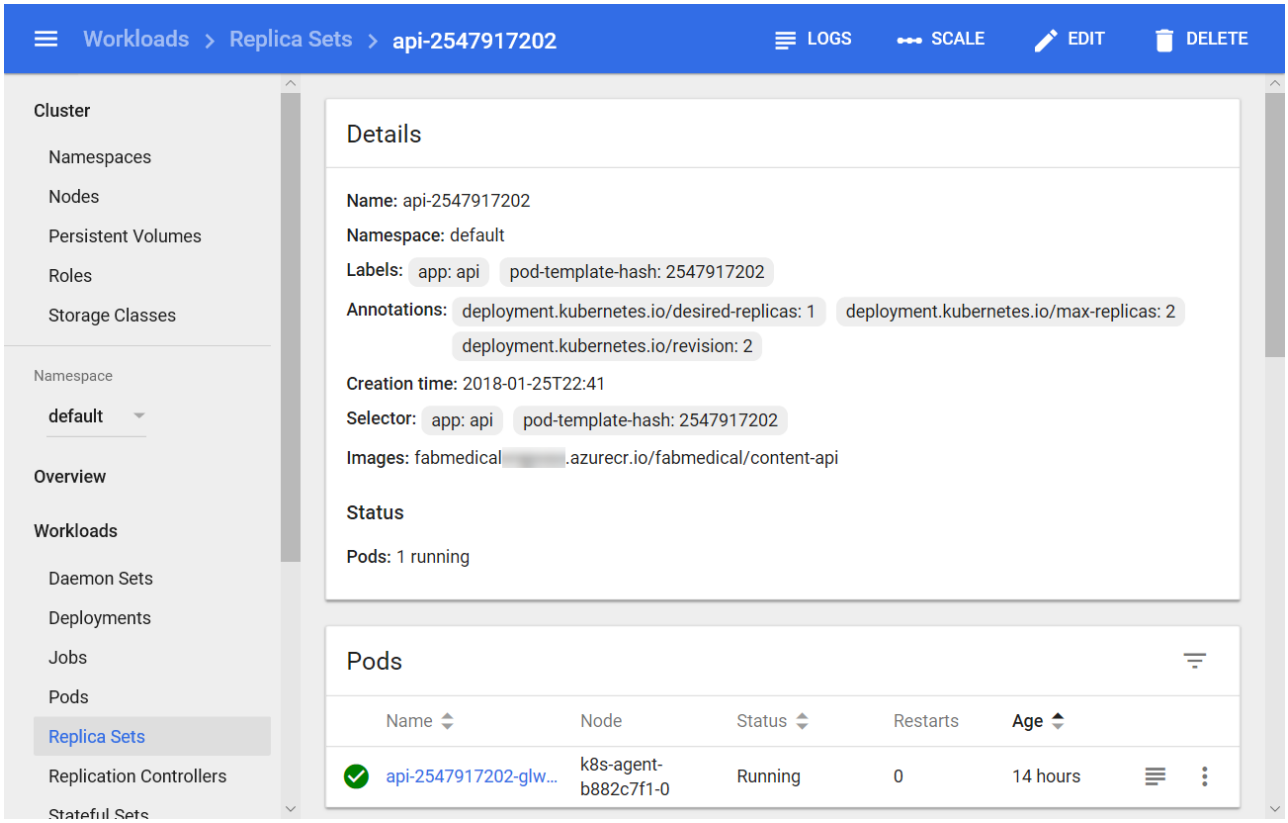



10. From the navigation menu, select Deployments under Workloads. From the view's Deployments list select the API deployment.

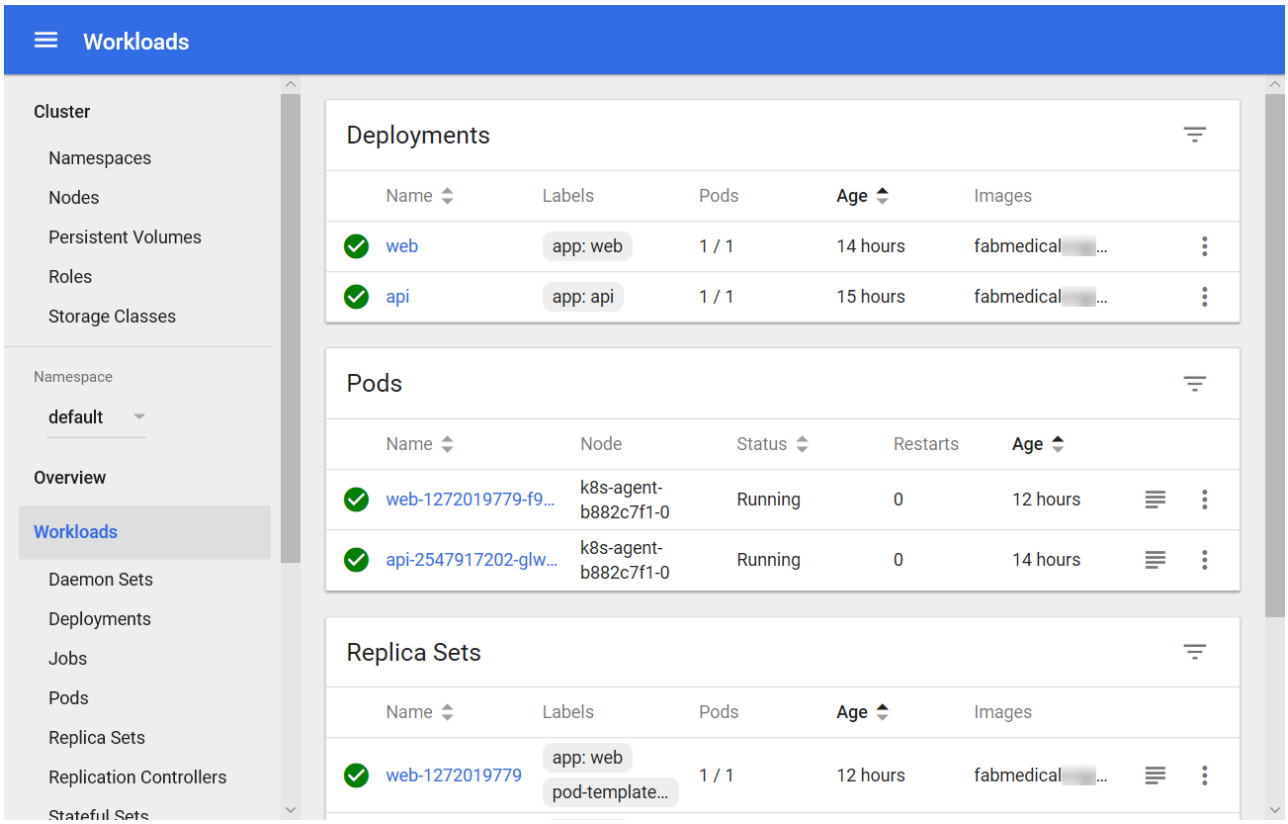
11. From the API Deployment view, select Scale and enter 1 as the desired number of pods. Select OK.




12. Return to the web site's stats.html page in the browser and refresh while this is scaling down. You'll notice that only one API host name shows up, even though you may still see several running pods in the API replica set view. Even though several pods are running, Kubernetes will no longer send traffic to the pods it has selected to scale down. In a few moments, only one pod will show in the API replica set view.




13. From the navigation menu, select Workloads. From this view, note that there is only one API pod now.




# Exercise 4: Setup load balancing and service discovery

**Duration**: 45 minutes

In the previous exercise we introduced a restriction to the scale properties of the service. In this exercise, you will configure the api deployments to create pods that use dynamic port mappings to eliminate the port resource

constraint during scale activities.

Kubernetes services can discover the ports assigned to each pod, allowing you to run multiple instances of the pod on the same agent node --- something that is not possible when you configure a specific static port (such as 3001 for the API service).

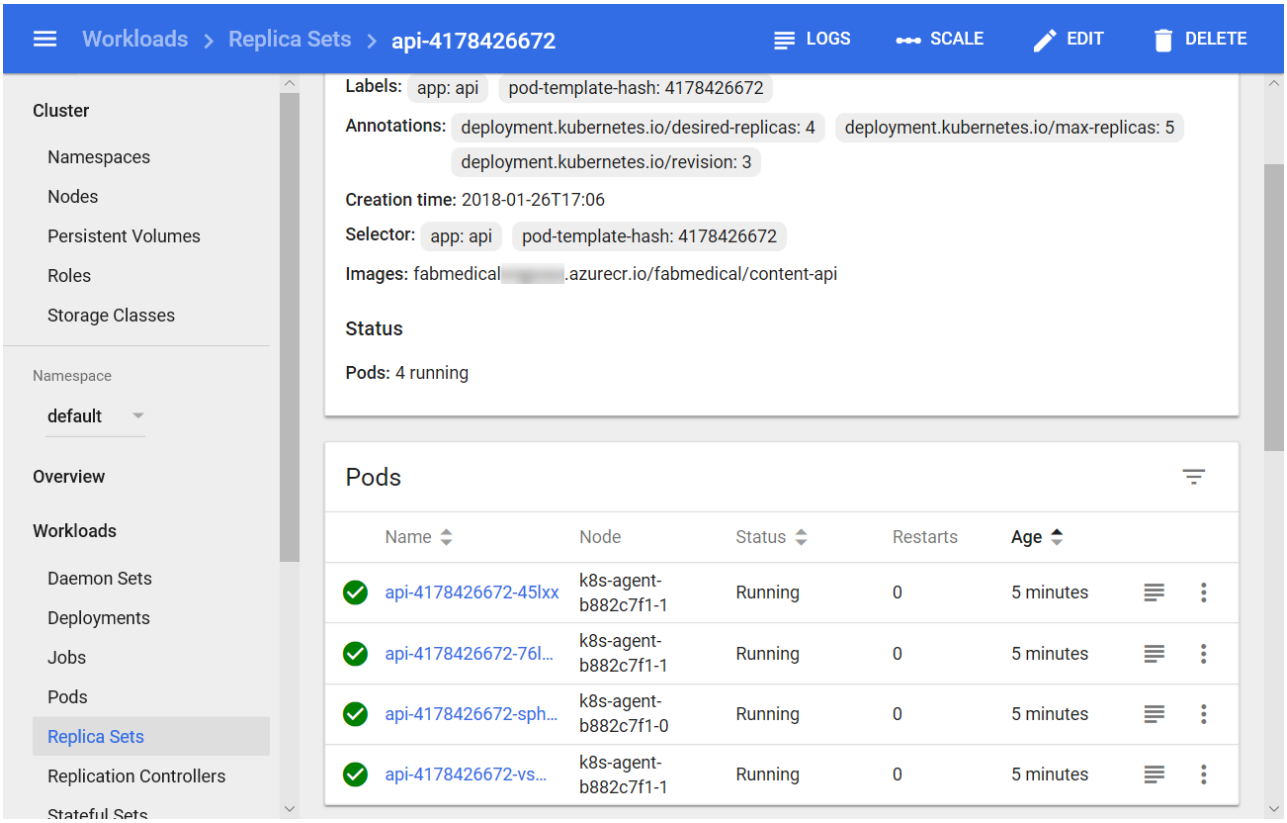
### Task 1: Scale a service without port constraints

In this task, we will reconfigure the API deployment so that it will produce pods that choose a dynamic hostPort for improved scalability.

1. From the navigation menu select Deployments under Workloads. From the view's Deployments list select the API deployment.
2. Select Edit
3. From the Edit a Deployment dialog, do the following:
    - Scroll to the first spec node that describes replicas as shown in the screenshot. Set the value for replicas to 4.
    - Within the replicas spec, beneath the template node, find the "api" containers spec as shown in the screenshot. Remove the hostPort entry for the API container's port mapping.


4. Select **Update**. New pods will now choose a dynamic port.

5. The API service can now scale to 4 pods since it is no longer constrained to an instance per node -- a previous limitation while using port 3001.




6. Return to the browser and refresh the stats.html page. You should see all 4 pods serve responses as you refresh.

## Task 2: Update an external service to support dynamic discovery with a load balancer

In this task, you will update the web service so that it supports dynamic discovery through the Azure load balancer.

1. From the navigation menu, select Deployments under Workloads. From the view's Deployments list select the web deployment.

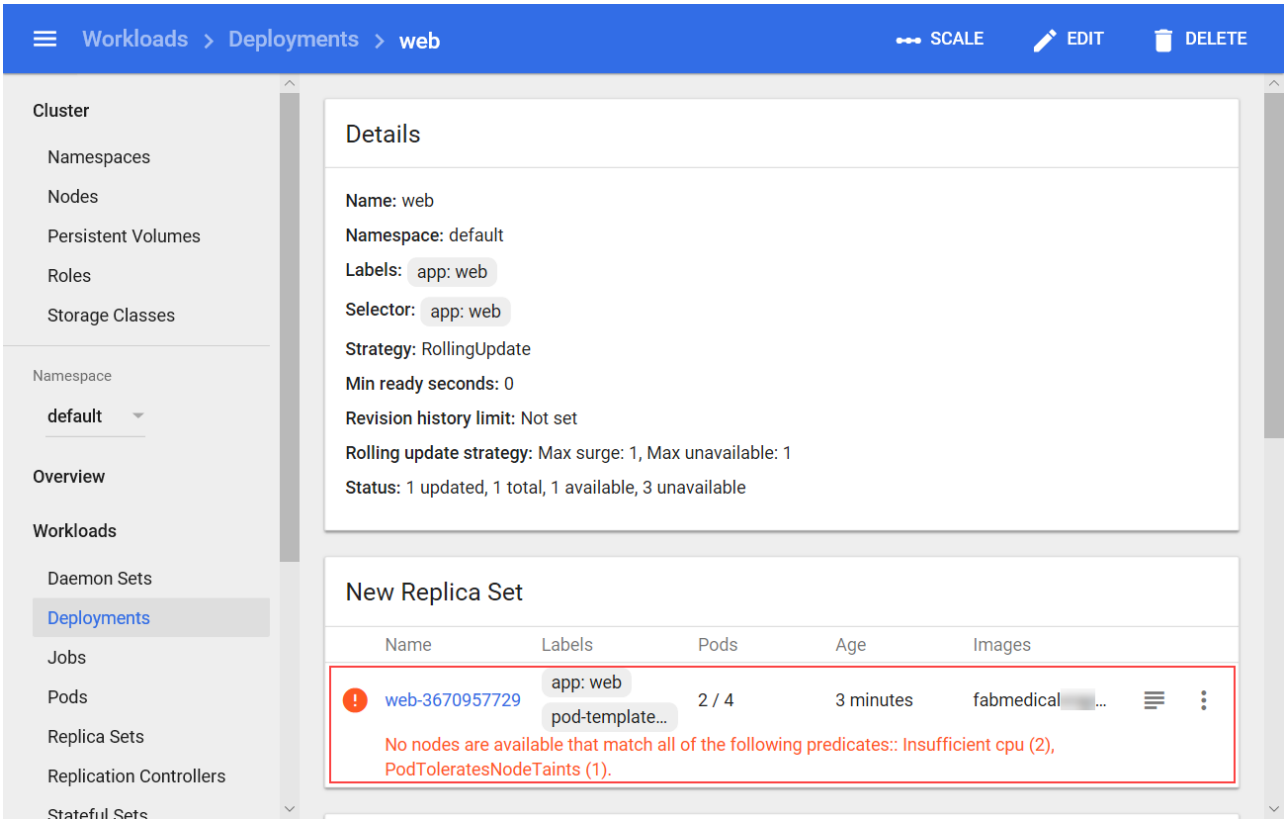
2. Select **Edit**

3. From the Edit a Deployment dialog, scroll to the web containers spec as shown in the screenshot. Remove the hostPort entry for the web container's port mapping.


4. Select **Update**

5. From the web Deployments view, select **Scale**. From the dialog presented enter 4 as the desired number of pods and select **OK**.

6. Check the status of the scale out by refreshing the web deployment's view. From the navigation menu, select Deployments from under Workloads. Select the web deployment. From this view, you should see an error like that shown in the following screenshot.




Like the API deployment, the web deployment used a fixed ***hostPort***, and your ability to scale was limited by the number of available agent nodes. However, after resolving this issue for the web service by removing the ***hostPort*** setting, the web deployment is still unable to scale past two pods due to CPU constraints. The deployment is requesting more CPU than the web application needs, so you will fix this constraint in the next task.

## Task 3: Adjust CPU constraints to improve scale

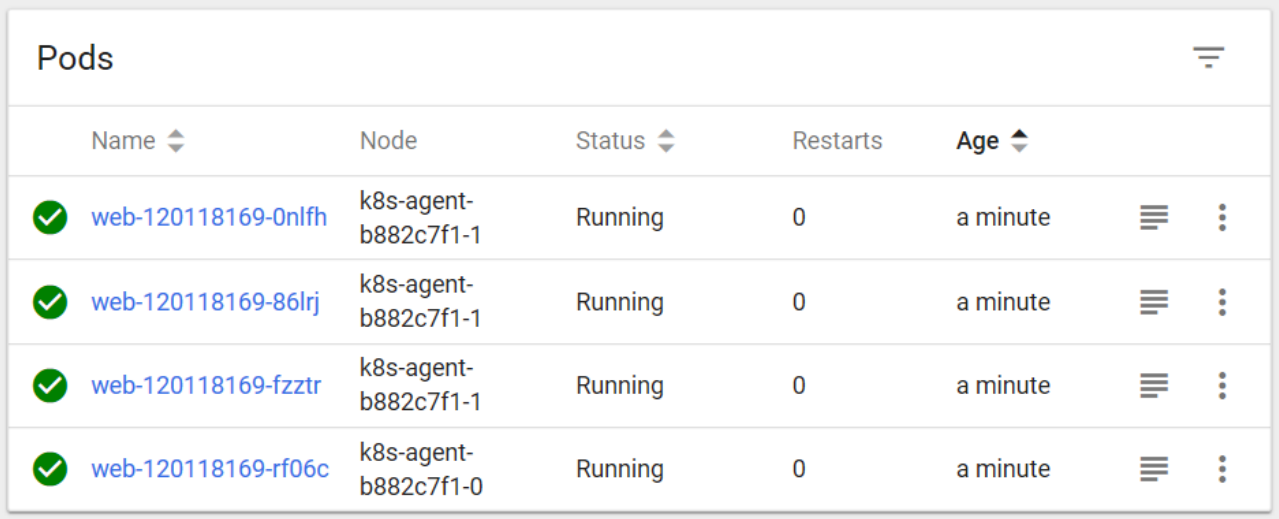
In this task, you will modify the CPU requirements for the web service so that it can scale out to more instances.

1. From the navigation menu, select Deployments under Workloads. From the view's Deployments list select the web deployment.
2. Select **Edit**
3. From the Edit a Deployment dialog, find the ***cpu*** resource requirements for the web container. Change this value to "125m".


4. Select **Update** to save the changes and update the deployment

5. From the navigation menu, select Replica Sets under Workloads. From the view's Replica Sets list select the web replica set.

6. When the deployment update completes, four web pods should be shown in running state

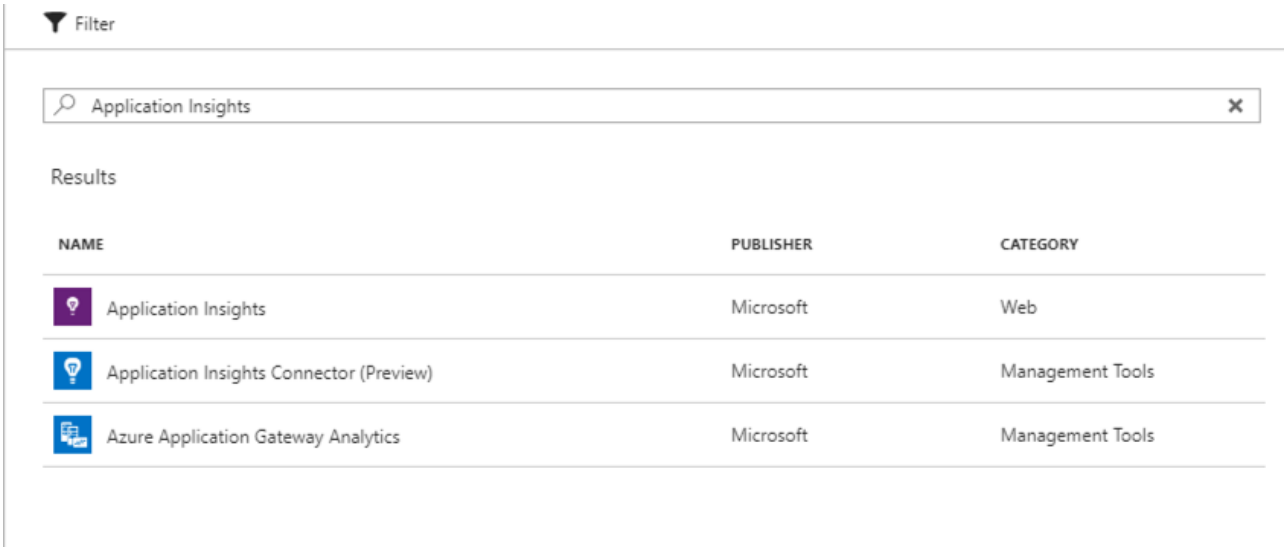



7. Return to the browser tab with the web application loaded. Refresh the stats page at /stats.html to watch the display update to reflect the different api pods by observing the host name refresh.

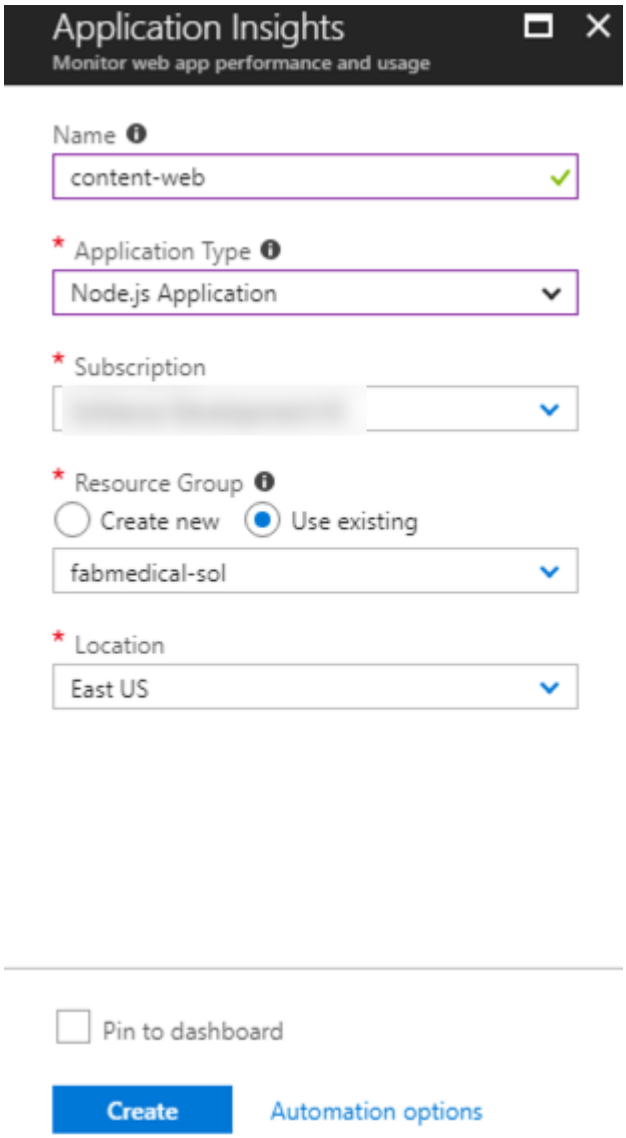
## Task 4: Perform a rolling update

In this task, you will edit the web application source code to add Application Insights and update the Docker image used by the deployment. Then you will perform a rolling update to demonstrate how to deploy a code change.

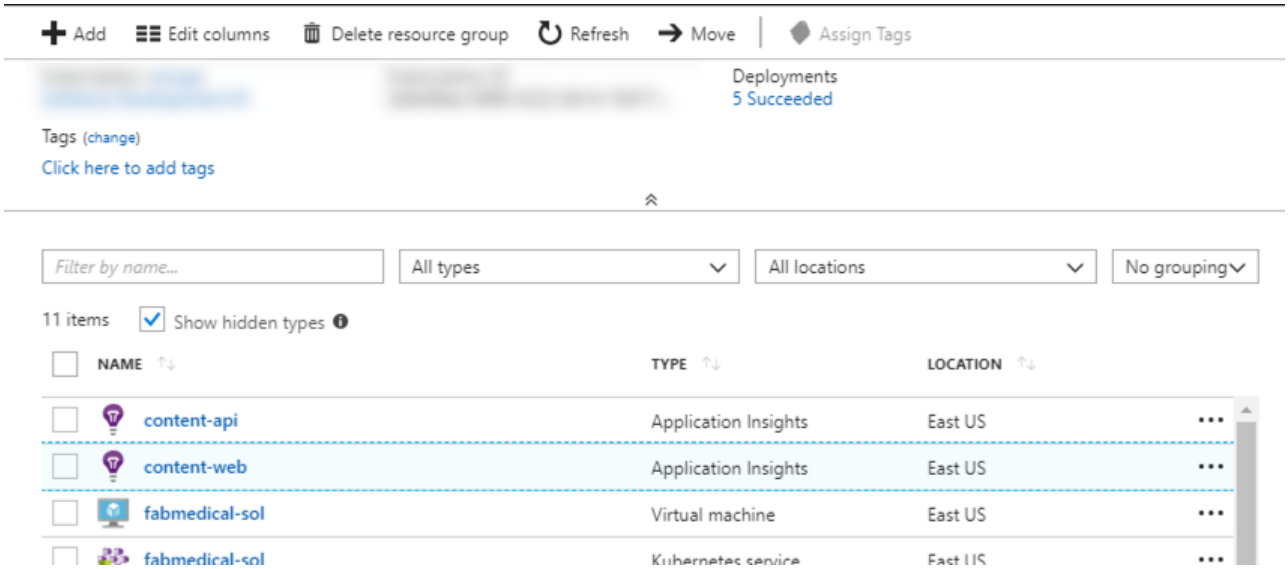
1. First create an Application Insights key for content-web using the Azure Portal
2. Select "+ Create a Resource" and search for "Application Insights" and select "Application Insights"



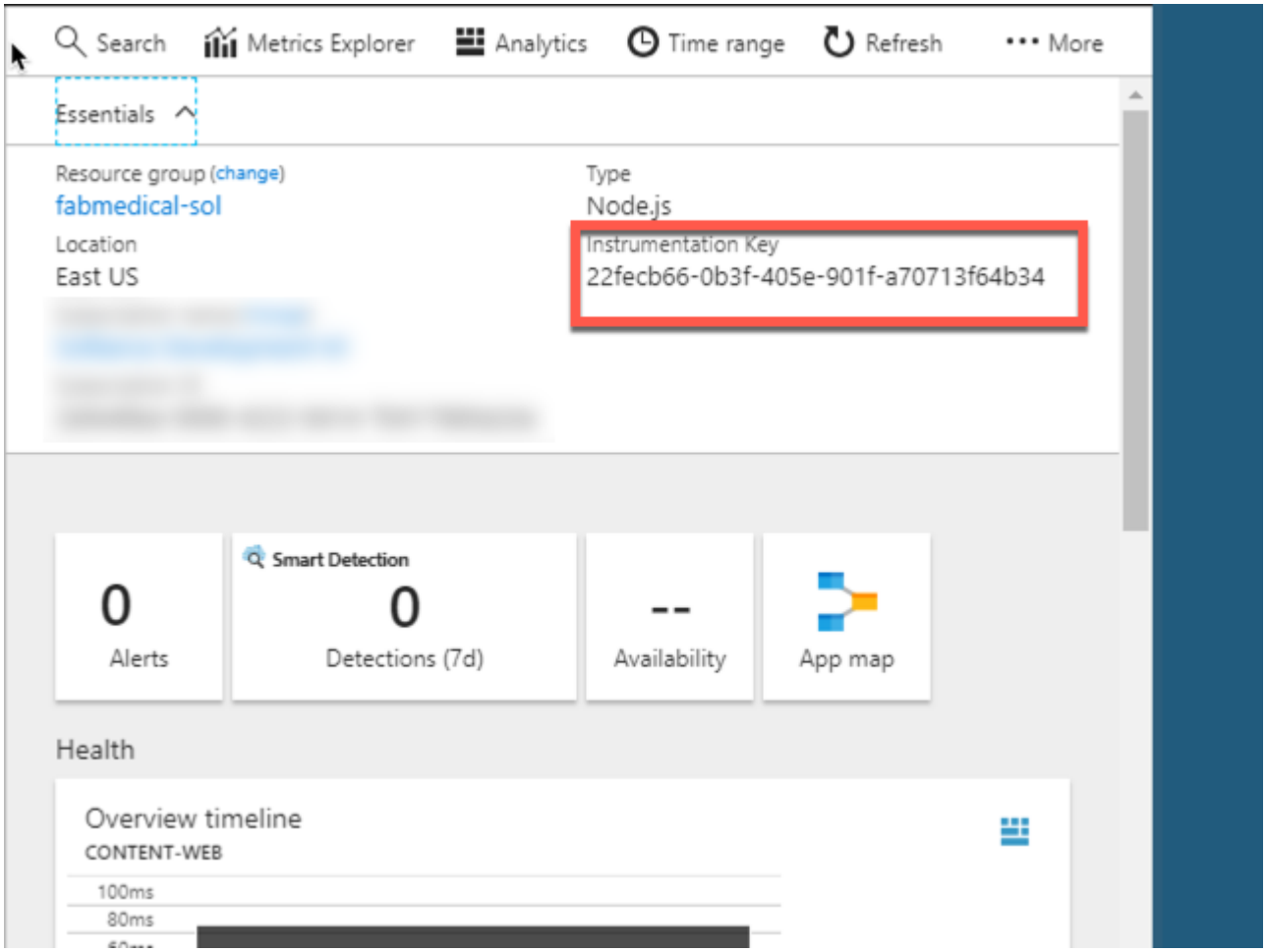

3. Configure the resource as follows, then select "Create":
    - **Name**: content-web
    - **Application Type**: Node.js Application
    - **Subscription**: Use the same subscription you have been using throughout the lab
    - **Resource Group**: Use the existing resource group fabmedical-SUFFIX
    - **Location**: Use the same location you have been using throughout the lab




4. While the Application Insights resource for content-web deploys, create a second Application Insights resource for content-api. Configure the resource as follows, then select "Create":
    - **Name**: content-api
    - **Application Type**: Node.js Application
    - **Subscription**: Use the same subscription you have been using throughout the lab
    - **Resource Group**: Use the existing resource group fabmedical-SUFFIX
    - **Location**: Use the same location you have been using throughout the lab
5. When both resources have deployed, locate them in your resource group




6. Select the content-web resource to view the details. Make a note of the Instrumentation Key; you will need it when configuring the content-web application.




7. Return to your resource group and view the details of the content-api Application Insights resource. Make a note of it's unique Instrumentation Key as well.

8. Connect to your build agent VM using ssh as you did in Task 6: Connect securely to the build agent before the hands-on lab

9. From the command line, navigate to the content-web directory

10. Install support for Application Insights

```
npm install applicationinsights --save
```

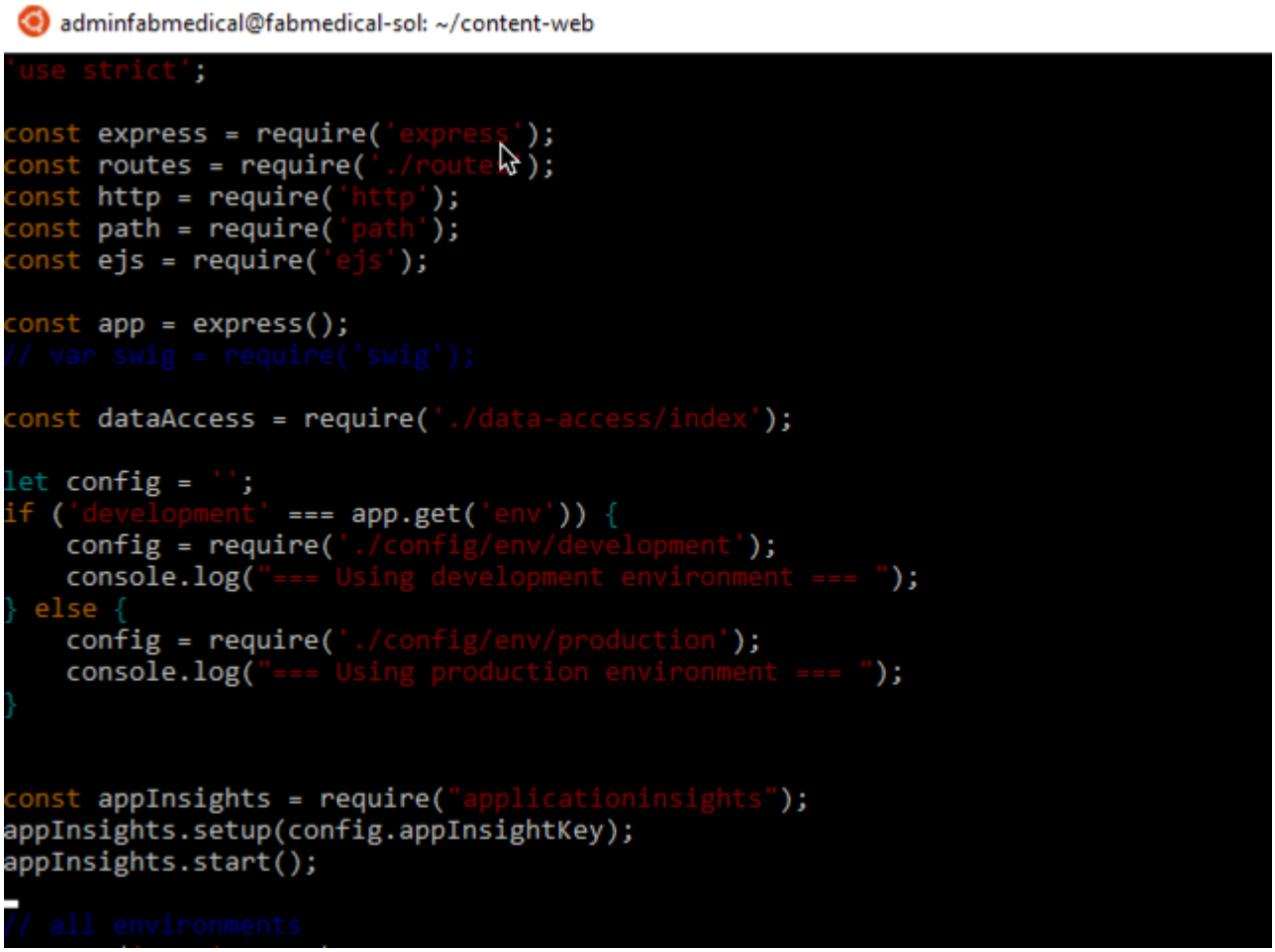
11. Open the server.js file using VI:

```
vi server.js
```

12. Enter insert mode by pressing <i>

13. Add the following lines immediately after the config is loaded

```
const appInsights = require("applicationinsights");
appInsights.setup(config.appInsightKey);
appInsights.start();
```




14. Press the Escape key and type ":wq". Then press the Enter key to save and close the file.

```
<Esc>
:wq
```

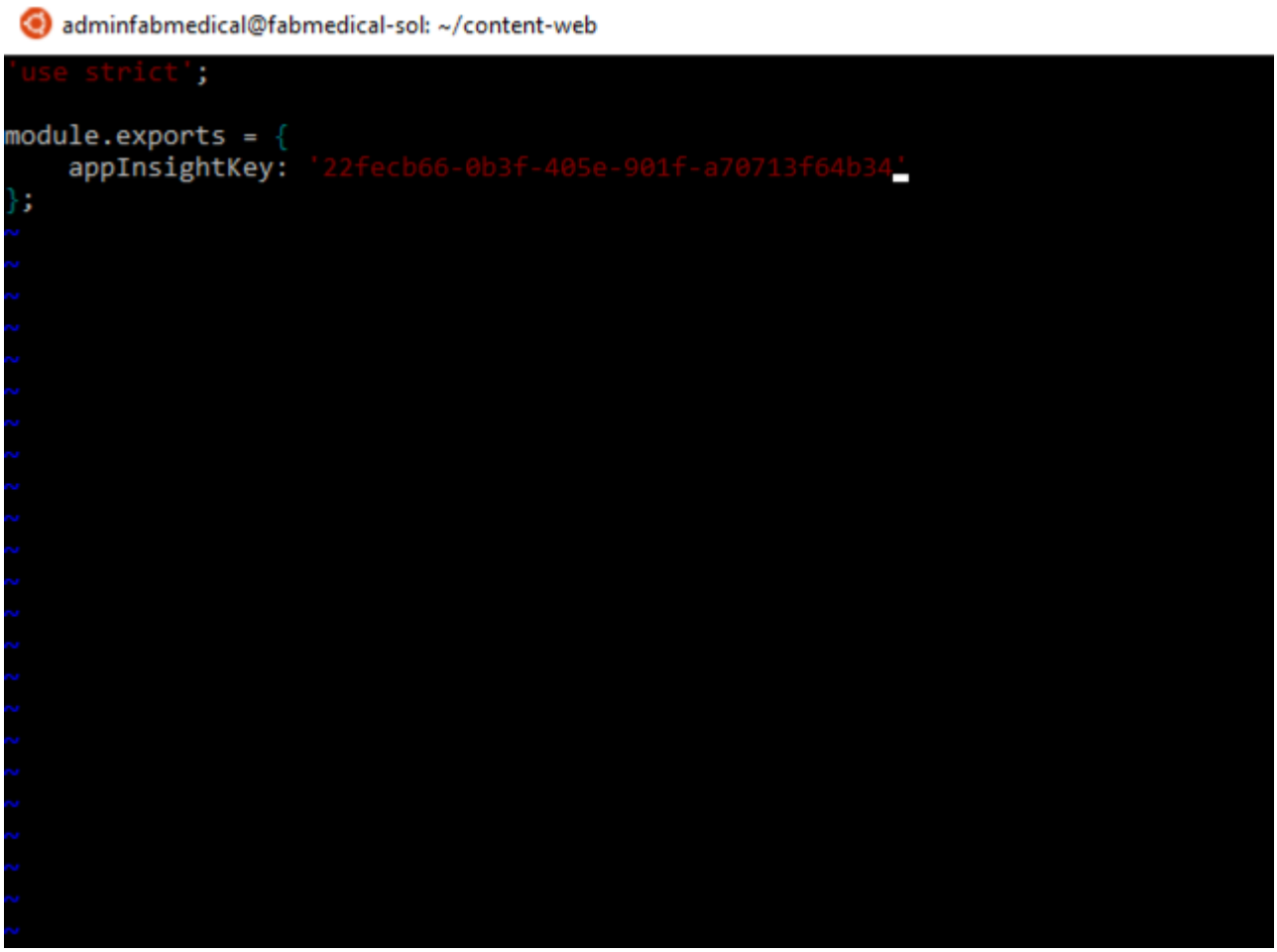
```
<Enter>
```

15. Update your config files to include the Application Insights Key

```
vi config/env/production.js
<i>
```

16. Add the following line to the `module.exports` object, and then update [YOUR APPINSIGHTS KEY] with the your Application Insights Key from the Azure portal.

```
appInsightKey: '[YOUR APPINSIGHTS KEY]'
```




17. Press the Escape key and type ":wq". Then press the Enter key to save and close the file.

18. Now update the development config

```
vi config/env/development.js
<i>
```

19. Add the following line to the `module.exports` object, and then update [YOUR APPINSIGHTS KEY] with the your Application Insights Key from the Azure portal

```
appInsightKey: '[YOUR APPINSIGHTS KEY]'
```

20. Press the Escape key and type ":wq". Then press the Enter key to save and close the file.

21. Push these changes to your repository so that VSTS CI will build a new image while you work on updating the content-api application

```
git add .
git commit -m "Added Application Insights"
git push
```

22. Now update the content-api application

```
cd ../content-api
npm install applicationinsights --save
```

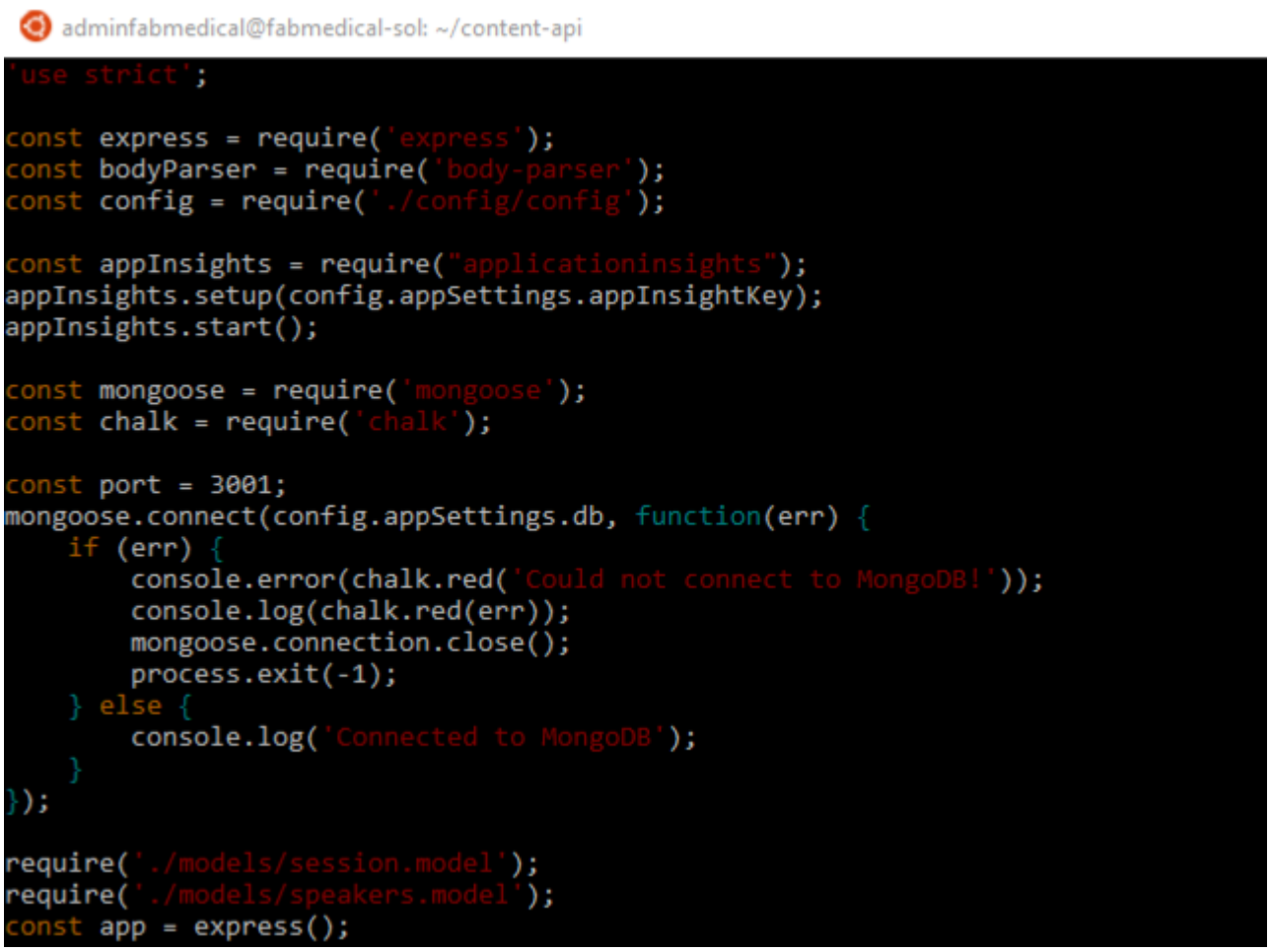
23. Open the server.js file using VI:

```
vi server.js
```

24. Enter insert mode by pressing `<i>`

25. Add the following lines immediately after the config is loaded:

```
const appInsights = require("applicationinsights");
appInsights.setup(config.appSettings.appInsightKey);
appInsights.start();
```




26. Press the Escape key and type ":wq". Then press the Enter key to save and close the file.

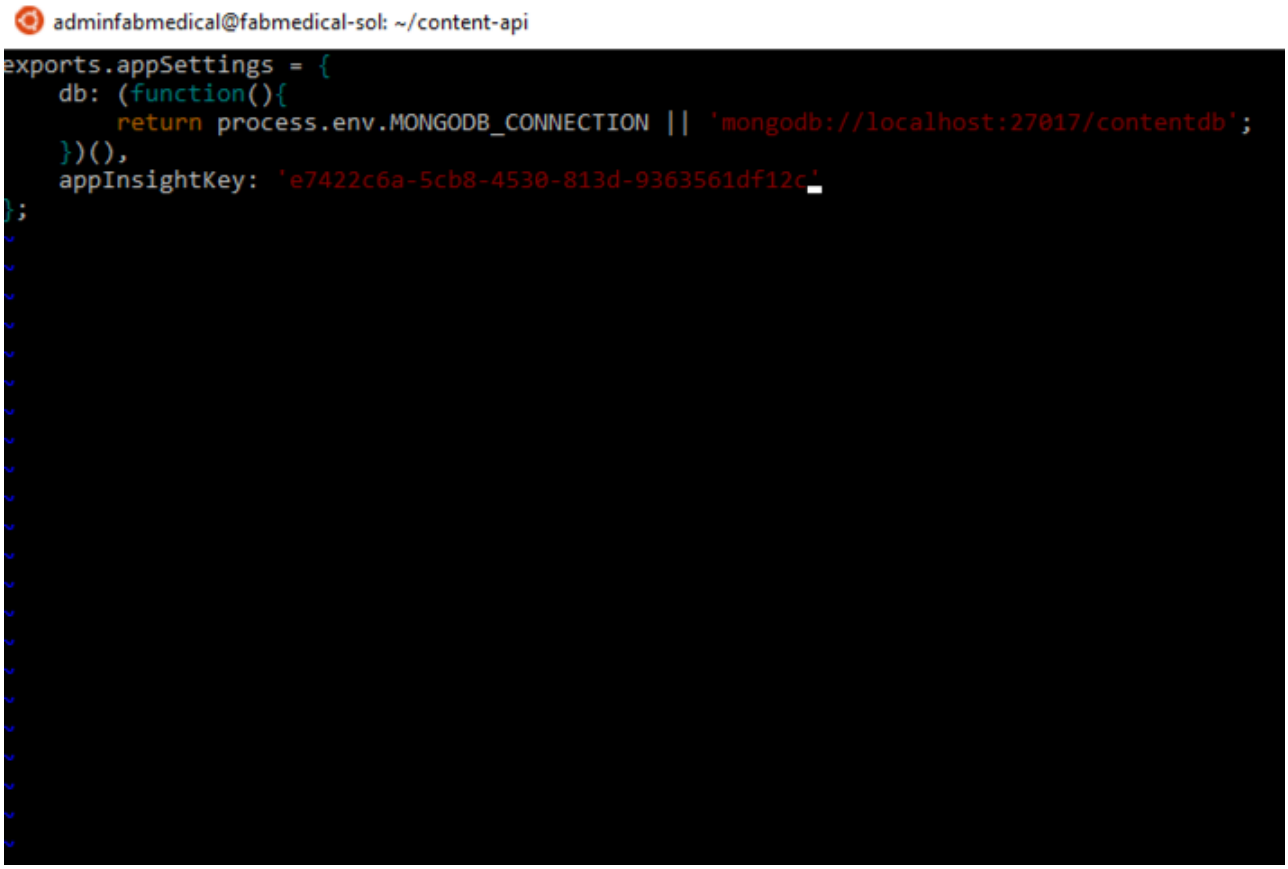
```
<Esc>
:wq
<Enter>
```

27. Update your config files to include the Application Insights Key

```
vi config/config.js
<i>
```

28. Add the following line to the `exports.appSettings` object, and then update [YOUR APPINSIGHTS KEY] with the your Application Insights Key for **content-api** from the Azure portal

```
appInsightKey: '[YOUR APPINSIGHTS KEY]'
```



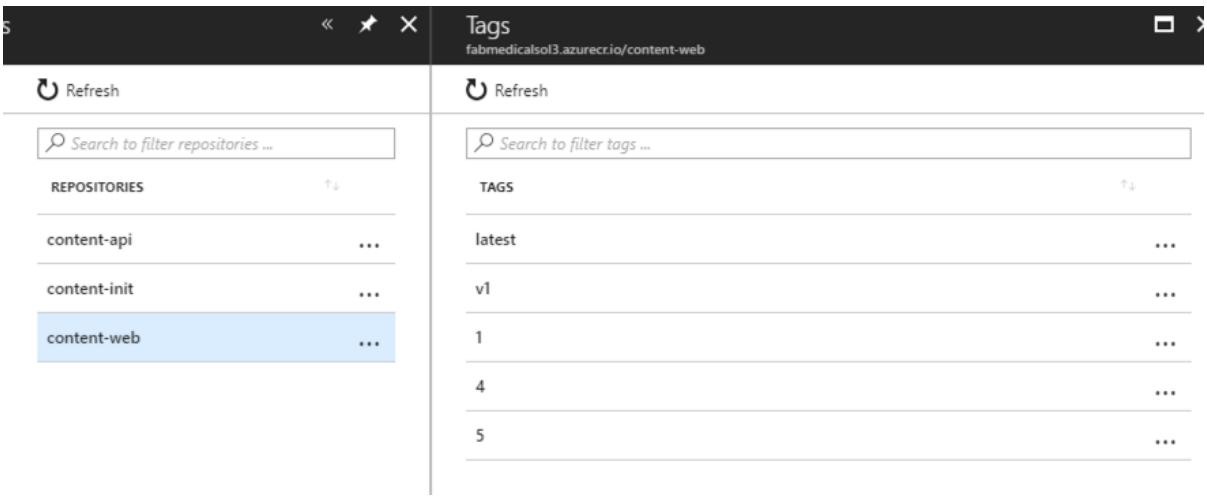

29. Press the Escape key and type ":wq". Then press the Enter key to save and close the file.

30. Push these changes to your repository so that VSTS CI will build a new image

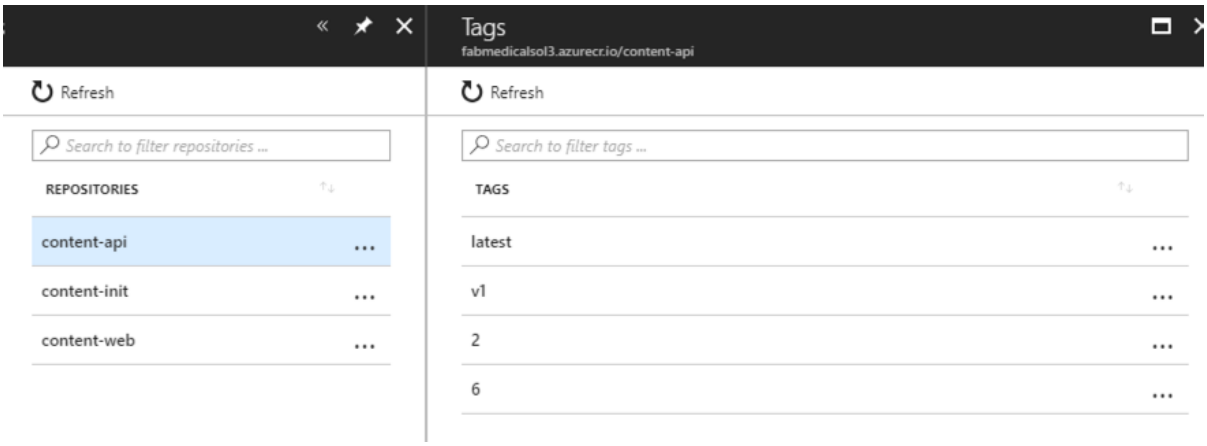
```
git add .
git commit -m "Added Application Insights"
git push
```

31. Visit your ACR to see the new images and make a note of the tags assigned by VSTS

    - Make a note of the latest tag for content-web




    - And the latest tag for content-api




32. Now that you have finished updating the source code, you can exit the build agent

```
exit
```

33. From WSL, request a rolling update using this kubectl command:

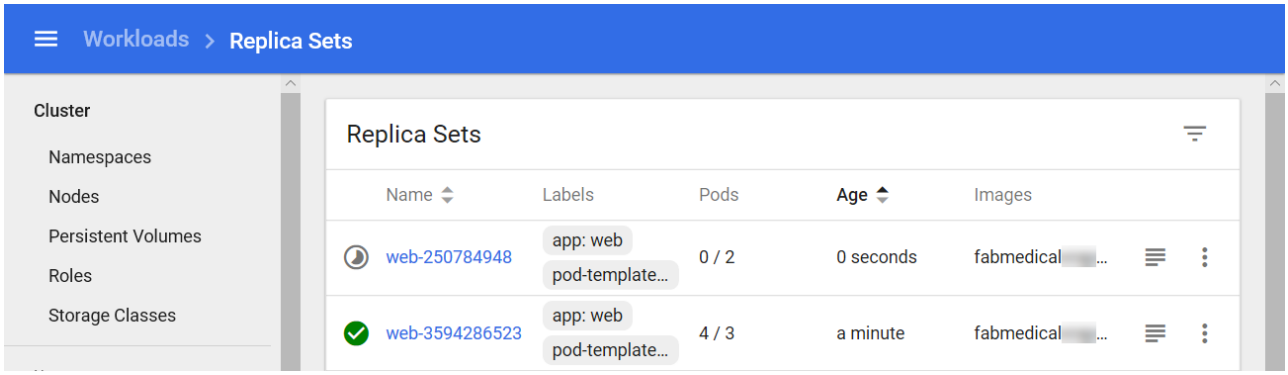
```
kubectl set image deployment/web web=[LOGINSERVER]/content-web:[LATEST TAG]
```

34. Next update the content-api application

```
kubectl set image deployment/api api=[LOGINSERVER]/content-api:[LATEST TAG]
```

35. While this update runs, return the Kubernetes management dashboard in the browser

36. From the navigation menu, select Replica Sets under Workloads. From this view you will see a new replica set for web which may still be in the process of deploying (as shown below) or already fully deployed.




37. While the deployment is in progress, you can navigate to the web application and visit the stats page at /stats.html. Refresh the page as the rolling update executes. Observe that the service is running normally and tasks continue to be load balanced.


| | |
|---|---|
| **webTaskId** | web-250784948-g9fk4 |
| **taskId** | 18 |
| **hostName** | api-4178426672-f0dp8 |
| **pid** | 18 |
| **mem** | {"rss":37785600,"heapTotal":19582720,"heapUsed":13256432,"external":211680} |
| **counters** | {"stats":4,"speakers":0,"sessions":0} |
| **uptime** | 2559.844 |

## Task 5: Configure Kubernetes Ingress

In this task you will setup a Kubernetes Ingress to take advantage of path based routing and TLS termination.

1. Install helm, a package manager for Kubernetes. Run the following commands in your WSL window:

```
curl
https://raw.githubusercontent.com/kubernetes/helm/master/scripts/get >
get_helm.sh
chmod 700 get_helm.sh
./get_helm.sh
```

2. Setup your local config and deploy the server side helm component `tiller`

```
helm init --upgrade --service-account default
```

3. Update your helm package list

```
helm repo update
```

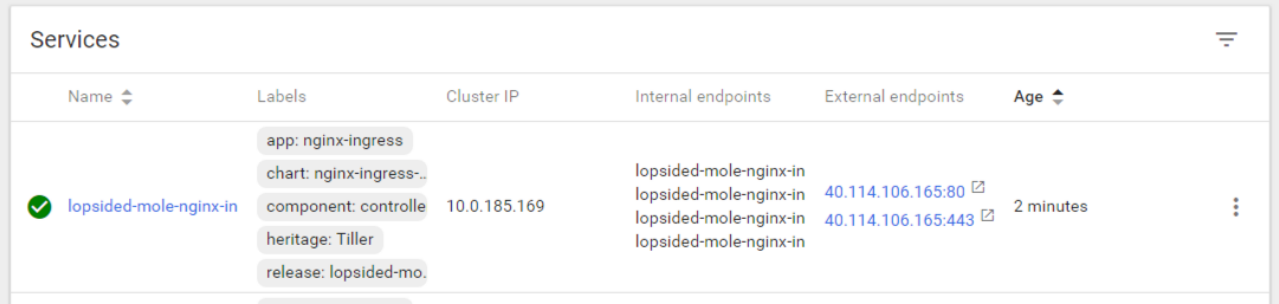
4. Install the ingress controller resource to handle ingress requests as they come in. The ingress controller will receive a public IP of its own on the Azure Load Balancer and be able to handle requests for multiple services over port 80 and 443.

```
helm install stable/nginx-ingress --namespace kube-system --set
rbac.create=false --set rbac.createRole=false --set
```

```
rbac.createClusterRole=false
```

5. Set a DNS prefix on the IP address allocated to the ingress controller. Visit the `kube-system` namespace in your kubeneretes dashboard to find the IP

   http://localhost:8001/#!/service?namespace=kube-system




6. Create a script to update the public DNS name for the IP

```
vi update-ip.sh
<i>
```

   Paste the following as the contents and update the IP and SUFFIX values

```
#!/bin/bash

# Public IP address
IP="[INGRESS PUBLIC IP]"

# Name to associate with public IP address
DNSNAME="fabmedical-[SUFFIX]-ingress"

# Get the resource-id of the public ip
PUBLICIPID=$(az network public-ip list --query "[?ipAddress!=null]|[?
contains(ipAddress, '$IP')].[id]" --output tsv)

# Update public ip address with dns name
az network public-ip update --ids $PUBLICIPID --dns-name $DNSNAME
```

7. Use `<esc>:wq` to save your script and exit VIM

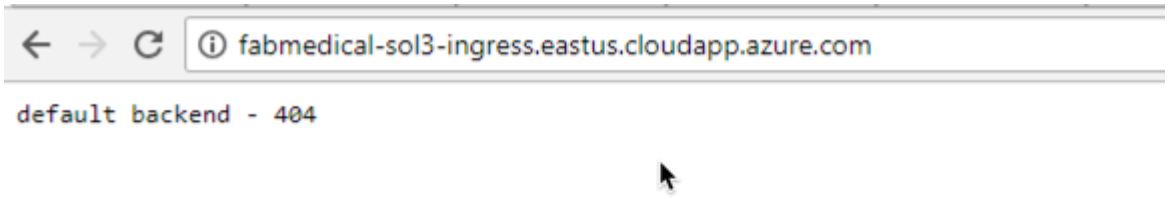
8. Run the update script

```
bash ./update-ip.sh
```

9. Verify the IP update by visiting the url in your browser

> Note, it is normal to receive a 404 message at this time

```
http://fabmedical-[SUFFIX]-ingress.[AZURE-REGION].cloudapp.azure.com/
```




10. Use helm to install `cert-manager`; a tool that can provision SSL certificates automatically from letsencrypt.org

```
helm install --name cert-manager --namespace kube-system --set
rbac.create=false stable/cert-manager
```

11. Cert manager will need a custom ClusterIssuer resource to handle requesting SSL certificates

```
vi clusterissuer.yml
<i>
```

The following resource configuration should work as is:

```
apiVersion: certmanager.k8s.io/v1alpha1
kind: ClusterIssuer
metadata:
  name: letsencrypt-prod
spec:
  acme:
```

```
    # The ACME server URL
    server: https://acme-v02.api.letsencrypt.org/directory
    # Email address used for ACME registration
    email: user@example.com
    # Name of a secret used to store theACMEaccount private key
    privateKeySecretRef:
      name: letsencrypt-prod
    # Enable HTTP01 validations
    http01: {}
```

12. Save the file with <esc>:wq

13. Create the issuer using kubectl

```
kubectl create --save-config=true -f clusterissuer.yml
```

14. Update the cert-manager to use the ClusterIssuer by default

```
helm upgrade cert-manager stable/cert-manager --namespace kube-system
--set rbac.create=false --set
ingressShim.defaultIssuerName=letsencrypt-prod --set
ingressShim.defaultIssuerKind=ClusterIssuer
```

15. Now you can create an ingress resource for the content applications

```
vi content.ingress.yml
<i>
```

Use the following as the contents and update the [SUFFIX] and [AZURE-REGION] to match your ingress DNS name

```
apiVersion: extensions/v1beta1
kind: Ingress
metadata:
  name: content-ingress
  annotations:
    kubernetes.io/tls-acme: "true"
    nginx.ingress.kubernetes.io/rewrite-target: /
spec:
  tls:
  - hosts:
    - fabmedical-[SUFFIX]-ingress.[AZURE-REGION].cloudapp.azure.com
    secretName: tls-secret
  rules:
  - host:   fabmedical-[SUFFIX]-ingress.[AZURE-
```

```
REGION].cloudapp.azure.com
    http:
      paths:
      - path: /
        backend:
          serviceName: web
          servicePort: 80
      - path: /content-api
        backend:
          serviceName: api
          servicePort: 3001
```

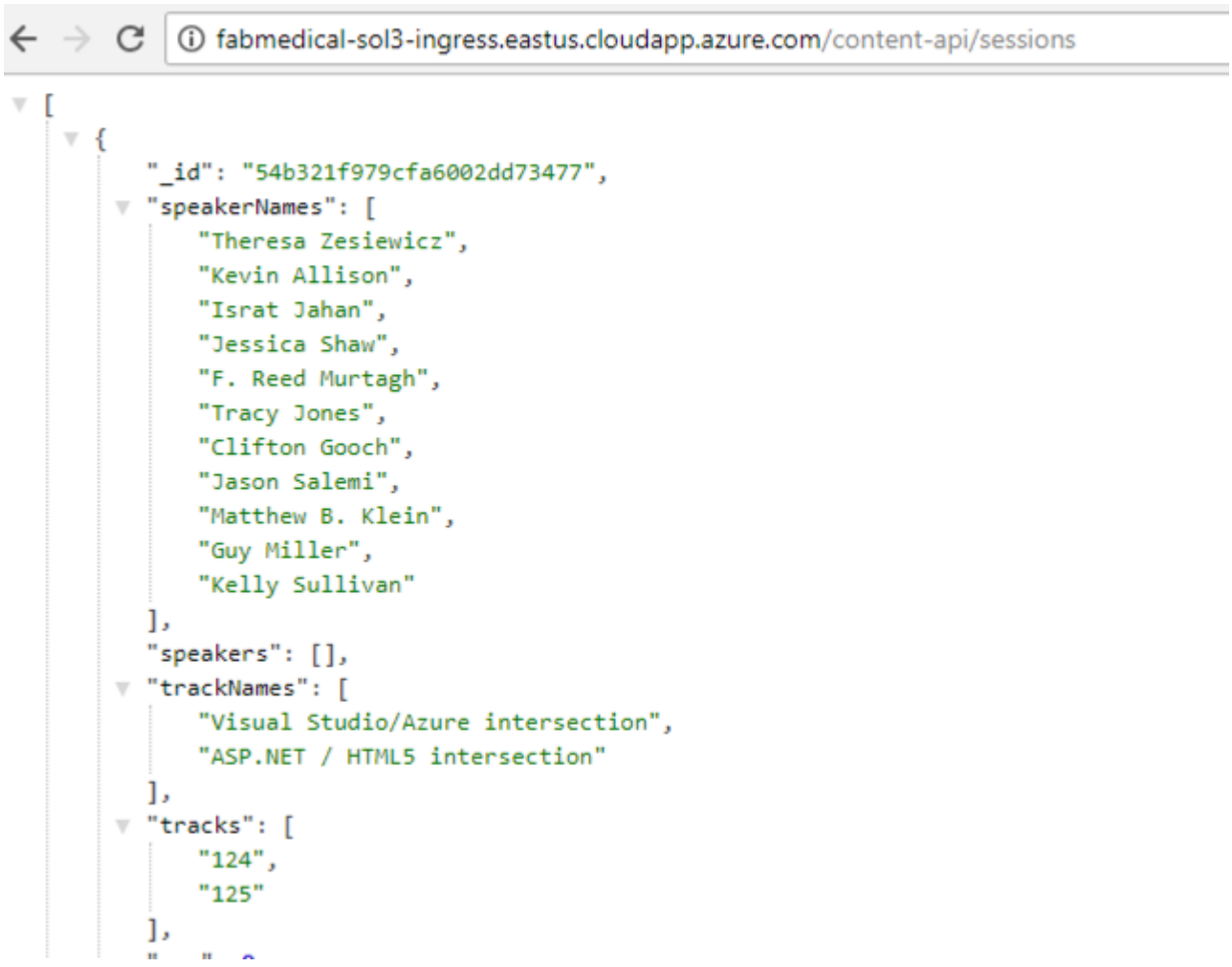
16. Save the file with `<esc>:wq`

17. Create the ingress using kubectl

```
kubectl create --save-config=true -f content.ingress.yml
```

18. Refresh the ingress endpoint in your browser. You should be able to visit the speakers and sessions pages and see all the content.

19. Visit the api directly, by navigating to `/content-api/sessions` at the ingress endpoint



20. Test TLS termination by visiting both services again using `https`

    > It can take a few minutes before the SSL site becomes avaiable. This is due to the delay involved with provisioning a TLS cert from letsencypt.

## After the hands-on lab

**Duration**: 10 mins

In this exercise, you will de-provision any Azure resources created in support of this lab.

1. Delete both of the Resource Groups in which you placed all of your Azure resources
    - From the Portal, navigate to the blade of your Resource Group and then select Delete in the command bar at the top
    - Confirm the deletion by re-typing the resource group name and selecting Delete
2. Delete the Service Principal created on Task 9: Create a Service Principal before the hands-on lab

    ```
    az ad sp delete --id "Fabmedical-sp"
    ```