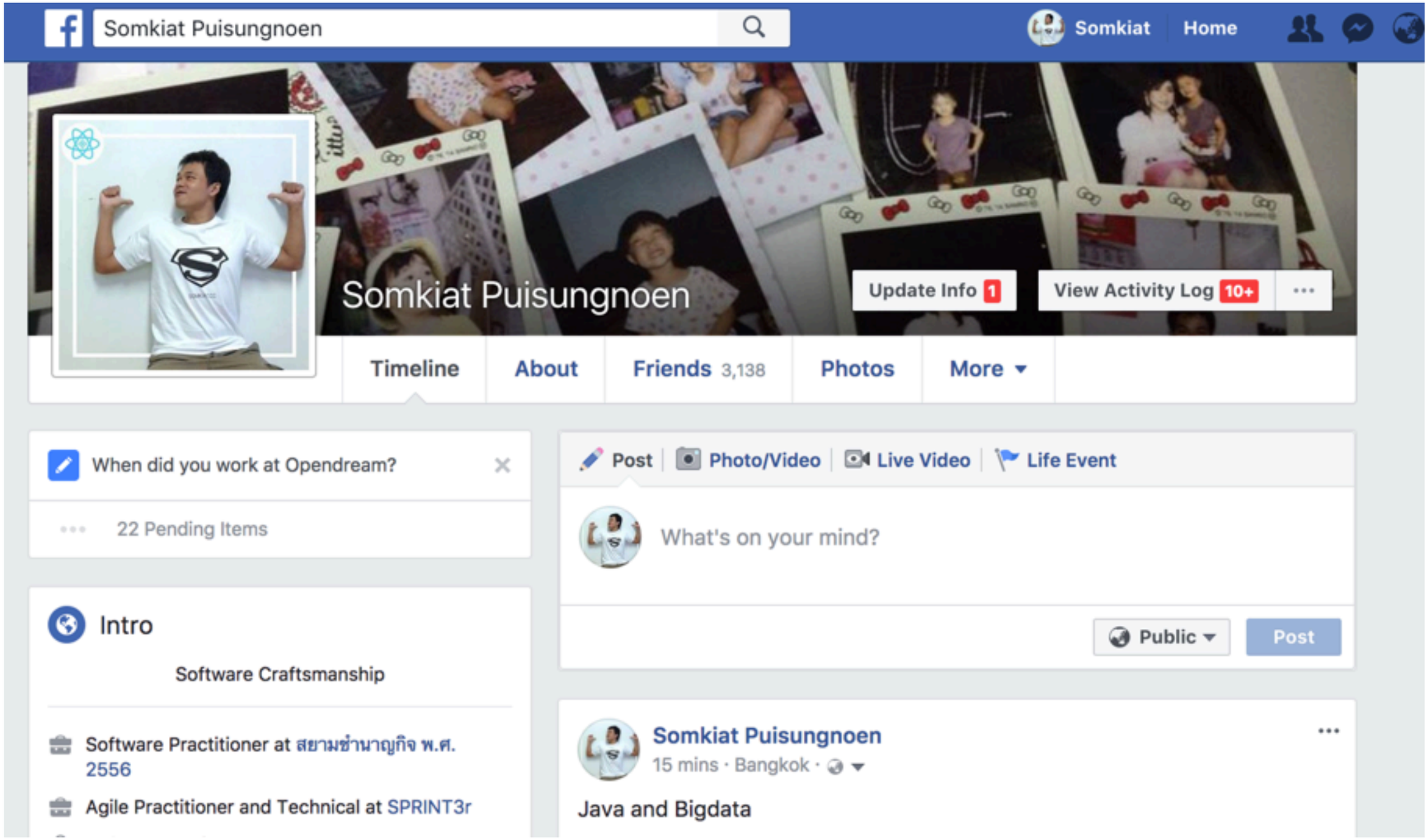
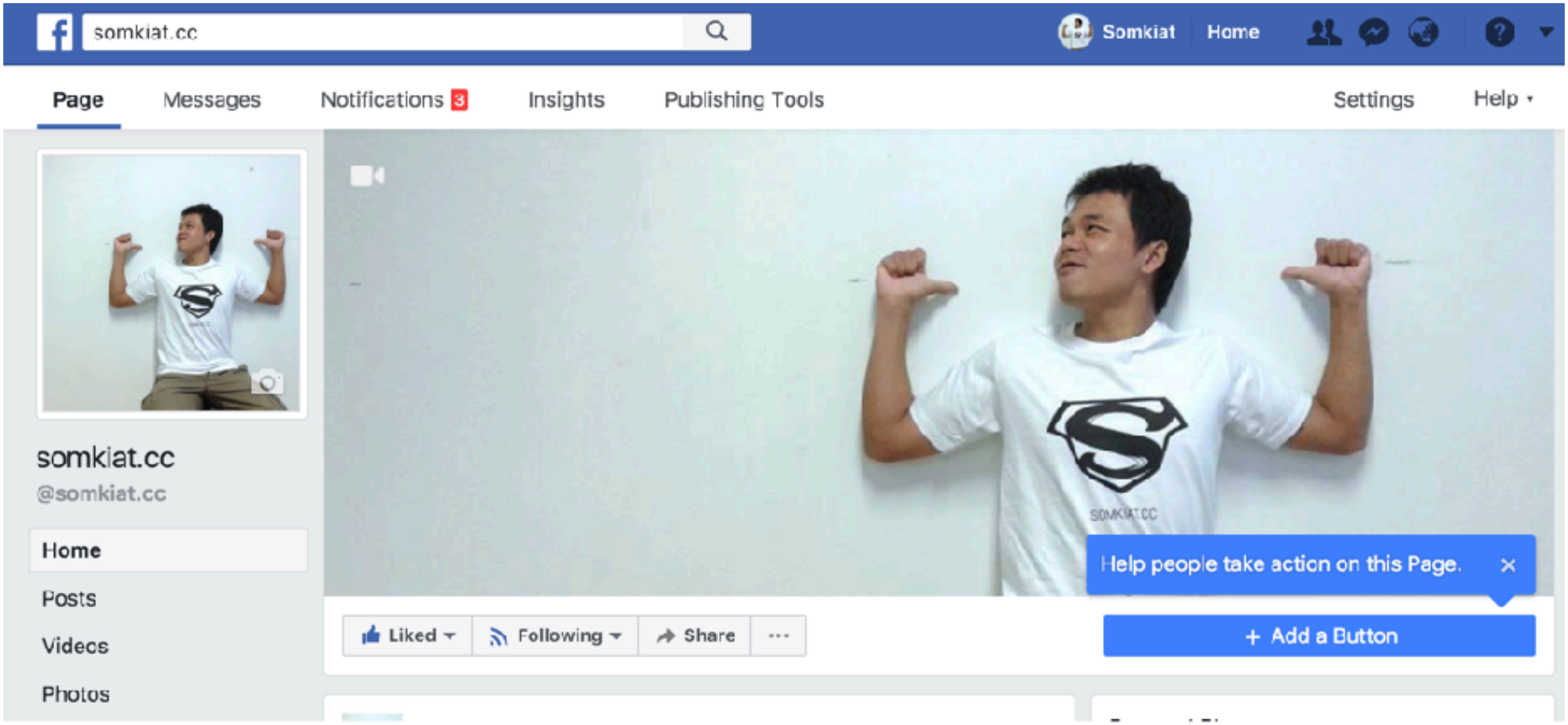
สยามชำนาญกิจ
SIAM CHAMNAN KIT

Kubernetes

Workshop with Java





Topics day 1

Kubernetes concepts

1. Pods
2. Replication Controllers
3. Replica Sets
4. Deployments
5. Services
6. Jobs
7. Volumes

Deploy the Java web app to Kubernetes

Topics day 2

Advance concepts

1. Persistent volume
2. Stateful Sets
3. Horizontal Pod Autoscaling (HPA)
4. Deamon Sets
5. Health of Pods
6. Namespaces
7. Rolling update

https://github.com/up1/course-kubernetes-in-practice

Kubernetes

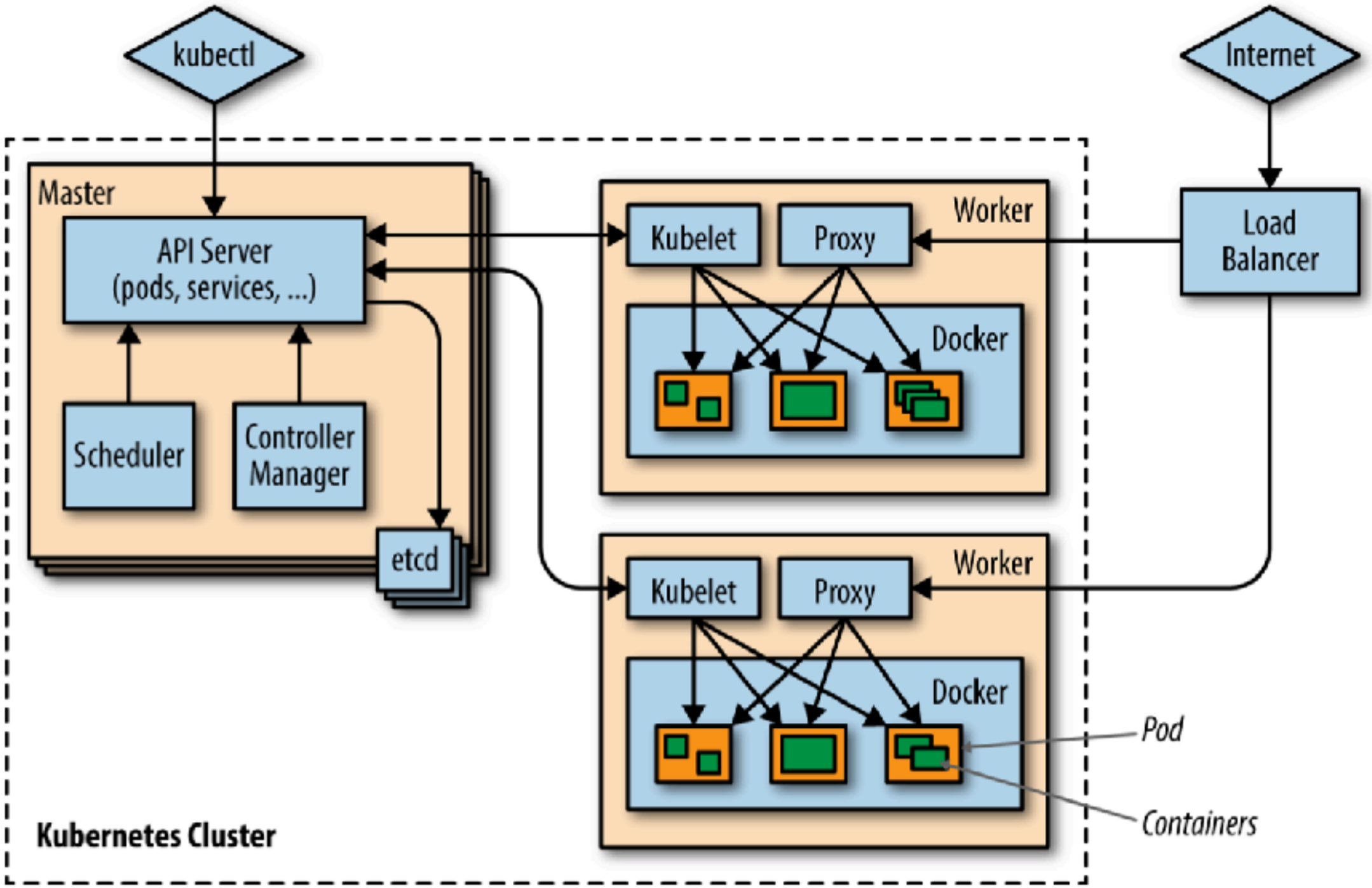
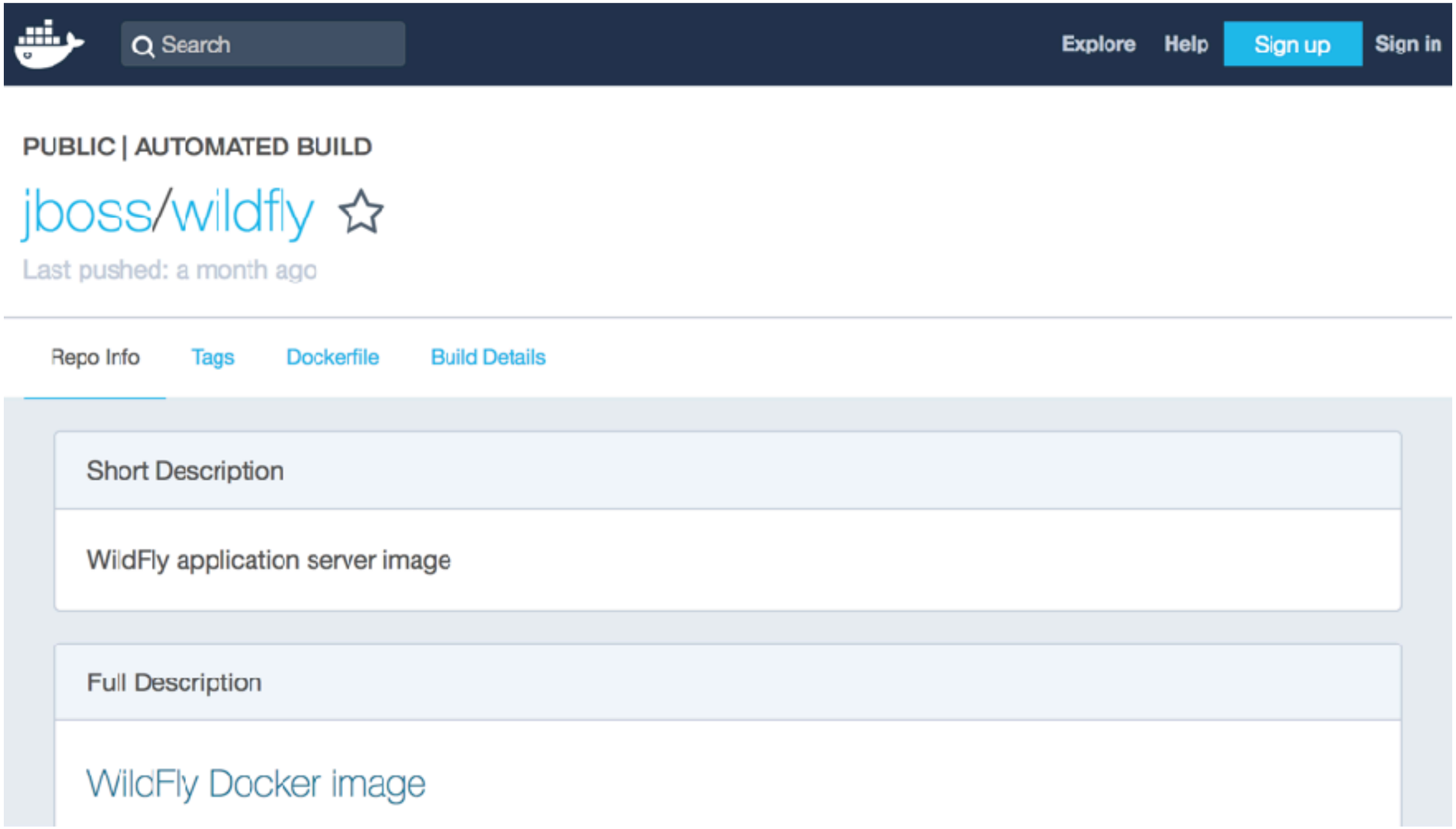


Image jboss/wildfly



https://hub.docker.com/r/jboss/wildfly/

Let’s start

1. Pods

Smallest deployable unit
Logical collection of containers
Pods are created in namespaces(ns)
All containers in a pod share the ns, volume and networking

Configuration of Pod

```yaml
apiVersion: v1
kind: Pod
metadata:
  name: wildfly-pod
  labels:
    name: wildfly-pod
spec:
  containers:
  - name: wildfly
    image: jboss/wildfly:10.1.0.Final
    ports:
    - containerPort: 8080
```

2. Replication Controllers (RC)

Ensure that a specified # of pod replicas are running at any time

Automatically replaces if pods fail

Support scale-up and scale-down

Configuration of RC

```yaml
apiVersion: v1
kind: ReplicationController
metadata:
  name: wildfly-rc
spec:
  replicas: 2
  selector:
    app: wildfly-rc-pod
  template:
    metadata:
      labels:
        app: wildfly-rc-pod
    spec:
      containers:
      - name: wildfly
        image: jboss/wildfly:10.1.0.Final
        ports:
        - containerPort: 8080
```

3. Replica Sets

Next-generation of RC
Selector support

Configuration of Replica Sets

```yaml
apiVersion: extensions/v1beta1
kind: ReplicaSet
metadata:
  name: wildfly-rs
spec:
  replicas: 2
  selector:
    matchLabels:
      app: wildfly-rs-pod
    matchExpressions:
      - {key: tier, operator: In, values: ["backend"]}
      - {key: environment, operator: NotIn, values: ["prod"]}
  template:
    metadata:
      labels:
        app: wildfly-rs-pod
        tier: backend
        environment: dev
    spec:
      containers:
      - name: wildfly
       ….
```

4. Deployments

Provide declarative updates for Pods and Replica Sets

Easy to start a RC or Replica set

Easy to check status of deployment

Update deployment to use a new image

Rollback deployment to previous version

Configuration of Deployments

```yaml
apiVersion: extensions/v1beta1
kind: Deployment
metadata:
  name: wildfly-deployment
spec:
  replicas: 3
  template:
    metadata:
      labels:
        app: wildfly
    spec:
      containers:
      - name: wildfly
        image: jboss/wildfly:10.1.0.Final
        ports:
        - containerPort: 8080
```

5. Services

Abstraction to define a logical set of Pods and policy to access them

IP of service doesn’t change over time

Pods belong to a service are defined by a label selector

Configuration of Services

```yaml
apiVersion: v1
kind: Service
metadata:
  name: wildfly-service
spec:
  selector:
    app: wildfly-rc-pod
  ports:
    - name: web
      port: 8080
```

6. Volumes

Pods are ephemeral and work well with **stateless**

Stateful containers require data to be persisted outside

Directory that is accessible to the containers in a Pod

Configuration of Volumes

```
spec:
  containers:
  - name: couchbase
    image: somkiat/couchbase:latest
    ports:
    - containerPort: 8091
    volumeMounts:
    - mountPath: /var/couchbase/lib
      name: couchbase-data
volumes:
- name: couchbase-data
  hostPath:
    path: /opt/data
```

Use Volume on Host Path

Workshop#0

File /working-with-java/01-basic

Start Wildfly server

$kubectl run hello-wildfly --image=jboss/wildfly:12.0.0.Final —port=8080

$kubectl get pod, deployment

```
NAME                              READY     STATUS              RESTARTS   AGE
hello-wildfly-7bd4cfc58-jw9xp     0/1       ContainerCreating   0          3m

NAME             DESIRED   CURRENT   UP-TO-DATE   AVAILABLE   AGE
hello-wildfly    1         1         1            0           3m

NAME                        DESIRED   CURRENT   READY     AGE
hello-wildfly-7bd4cfc58     1         1         0         3m
```

Start Wildfly server

$kubectl proxy

Try with configuration file

```
$kubectl create -f wildfly-pod.yaml
$kubectl create -f wildfly-rc.yaml
$kubectl create -f wildfly-service.yaml
```

Workshop #1
with Spring boot service

File /working-with-java/02-web-app

Structure of project

1. Build Spring Boot Service

Create executable JAR file

$./gradlew bootRepackage

Create Docker image

$./gradlew buildDocker

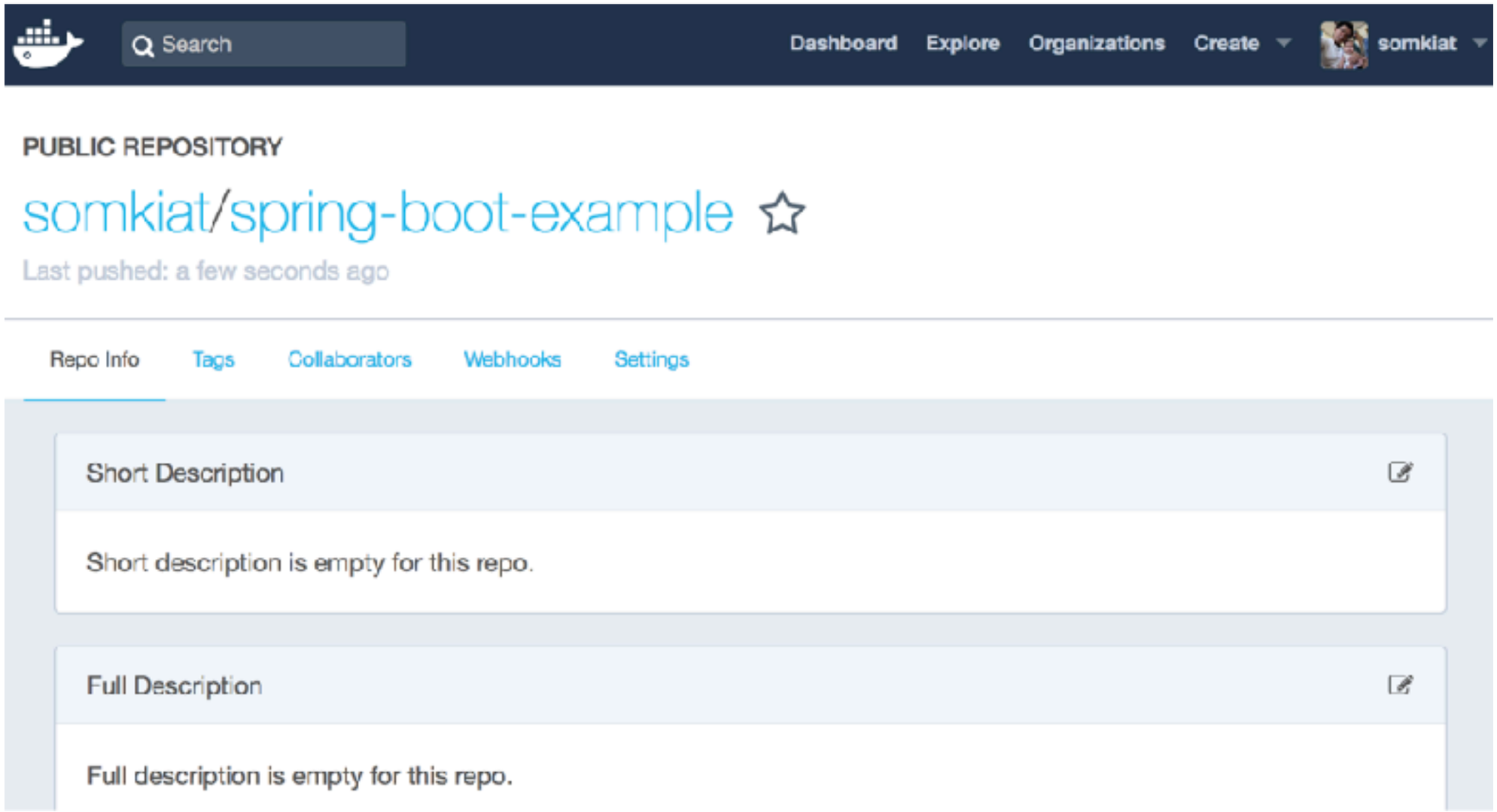
2. Push Docker image to Docker Hub

```
$docker login
$docker push <username>/spring-boot-example
```

Required :: register at https://hub.docker.com/

2. Push Docker image to Docker Hub

Check your image



https://hub.docker.com/r/somkiat/spring-boot-example/

3. Deploy application

1. MongoDB
2. Spring boot service

3.1 Deploy MongoDB

```
$kubectl create -f mongo-controller.yaml
$kubectl create -f mongo-service.yaml
```

3.1 Mongo-controller.yaml

```
containers:
 - image: mongo
   name: mongo
   ports:
   - name: mongo
     containerPort: 27017
     hostPort: 27017
   volumeMounts:
       - name: mongo-persistent-storage
         mountPath: /data/db
volumes:
  - name: mongo-persistent-storage
    hostPath:
          path: /data/storage/mongodb
```

Use Volume on Host Path

3.1 Mongo-controller.yaml

```
containers:
 - image: mongo
   name: mongo
   ports:
   - name: mongo
     containerPort: 27017
     hostPort: 27017
```

Mount volume from container

```
   volumeMounts:
       - name: mongo-persistent-storage
         mountPath: /data/db
volumes:
   - name: mongo-persistent-storage
     hostPath:
           path: /data/storage/mongodb
```

3.2 Deploy Spring boot service

```
$kubectl create -f boot-deployment.yaml
$kubectl create -f boot-service.yaml
```

3.2 Boot-deployment.yaml

```
spec:
      containers:
      - name: spring-boot-service
        image: somkiat/spring-boot-example
        ports:
        - containerPort: 8080
```

Use environment variables

```
env:
    - name: MONGO_URI
      value: mongo-service
```

4. Testing

Try to add new data and see result in browser

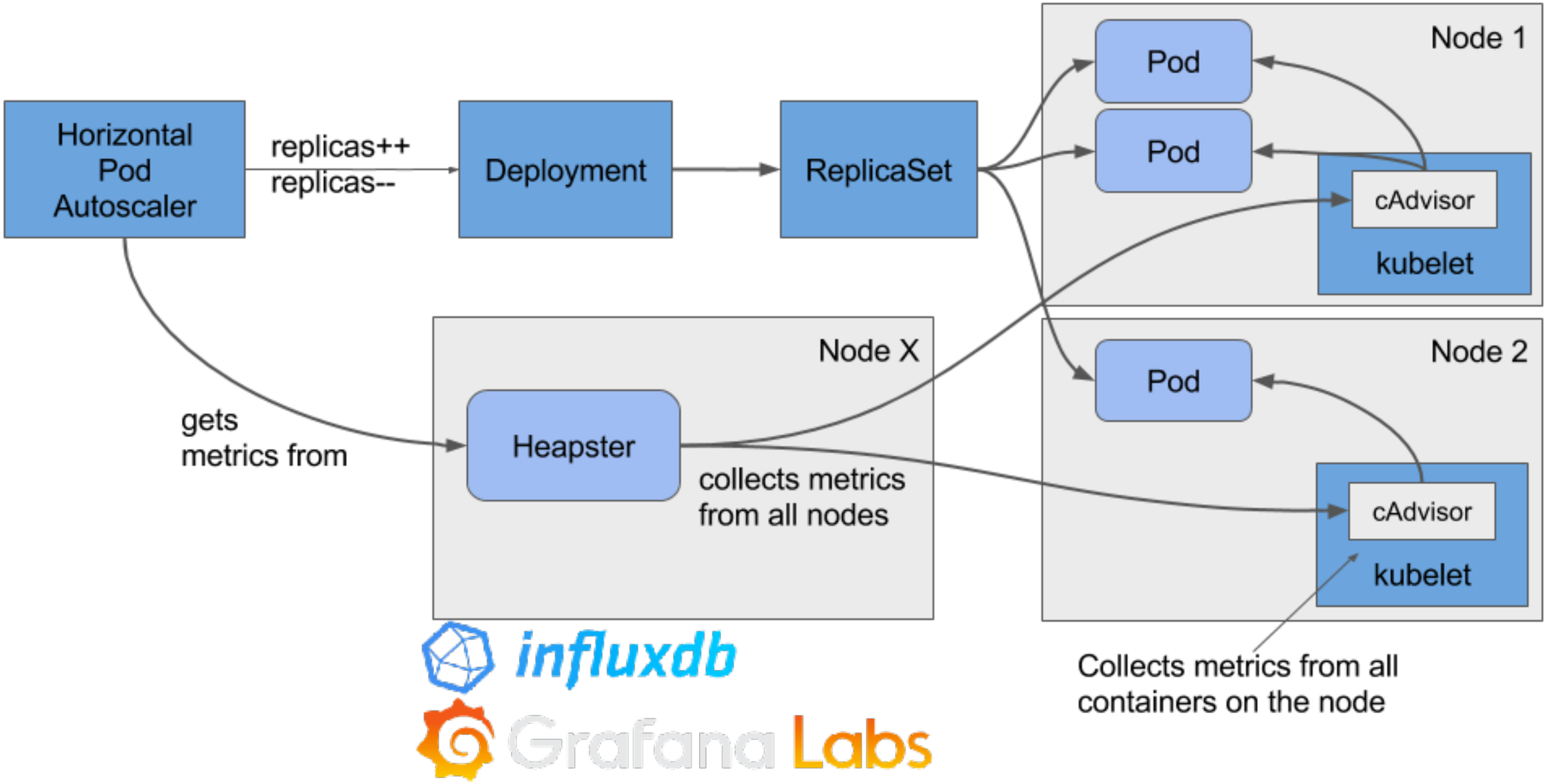
192.168.99.100:30265/user


```
[
  - {
        id: "5b043054cff47e0005b9f94e",
        firstName: "Somkiat",
        lastName: "Puisungnoen",
        email: "xxx@gmail.com",
        address: null
    }
]
```

Workshop #2
Horizontal Pods Autoscale (HPA)

File /working-with-java/03-hpa

Components in Autoscaling



https://kubernetes.io/docs/tasks/run-application/horizontal-pod-autoscale-walkthrough/

1. Enable hipster in minikube

```
$minikube addons enable heapster
$minikube addons start heapster
$minikube addons open heapster
```

See all pods from heapster

$kubectl get pods --all-namespaces

```
NAMESPACE     NAME                                          READY   STATUS    RESTARTS   AGE
default       mongo-controller-xdh28                        1/1     Running   0          9h
default       spring-boot-service-deployment-74f5df876f-gxn24   1/1     Running   0          4h
kube-system   default-http-backend-kf92s                    1/1     Running   0          4h
kube-system   heapster-2ssh2                                1/1     Running   0          8h
kube-system   influxdb-grafana-vk6j6                        2/2     Running   0          8h
kube-system   kube-addon-manager-minikube                   1/1     Running   2          1d
kube-system   kube-dns-54cccfbdf8-xkpl6                     3/3     Running   6          1d
kube-system   kubernetes-dashboard-77d8b98585-n49sg         1/1     Running   4          1d
kube-system   metrics-server-bb9ffc6b8-5mgnv                1/1     Running   0          8h
kube-system   nginx-ingress-controller-hrk4d                1/1     Running   0          4h
kube-system   storage-provisioner                           1/1     Running   2          1d
```

See all services from heapster

$kubectl get service --all-namespaces

NAMESPACE	NAME	TYPE	CLUSTER-IP	EXTERNAL-IP	PORT(S)	AGE
default	kubernetes	ClusterIP	10.96.0.1	<none>	443/TCP	1d
default	mongo-service	ClusterIP	10.99.242.178	<none>	27017/TCP	9h
default	spring-boot-service	NodePort	10.98.105.78	<none>	80:32132/TCP	4h
kube-system	default-http-backend	NodePort	10.102.224.179	<none>	80:30081/TCP	4h
kube-system	heapster	ClusterIP	10.100.221.108	<none>	80/TCP	8h
kube-system	kube-dns	ClusterIP	10.96.0.10	<none>	53/UDP,53/TCP	1d
kube-system	kubernetes-dashboard	NodePort	10.99.243.227	<none>	80:30000/TCP	1d
kube-system	metrics-server	ClusterIP	10.107.38.180	<none>	443/TCP	8h
kube-system	monitoring-grafana	NodePort	10.104.125.177	<none>	80:30002/TCP	8h
kube-system	monitoring-influxdb	ClusterIP	10.99.175.232	<none>	8083/TCP,8086/TCP	8h

See result in Grafana

http://192.168.99.100:30002

192.168.99.100:30002/?orgId=1

Home

Zoom Out

Last 6 hours

Home Dashboard

Getting Started with Grafana

Install Grafana

Create your first data source

Create your first dashboard

Add Users

Install apps & plugins

Starred dashboards

Recently viewed dashboards

Pods

Cluster

Installed Apps

None installed. Browse Grafana.net

Installed Panels

None installed. Browse Grafana.net

Installed Datasources

None installed. Browse Grafana.net

2. Create metric server

Starting from Kubernetes 1.8, resource usage metrics, such as container CPU and memory usage, are available in Kubernetes through the Metrics API. These metrics can be either accessed directly by user, for example by using `kubectl top` command, or used by a controller in the cluster, e.g. Horizontal Pod Autoscaler, to make decisions.

https://github.com/kubernetes-incubator/metrics-server

3. Deploy Springboot service

```
$kubectl create -f boot-deployment.yaml
$kubectl create -f boot-service.yaml
```

4. Create HPA in command line

$kubectl autoscale
deployment/spring-boot-service-deployment
--min=1 --max=5 --cpu-percent=5

min = minimum of replica
max = maximum of replica
cpu-percent = average of % of CPU usage

4. Create HPA in command line

$kubectl get hpa

```
REFERENCE                                    TARGETS   MINPODS   MAXPODS
Deployment/spring-boot-service-deployment    0%/5%     1         5
```

4. Create HPA in command line

Scale-up can only happen if there was no rescaling within the last **3** minutes

Scale-down will wait for **5** minutes from the last rescaling

https://github.com/kubernetes/community/blob/master/contributors/design-proposals/autoscaling/horizontal-pod-autoscaler.md#autoscaling-algorithm

5. Load testing with command line

http://**spring-boot-service**.default.svc.cluster.local:8080/user

5. See result

$kubectl get pods

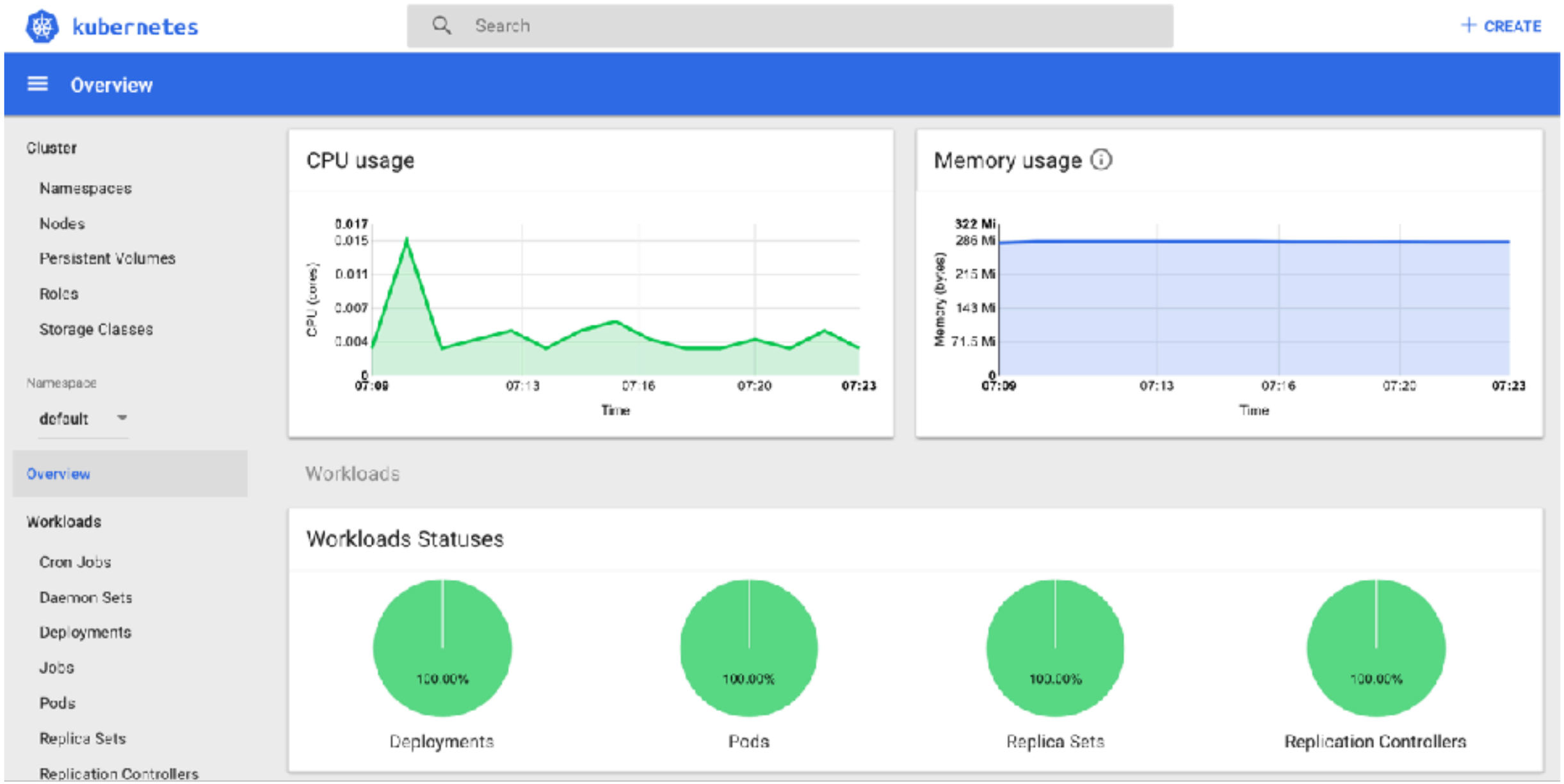
```
NAME                                          READY     STATUS    RESTARTS   AGE
load-test-6f86656986-9qvdl                    0/1       Error     0          4m
mongo-controller-xdh28                        1/1       Running   0          1h
spring-boot-service-deployment-86c7b47b7b-9l9sn   1/1       Running   0          15m
spring-boot-service-deployment-86c7b47b7b-9srkg   1/1       Running   0          1m
spring-boot-service-deployment-86c7b47b7b-kbtrl   1/1       Running   0          1m
spring-boot-service-deployment-86c7b47b7b-pqbsm   1/1       Running   0          1m
```

5. See result

$kubectl describe hpa

```
Metrics:                                                  ( current / target )
  resource cpu on pods  (as a percentage of request):  134% (269m) / 5%
Min replicas:                                             1
Max replicas:                                             5
Conditions:
  Type            Status  Reason            Message
  ----            ------  ------            -------
  AbleToScale     False   BackoffBoth       the time since the previous scale is still within both the downscale and upscale fo
rbidden windows
  ScalingActive   True    ValidMetricFound  the HPA was able to succesfully calculate a replica count from cpu resource utiliza
tion (percentage of request)
  ScalingLimited  True    TooManyReplicas   the desired replica count is more than the maximum replica count
Events:
  Type     Reason                        Age   From                       Message
  ----     ------                        ----  ----                       -------
  Normal   SuccessfulRescale             1m    horizontal-pod-autoscaler  New size: 4; reason: cpu resource utilization (percen
tage of request) above target
  Warning  FailedGetResourceMetric       19s   horizontal-pod-autoscaler  unable to get metrics for resource cpu: unable to fet
ch metrics from API: the server could not find the requested resource (get pods.metrics.k8s.io)
  Warning  FailedUpdateStatus            19s   horizontal-pod-autoscaler  Operation cannot be fulfilled on horizontalpodautosca
lers.autoscaling "spring-boot-service-deployment": the object has been modified; please apply your changes to the latest versio
n and try again
  Warning  FailedComputeMetricsReplicas  19s   horizontal-pod-autoscaler  failed to get cpu utilization: unable to get metrics
for resource cpu: unable to fetch metrics from API: the server could not find the requested resource (get pods.metrics.k8s.io)
```

5. See result in dashboard



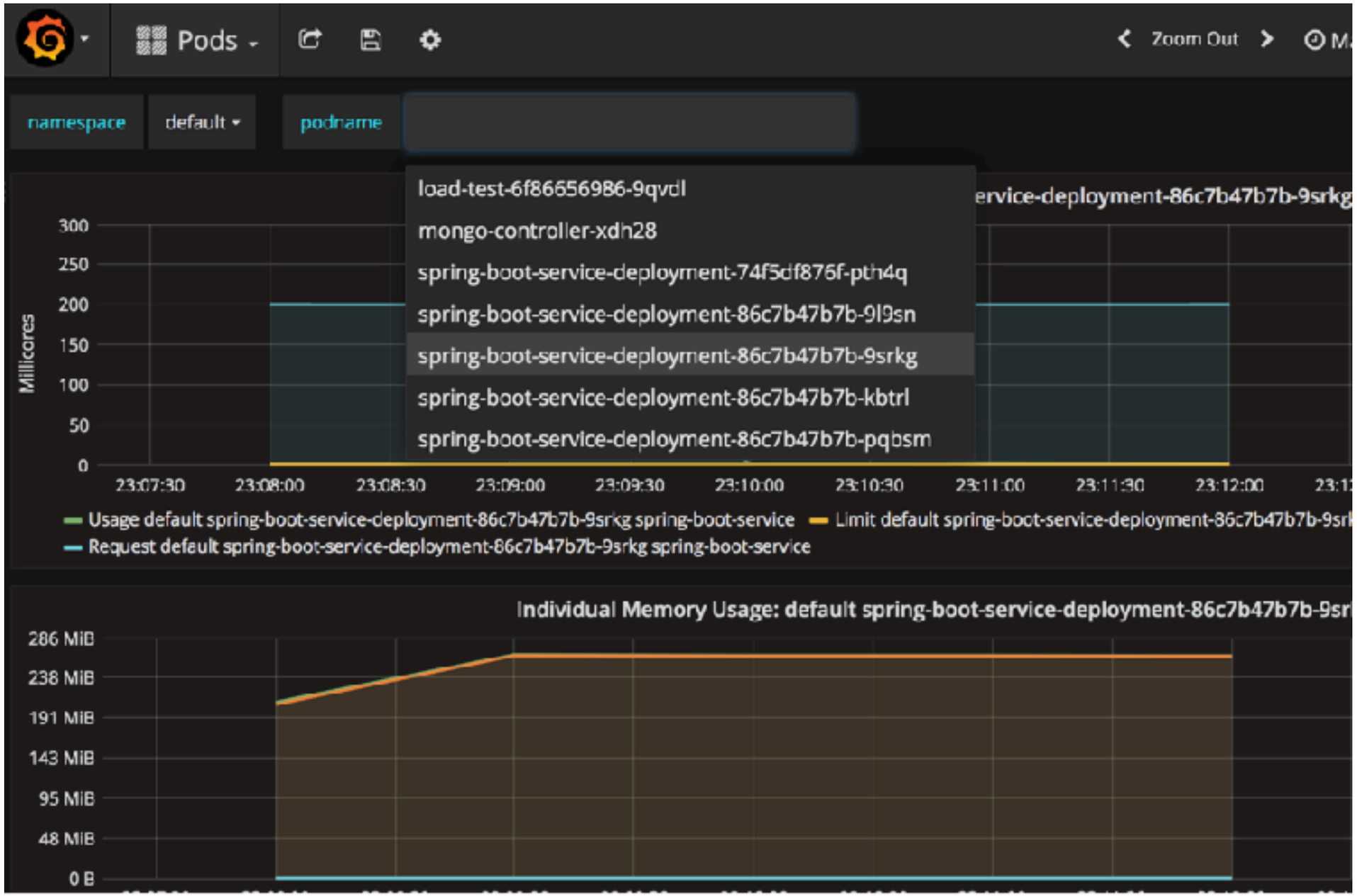
5. See result in dashboard

Pods

Name	Node	Status	Restarts	Age	CPU (cores)	Memory (bytes)
spring-boot-service-de	minikube	Running	0	2 minutes	0.249	265.926 Mi
spring-boot-service-de	minikube	Running	0	2 minutes	0.03	254.156 Mi
spring-boot-service-de	minikube	Running	0	2 minutes	0.001	94.840 Mi
load-test-6f86656986-	minikube	Running	1	5 minutes	0	688 Ki
spring-boot-service-de	minikube	Running	0	16 minutes	0.018	33.211 Mi
mongo-controller-xdh2	minikube	Running	0	an hour	0.004	24.453 Mi

5. See result

In Grafana dashboard



Workshop #3
Secret and ConfigMap

File /working-with-java/04-secret-configmap

Secret

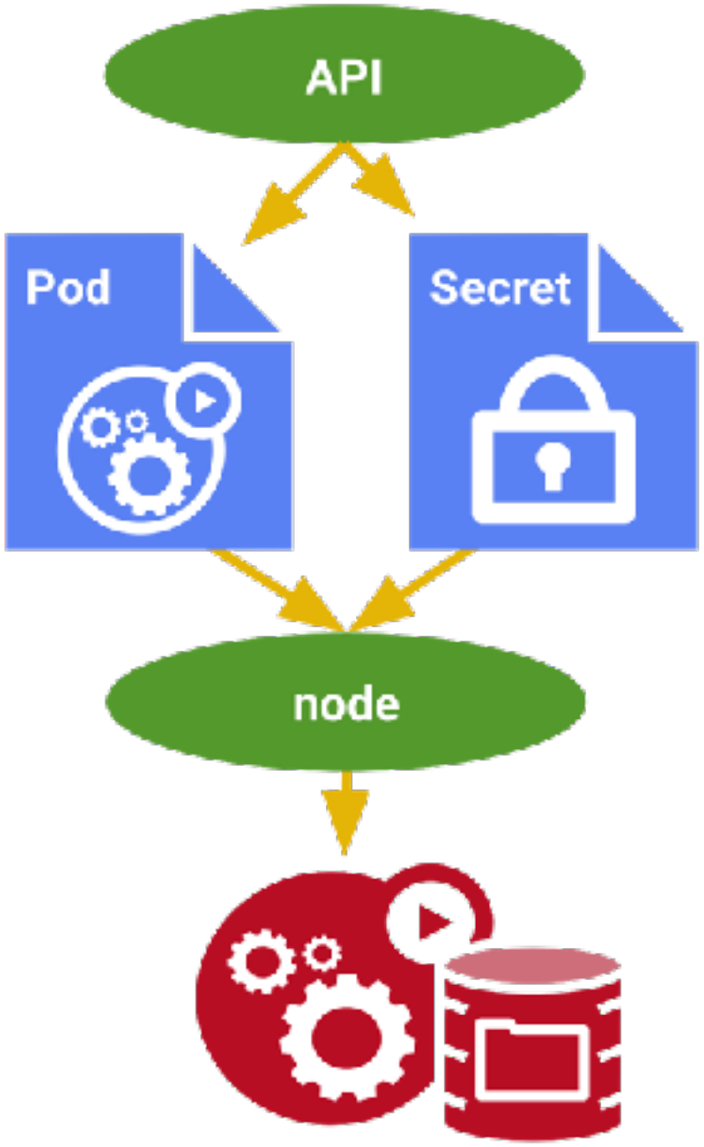
Good to working with secret data and config
Each container need some config and data

Store config/data in Pod/Container/Deployment ?

Root password of database
Environment variables
Path to mount volume data

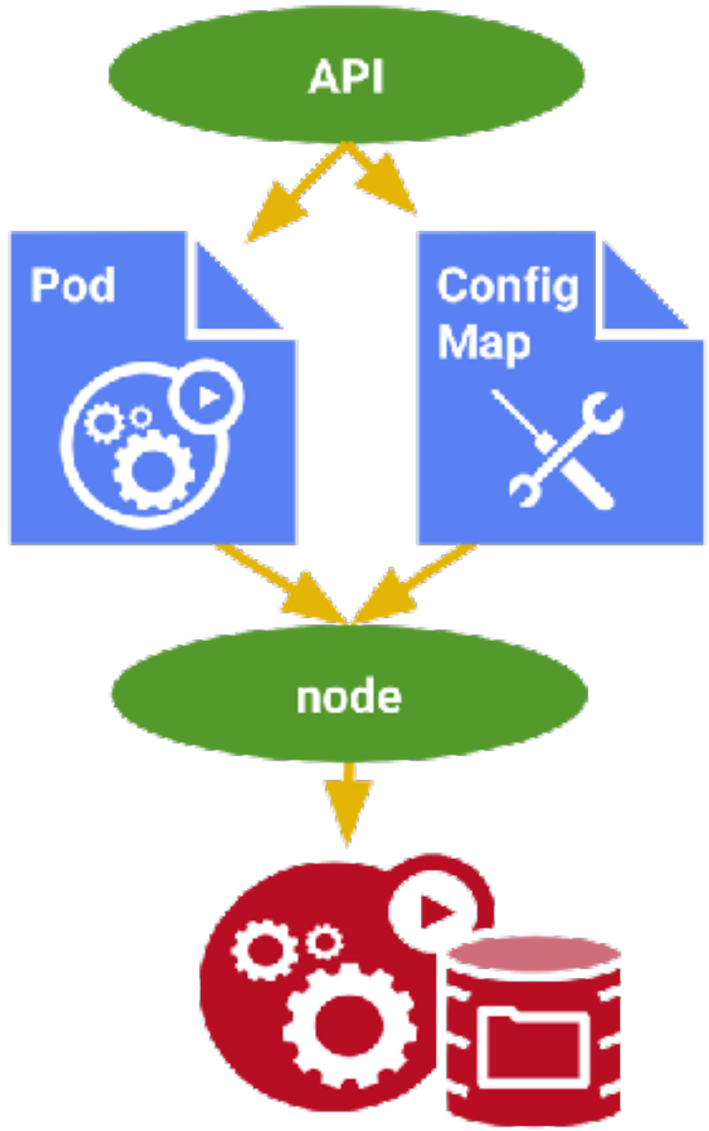
Secret

Secret encode sensitive data for keep secret



ConfigMap

ConfigMap provide centralize of configuration



Create ConfigMap

```
apiVersion: v1
kind: ConfigMap
metadata:
  name: boot-configmap
  namespace: myservice
  labels:
    name: boot-configmap
data:
  MONGO_URI: mongo-service
```

Use Configmap from container

```
containers:
- name: spring-boot-service
  image: somkiat/spring-boot-example
  ports:
  - containerPort: 8080
  env:
      - name: MONGO_URI
        valueFrom:
          configMapKeyRef:
            name: boot-configmap
            key: MONGO_URI
```

Create Secret

```
apiVersion: v1
kind: Secret
metadata:
  name: mongo-secret
  namespace: myservice
  labels:
    name: mongo-secret
type: Opaque
data:
  username: cm9vdA==
  password: cGFzc3dvcmQ=
```

Use Secret from container

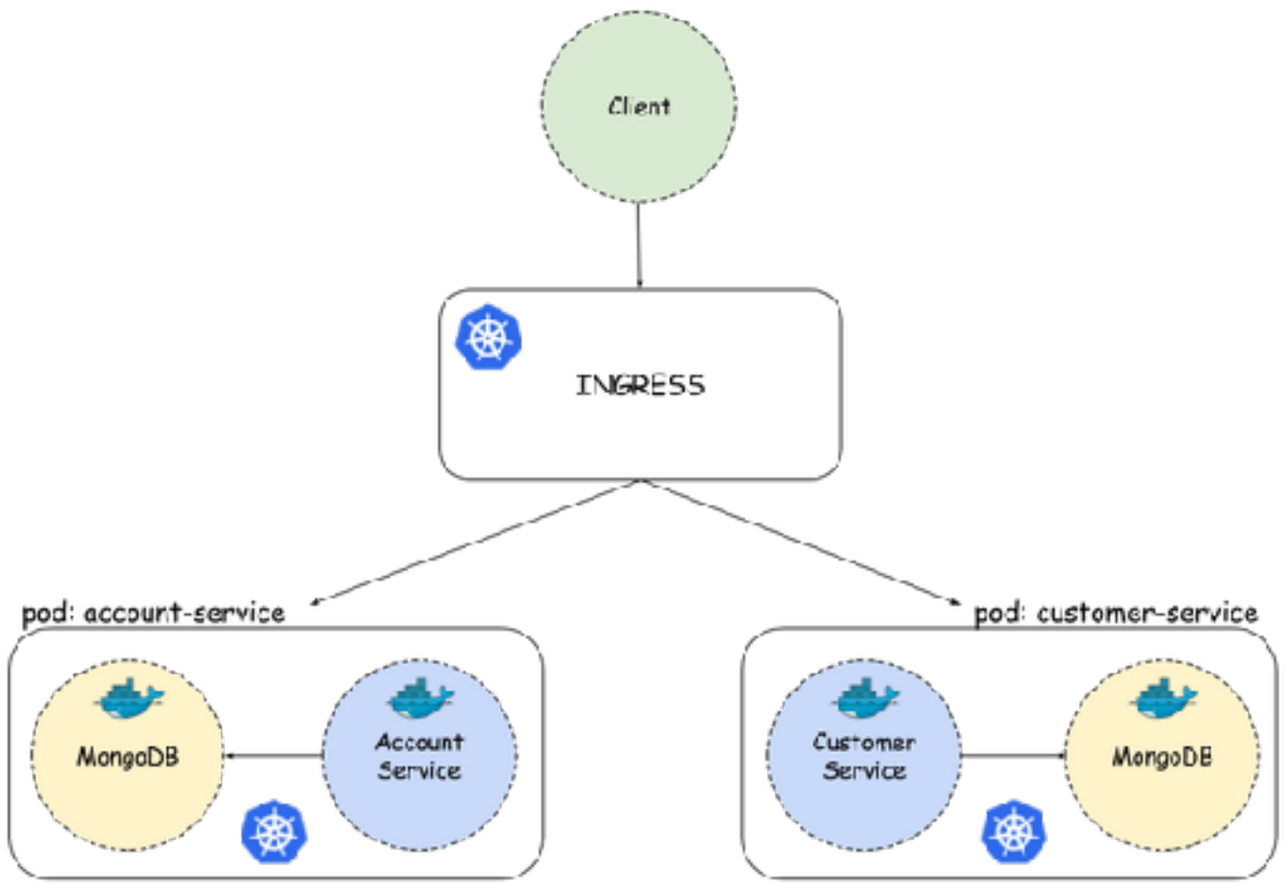
```
spec:
   containers:
   - image: mongo
     name: mongo
     ports:
     - name: mongo
       containerPort: 27017
       hostPort: 27017
     env:
     - name: MONGO_USERNAME
       valueFrom:
         secretKeyRef:
           name: mongo-secret
           key: username
     - name: MONGO_PASSWORD
       valueFrom:
         secretKeyRef:
           name: mongo-secret
           key: password
```

Workshop #4
Ingress Network

File /working-with-java/05-ingress

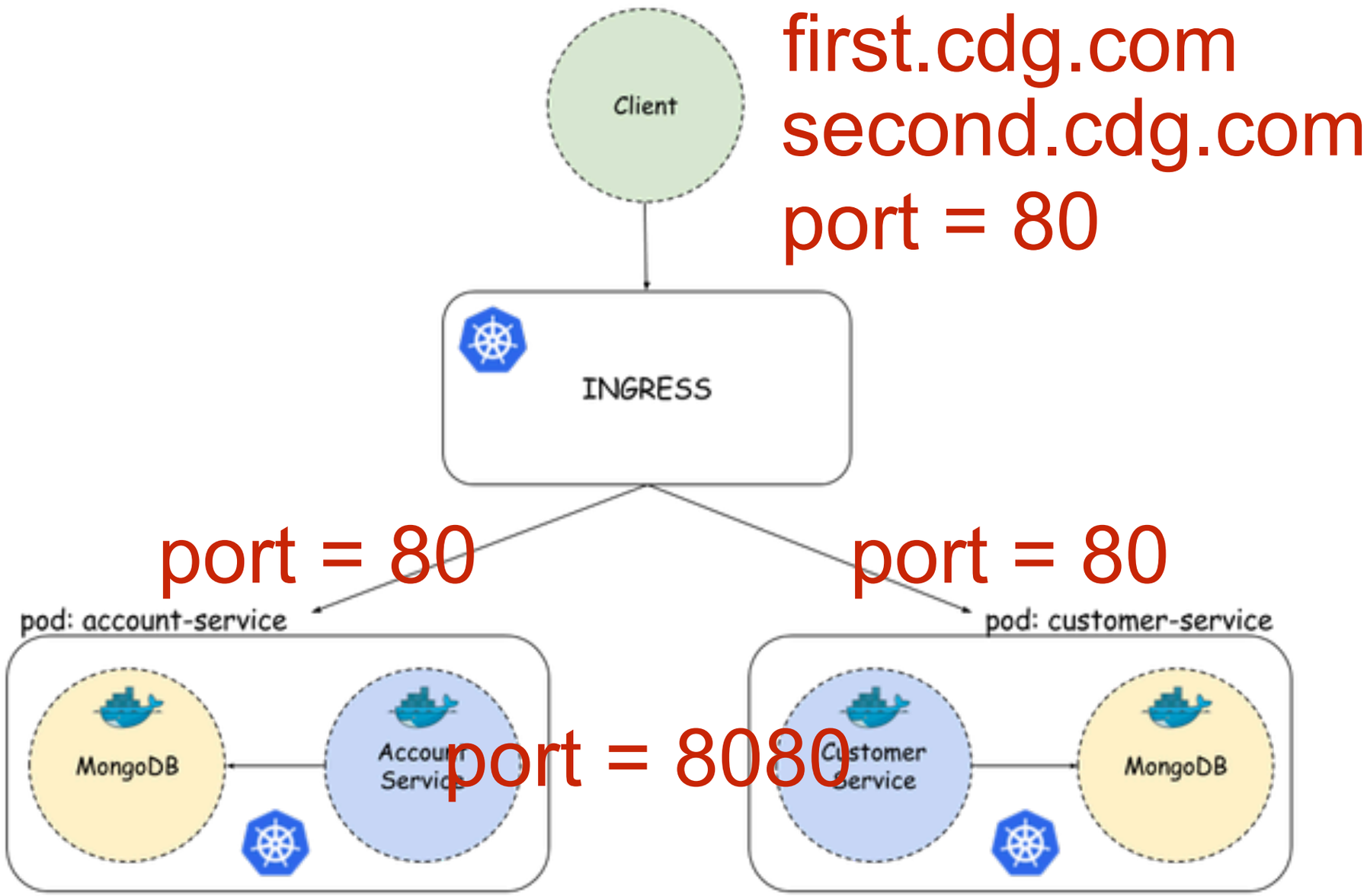
Ingress Network

How to handle multiple services in same port ?
How to limit protocol to access ?



https://kubernetes.io/docs/concepts/services-networking/ingress/

Ingress Network



Create ingress

```
apiVersion: extensions/v1beta1
kind: Ingress
metadata:
  name: ingresswebtest
spec:
  rules:
  - host: first.cdg.com
    http:
      paths:
      - backend:
          serviceName: spring-boot-service
          servicePort: 80
  - host: second.cdg.com
    http:
      paths:
      - backend:
          serviceName: spring-boot-service
          servicePort: 80
```

Service

```yaml
apiVersion: v1
kind: Service
metadata:
  name: spring-boot-service
spec:
  selector:
    app: spring-boot-service
  type: NodePort
  ports:
    - port: 80
      name: http
      targetPort: 8080
      protocol: TCP
```

Workshop #5
StatefulSet

File /working-with-java/06-stateful-set