

Kubernetes Introduction Workshop

Golang Warsaw Meetup

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1 Prerequisites

You need to feel good with Command Line Interface. You should understand what Docker is.

- Workstation with Linux or OSX recommended.
- Software
 - Minikube
 - Kubernetes CLI
 - Docker
- Tools
 - jq
- Good to have
 - hub.docker.com account or alternative docker repository

1.1 HowTos

- Install Minikube at kubernetes.io
- Install Kubernetes CLI - kubectl at kubernetes.io

1.2 Verify the setup

```
$ minikube status
```

```
$ minikube start
```

```
$ kubectl config use-context minikube
```

```
$ kubectl get nodes
```

NAME	STATUS	ROLES	AGE	VERSION
minikube	Ready	master	6d	v1.12.4

1.3 Kubernetes CLI Basics

Let's learn first some basics regarding the *kubectl*:

```
kubectl get <ARTIFACT>
kubectl describe <ARTIFACT>
```

1. List the nodes

```
kubectl get nodes
```

What the names of our nodes are? . . .

2. Learn about the node

```
kubectl get nodes minikube
```

notice:

```
kubectl get no minikube
kubectl get node minikube
```

3. Get more details:

```
kubectl describe nodes minikube
```

Note down:

- Container Runtime Version: . . .
- What the namespaces we have: . . .
- Note down name of two pods:
 - . . .
 - . . .

4. YAML and JSON output

```
kubectl get node minikube -o yaml
kubectl get node minikube -o json
```

Use *jq* to get the *kubeletVersion*, write down below:

...

5. Notice jsonpath support

```
kubectl get node minikube \
  -o jsonpath="{.status.daemonEndpoints.kubeletEndpoint.Port}"

kubectl get node minikube -o jsonpath="{.metadata.labels}"
```

Write down a command with jsonpath to get information on how many CPU we have allocated to our minikube:

...

6. Select with labels

```
kubectl get nodes -l 'kubernetes.io/hostname'=minikube
```

Please find another label, you could select our node and run the command.

7. Select with labels

```
kubectl api-resources
```

Hints

- kubectlx and kubens - <https://github.com/ahmetb/kubectlx>
- alias k=kubectl or alias kb=kubectl

2 Kubectl configuration file

Good to know. You can find there also your token, certificates, etc.

1. View `/.kube/config`
2. Find *certificate-authority*
3. Note the main sections:
.....

3 Exploring Namespace kube-system

Let's look around what we have here.

1. What are the namespaces?

```
$ kubectl get ns
$ kubectl get namespaces
```

Notice:

- you can create namespaces to better organize your components
- you define resource restrictions for namespaces
- affect the name: *service-name.namespace-name.svc.cluster.local*.
We will talk about it later.

To change the selected namespace for our commands

```
kubectl config set-context \
  $(kubectl config current-context) \
  --namespace <namespace-name>
```

2. Get the list of pods in namespace kube-system:

```
$ kubectl get po --namespace=kube-system
$ kubectl get po -n=kube-system
```

Use `kubectl describe po <pod-name> --namespace=kube-system` to find what the version is of:

- kube-proxy: . . .
- apiserver: . . .
- coredns: . . .

3. Get the list of services:

```
$ kubectl get svc --namespace=kube-system
```

Use `kubernetes describe svc <svc-name> --namespace=kube-system` to find the endpoints for:

- kube-dns: . . .
- kubernetes-dashboard: . . .

4. Logs:

```
$ kubectl logs coredns-c4c -n=kube-system
$ kubectl logs coredns-c4c -n=kube-system -f
$ kubectl logs coredns-c4c -n=kube-system --tail=10
```

Please display logs of:

kube-apiserver, kube-proxy, kube-scheduler, and etcd-minikube.

Later, we will also cover events:

```
kubectl get events -n=kube-system.
```

5. Get the console:

```
$ kubectl exec -it kube-apiserver-minikube \
/bin/sh -n=kube-system
```

6. Kubernetes Dashboard:

```
# on normal deployment:
# $ kubernetes proxy
$ minikube dashboard
```

7. Basic metrics:

```
minikube addons enable metrics-server
```

```
# wait 5 seconds
kubectl top nodes
kubectl top pods
```

4 Kubernetes deployments.yaml

We have been playing around with kube-system, now let's get our service up and running.

1. Get the deployment file introduction/kube-deployment.yaml:

```
apiVersion: apps/v1
kind: Deployment
metadata:
  name: intro-app
  labels:
    app: intro-app
spec:
  replicas: 1
  selector:
    matchLabels:
      app: intro-app
  template:
    metadata:
      labels:
        app: intro-app
    spec:
      containers:
        - name: app
          image: wojciech11/api-status:1.0.0
          ports:
            - containerPort: 80
```

Notice:

- if your repo is private, you need to define `imagePullSecrets`.
- A force pulling image every time: `imagePullPolicy: Always`, helpful during development, do not use in **production**.

2. Deploy:

```
$ kubectl create -f introduction/kube-deployment.yaml
```


3. Check:

```
$ kubectl get po
$ kubectl get po -n default

$ kubectl describe po <POD_NAME>
```

4. To learn about the deployments:

```
$ kubectl get deploy
$ kubectl get deployment

$ kubectl describe deploy <DEPLOYMENT_NAME>
```

What the update strategy do we use?

. . .

5. Find the following information:

- What is the IP of your app pod? . . .
- What is ReplicatSet? . . .
- Ready? . . .
- Restart Count? . . .
- Events? . . .

Notice: the next step are Liveness/Readiness probes.

5 Opening console in your container

Imagine, we cannot reach our application. Let's check it within the running container.

1. Get the console:

```
kubectl exec -it intro-app-65d /bin/bash
```

Notice: There is an ongoing discussion whether it is the "new" ssh.

```
kubectl exec -it intro-app-65d /bin/bash
\# printenv
```

2. Add tool for debugging - curl:

```
apt-get update && apt-get install -qq curl
```

3. Does it work?

```
# does it work?
curl 127.0.0.1
```

```
# can we get outside
curl -I wbarczynski.pl
```

```
# can we reach other services:
telnet kube-dns.kube-system 53
```

4. Yes, we fix the bug, let's clean up:

```
kubectl delete po intro-app-65db4-...
```

```
# notice the name change
kubectl get po
```

6 Port-forwarding

What If I told you, you can debug your app from your laptop.

1. Find the port our service listen, check the deployment file.
2. Setup the port forwarding:

```
kubectl proxy-forward <POD_NAME> 8080:<PORT_NUMBER>
```

3. Use curl to query our app from your local console.

Let's learn about services and ingresses first, later we see how we can modify our deployment and update the application.

7 Kubernetes Service

Our factory, I mean the deployment defines how we create our applications as pods. The service, how it is consumed.

1. Get the service file `introduction/kube-service.yaml`:

```
apiVersion: apps/v1
kind: Deployment
metadata:
  name: intro-app
  labels:
    app: intro-app
spec:
  replicas: 1
  selector:
    matchLabels:
      app: intro-app
  template:
    metadata:
      labels:
        app: intro-app
    spec:
      containers:
      - name: app
        image: wojciech11/api-status:1.0.0
        ports:
        - containerPort: 80
```

2. Deploy:

```
$ kubectl create -f introduction/kube-service.yaml
$ kubectl apply -f introduction/kube-service.yaml
```

3. Check:

```
$ kubectl get svc
```

4. Find out the endpoint IP: . . .

5. We few types of services:

- with ClusterIP
- ClusterIP: None
- LoadBalanced

6. Let's access it:

```
export SVC_PORT=$(kubectl get service intro-app \
  --output='jsonpath="{.spec.ports[0].nodePort}"' \
  | tr -d ' ')
curl $(minikube ip):${SVC_PORT}
```

Notice: on Azure, AWS, or Google, we would get the loadbalancer created and public IP assigned.

7. How it works?

```
$ kubectl exec -it intro-app-65db487447-lrhh9 /bin/bash
```

```
/# curl intro-app
/# curl intro-app.default
/# curl intro-app.default.svc
```

```
/# apt-get update && apt-get install dnsutils -qq
/# # resolve the same host names:
/# nslookup intro-app
```

8. How it works from other apps?

```
$ kubectl run -i --tty busybox --image=busybox -- sh
/# curl intro-app
/#
/# wget -O- intro-app
/# wget -O- kubernetes-dashboard.kube-system
```

8 Modifying kubernetes deployment and service

Avoid editing files on kubernetes, always modify a yaml and apply the changes.

1. Change the number of pods running to 2 with:

```
$ kubectl edit deploy
```

```
$ kubectl get po
```

2. Change the value of label `me` to your name in the service definition.
3. Modify the `deployment.yml` to get 3 running pods, use: `kubectl apply -f`
4. Add one more label to service.
5. What does happen if we add one more selector, apply it:

```
apiVersion: v1
kind: Service
metadata:
  name: intro-app
  labels:
    me: wojtek
spec:
  ports:
    - port: 80
      protocol: TCP
  selector:
    app: intro-app
    break: the-connection-with-pods
  type: LoadBalancer
```

Can we connect?

```
curl -I $(minikube ip):${SVC_PORT}
```

What has changed?

```
kubectl describe svc intro-app
```

Notice: very very very common issue :D

6. Fix our service.

9 Updating service

Let's update our app from the version 1.0.0 to 2.0.0:

1. Change in the deployment file and apply changes.
2. You can also change it with set image:

```
$ kubectl set image deployment/<CONTAINER_NAME> \  
  <CONTAINER_NAME>=<DOCKER_IMAGE_NAME>:<VERSION>
```

3. Change two times from 1.0.0 to 2.0.0 and back:

```
$ curl -I $(minikube ip):${SVC_PORT}
```

10 Kubernetes Ingress

1. Install our ingress-controller:

```
$ kubectl apply -f introduction/ingress/
```

2. Apply the ingress controller:

```
apiVersion: extensions/v1beta1
kind: Ingress
metadata:
  name: intro-app
  annotations:
    kubernetes.io/ingress.class: traefik
    traefik.frontend.rule.type: PathPrefixStrip
spec:
  rules:
  - host: my.app
    http:
      paths:
      - path: /echo
        backend:
          serviceName: intro-app
          servicePort: 80
```

3. Check:

```
kubectl get ing
kubectl describe ing <YOUR_ING>
```

4. Use:

```
$ export ING_CNTR_PORT=$(kubectl \
  get service traefik-ingress-service \
  -n kube-system \
  --output='jsonpath="{.spec.ports[0].nodePort}"' \
  | tr -d '')
```



```
$ export MK_IP=$(minikube ip)
```

```
$ curl --header 'Host: my.app' http://${MK_IP}:${ING_CNTR_PORT}/echo
```

5. Open traefik dashboard:

```
kubectl port-forward -n kube-system \
traefik-ingress-controller-s58cv \
8080:8080
```

11 Containers vs Pods

Please answer the following questions:

- How many containers can a Pod has?
- Do containers share disk?
- Do container share port space?
- What does 1/1 mean in the output of `kubectl get po`?

12 Fail-over

1. Open console.

2. Force restart:

```
# should work
kill 1
```

```
# always works
kill -9 1
```

Repeat 5 times. Observer the output from: `kubectl get po`.

13 How to debug

Good to ship a minimum of debugging tools in your container, such as, curl or telnet.

Happy debugging path:

```
kubectl describe ing
kubectl describe svc
kubectl exec -it <> /bin/bash
```

```
# curl, telnet, ...
kubectl describe po <>
```

```
kubectl logs <>
kubectl logs <> -f
kubectl logs <> --tail=100
```

```
kubectl logs <YOUR_INGRESS_CONTROLLER_POD>
```

```
kubectl get events
```

14 Kubernetes configmap

With configmaps, we can deliver values for environment variables or files. Let's change the page in our application:

1. Copy index.html:

```
cp introduction/dockers/site-1.0.0/index.html index.html
```

2. Add your name after the version number:

```
<html>
<h1>1.0.0-Maria</h1>
</html>
```

3. Let's create a configmap:

```
kubectl create cm index-html --from-file index.html
```

4. Check the commands:

```
kubectl describe cm index-html
kubectl get cm index-html -o yaml
kubectl get cm index-html -o json
```

5. Let's mount it:

```
apiVersion: apps/v1
kind: Deployment
metadata:
  name: intro-app
  labels:
    app: intro-app
spec:
  replicas: 1
  selector:
    matchLabels:
      app: intro-app
  template:
    metadata:
      labels:
        app: intro-app
    spec:
      containers:
        - name: app
          image: wojciech11/api-status:1.0.0
          ports:
            - containerPort: 80
          volumeMounts:
            - mountPath: "/usr/share/nginx/html"
              name: "html-content"
      volumes:
        - name: html-content
          configMap:
            name: index-html
```

5. Smoke test:

```
# 30288 is the port, the ingress-controller is listening:
curl --header 'Host: my.app' "http://$(minikube ip):30288/echo"
```

15 Kubernetes secret

The same as the Kubernetes config, difference, it is stored only on the master nodes.

16 Opinionated Configuration

1. envsubst
2. Ksonnect
3. Helm

17 Kubernetes Persistent Volumes

A persistence storage that survives your pod being deleted.
TBD: mention about empty

18 Outlook

What could be the next steps in learning k8s.

What you could learn next.

Next course *Immediate (Developer)*:

1. Liveness/Readiness probes
2. Monitoring with Prometheus
3. Resource and Limits, QoS for your pods, schedule policies
4. Statefulsets
5. DaemonSets

Observability plus with Istio demo as what might the future be:

1. Monitoring
2. Logging
3. Traceability

Advance (Developer):

1. Zero-downtime deployment strategies
2. Horizontal scaling (beta: vertical pod scaling for the pets)
3. Continuous Deployment and Integration
4. TravisCI and Gitlab
5. (sic :/) gitops, have to say few things...

Network and Security:

1. RBAC deep dive
2. Networking - Internal Loadbalancing - <https://kubernetes.io/docs/concepts/services-networking/>
3. Egress - <https://kubernetes.io/docs/concepts/services-networking/network-policies/>
4. IpBlock

Kubernetes customization

1. Write your first CRD
2. ...
3. ...
4. FaaS? Kubeless?

CloudNative Ecosystem

1. Observability: Prometheus stack
2. Observability: EFK
3. Observability: Tracing
4. Ingress Controllers: Traefik, ... , talk about standard and controller-specific annotations
5. Cert-manager
6. (Traditional) backups with Ark
7. Operators for etcd and Vault

More

1. Istio
2. Operators for ...

Optionals

1. Google Kubernetes Engine - GKE
2. Azure Kubernetes Service - AKS
3. Amazon Elastic Kubernetes - EKS

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