



Exercise 3.4: Deploy A Simple Application

We will test to see if we can deploy a simple application, in this case the **nginx** web server.

1. Create a new deployment, which is a Kubernetes object, which will deploy an application in a container. Verify it is running and the desired number of containers matches the available.

```
student@lfs458-node-1a0a:~$ kubectl create deployment nginx --image=nginx
deployment.apps/nginx created
```

```
student@lfs458-node-1a0a:~$ kubectl get deployments
```

NAME	READY	UP-TO-DATE	AVAILABLE	AGE
nginx	1/1	1	1	8s

2. View the details of the deployment. Remember auto-completion will work for sub-commands and resources as well.

```
student@lfs458-node-1a0a:~$ kubectl describe deployment nginx

Name:                nginx
Namespace:            default
CreationTimestamp:    Mon, 23 Apr 2019 22:38:32 +0000
Labels:               app=nginx
Annotations:          deployment.kubernetes.io/revision: 1
Selector:              app=nginx
Replicas:             1 desired | 1 updated | 1 total | 1 ava...
StrategyType:         RollingUpdate
MinReadySeconds:      0
RollingUpdateStrategy: 25% max unavailable, 25% max surge
<output_omitted>
```

3. View the basic steps the cluster took in order to pull and deploy the new application. You should see several lines of output. The first column shows the age of each message. Over time older messages will be removed.

```
student@lfs458-node-1a0a:~$ kubectl get events
<output_omitted>
```

4. You can also view the output in **yaml** format, which could be used to create this deployment again or new deployments. Get the information but change the output to yaml. Note that halfway down there is status information of the current deployment.

```
student@lfs458-node-1a0a:~$ kubectl get deployment nginx -o yaml
```

YAML

```
1 apiVersion: apps/v1
2 kind: Deployment
3 metadata:
4   annotations:
5     deployment.kubernetes.io/revision: "1"
6   creationTimestamp: 2017-09-27T18:21:25Z
7 <output_omitted>
```

5. Run the command again and redirect the output to a file. Then edit the file. Remove the `creationTimestamp`, `resourceVersion`, `selfLink`, and `uid` lines. Also remove all the lines including and after `status:`, which should be somewhere around line 40, if others have already been removed.

```
student@lfs458-node-1a0a:~$ kubectl get deployment nginx -o yaml > first.yaml
```

```
student@lfs458-node-1a0a:~$ vim first.yaml
```

<Remove the lines mentioned above>

6. Delete the existing deployment.

```
student@lfs458-node-1a0a:~$ kubectl delete deployment nginx
deployment.apps "nginx" deleted
```

7. Create the deployment again this time using the file.

```
student@lfs458-node-1a0a:~$ kubectl create -f first.yaml
deployment.apps/nginx created
```

8. Look at the yaml output of this iteration and compare it against the first. The time stamp, resource version and uid we had deleted are in the new file. These are generated for each resource we create, so we need to delete them from yaml files to avoid conflicts or false information. The status should not be hard-coded either.

```
student@lfs458-node-1a0a:~$ kubectl get deployment nginx -o yaml > second.yaml
```

```
student@lfs458-node-1a0a:~$ diff first.yaml second.yaml
```

<output_omitted>

9. Now that we have worked with the raw output we will explore two other ways of generating useful YAML or JSON. Use the `--dry-run` option and verify no object was created. Only the prior `nginx` deployment should be found. The output lacks the unique information we removed before, but does have different output such as the `apiVersion`.

```
student@lfs458-node-1a0a:~$ kubectl create deployment two --image=nginx --dry-run -o yaml
```

YAML

```
1 apiVersion: apps/v1
2 kind: Deployment
3 metadata:
4   creationTimestamp: null
5   labels:
6     app: two
7     name: two
8 spec:
9 <output_omitted>
```

```
student@lfs458-node-1a0a:~$ kubectl get deployment
```

NAME	READY	UP-TO-DATE	AVAILABLE	AGE
nginx	1/1	1	1	7m

10. Existing objects can be viewed in a ready to use YAML output. Take a look at the existing `nginx` deployment. Note there is more detail to the `--export` option. The flag has been **deprecated** and may be removed in the future.

```
student@lfs458-node-1a0a:~$ kubectl get deployments nginx --export -o yaml
```

YAML

```
1 apiVersion: apps/v1
2 kind: Deployment
3 metadata:
4   annotations:
5     deployment.kubernetes.io/revision: "1"
```

YAML

```

1  creationTimestamp: null
7  generation: 1
8  labels:
9    run: nginx
10 <output_omitted>

```

11. The output can also be viewed in JSON output.

```
student@lfs458-node-1a0a:~$ kubectl get deployment nginx --export -o json
```

JSON

```

1  {
2    "apiVersion": "extensions/v1beta1",
3    "kind": "Deployment",
4    "metadata": {
5      "annotations": {
6        "deployment.kubernetes.io/revision": "1"
7      },
8    <output_omitted>

```

12. The newly deployed **nginx** container is a light weight web server. We will need to create a **service** to view the default welcome page. Begin by looking at the help output. Note that there are several examples given, about halfway through the output.

```
student@lfs458-node-1a0a:~$ kubectl expose -h
<output_omitted>
```

13. Now try to gain access to the web server. As we have not declared a port to use you will receive an error.

```
student@lfs458-node-1a0a:~$ kubectl expose deployment/nginx
error: couldn't find port via --port flag or introspection
See 'kubectl expose -h' for help and examples.
```

14. To change an object configuration one can use subcommands **apply**, **edit** or **patch** for non-disruptive updates. The **apply** command does a three-way diff of previous, current, and supplied input to determine modifications to make. Fields not mentioned are unaffected. The **edit** function performs a **get**, opens an editor, then an **apply**. You can update API objects in place with **JSON patch** and **merge patch** or **strategic merge patch** functionality.

If the configuration has resource fields which cannot be updated once initialized then a disruptive update could be done using the **replace --force** option. This deletes first then re-creates a resource.

Edit the file. Find the container name, somewhere around line 31 and add the port information as shown below.

```
student@lfs458-node-1a0a:~$ vim first.yaml
```

YAML

first.yaml

```

1  ....
2  spec:
3    containers:
4      - image: nginx
5        imagePullPolicy: Always
6        name: nginx
7        ports:                                # Add these
8          - containerPort: 80                 # three
9            protocol: TCP                     # lines
10       resources: {}
11  ....

```

15. Due to how the object was created we will need to use `replace` to terminate and create a new deployment.

```
student@lfs458-node-1a0a:~$ kubectl replace -f first.yaml
deployment.apps/nginx replaced
```

16. View the Pod and Deployment. Note the AGE shows the Pod was re-created.

```
student@lfs458-node-1a0a:~$ kubectl get deploy,pod
```

NAME	READY	UP-TO-DATE	AVAILABLE	AGE
deployment.apps/nginx	1/1	1	1	2m4s

NAME	READY	STATUS	RESTARTS	AGE
pod/nginx-7db75b8b78-qjffm	1/1	Running	0	8s

17. Try to expose the resource again. This time it should work.

```
student@lfs458-node-1a0a:~$ kubectl expose deployment/nginx
service/nginx exposed
```

18. Verify the service configuration. First look at the service, then the endpoint information. Note the ClusterIP is not the current endpoint. Calico provides the ClusterIP. The Endpoint is provided by kubelet and kube-proxy. Take note of the current endpoint IP. In the example below it is 192.168.1.5:80. We will use this information in a few steps.

```
student@lfs458-node-1a0a:~$ kubectl get svc nginx
```

NAME	TYPE	CLUSTER-IP	EXTERNAL-IP	PORT(S)	AGE
nginx	ClusterIP	10.100.61.122	<none>	80/TCP	3m


```
student@lfs458-node-1a0a:~$ kubectl get ep nginx
```

NAME	ENDPOINTS	AGE
nginx	192.168.1.5:80	26s

19. Determine which node the container is running on. Log into that node and use `tcpdump` to view traffic on the `tunl0`, as in tunnel zero, interface. The second node in this example. You may also see traffic on an interface which starts with `cali` and some string. Leave that command running while you run `curl` in the following step. You should see several messages go back and forth, including a HTTP HTTP/1.1 200 OK: and a ack response to the same sequence.

```
student@lfs458-node-1a0a:~$ kubectl describe pod nginx-7cbc4b4d9c-d27xw \
| grep Node:
Node:    lfs458-worker/10.128.0.5
```



```
student@lfs458-worker:~$ sudo tcpdump -i tunl0
```

```
tcpdump: verbose output suppressed, use -v or -vv for full protocol...
listening on tunl0, link-type EN10MB (Ethernet), capture size...
<output_omitted>
```

20. Test access to the Cluster IP, port 80. You should see the generic `nginx` installed and working page. The output should be the same when you look at the ENDPOINTS IP address. If the `curl` command times out the pod may be running on the other node. Run the same command on that node and it should work.

```
student@lfs458-node-1a0a:~$ curl 10.100.61.122:80
<!DOCTYPE html>
<html>
<head>
<title>Welcome to nginx!</title>
<style>
<output_omitted>
```



```
student@lfs458-node-1a0a:~$ curl 192.168.1.5:80
```

21. Now scale up the deployment from one to three web servers.

```
student@lfs458-node-1a0a:~$ kubectl get deployment nginx
NAME      READY   UP-TO-DATE   AVAILABLE   AGE
nginx     1/1     1            1           12m

student@lfs458-node-1a0a:~$ kubectl scale deployment nginx --replicas=3
deployment.apps/nginx scaled

student@lfs458-node-1a0a:~$ kubectl get deployment nginx
NAME      READY   UP-TO-DATE   AVAILABLE   AGE
nginx     3/3     3            3           12m
```

22. View the current endpoints. There now should be three. If the UP-TO-DATE above said three, but AVAILABLE said two wait a few seconds and try again, it could be slow to fully deploy.

```
student@lfs458-node-1a0a:~$ kubectl get ep nginx
NAME      ENDPOINTS                                     AGE
nginx     192.168.0.3:80,192.168.1.5:80,192.168.1.6:80 7m40s
```

23. Find the oldest pod of the **nginx** deployment and delete it. The Tab key can be helpful for the long names. Use the AGE field to determine which was running the longest. You may notice activity in the other terminal where **tcpdump** is running, when you delete the pod. The pods with 192.168.0 addresses are probably on the master and the 192.168.1 addresses are probably on the worker

```
student@lfs458-node-1a0a:~$ kubectl get po -o wide
NAME                                READY   STATUS    RESTARTS   AGE   IP
nginx-1423793266-7f1qw             1/1     Running   0          14m   192.168.1.5
nginx-1423793266-8w2nk             1/1     Running   0          86s   192.168.1.6
nginx-1423793266-fbt4b             1/1     Running   0          86s   192.168.0.3

student@lfs458-node-1a0a:~$ kubectl delete po nginx-1423793266-7f1qw
pod "nginx-1423793266-7f1qw" deleted
```

24. Wait a minute or two then view the pods again. One should be newer than the others. In the following example nine seconds instead of four minutes. If your **tcpdump** was using the **veth** interface of that container it will error out.

```
student@lfs458-node-1a0a:~$ kubectl get po
NAME                                READY   STATUS    RESTARTS   AGE
nginx-1423793266-13p69             1/1     Running   0          9s
nginx-1423793266-8w2nk             1/1     Running   0          4m1s
nginx-1423793266-fbt4b             1/1     Running   0          4m1s
```

25. View the endpoints again. The original endpoint IP is no longer in use. You can delete any of the pods and the service will forward traffic to the existing backend pods.

```
student@lfs458-node-1a0a:~$ kubectl get ep nginx
NAME      ENDPOINTS                                     AGE
nginx     192.168.0.3:80,192.168.1.6:80,192.168.1.7:80 12m
```

26. Test access to the web server again, using the ClusterIP address, then any of the endpoint IP addresses. Even though the endpoints have changed you still have access to the web server. This access is only from within the cluster. When done use **ctrl-c** to stop the **tcpdump** command.

```
student@lfs458-node-1a0a:~$ curl 10.100.61.122:80
<!DOCTYPE html>
<html>
<head>
<title>Welcome to nginx!</title>
<style>
    body
<output_omitted>
```