به نام خالق ابرها

Distributed Systems

Serverless FaaS Platform

https://github.com/mohsafer

ابتدا نیازمندی های اصلی مورد نظر از جمله Dockerو Minikube و faas-cli و سپس سرویس هایی نظیر dashboard, Gateway , prometheus را راه اندازی می نماییم

برای نصب داکر از اسکریپت استاندارد

```
$ curl -fsSL https://get.docker.com -o install-docker.sh

$ sudo sh install-docker.sh
```

نصب minikube

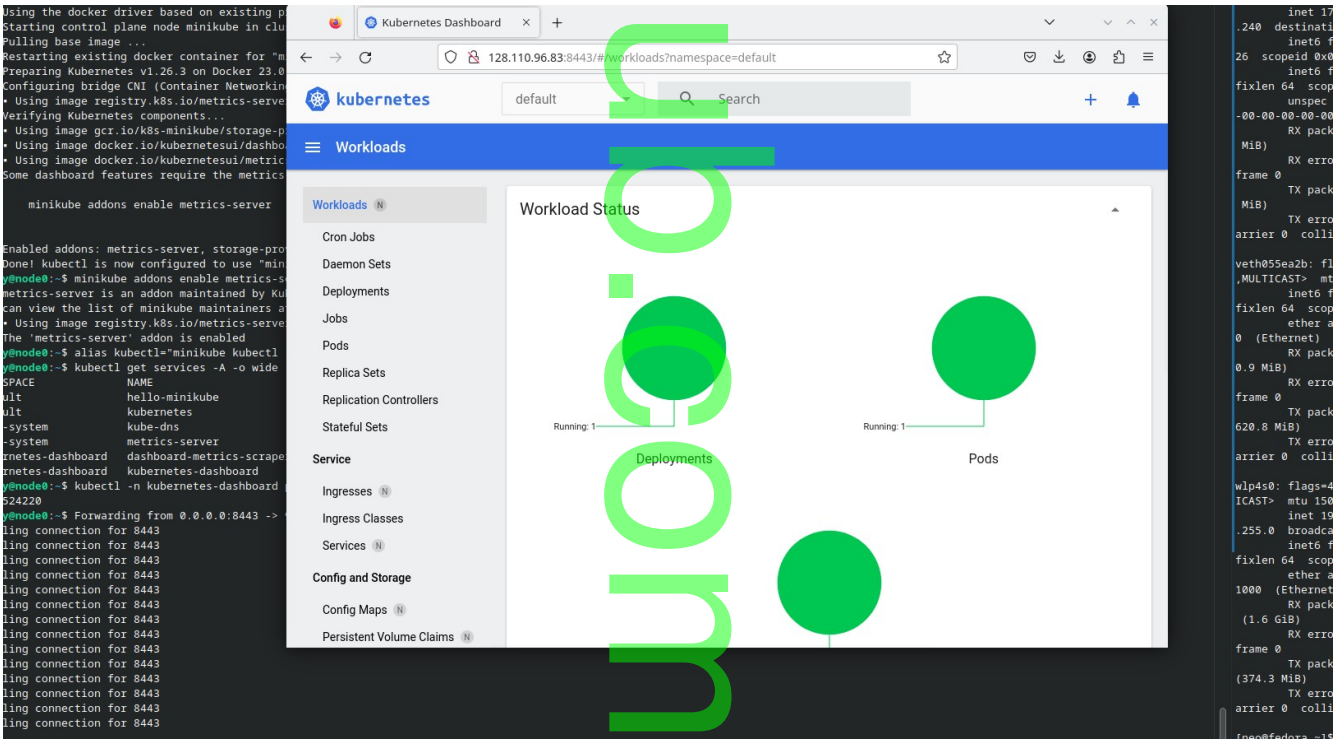
```
curl -LO
https://storage.googleapis.com/minikube/releases/latest/minikube-
linux-amd64
sudo install minikube-linux-amd64 /usr/local/bin/minikube
```

```
mosafer@node0:~$ kubectl get nodes -A -o wide
NAME       STATUS   ROLES           AGE     VERSION   INTERNAL-IP    EXTERNAL-IP   OS-IMAGE             KERNEL-VERSION      CONTAINER-RUNTIME
minikube   Ready    control-plane   5h37m   v1.26.3   192.168.49.2   <none>        Ubuntu 20.04.5 LTS   5.15.0-69-generic   docker://23.0.2
mosafer@node0:~$
mosafer@node0:~$
mosafer@node0:~$
mosafer@node0:~$ kubectl get services -A -o wide
NAMESPACE              NAME                        TYPE        CLUSTER-IP       EXTERNAL-IP   PORT(S)                  AGE     SELECTOR
default                hello-minikube              NodePort    10.100.220.234   <none>        8080:31779/TCP           5h34m   app=hello-minikube
default                kubernetes                  ClusterIP   10.96.0.1        <none>        443/TCP                  5h37m   <none>
kube-system            kube-dns                    ClusterIP   10.96.0.10       <none>        53/UDP,53/TCP,9153/TCP   5h37m   k8s-app=kube-dns
kube-system            kube-state-metrics          ClusterIP   None             <none>        8080/TCP,8081/TCP        5h16m   app.kubernetes.io/n
kube-system            metrics-server              ClusterIP   10.111.203.84    <none>        443/TCP                  5h22m   k8s-app=metrics-ser
kubernetes-dashboard   dashboard-metrics-scraper   ClusterIP   10.104.198.178   <none>        8000/TCP                 5h25m   k8s-app=dashboard-m
kubernetes-dashboard   kubernetes-dashboard        ClusterIP   10.109.168.254   <none>        80/TCP                   5h25m   k8s-app=kubernetes-
monitoring             node-exporter               ClusterIP   10.109.84.113    <none>        9100/TCP                 4h45m   app.kubernetes.io/c
monitoring             prometheus-service          NodePort    10.103.245.121   <none>        8080:30000/TCP           4h45m   app=prometheus-serv
openfaas               alertmanager                ClusterIP   10.102.142.233   <none>        9093/TCP                 4h13m   app=alertmanager
openfaas               gateway                     ClusterIP   10.102.135.186   <none>        8080/TCP                 4h13m   app=gateway
openfaas               gateway-external            NodePort    10.105.40.198    <none>        8080:31112/TCP           4h13m   app=gateway
openfaas               nats                        ClusterIP   10.99.197.155    <none>        4222/TCP                 4h13m   app=nats
openfaas               prometheus                  ClusterIP   10.98.227.192    <none>        9090/TCP                 4h13m   app=prometheus
mosafer@node0:~$
```

لازم به ذکر است چندین مرتبه برای نصب به صورت لوکال اقدام شد که به علت مشکلات ومحدودیت IPها کلاستر کوبر روی فضای ابری CloudLab راه اندازی شد

برای مانیتور اجزای کلاستر داشبورد کلاستر به سمت اینترنت اکسپوز شد

```
kubectl -n kubernetes-dashboard port-forward --address 0.0.0.0
svc/kubernetes-dashboard 8443:80 &
```



جهت پیاده سازی OpenFaaS به minikube

نصب fass-cli

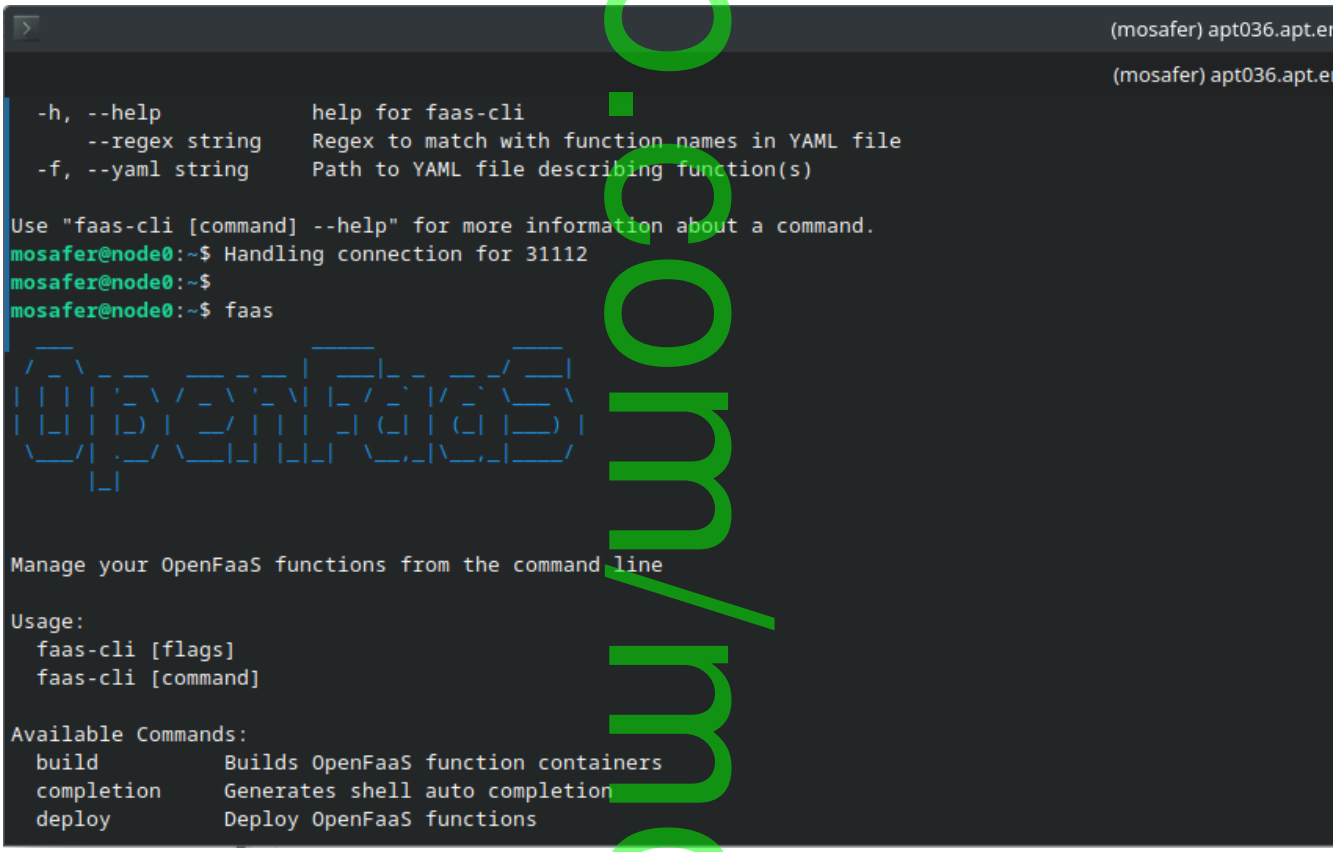
```
curl -sL cli.openfaas.com | sudo sh
```

```
 kubectl apply -f https://raw.githubusercontent.com/openfaas/faas-
netes/master/namespaces.yml
```

```
helm repo add openfaas https://openfaas.github.io/faas-netes/
```

```
export PASSWORD=$(head -c 12 /dev/urandom | shasum| cut -d' ' -f1)
echo $PASSWORD before
kubectl -n openfaas create secret generic basic-auth --from-
literal=basic-auth-user=admin --from-literal=basic-auth-
password="$PASSWORD"
```

```
helm upgrade openfaas --install openfaas/openfaas --namespace
openfaas --set functionNamespace=openfaas-fn --set basic_auth=true
export OPENFAAS_URL=$(minikube ip):31112
echo -n $PASSWORD | faas-cli login -g http://$OPENFAAS_URL -u admin –
password-stdin
```




```
export OPENFAAS_URL=http://127.0.0.1:8080
kubectl port-forward -n openfaas svc/gateway 8080:8080 &
```

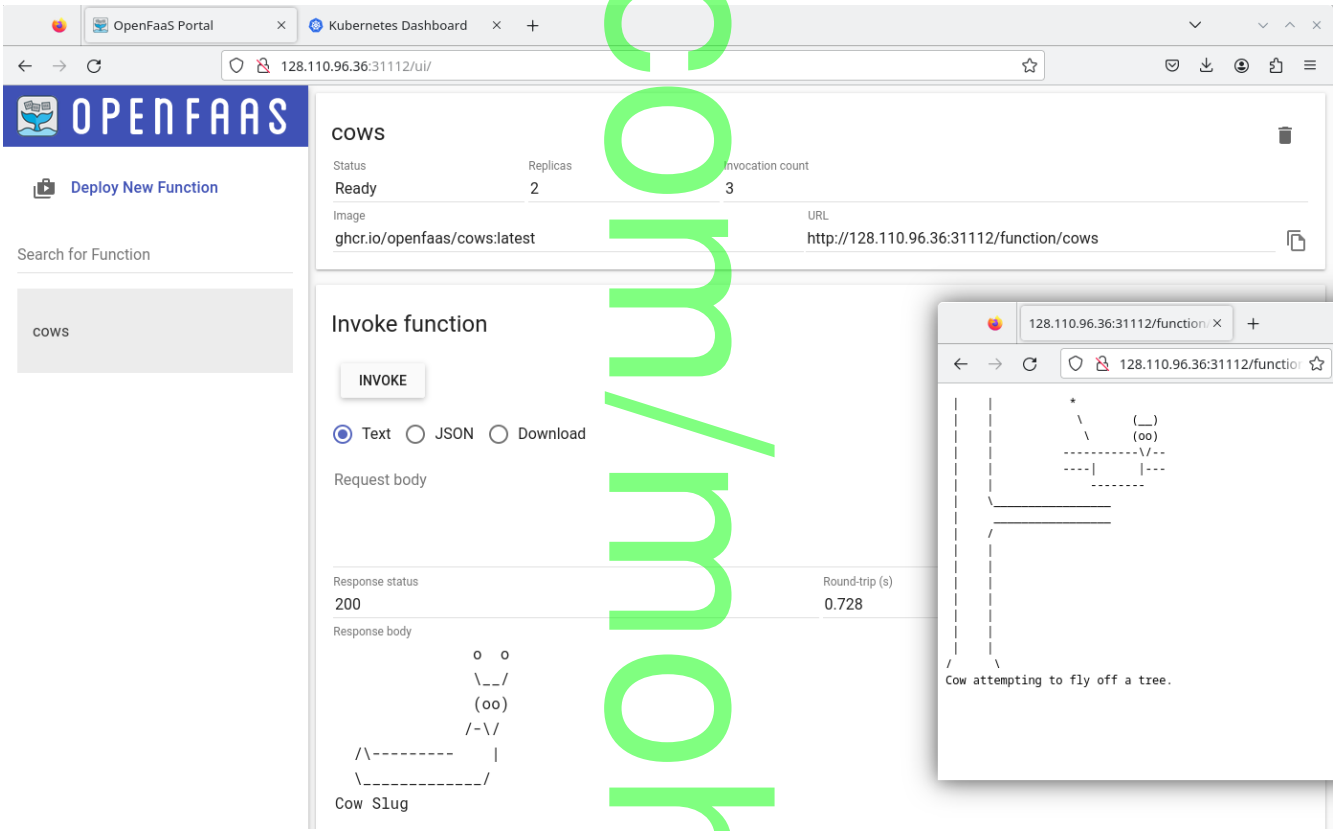
دیپلوی از طریق Helm

```
git clone https://github.com/openfaas/faas-netes.git
cd faas-netes

helm template \
  openfaas chart/openfaas/ \
  --namespace openfaas \
  --set basic_auth=true \
```

```
  --set functionNamespace=openfaas-fn > openfaas.yaml

kubectl apply -f namespaces.yml,openfaas.yaml
```

فراخوانی فانکشن Cow

```
faas-cli store deploy cows
kubectl get -n openfaas-fn service/cows -o yaml
kubectl get -n openfaas-fn deploy/cows -o yaml
```



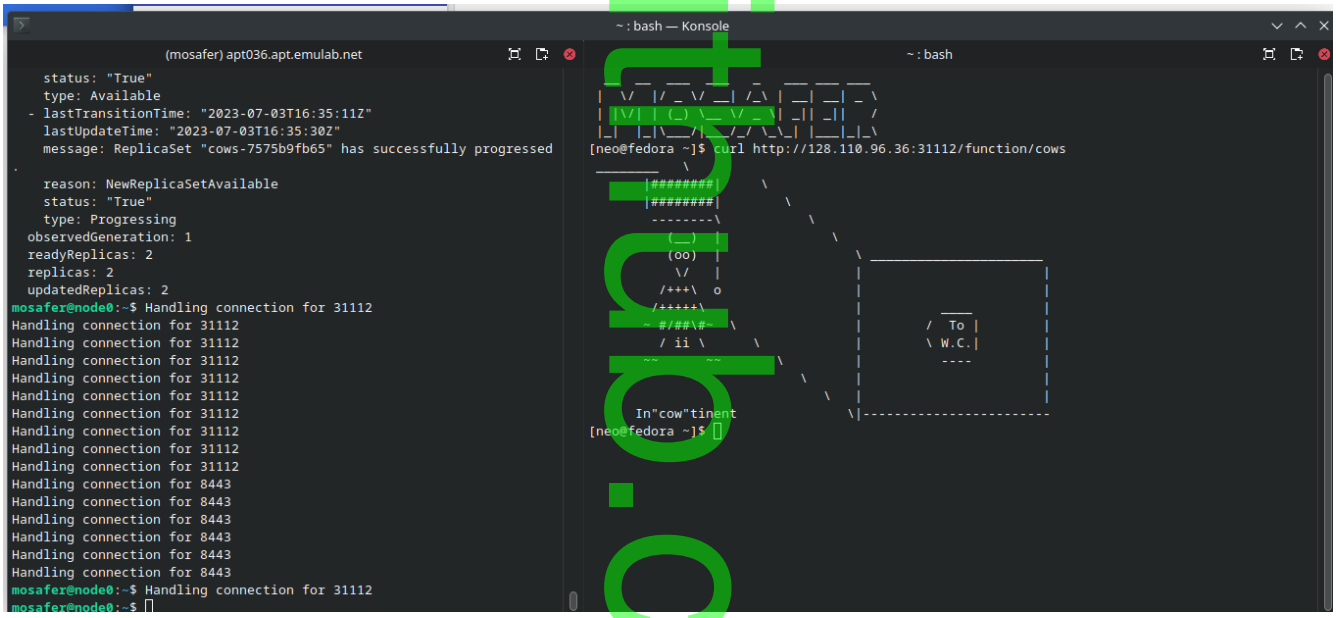

```
mosafer@node0:~$ Handling connection for 31112
kubectl get -n opkubectl get -n openfaas-fn service/cows -o yaml
apiVersion: v1
kind: Service
```

```
metadata:
 annotations:
   com.openfaas.git-repo-url: https://github.com/openfaas/store-
functions
   prometheus.io.scrape: "false"
 creationTimestamp: "2023-07-03T16:35:11Z"
 name: cows
 namespace: openfaas-fn
 resourceVersion: "19639"
 uid: 561a7038-626f-49d3-b78b-ea05d6771ac6
spec:
 clusterIP: 10.103.139.59
 clusterIPs:
 - 10.103.139.59
 internalTrafficPolicy: Cluster
 ipFamilies:
 - IPv4
 ipFamilyPolicy: SingleStack
 ports:
 - name: http
   port: 8080
   protocol: TCP
   targetPort: 8080
 selector:
   faas_function: cows
 sessionAffinity: None
 type: ClusterIP
status:
 loadBalancer: {}
mosafer@node0:~$ Handling connection for 8443
Handling connection for 8443
Handling connection for 8443
Handling connection for 8443
Handling connection for 8443
Handling connection for 8443
^C
mosafer@node0:~$ kubectl get -n openfaas-fn deploy/cows -o yaml
apiVersion: apps/v1
kind: Deployment
```

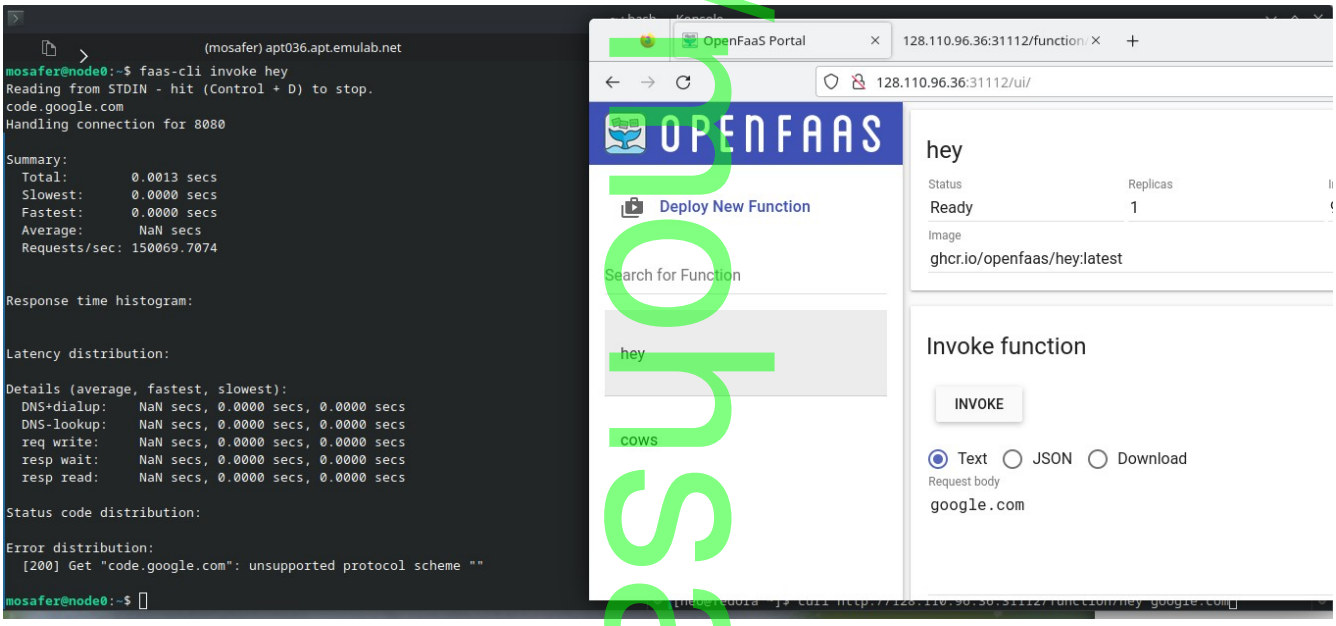
```
metadata:
 annotations:
   com.openfaas.git-repo-url: https://github.com/openfaas/store-
functions
   deployment.kubernetes.io/revision: "1"
   prometheus.io.scrape: "false"
 creationTimestamp: "2023-07-03T16:35:11Z"
 generation: 1
 labels:
   faas_function: cows
 name: cows
 namespace: openfaas-fn
 resourceVersion: "19695"
 uid: cf2dc451-b497-428f-8220-bf1bc2f5a404
spec:
 progressDeadlineSeconds: 600
 replicas: 2
 revisionHistoryLimit: 10
 selector:
   matchLabels:
     faas_function: cows
 strategy:
   rollingUpdate:
     maxSurge: 1
     maxUnavailable: 0
   type: RollingUpdate
 template:
   metadata:
     annotations:
       com.openfaas.git-repo-url: https://github.com/openfaas/store-
functions
       prometheus.io.scrape: "false"
     creationTimestamp: null
     labels:
       com.openfaas.git-branch: master
       com.openfaas.git-owner: openfaas
       com.openfaas.git-repo: store-functions
       com.openfaas.git-sha: f79e2c86e8d67f747d1e449ba6ca63eb5858e5bb
       com.openfaas.scale.min: "2"
```

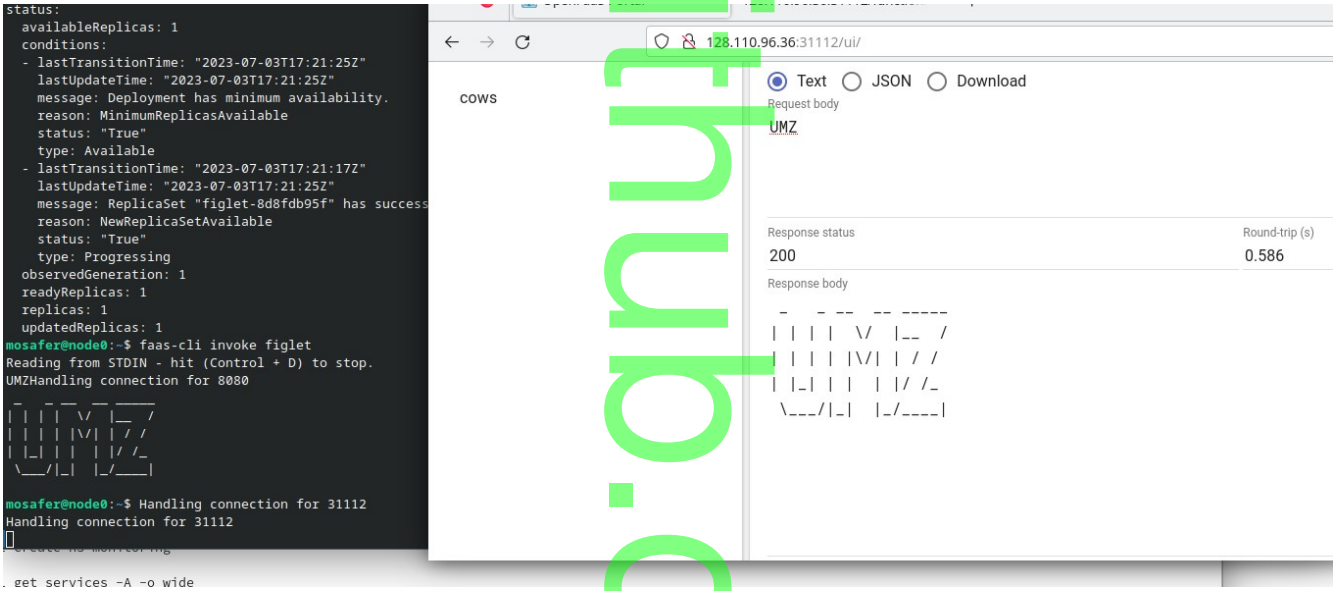
```
    faas_function: cows
  name: cows
spec:
  containers:
  - image: ghcr.io/openfaas/cows:latest
    imagePullPolicy: Always
    livenessProbe:
      failureThreshold: 3
      httpGet:
        path: /_/health
        port: 8080
        scheme: HTTP
      initialDelaySeconds: 2
      periodSeconds: 2
      successThreshold: 1
      timeoutSeconds: 1
    name: cows
    ports:
    - containerPort: 8080
      name: http
      protocol: TCP
    readinessProbe:
      failureThreshold: 3
      httpGet:
        path: /_/health
        port: 8080
        scheme: HTTP
      initialDelaySeconds: 2
      periodSeconds: 2
      successThreshold: 1
      timeoutSeconds: 1
    resources: {}
    securityContext:
      readOnlyRootFilesystem: true
    terminationMessagePath: /dev/termination-log
    terminationMessagePolicy: File
    volumeMounts:
    - mountPath: /tmp
      name: temp
```

```
      dnsPolicy: ClusterFirst
      restartPolicy: Always
      schedulerName: default-scheduler
      securityContext: {}
      terminationGracePeriodSeconds: 30
      volumes:
      - emptyDir: {}
        name: temp
status:
 availableReplicas: 2
 conditions:
 - lastTransitionTime: "2023-07-03T16:35:30Z"
   lastUpdateTime: "2023-07-03T16:35:30Z"
   message: Deployment has minimum availability.
   reason: MinimumReplicasAvailable
   status: "True"
   type: Available
 - lastTransitionTime: "2023-07-03T16:35:11Z"
   lastUpdateTime: "2023-07-03T16:35:30Z"
   message: ReplicaSet "cows-7575b9fb65" has successfully progressed.
   reason: NewReplicaSetAvailable
   status: "True"
   type: Progressing
 observedGeneration: 1
 readyReplicas: 2
 replicas: 2
 updatedReplicas: 2
```



فراخوانی فانکشن Figlet و HEY






```
curl -X POST http://128.110.96.36:31112/function/nslookup -d
'developer.cisco.com'
```

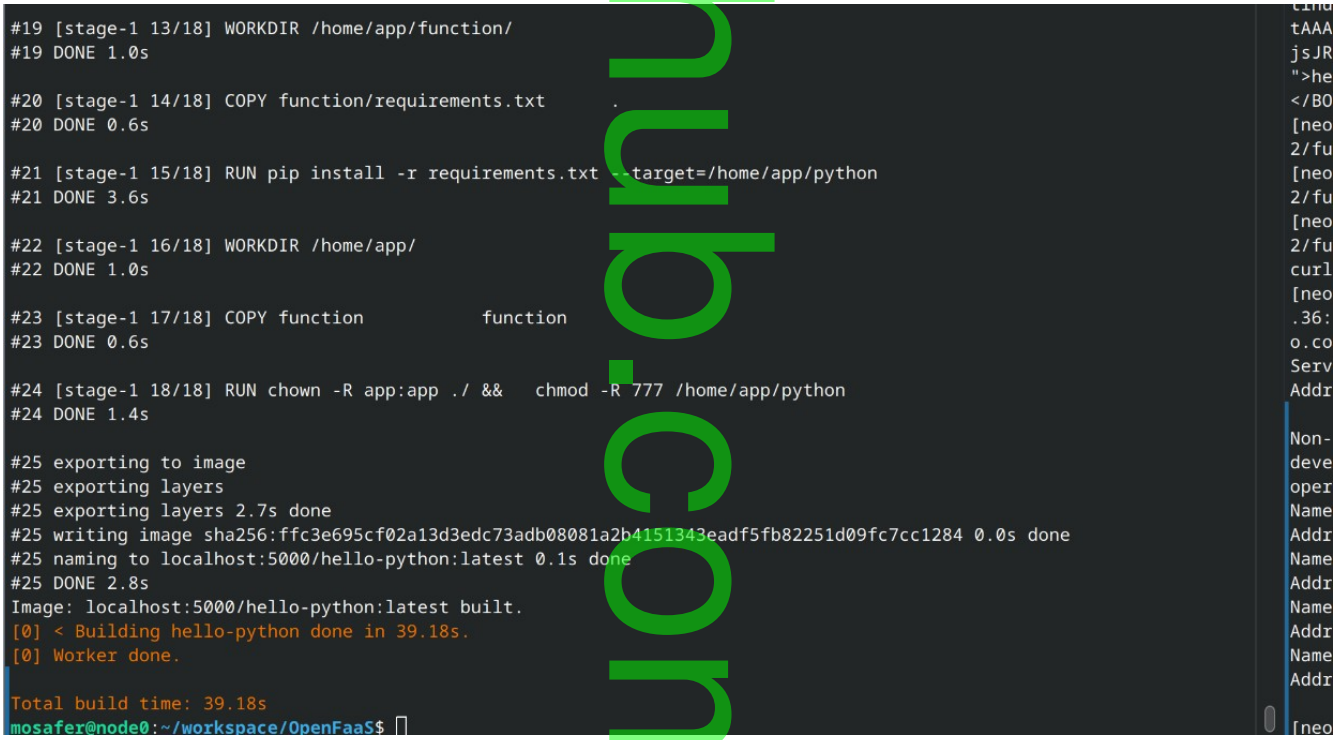
ساختن Costume Function در CLI

```
faas-cli template store pull python3

faas-cli new --lang python3 hello-python
```

```
mosafer@node0:~/workspace/OpenFaaS/hello-python$ cat handler.py
def handle(req):
    """handle a request to the function
    Args:
        req (str): request body
    """

    print("I am a great magician!, I think you said: " + req)
```

عملیات BUILD

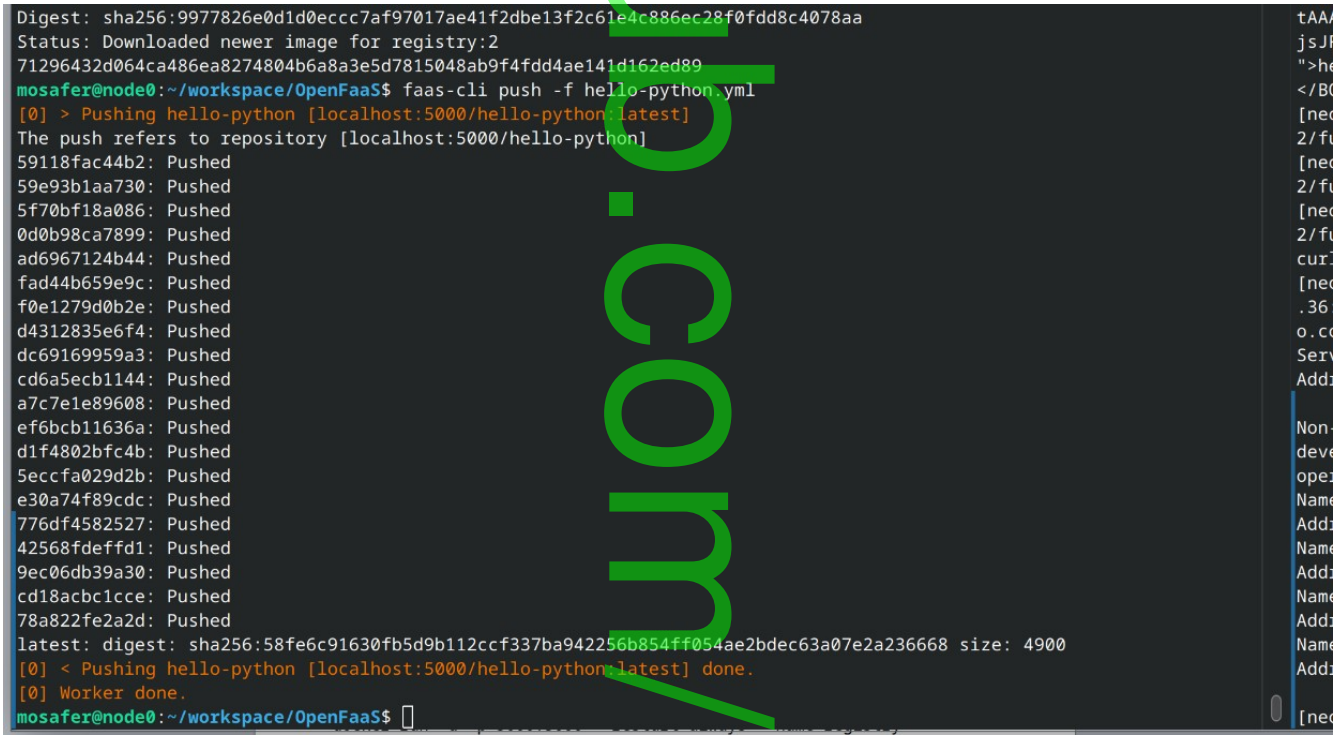
```
faas-cli build -f hello-python.yml
```




```
docker run -d -p 5000:5000 --restart=always --name registry
registry:2
```

عمليات PUSH, DEPLOY

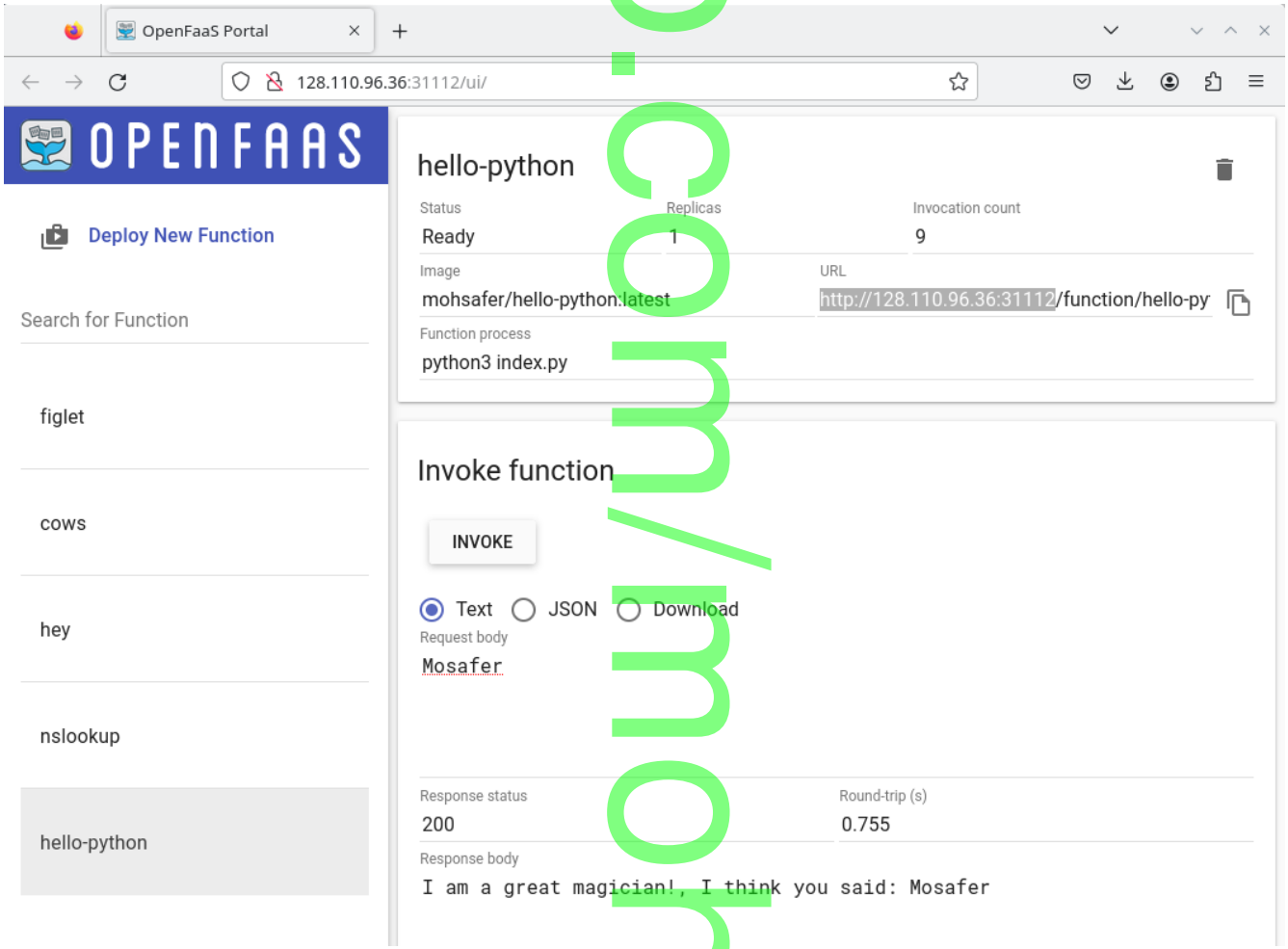
```
faas-cli push -f hello-python.yml
```




```
faas-cli deploy -f hello-python.yml
```

```
mosafer@node0:~/workspace/OpenFaaS$ cat hello-python.yml
version: 1.0
provider:
 name: openfaas
 gateway: http://127.0.0.1:8080
functions:
 hello-python:
   lang: python3
   handler: ./hello-python
   image: mohsafer/hello-python:latest
```

```
curl -X POST http://128.110.96.36:31112/function/hello-python -d
"Mosafer"
I am a great magician!, I think you said: Mosafer
[neo@fedora ~]$
```




```
mosafer@node0:~$ kubectl get services -A
NAMESPACE              NAME                              TYPE
CLUSTER-IP       EXTERNAL-IP   PORT(S)                       AGE
```

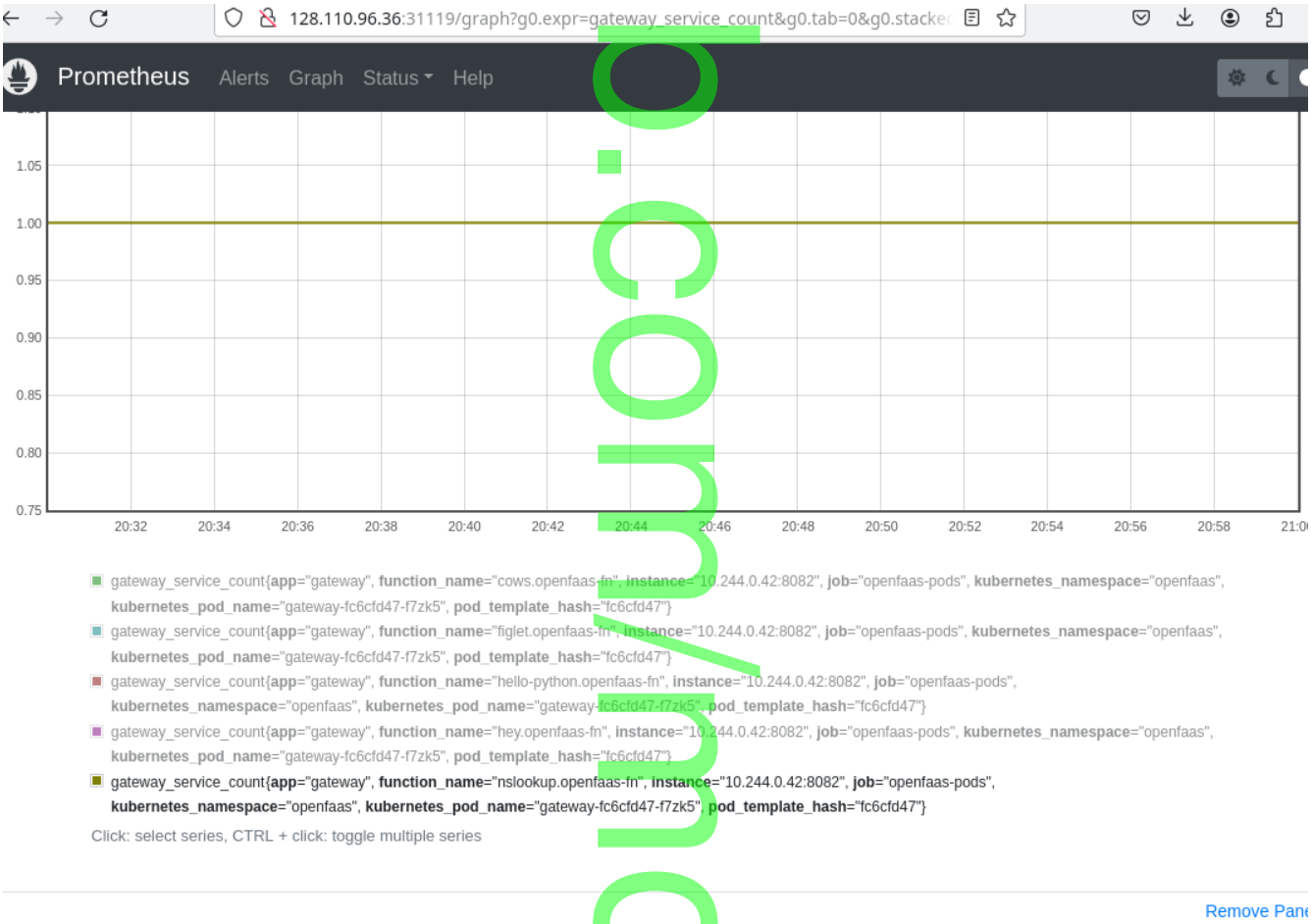
```
default                 hello-minikube              NodePort
10.100.220.234   <none>        8080:31779/TCP          10h
default                 kubernetes                  ClusterIP
10.96.0.1        <none>        443/TCP                 11h
kube-system             kube-dns                    ClusterIP
10.96.0.10       <none>        53/UDP,53/TCP,9153/TCP   11h
kube-system             kube-state-metrics          ClusterIP   None
<none>        8080/TCP,8081/TCP        10h
kube-system             metrics-server              ClusterIP
10.111.203.84    <none>        443/TCP                 10h
kubernetes-dashboard   dashboard-metrics-scraper   ClusterIP
10.104.198.178   <none>        8000/TCP                10h
kubernetes-dashboard   kubernetes-dashboard        ClusterIP
10.109.168.254   <none>        80/TCP                  10h
monitoring              node-exporter               ClusterIP
10.109.84.113    <none>        9100/TCP                10h
monitoring              prometheus-service          NodePort
10.103.245.121   <none>        8080:30000/TCP          10h
openfaas-fn             cows                        ClusterIP
10.103.139.59    <none>        8080/TCP                4h33m
openfaas-fn             figlet                      ClusterIP
10.106.213.48    <none>        8080/TCP                3h47m
openfaas-fn             hello-python                ClusterIP
10.100.2.7       <none>        8080/TCP                28m
openfaas-fn             hey                         ClusterIP
10.105.44.183    <none>        8080/TCP                4h6m
openfaas-fn             nslookup                    ClusterIP
10.109.216.69    <none>        8080/TCP                3h38m
openfaas                alertmanager                ClusterIP
10.102.142.233   <none>        9093/TCP                9h
openfaas                gateway                     ClusterIP
10.102.135.186   <none>        8080/TCP                9h
openfaas                gateway-external            NodePort
10.105.40.198    <none>        8080:31112/TCP          9h
openfaas                nats                        ClusterIP
10.99.197.155    <none>        4222/TCP                9h
openfaas                prometheus                  ClusterIP
10.98.227.192    <none>        9090/TCP                9h
openfaas                prometheus-ui               NodePort
```

```
10.97.159.22      <none>          9090:31612/TCP          14m
```

اکسپوز پرومتئوس

```
kubectl expose deployment prometheus -n openfaas --type=NodePort -name=prometheus-
ui
```

جمع آوری داده ها از طریق مانیفست هایی نظیر service-metric.yaml

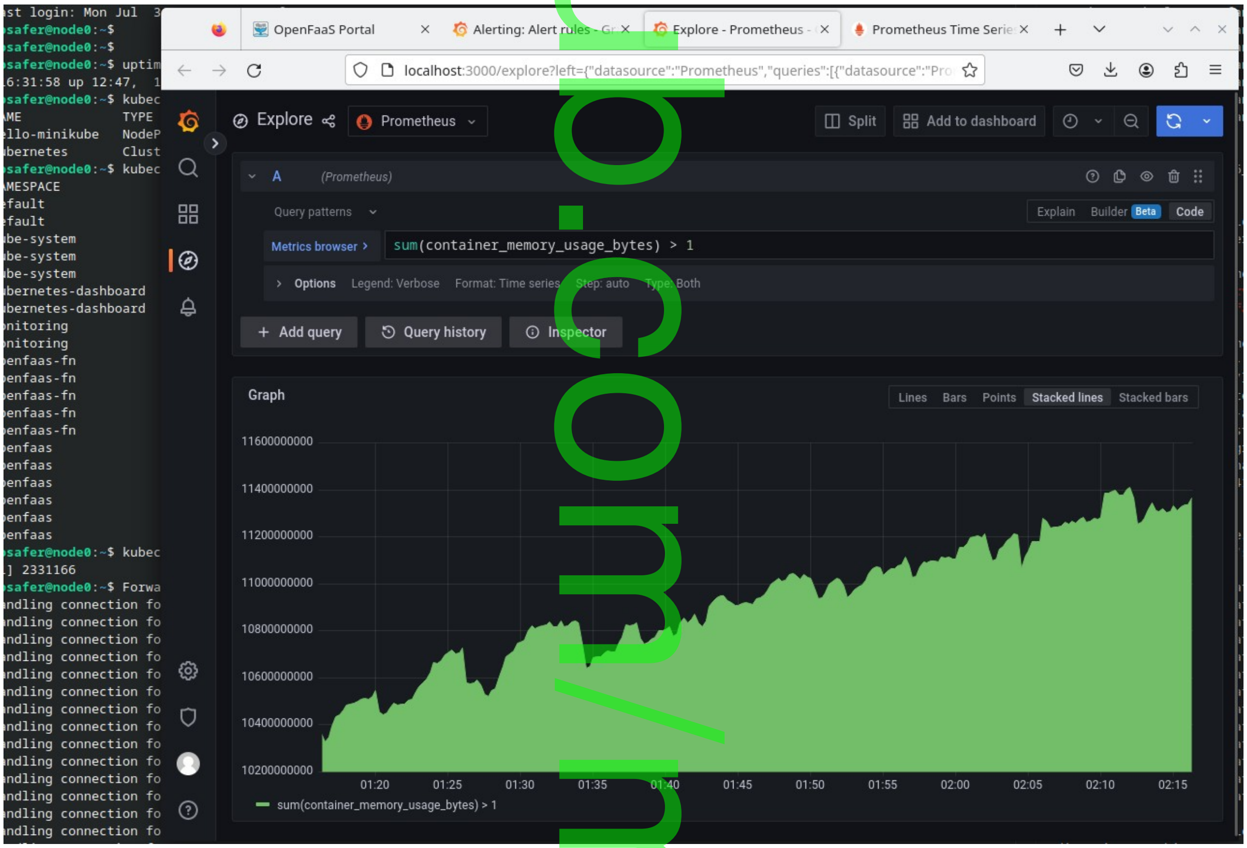



```
kubectl expose deployment prometheus -n openfaas --type=NodePort --
name=prometheus-ui
```

```
minikube kubectl -- --namespace monitoring port-forward --address
0.0.0.0 svc/prometheus-service 3000
0:8080 &
```

```
kubectl port-forward -n openfaas svc/grafana 3000:3000 &


mosafer@node0:~/workspace/OpenFaaS/hello-python$ kubectl get deploy
-A
NAMESPACE              NAME                        READY   UP-TO-DATE
AVAILABLE   AGE
default                hello-minikube              1/1     1
1           13h
kube-system            coredns                     1/1     1
1           13h
kube-system            kube-state-metrics          1/1     1
1           12h
kube-system            metrics-server              1/1     1
1           13h
kubernetes-dashboard   dashboard-metrics-scraper   1/1     1
1           13h
kubernetes-dashboard   kubernetes-dashboard        1/1     1
1           13h
monitoring             prometheus-deployment       1/1     1
1           12h
openfaas-fn            cows                        2/2     2
2           6h52m
openfaas-fn            figlet                      1/1     1
1           6h6m
openfaas-fn            hello-python                1/1     1
1           167m
openfaas-fn            hey                         1/1     1
1           6h25m
openfaas-fn            nslookup                    1/1     1
1           5h56m
openfaas               alertmanager                1/1     1
1           11h
openfaas               gateway                     1/1     1
1           11h
openfaas               nats                        1/1     1
1           11h
openfaas               prometheus                  1/1     1
```

```
1              11h
openfaas                    queue-worker                 1/1      1
1              11h
```



ایجاد لود توسط hey روی فانکشن Nslookup

در ابتدازمان Execution اندکی بالاتر رفت ولی نه چندان زیاد که باعث خارج شدن از سرویسدهی شود..

```
Response time histogram:
  0.017 [1]     |■
  0.025 [12]    |■■■■■■■
  0.034 [66]    |■■■■■■■■■■■■■■■■■■■■■■■■■■■■■■■■■■■■■■■■
  0.042 [60]    |■■■■■■■■■■■■■■■■■■■■■■■■■■■■■■■■■■■■
  0.051 [21]    |■■■■■■■■■■■■■
```

```
 0.059 [16]     |■■■■■■■■■■
 0.068 [8]      |■■■■■
 0.077 [10]     |■■■■■■
 0.085 [1]      |■
 0.094 [4]      |■■
 0.102 [1]      |■
```

اما با بالا رفتن نرخ درخواست ها فانکشن از سرویس دهی خارج گردید

```
hey http://128.110.96.36:31112/function/nslookup -d
'developer.cisco.com' -m POST -n 10000
```