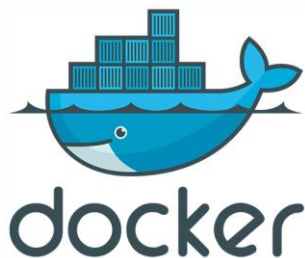


Build, Run, & Ship Containerized Apps with Docker Enterprise Edition

Hands-on Lab Manual

This hands-on lab session will give you a brief introduction and lab experience for a Containerized Applications solution stack on Azure, built with Docker Enterprise and CloudBees Jenkins.



Introduction

The **Build, Deploy and Run Containerized Apps with Docker Enterprise Edition**

Azure Partner Quick Start template launches Docker Enterprise, an integrated platform that enables agile application development and management along with Jenkins for continuous integration and continuous delivery with GitHub used as a source repository.

What You Will Learn

In this hands-on lab session, you will learn how to leverage the Jenkins Continuous Integration/Continuous Deployment (CI/CD) platform to build and push a container-based application into the Docker Trusted Registry (DTR). Once the images are pushed, you will then leverage the Docker Universal Control Plane (UCP) to compose the application and run it on Docker Enterprise Edition container platform. You will also scale up the application and see how Docker Enterprise seamlessly scales your application.

Docker EE components:

Docker CS Engine (CS Engine)

The building block of Docker EE, the Docker Commercially Supported Engine (CS Engine) is responsible for container-level operations, interaction with the OS, providing the Docker API, and running the Swarm cluster. The Engine is also the integration point for infrastructure, including the OS resources, networking, and storage.

Universal Control Plane (UCP)

UCP extends CS Engine by providing an integrated application management platform. It is both the main interaction point for users and the integration point for applications. UCP runs an agent on all nodes in the cluster to monitor them and a set of services on the *controller nodes*. This includes *identity services* to manage users, *Certificate Authorities (CA)* for user and cluster PKI, the main *controller* providing the Web UI and API, data stores for UCP state, and a *Classic Swarm* service for backward compatibility.

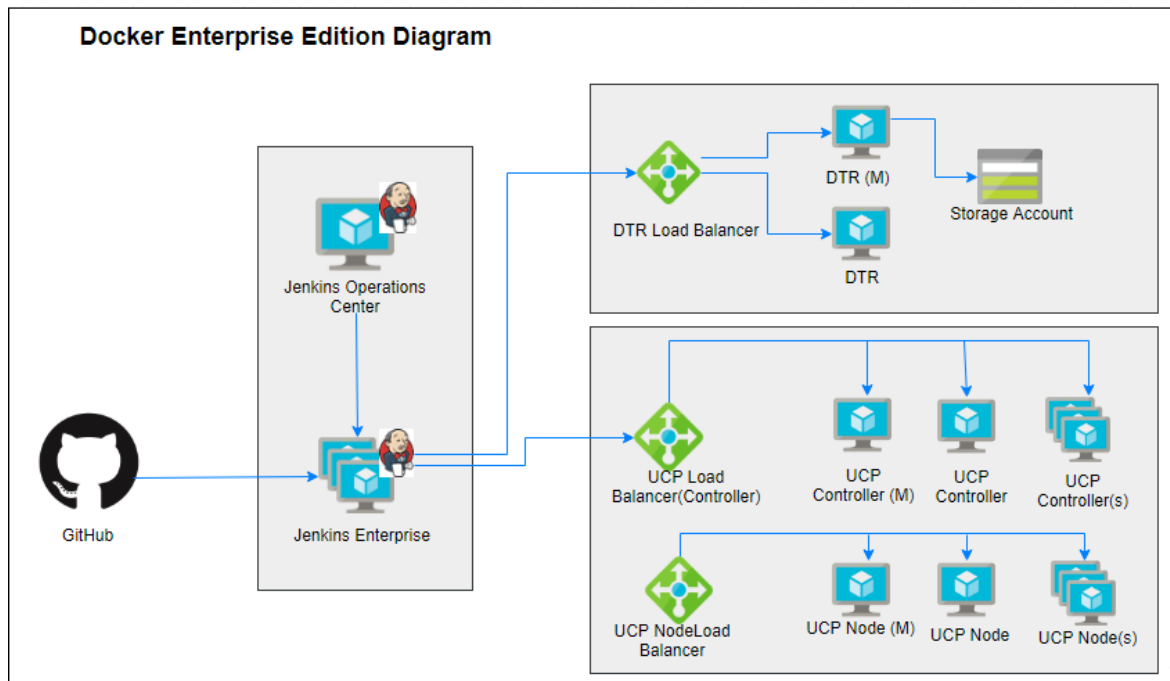
Docker Trusted Registry (DTR)

The DTR is an application managed by, and integrated with UCP, that provides Docker images distribution and security services. The DTR uses UCP's identity services to provide Single Sign-On (SSO), and establish a mutual trust to integrate with its PKI. It runs as a set of services on one or several *replicas*: the *registry* to store and distribute images, an image signing service, a Web UI, an API, and data stores for image metadata and DTR state.

Swarm Mode

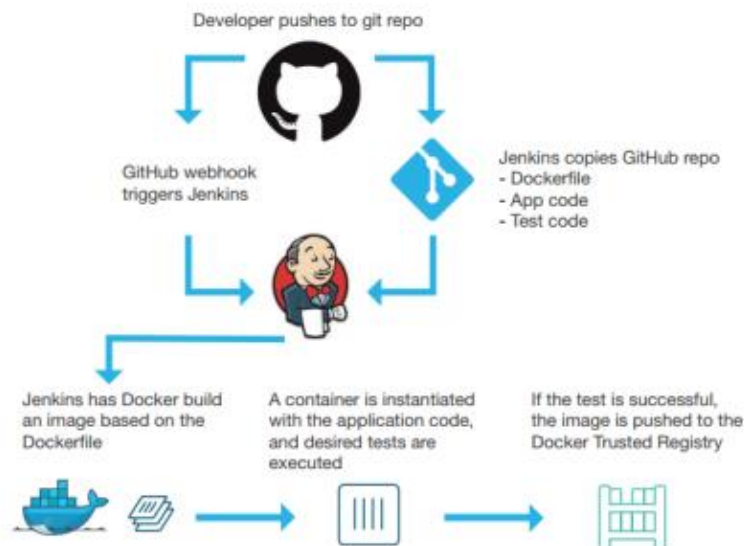
To provide a seamless cluster based on a number of nodes, DDC relies on CS Engine's swarm mode capability. Swarm mode divides nodes between *workers*, nodes running application workloads defined as services, and *managers*, nodes in charge of maintaining desired state, managing the cluster's internal PKI, and providing an API. Managers can also run workloads. In a Docker EE environment, they run UCP controllers and shouldn't run anything else.

The Swarm mode service model provides a declarative desired state for workloads, scalable to a number of *tasks* (the service's containers), accessible through a stable resolvable name, and optionally exposing an end-point. Exposed services are accessible from any node on a cluster-wide reserved port, reaching tasks through the *routing mesh*, a fast routing layer using high-performance switching in the Linux kernel. This set of features enable internal and external discoverability for services, UCP's *HTTP Routing Mesh* (HRM) adding hostname-to-service mapping.



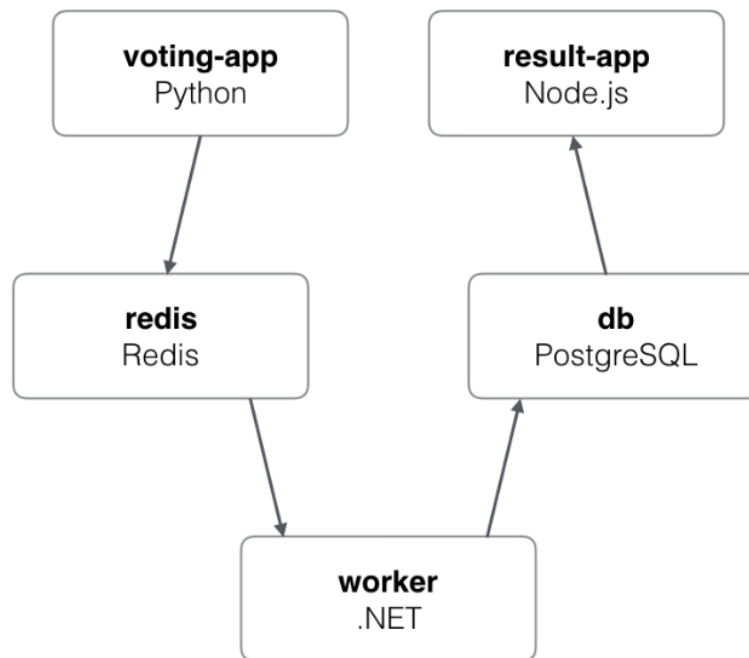
CI & CD Workflow

The diagram below shows a typical developer/operations (DevOps) workflow using Docker Enterprise Edition.



Sample Application

- To better understand the Continuous Integration and Continuous Deployment (CI/CD) process, we will use the Sample Voting Application that has been pulled from GitHub.
- The Components of the Sample Application are shown below:



- **Voting App:** A Python web-app to let you vote between two options.
- **Caching App:** A Redis queue to collect new votes.
- **Worker App:** A .NET worker to consume votes and store them in a Postgres database.
- **Results App:** A Node.js web-app to show the results of the voting in real-time

Lab Prerequisites

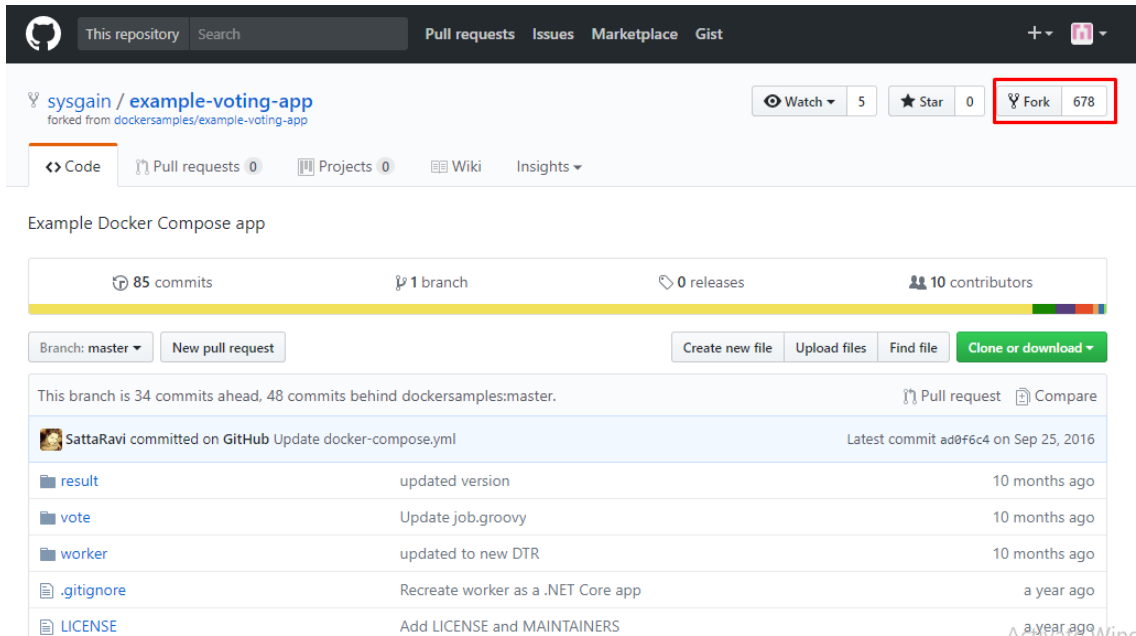
The following will already be provided by the lab instructor before or during the session:

- GitHub account. (You need to have a GitHub Account). Please sign up for a GitHub account if you do not have one at <https://www.github.com>
- Voting App Git repository.
- A Jenkins environment.
- Jenkins Credentials plugin ID.
- Docker Trusted Registry.
- Universal Control Panel.
- Login credentials for all the above, except GitHub account.

Lab Steps

1. Login to your GitHub account (<http://www.github.com>) and fork the sample voting application by going to the below URL and selecting the **"Fork"** option in the top right of the page.

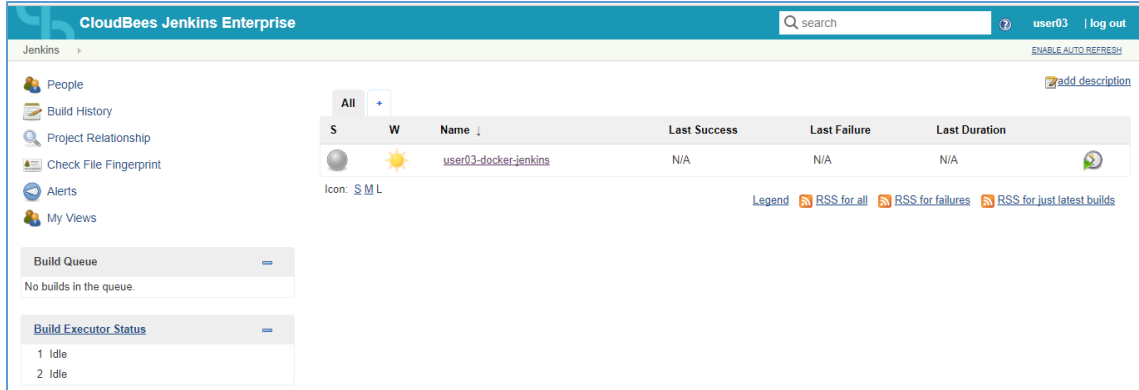
- Available here: <https://github.com/sysgain/example-voting-app>



The screenshot shows the GitHub repository page for `sysgain / example-voting-app`, which is forked from `dockersamples/example-voting-app`. The repository has 5 watchers, 0 stars, and 678 forks. The `Fork` button is highlighted with a red box. Below the repository information, the page shows the commit history for the `master` branch, including a commit by SattaRavi that updated the `docker-compose.yml` file.

Commit	Message	Time
result	updated version	10 months ago
vote	Update job.groovy	10 months ago
worker	updated to new DTR	10 months ago
.gitignore	Recreate worker as a .NET Core app	a year ago
LICENSE	Add LICENSE and MAINTAINERS	a year ago

2. Once you've forked the repo, go to the Jenkins environment using the URL provided in the invitation. There, you can configure the job assigned to you (Ends with the username assigned to you). Select the Job from the list, then select **'Configure'** from the left side navigation.



CloudBees Jenkins Enterprise

user03 | log out

ENABLE AUTO REFRESH

add description

S	W	Name	Last Success	Last Failure	Last Duration
		user03-docker-jenkins	N/A	N/A	N/A

Icon: S M L

Legend RSS for all RSS for failures RSS for just latest builds

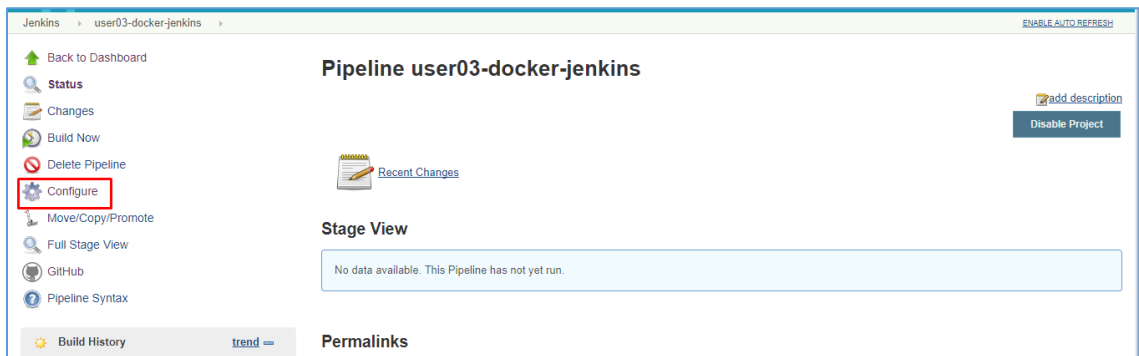
Build Queue

No builds in the queue.

Build Executor Status

1 Idle

2 Idle



Jenkins > user03-docker-jenkins

ENABLE AUTO REFRESH

Back to Dashboard

Status

Changes

Build Now

Delete Pipeline

Configure

Move/Copy/Promote

Full Stage View

Git-Hub

Pipeline Syntax

Build History trend

Pipeline user03-docker-jenkins

add description

Disable Project

Recent Changes

Stage View

No data available. This Pipeline has not yet run.

Permalinks

- After selecting Configure, go to the bottom of the page and perform a search with Ctrl+F for **"dtr-login-user0"** in the Pipeline text box. Replace that on **line 3** with the DTR credential ID you were provided at the start of the session.

Pipeline

Definition

Pipeline script

```
Script
1 node
2 {
3   docker.withRegistry('https://dtr1b-vpvk3n5huf1f4.westus.cloudapp.azure.com/', 'dtr-login-user0'){
4     // dtr-login is a login ID in credentials
5     stage "syncing files"
6     git 'https://github.com/sample/sample-app.git'
7
8     stage "Building and pushing Vote Image"
9     def vote_img = docker.build('admin/voting-app-vote', './vote').push('latest')
10
11    stage "Building and pushing Worker Image"
12    def worker_img = docker.build('admin/voting-app-worker', './worker').push('latest')
13
14    stage "Building and pushing Result Image"
15    def result_img = docker.build('admin/voting-app-result', './result').push('latest')
16  }
17 }
```

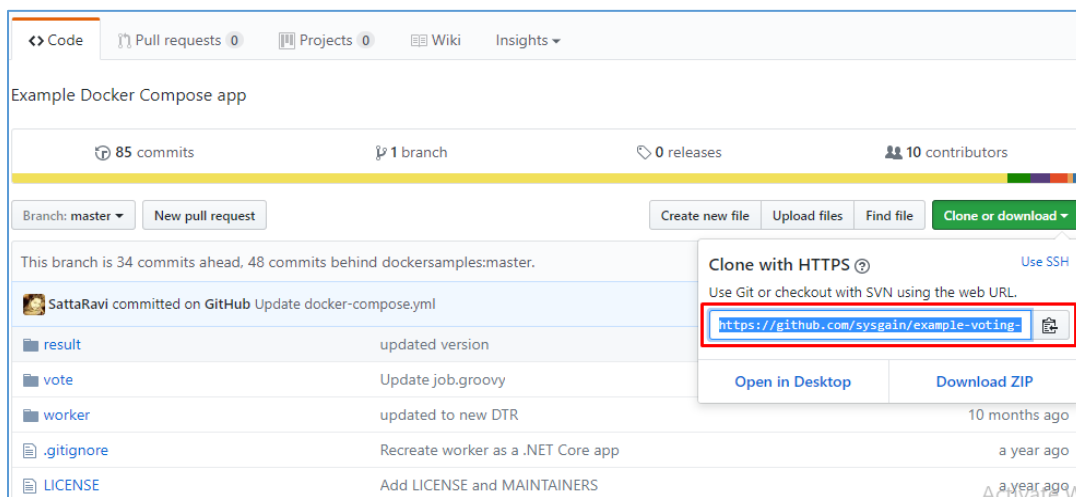
☒ Use Groovy Sandbox

[Pipeline Syntax](#)

Save

Apply

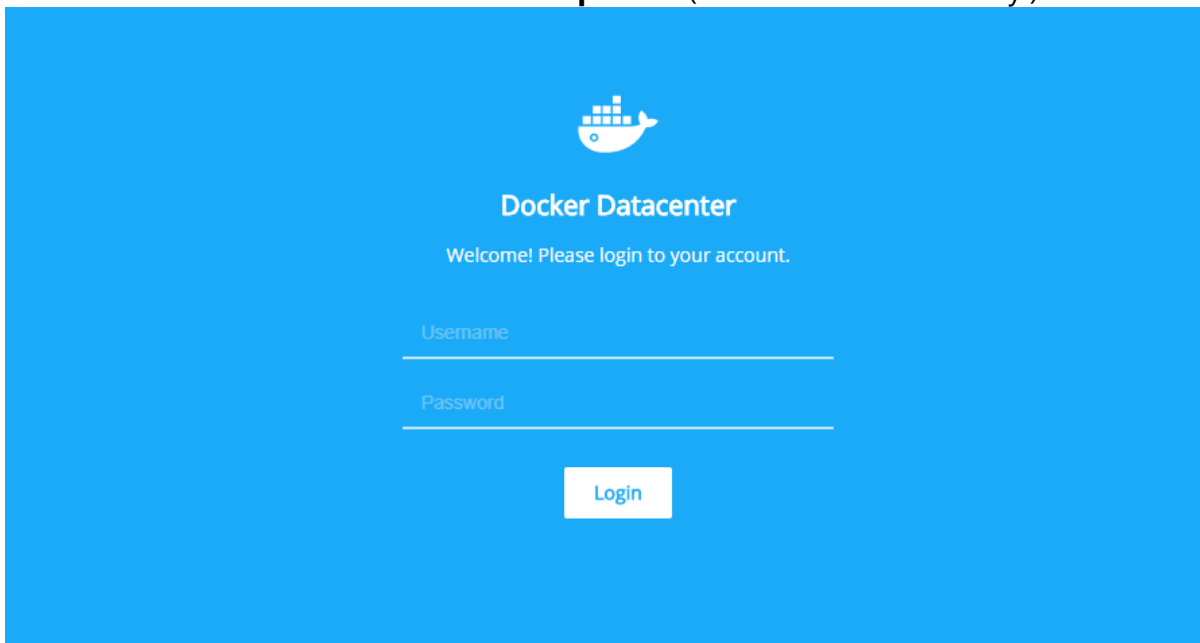
- Next, in the same Pipeline text box, replace the **GitHub URL** on **line 6** with your forked GitHub repository's URL from step 1. See the below screenshot for reference.



- Search for the admin and replace with your user name in the same pipeline text box. (ex: user03)

6. Next, replace the username **usr0** from **lines 9, 12, and 15** with your user name.
7. Select **save** to save your changes and close the job configuration. You have now configured the Jenkins job to be used later.
8. Login to the DTR URL in a new tab/window using the DTR Login URL provided you at the starting of the session and select '**Create**'. Create repositories with the following names:
 - voting-app-result
 - voting-app-worker
 - voting-app-vote

And make sure to set them as **private** (selected under 'Visibility').



- Enter your Username and the password for the Docker Trusted Registry at the login page. You can find the Username & Password in the information provided previously – replace "**userxx**" with your assigned user name. (Example: "user03")
- The Repository creation screen looks like the screen shot below.


Repositories

Filter by All accounts New repository

ACCOUNT
ddcadmin

REPOSITORY NAME
voting-app-vote ✓

VISIBILITY

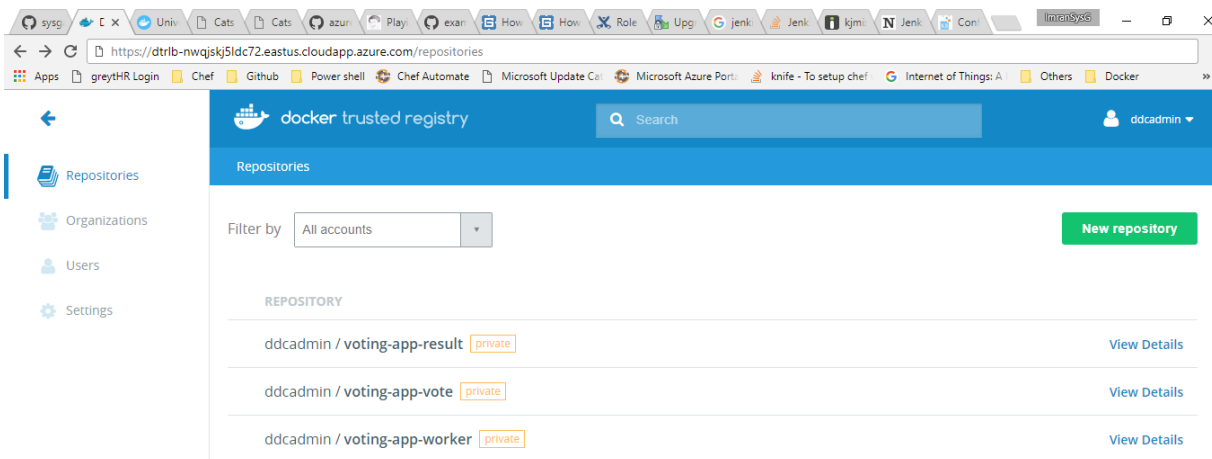
 **Public**
Visible to everyone

Private
Hide this repository

DESCRIPTION (OPTIONAL)

Cancel
Save

- After you have created the 3 repositories the DTR screen should look similar to the one below.



9. With the repositories in place we can now build Docker images to be pushed to the DTR using the Jenkins job you configured earlier. Return to the Jenkins page that was previously opened and click on **'Build Now'** button on the left side navigation to trigger the build process. This process builds the **Three Docker images** (Vote, Worker and Result images) and pushes them to DTR.

Build Now (highlighted in red)

Recent Changes

Stage View

Average stage times:	
syncing files	Building and pushing Vote Image
708ms	12s
#2 Jul 24 11:06 No Changes	781ms 7s
#1 Jul 21 12:26 No Changes	636ms 17s

Build History

find

#2 Jul 24, 2017 5:36 AM

#1 Jul 21, 2017 6:56 AM

RSS for all RSS for failures

10. Once the job succeeds, we can find the images being pushed to the respective repositories we created in DTR from step 8.

- Select one of the images. It will show details about that image, such as its **tags**, **size**, and **ID** – as shown below.

docker trusted registry

Search

ddcadmin

Repositories > ddcadmin/voting-app-result > Images

ddcadmin/voting-app-result **private**

No description

INFO IMAGES MANIFESTS SETTINGS

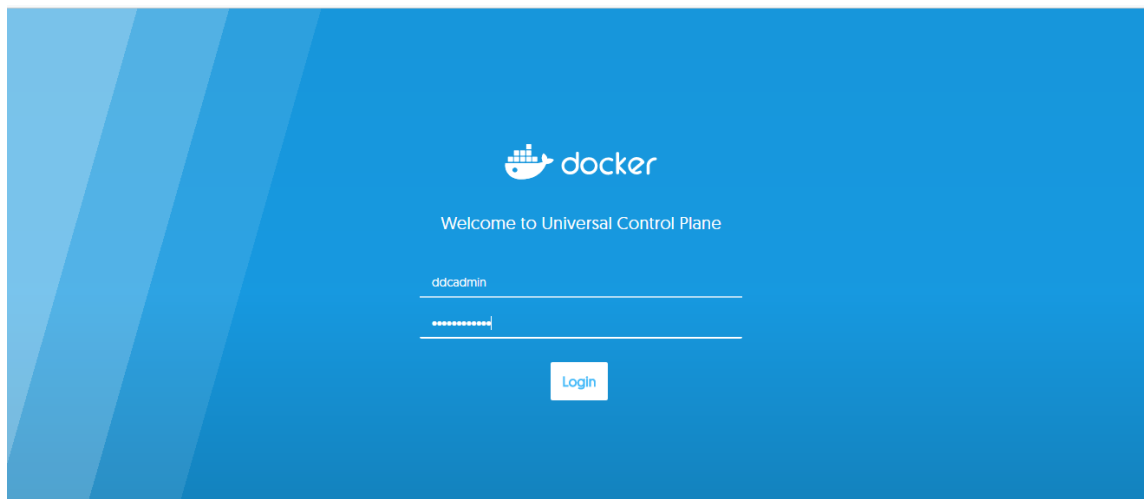
TAG	ID	SIZE (COMPRESSED)	LAST PUSHED
latest	43bb58a3c1	90.45 MB	9 hours ago by ddcadmin

Previous Next

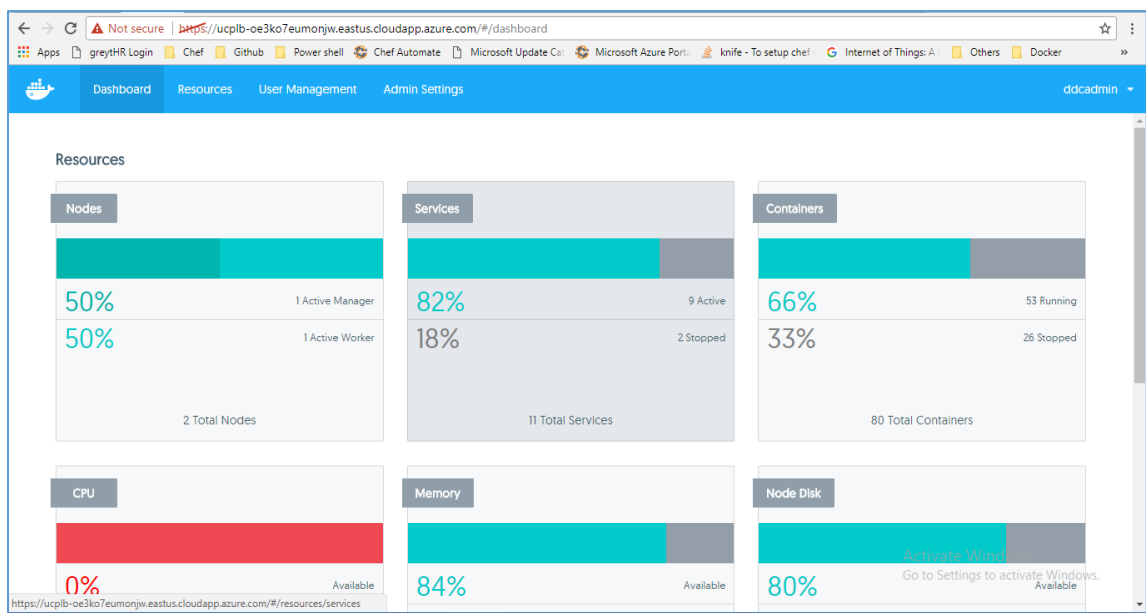
Items per page 10 25 50 100

Now that you've seen these images in DTR, in the next section we will see how these images will be deployed as a containerized application in Docker Enterprise.

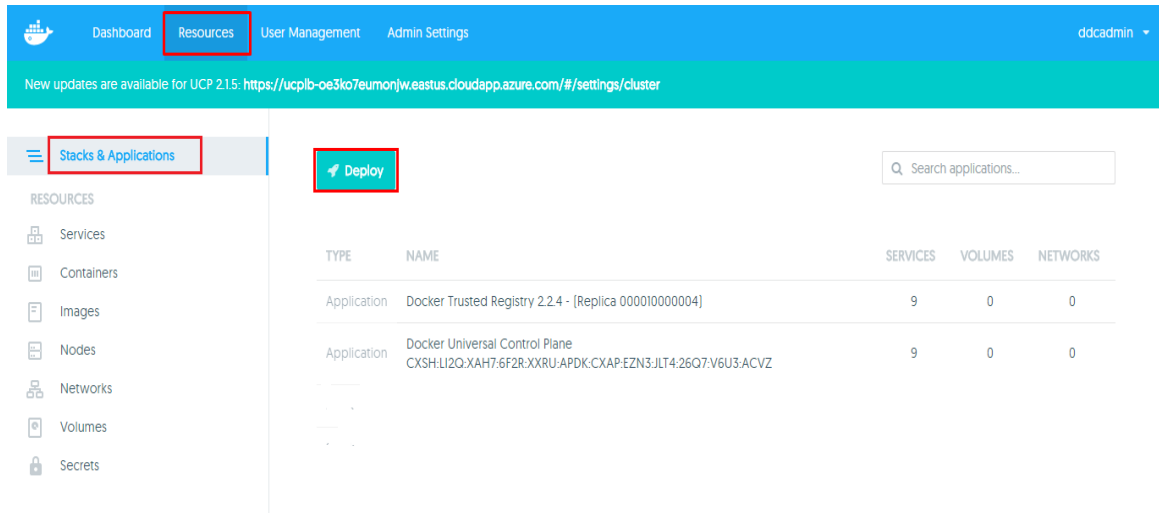
11. With the images pushed, now you can deploy the voting application from the UCP. Login to the UCP URL provided as part of the session. Open the UCP URL in a new browser tab/window. The UCP login page will look like the screenshot shown below:



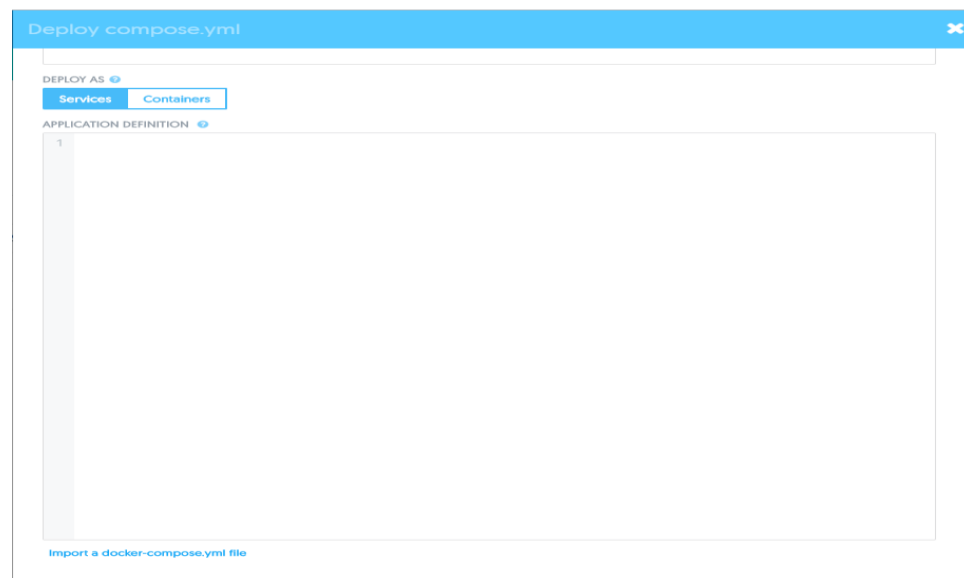
12. Once you have logged in to UCP, the screen should look like the screenshot below:



13. Next, you will deploy the **Sample Voting Application** to the Docker EE cluster running in Azure using the `docker-compose.yml` file. Click the **Resources** button, then go to **Stacks & Applications** and click on **Deploy**, as shown below:



14. After Clicking on **deploy** button the **Create Application** dialog box should appear, as shown below:



Keep this browser tab open, as we will return to it in the next section.

15. Go to the below GitHub URL and Copy the contents of the **docker-compose.yml** file to compose and deploy the application.

Docker compose file URL:

<https://raw.githubusercontent.com/sysgain/Docker-HOL/master/docker-compose.yml>

16. Copy the entire contents of the **docker-compose.yml** file, as shown below:

```
version: "3"
services:
  redis:
    image: redis:alpine
    ports:
      - "6379"
    networks:
      - frontend
    deploy:
      replicas: 2
      update_config:
        parallelism: 2
        delay: 10s
      restart_policy:
        condition: on-failure
  db:
    image: postgres:9.4
    volumes:
      - db-data:/var/lib/postgresql/data
    networks:
      - backend
    deploy:
      placement:
        constraints: [node.role == manager]
  vote:
    image: dtr1b-oe3ko7eumonjw.eastus.cloudapp.azure.com/ddcadmin/voting-app-vote:latest
    ports:
      - 5000:80
    networks:
      - frontend
    depends_on:
      - redis
    deploy:
      replicas: 6
      update_config:
        parallelism: 2
```

17. Then, return to the UCP window/tab in your web browser and paste the copied docker-compose.yml file code into the window as shown below:
18. For the **Application Name** field, enter a unique name with the following format, as shown below:
 - a. [your_username-app_name]

Deploy compose.yml ✕

APPLICATION NAME ⓘ

userxx-votingapp

DEPLOY AS ⓘ

Services

Containers

APPLICATION DEFINITION ⓘ

```

1  version: "3"
2  services:
3
4    redis:
5      image: redis:alpine
6      ports:
7        - "6379"
8      networks:
9        - frontend
10     deploy:
11       replicas: 2
12       update_config:
13         parallelism: 2
14         delay: 10s
15       restart_policy:
16         condition: on-failure
17   db:
18     image: postgres:9.4
19     volumes:
20       - db-data:/var/lib/postgresql/data
21     networks:
22       - backend
23     deploy:
24       placement:
25         constraints: [node.role == manager]
26   vote:
27     image: dtr1b-y5e6urbmgshym.westus.cloudapp.azure.com/admin/voting-app-vote:latest
28     ports:
29       - 0000:80
30     networks:

```

[Import a docker-compose.yml file](#)

☐ Show verbose logs

Create

Cancel

19. Go to lines **27, 41, and 55** in the docker-compose.yml window and replace the user "**admin**" with your own username and change the port numbers, as shown below:


```

APPLICATION DEFINITION
20 - db-data:/var/lib/postgresql/data
21 networks:
22   - backend
23 deploy:
24   placement:
25     constraints: [node.role == manager]
26 vote:
27   image: dtr1b-y5e6urbmgshym.westus.cloudapp.azure.com/admin/voting-app-vote:latest
28   ports:
29     - 0000:80
30   networks:
31     - frontend
32   depends_on:
33     - redis
34   deploy:
35     replicas: 6
36     update_config:
37       parallelism: 2
38     restart_policy:
39       condition: on-failure
40 result:
41   image: dtr1b-y5e6urbmgshym.westus.cloudapp.azure.com/admin/voting-app-result:latest
42   ports:
43     - 0001:80
44   networks:
45     - backend
46   deploy:
47     replicas: 2
48     update_config:
49       parallelism: 2
50     delay: 10s

```

20. Go to lines **29** and **43** in the docker-compose.yml window. The default outbound port number will be 000 and 001. Replace the first digit you're your user name number. For example, if the user name is **user20**, the port should be 2000 and 2001, respectively. If the user name is **user01** then change the port number as 100 and 101.

```

27   image: dtr1b-y5e6urbmgshym.westus.cloudapp.azure.com/admin/voting-app-vote:latest
28   ports:
29     - 0000:80
30   networks:
31     - frontend
32   depends_on:
33     - redis
34   deploy:
35     replicas: 6
36     update_config:
37       parallelism: 2
38     restart_policy:
39       condition: on-failure
40 result:
41   image: dtr1b-y5e6urbmgshym.westus.cloudapp.azure.com/admin/voting-app-result:latest
42   ports:
43     - 0001:80
44   networks:

```

21. Go to line **71** in the docker-compose.yml window and change the port number as per the username. If the user is **user01**, change it to **8001:8001** and for user20 the number will be **8020:8020**, as shown below:

```

69     constraints: [node.role == worker]
70   ports:
71     - "8001:8001"
72   stop_grace_period: 1m30s
73   volumes:
74     - "/var/run/docker.sock:/var/run/docker.sock"
75
76 networks:
77   frontend:

```

22. Enable the **Show Verbose Logs** checkbox near the bottom of the dialog box, then click **Create** to deploy the application.

```

69     constraints: [node.role == worker]
70   ports:
71     - "8000:8000"
72   stop_grace_period: 1m30s
73   volumes:
74     - "/var/run/docker.sock:/var/run/docker.sock"
75
76 networks:
77   frontend:
78   backend:
79
80 volumes:
81   db-data:

```

☒ Show verbose logs

Create

Cancel

23. Once the deployment succeeds (it may take a few minutes) you will now see that your application deployed successfully, as shown below:

Deploy compose.yml ✕

APPLICATION NAME ⓘ

ddcadmin-votingapp

DEPLOY AS ⓘ

Services

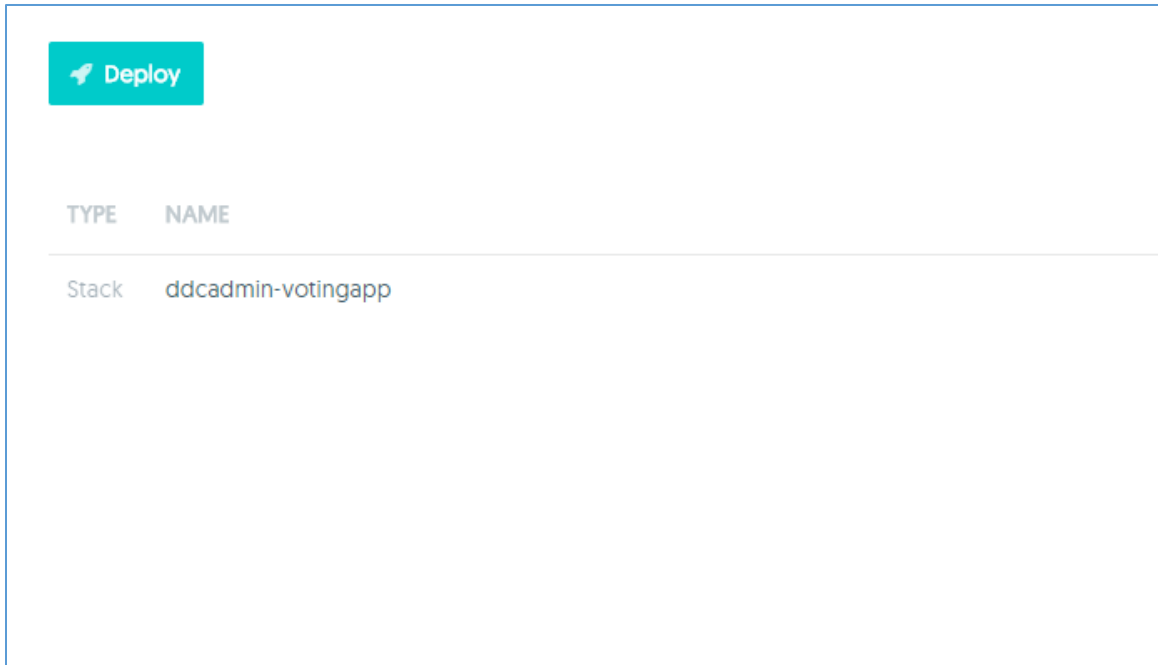
Containers

```
Creating network ddcadmin-votingapp_frontend
Creating network ddcadmin-votingapp_backend
Creating service ddcadmin-votingapp_redis
Creating service ddcadmin-votingapp_db
Creating service ddcadmin-votingapp_vote
Creating service ddcadmin-votingapp_result
Creating service ddcadmin-votingapp_worker
```

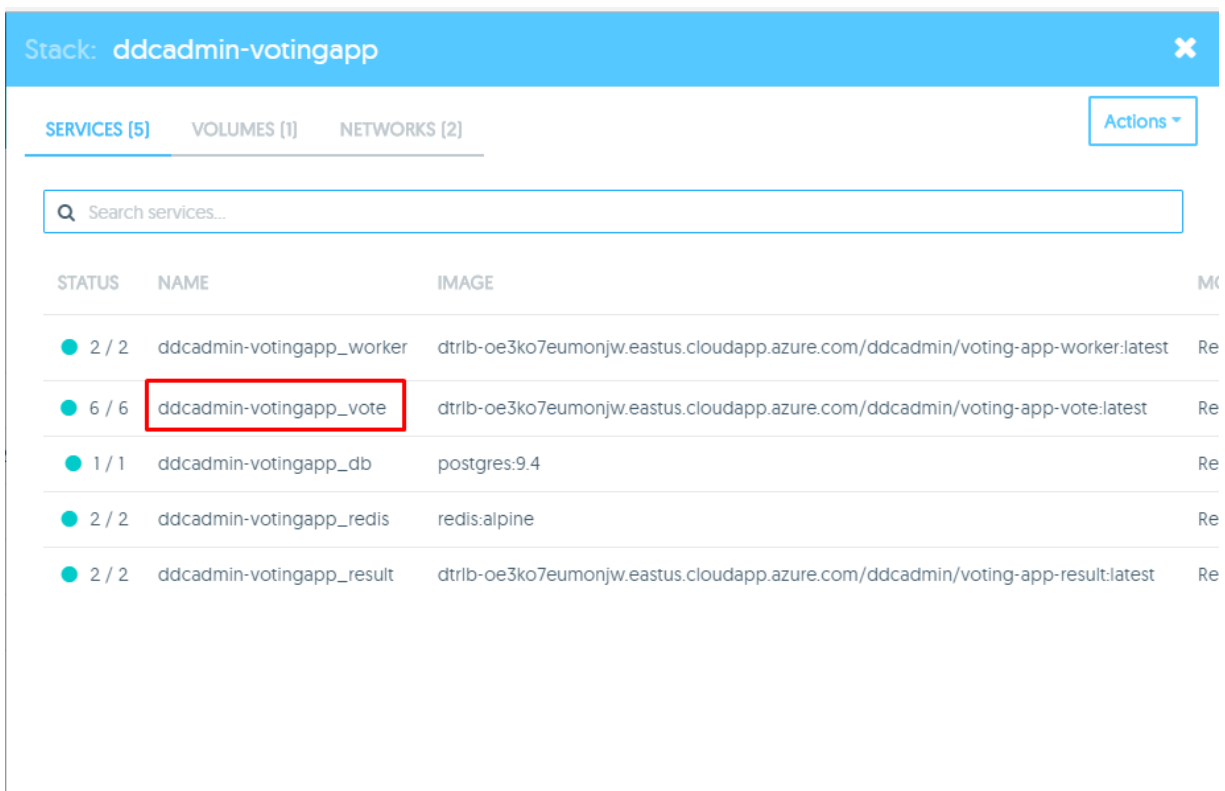
Done

Back to Edit

- Click the **Done** button to see your application deployed in the Universal Control Plane, as shown below:



24. Click on the app that we have just created, then click on the votingapp, as shown below.



25. The voting app will now be displayed in the same browser tab. On the voting app screen, scroll down and find the URL as highlighted. Click the url to vote for Cat or Dog.

Service: ddcadmin-votingapp_vote ✕

[DETAILS](#)
[SCHEDULING](#)
[ENVIRONMENT](#)
[RESOURCES](#)
[TASKS](#)

Actions ▾

Created	2017-07-21 21:02:37 +0530
Service Specification Updated	2017-07-21 21:02:37 +0530
Update Status	Never updated
Last Error	No errors

Task Template

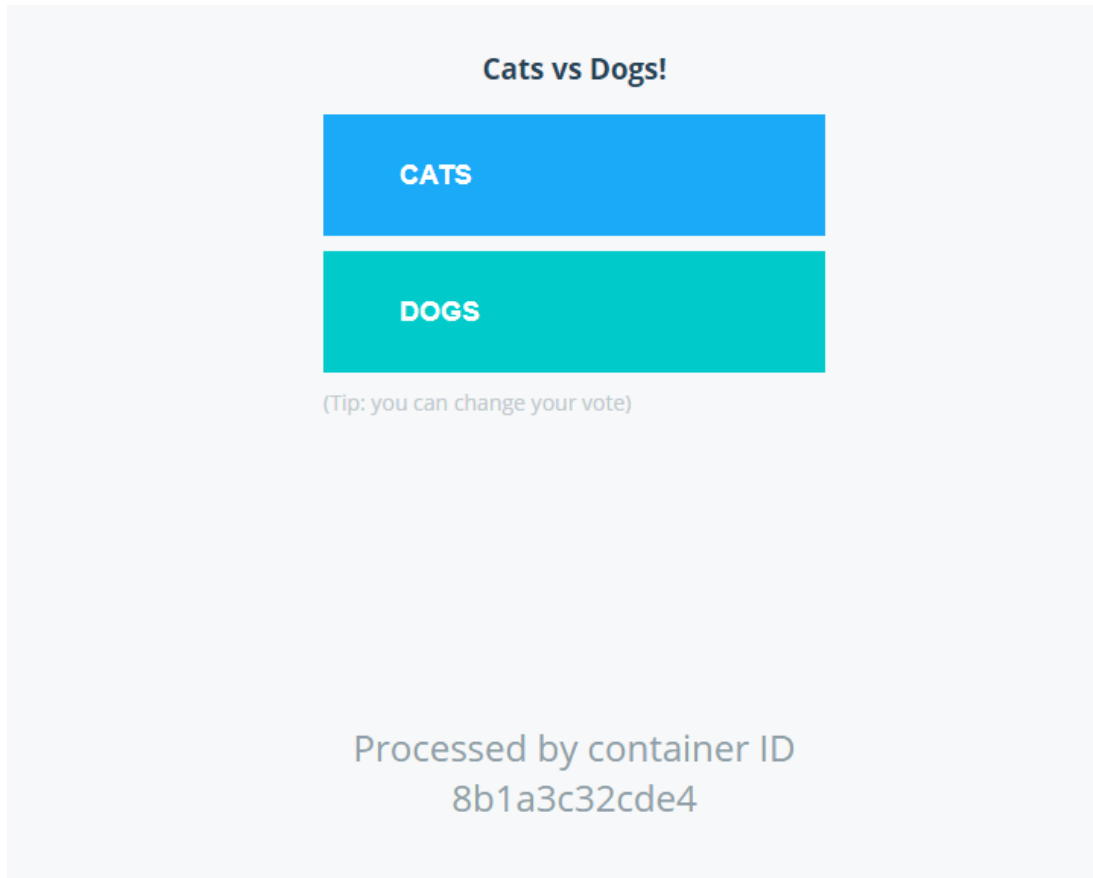
Image	dtr1b-oe3ko7eumonjw.eastus.cloudapp.azure.com/ddcadmin/voting-app-vote:latest@sha256:69ee68d80fa64c6eb336ce1770a35f1c5f1fd76619a89bae755ddf7d62641200 ✎
Requires Registry Authentication	<input type="checkbox"/> ?
Command	Default command ✎
Args	Default args ✎
Working Directory	Default working directory ✎
User	Default user ✎
Stop Grace Period (seconds)	0 ✎

Published Ports

+ Publish a Port

TARGET PORT/PROTOCOL	PUBLISHED PORT		
80/tcp	Ingress: 9000	Ingress: applb-oe3ko7eumonjw.eastus.cloudapp.azure.com:9000	✕







- You should see the running **Voting Application**, as shown below:



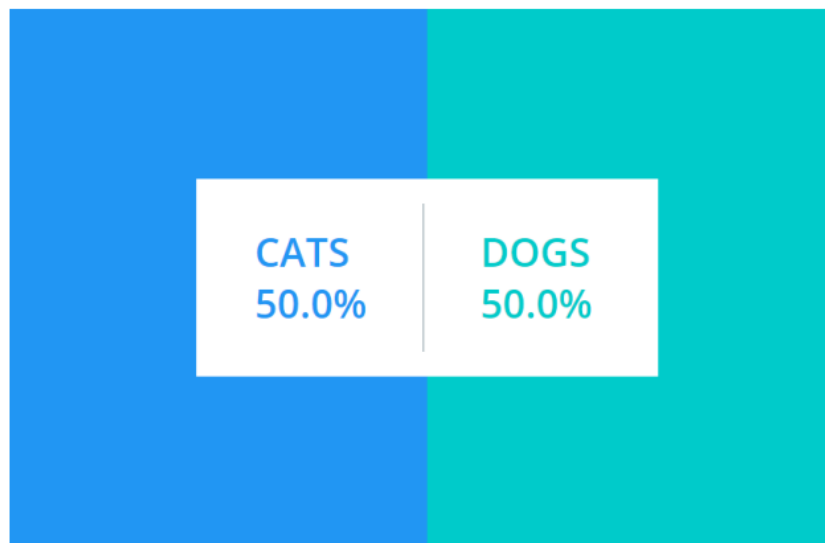
26. Click on the app that we have just created, then click on the result app, as shown below.

Stack: ddcadmin-votingapp				
SERVICES [5] VOLUMES [1] NETWORKS [2]				
<input type="text" value="Search services..."/>				
STATUS	NAME	IMAGE	MK	
2 / 2	ddcadmin-votingapp_worker	dtrib-oe3ko7eumonjw.eastus.cloudapp.azure.com/ddcadmin/voting-app-worker:latest	Re	
6 / 6	ddcadmin-votingapp_vote	dtrib-oe3ko7eumonjw.eastus.cloudapp.azure.com/ddcadmin/voting-app-vote:latest	Re	
1 / 1	ddcadmin-votingapp_db	postgres:9.4	Re	
2 / 2	ddcadmin-votingapp_redis	redis:alpine	Re	
2 / 2	ddcadmin-votingapp_result	dtrib-oe3ko7eumonjw.eastus.cloudapp.azure.com/ddcadmin/voting-app-result:latest	Re	

27. In the application, go to result app and click on it. Scroll down to get the result URL. Copy and paste that URL in the browser to see the result. As show in below.

Requires Registry Authentication	<input type="checkbox"/> ?
Command	Default command 
Args	Default args 
Working Directory	Default working directory 
User	Default user 
Stop Grace Period (seconds)	0 
Published Ports	
+ Publish a Port	
TARGET PORT/PROTOCOL	PUBLISHED PORT
80/tcp	Ingress: 9000
	Ingress: applb-oe3ko7eumonjw.eastus.cloudapp.azure.com:9000 

28. The result app will now be displayed in the same browser tab. Now you can see the result.



- Congratulations! You now have both the Voting and Results applications running.

29. Next, we will scale up the Voting App to 7 containers, because we believe we need additional resources to handle the load.

- Return to the UCP main page and select '**Resources**'.
- Go to your app and select the "**voting-app**" item. In the next pane, go to scheduling, where you see the scaling.

Service: ddcadmin-votingapp_vote

DETAILS


SCHEDULING

ENVIRONMENT



RESOURCES


TASKS

Mode
Replicated

Scale
6 



Update Configuration

Update Parallelism 
2 

Update Delay (seconds)
0 

Failure Action

Pause
Continue

Max Failure Ratio 
0 

- Change the scaling to 7 and save it.

DETAILS
SCHEDULING
ENVIRONMENT
RESOURCES
TASKS

Save Changes
Cancel

! Changing this service will restart the tasks using the updated specifications.

ModeReplicated

Scale7

Update Configuration

Update Parallelism2

Update Delay [seconds]0

You should see that the total containers running on your application have increased by 1.

Stack: ddcadmin-votingapp

SERVICES [5] VOLUMES [1] NETWORKS [2] Actions

STATUS	NAME	IMAGE	MODE
0 / 2	ddcadmin-votingapp_worker	dtrib-oe3ko7eumonjw.eastus.cloudapp.azure.com/ddcadmin/voting-app-worker:latest	Re
7 / 7	ddcadmin-votingapp_vote	dtrib-oe3ko7eumonjw.eastus.cloudapp.azure.com/ddcadmin/voting-app-vote:latest	Re
1 / 1	ddcadmin-votingapp_db	postgres:9.4	Re
2 / 2	ddcadmin-votingapp_redis	redis:alpine	Re
2 / 2	ddcadmin-votingapp_result	dtrib-oe3ko7eumonjw.eastus.cloudapp.azure.com/ddcadmin/voting-app-result:latest	Re

- **Congratulations!** You've now scaled up your containers running in the application you created in UCP.

Thank you for attending this Hands-on Lab for Docker Enterprise Edition. For more information on Docker or CloudBees Jenkins, visit the Docker or CloudBees websites, or contact check out this solution on the [Azure Quick starts GitHub site](#).