Hand-on session
DODAS generated Spark cluster

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Markdown version of this presentation can be found here

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Presentation keyboard shortcut

- Press `h` to toggle display of help
- Press `left arrow` and `right arrow` to navigate
- Press `t` to toggle a table of contents for your presentation. Slide titles are links
- Press `ESC` to display the presentation overview (Exposé)
- Press `n` to toggle slide number visibility
- Press `e` to make slides filling the whole available space within the document body

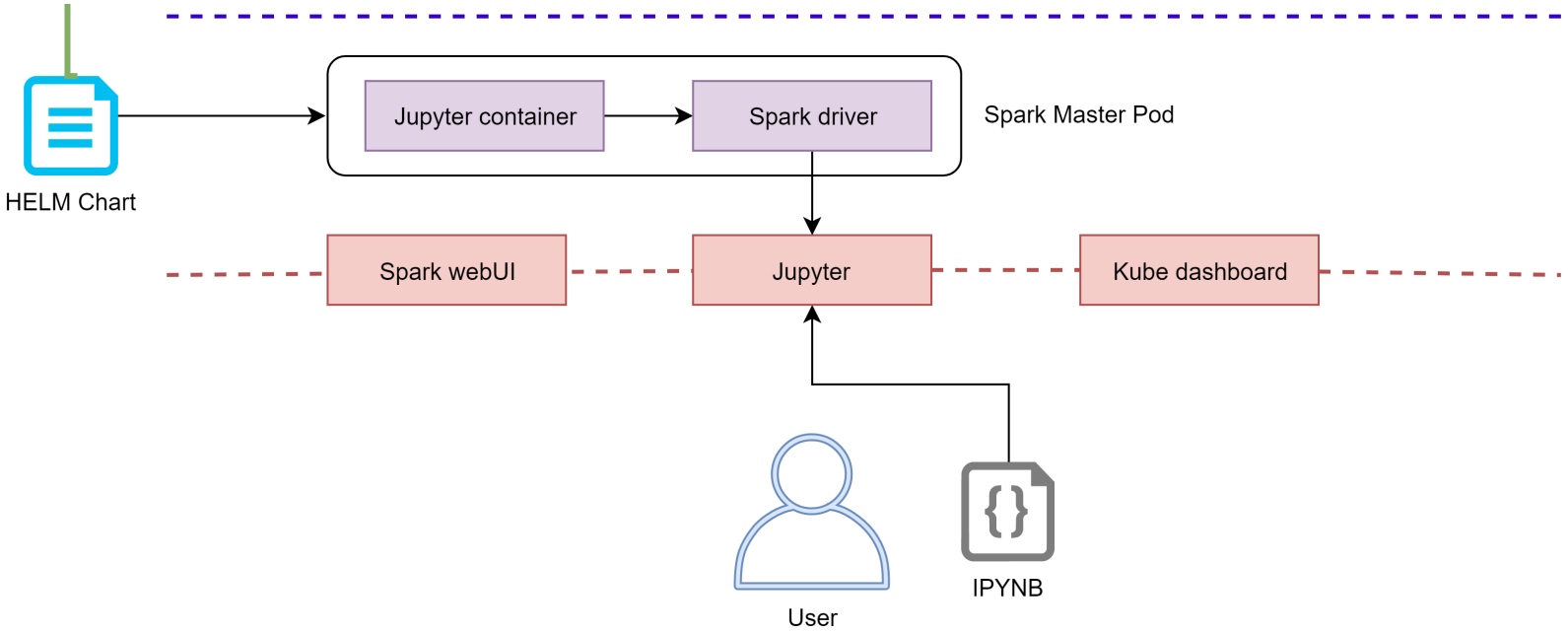
Overview

- Objective recap
  1. Deploy your own Spark cluster with Dodas
  2. How to template applications with Helm
     - Simple function example
  3. Get to know user interfaces for Spark on Dodas
     - Experimenting base features
     - Debugging

K8s on DODAS

Spark on DODAS

Client mode with Jupyter notebook



You see here Helm as a tool for templating applications on K8s. We will take a look at this later after we start the deployment (sorry time reason)

At the end we wiil also see an example of job submission in **cluster mode**

Setup architecture: recap

- **1 Master pod:**
  - **Spark driver**
  - **Jupyter**
- **Services:**
  - **Jupyter**
  - **Spark webUI**
  - **K8s dashboard**
- **At notebook python Kernel start:**
  - **2 executor pods**

Directly from the notebook is also possible to stop the current spark context and to reload a new one with different executors.

Question time 1.

Let's start our deployment

Download the Hands-on repo

```
git clone https://github.com/DODAS-TS/HandsOnSparkDODAS2019.git
cd HandsOnSparkDODAS2019
```

Copy your DODAS configuration template

```
cp templates/dodas_template.yaml ~/.dodas_template.yaml
```

Quick look at DODAS client configuration

```
cloud:
    id: ost
    type: OpenStack
    host: https://horizon.cloud.cnaf.infn.it:5000/v3
    username: iam-demo
    password: token_template
    tenant: oidc
    auth_version: 3.x_oidc_access_token
    service_region: regionOne
    auth_url: "https://horizon.cloud.cnaf.infn.it:5000"
im:
    id: im
    type: InfrastructureManager
    host: https://im-demo.cloud.cnaf.infn.it/infrastructures
    token: token_template
```

Retrieve you access token from IAM

Import the pre-configured client for the demo

```
export IAM_DEVICE_CODE_CLIENT_ID=7b50c794-c45a-45ad-906f-83cb18e36a5d

export IAM_DEVICE_CODE_CLIENT_SECRET=AJTXpc_Mo4ZgtcO7cT5CYYFHEQbeaV5IVYTiU4YQFoHyDMYZWiDPqvo
```

Retrieve the token

Simply run and follow the instructions:

```
./scripts/get_token.sh
```

Check $HOME/.dodas.yaml file correctly filled

```
cat ~/.dodas.yaml
```

Install DODAS client

Documentation

You can find a quick start guide and reference guide here

Download the binary

```
wget https://github.com/Cloud-PG/dodas-go-client/releases/download/v0.3.0/dodas.zip
unzip dodas.zip
```

Test the installation

```
./dodas --version
```

Deploy your cluster

Get TOSCA template

```
less templates/spark_template.yml
```

Question time 2.

Deploy the cluster

Validation

You can check for an error in your templates with `dodas validate command`

```
dodas validate --template templates/spark_template.yml
```

Launch the deployment

```
$ ./dodas create templates/spark_template.yml
    Using config file: /home/centos/.dodas.yaml
    validate called
    Template OK
    Template: templates/spark_template.yml
    Submitting request to  :  https://im-demo.cloud.cnaf.infn.it/infrastructures
    InfrastructureID:  c8a7a544-1bee-11ea-a67e-0242ac160003
```

Check the status of the vm configuration

Checking the status of configuration on master node:

```
$ ./dodas get status vm c8a7a544-1bee-11ea-a67e-0242ac160003 0
```

Time for Helm... in a nutshell

Helm: introduction exercise

While the deployment goes, let's setup a local playgroud to understand how the K8s templating works with HELM.

1. Knowing the tool
2. How you can develop and test a chart
3. A look at Dodas spark chart

What's Helm 1/2

Helm helps managing Kubernetes applications through a standard templating. The latest version of Helm is maintained by the CNCF - in collaboration with Microsoft, Google, Bitnami and the Helm contributor community. For this hands on we will use the v2 though, since DODAS is currently in the middle of the migration from v2 to v3.

What's Helm 2/2

On HelmHub you can find by yourselves the motivation of adopting a widely adopted template format.

Helm uses a packaging format called charts. A chart is a collection of files that describe a related set of Kubernetes resources. A single chart might be used to deploy something simple, like a memcached pod, or something complex, like a full web app stack with HTTP servers, databases, caches, and so on.

Install Helm and local k8s

Let's setup our local cluster with 2 fake nodes that will be our **dev environment**:

```
# Install k8s cli
curl -LO https://storage.googleapis.com/kubernetes-release/release/`curl -s https://storage.
chmod +x kubectl

# Install k8s in docker
curl -Lo ./kind https://github.com/kubernetes-sigs/kind/releases/download/v0.6.1/kind-$(unam
chmod +x ./kind

# deploy the playground
./kind create cluster --config templates/kind_cluster_config.yml

# install helm client
curl https://raw.githubusercontent.com/helm/helm/master/scripts/get-helm-3 | bash
```

Check that everything is working with:

```
$ ./kubectl get node
    NAME                 STATUS   ROLES    AGE     VERSION
    kind-control-plane   Ready    master   3m55s   v1.16.3
    kind-worker          Ready    <none>   2m36s   v1.16.3
    kind-worker2         Ready    <none>   2m36s   v1.16.3
```

Simple example

Init your chart

```
# Create a defualt chart
helm create myfirstchart

# Remove standard templates
rm -rf mychart/templates/*.*
```

Chart folder tree

Charts are created as files laid out in a particular directory tree, then they can be packaged into versioned archives to be deployed.

```
myfirstchart/
    Chart.yaml          # A YAML file containing information about the chart
    LICENSE             # OPTIONAL: A plain text file containing the license for the chart
    README.md           # OPTIONAL: A human-readable README file
    values.yaml         # The default configuration values for this chart
    templates/          # A directory of templates that, when combined with values,
                        # will generate valid Kubernetes manifest files.
    templates/NOTES.txt # OPTIONAL: A plain text file containing short usage notes
```

Helm: "chart up" your application

Deployment template

```
apiVersion: apps/v1
kind: Deployment
metadata:
    name: lookup-deployment
spec:
    replicas: 1
    template:
        metadata:
            labels:
                app: {{ .Values.appName }}
        spec:
            containers:
            - name: lookup-container-deployment
                image: dciangot/lookup
                ports:
                - containerPort: 80
                env:
                - name: SIMPLE_SERVICE_VERSION
                value: "1.0"
                resources:
                    limits:
                        memory: "64Mi"
                        cpu: "500m"
            - name: probe-container
              image: dciangot/probe

    selector:
        matchLabels:
            app: {{ .Values.appName }}
```

Service template

```
apiVersion: v1
kind: Service
metadata:
    name: simpleservice
spec:
    ports:
        - port: {{ .Values.servicePort }}
          targetPort: 80
    selector:
        app: {{ .Values.appName }}
```

Value file

In `values.yaml` we can now put our deployment variables:

```
servicePort: 30080
appName: myApp
```

Install your Helm chart on the cluster

```
$ helm install mychart ./myfirstchart
    NAME: mychart
    LAST DEPLOYED: Wed Dec 11 09:02:50 2019
    NAMESPACE: default
    STATUS: deployed
    REVISION: 1
    TEST SUITE: None
```

One can also verified the manifest that has been actually submitted to k8s with:

```
helm get manifest mychart
```

You should see that the parameters in the templates should be filled with the values we passed on values.yaml file.

Verify the deployments

```
$ ./kubectl get pod
    NAME                                  READY   STATUS    RESTARTS   AGE
    lookup-deployment-64dd5568bc-6dft5    2/2     Running   0          49s
```

Publish the chart

Charts can then be exposed for external reuse creating repositories with various methods described here

Question time 3.

Spark HELM chart

A look at need values

```
Spark:
    Path: /opt/spark

externalIP:
    enabled: true
    ip: {{ externalIP }}

Master:
    Name: master
    Image: cloudpg/spark-py
    ImageTag: dodas-2.4.3-bigdl
    Replicas: 1
    Component: spark-master
    Cpu: 100m
    Memory: 1024Mi
    ServicePort: 7077
    ContainerPort: 7077
    # Set Master JVM memory. Default 1g
    # DaemonMemory: 1g
    ServiceType: ClusterIP
Jupyter:
    NodePort: 30888
```

More details

Find the whole chart tree in `templates/helm/spark` And the spark image for Kubernetes resource manager here

Question time 4.

Time to play with DODAS Spark cluster

Retrieve again the token

Check the status of the deployment

By now you should see something like:

```
$ /usr/local/bin/dodas get status vm c8a7a544-1bee-11ea-a67e-0242ac160003 0
    ...
    ...
    TASK [cloud-pg.ansible_role_helm : Helm install chart cloudpg/spark] ***********
    Wednesday 11 December 2019  08:35:44.102069
    changed: [131.154.96.135_0]

    PLAY RECAP *********************************************************************
    131.154.96.135_0           : ok=4    changed=4    unreachable=0    failed=0
    131.154.96.135_0           : ok=4    changed=4    unreachable=0    failed=0

    Task helm_spark_conf_k8s_master_server finished successfully
    Process finished
```

If not, don't worry, we got a backup solution at `131.154.96.222:30888`

Kubernetes Web-UI

The UI should be now exposed on the port 30443 of you master node e.g. `https://<your master IP>:30443`

Spark Web-UI

The UI should be now exposed on the port 30443 of you master node e.g. `https://<your master IP>:30808`

Log into the k8s master

You are also able to log into the master retrieving access information with the dodas client:

```
./dodas get vm c8a7a544-1bee-11ea-a67e-0242ac160003 0
```

Just save the prompted private key and login with `cloudadm` user

Question time 5.

Using Jupyter

Jupyter is accessible at `http://<your master IP>:30888` with the password `testme`

Load the exercise notebook

You should be able now to import the exercise notebook in `templates/spark_notebook.ipynb` with the upload button and to start its kernel.

Check the executor pods appearing

In the k8s web ui you should see now 2 additional pods appearing as the spark shell have been started by the kernel automatically creating a pool of executor.

The number and size of executors can be tuned both at TOSCA level and directly from Jupyter as you can find the in the example playbook provided.

Question time 6 and the last one :)

Destroy the cluster

Just retrieve the token again and then do:

```
./dodas destroy  c8a7a544-1bee-11ea-a67e-0242ac160003
```

Finally, what about lego composition?

Let's take a look at how you can leverage the DODAS stack and compose different application.

In `templates/spark_minio_template.yaml` you can find an example where the setup you just made with an S3 object storage using MINIO.

The chart relative to Minio installation is here