

3. Hands-On Spark Operator

Tutorial Com ArgoCD

Download do Helm Chart para o Spark Operator

Link: <https://github.com/kubeflow/spark-operator/tree/master>

1. Adicionar o repositório helm
 1. helm repo add spark-operator <https://kubeflow.github.io/spark-operator>
 2. helm repo update
2. Criar um folder dentro da pasta dos helm-charts e colocar os arquivos baixados
3. O values.yaml pode manter padrão, alterando somente o namespace padrão dos jobs de default para processing

Criação da Aplicação Yaml do ArgoCD

1. Construir arquivo manifesto apontando para a pasta configurada

```
apiVersion: argoproj.io/v1alpha1
kind: Application
metadata:
  name: spark-operator-datawaybr
  namespace: argocd
spec:
  project: default
  source:
    repoURL: 'git@github.com:Alexno9/k8s-argo-minio.git'
    path: helm-charts/spark-operator
    targetRevision: main
    helm:
      valueFiles:
        - values.yaml
  destination:
    server: 'https://kubernetes.default.svc'
    namespace: processing
  syncPolicy:
    automated:
      prune: true
      selfHeal: true
```

2. Realizar apply do manifesto: `kubectl apply -f arquivo.yaml -n argocd`
3. Acompanhar a subida do operador via argocd

Tutorial via Helm Manual

Instalação do Helm Chart Padrão

1. `helm install spark-operator spark-operator/spark-operator -n processing --wait`
 1. Instalação default sem modificações na versão mais recente do Helm-Chart
2. Irá instalar dois pods: controller e webhook
 1. Ambos controlam os submits de aplicações + gestão de recursos

Criar Imagem Docker PySpark + Delta

```
1. # Escolha uma imagem base oficial do Spark com suporte ao Hadoop e Python
FROM bitnami/spark:3.4.1

# Defina as variáveis de ambiente necessárias
ENV DELTA_CORE_VERSION=2.4.0 \
    JAVA_HOME=/opt/bitnami/java \
    PATH=$PATH:/opt/bitnami/java/bin

# Instale dependências de sistema e Python
USER root
RUN apt-get update && apt-get install -y --no-install-recommends \
    python3-pip \
    python3-dev \
    && apt-get clean && rm -rf /var/lib/apt/lists/*

# Instale bibliotecas Python necessárias
# COPY requirements.txt /tmp/requirements.txt
RUN pip3 install --no-cache-dir delta-spark==${DELTA_CORE_VERSION}

# Copie os scripts para o contêiner
WORKDIR /opt/spark/work-dir
COPY notebooks/delta.py .
COPY data/dados_fake.csv .

# Altere permissões (necessário para execução com usuários não root)
RUN chmod -R 775 /opt/spark/work-dir

# Usuário padrão para execução
USER 1001
```

2. `docker build -t nome-imagem -f Dockerfile.jobcontainer .`
3. `docker tag nome-imagem hub/reponame`
4. `docker push hub/reponame`

Construir Manifesto para o Job Spark

Configs Principais

- `sparkConf`:
 - Delta Dependencies devem ser anexadas ao spark manifest, se não, independente de ter uma imagem com Delta, ela não sera executada
 - Isso se deve em conta da estrutura de execução dos jobs via spark-submit
- `volumes`:
 - É possível criar um ConfigMap do seu script e cria-lo dentro do cluster e referenciar via mountpoint dentro do manifesto spark
- `macros.datetime`:
 - Não funciona para deploy local via kubectl
 - Somente com chamada via Airflow
- `sparkVersion`:
 - Deve ser igual a imagem do dockerfile
- `dynamicAllocation`: Alocação de replica de containers conforme demanda dos Executores
 - `enabled`: true
 - `initialExecutors`: 2
 - `maxExecutors`: 5
 - `minExecutors`: 1

O Manifesto

```
apiVersion: "sparkoperator.k8s.io/v1beta2"
kind: SparkApplication
metadata:
  name: delta-faker-app-{{ macros.datetime.now().strftime("%Y-%m-%d-%H-%M-%S") }}
  namespace: default
spec:
  timeToLiveSeconds: 3600
  type: Python
  pythonVersion: "3"
  mode: cluster
  image: alexno9/spark-job-container:v01
  imagePullPolicy: IfNotPresent
```

```

mainApplicationFile: "local:///opt/spark/work-dir/delta.py"
sparkVersion: 3.4.1
sparkConf:
  "spark.jars.packages": "io.delta:delta-core_2.12:2.4.0"
  "spark.sql.extensions": "io.delta.sql.DeltaSparkSessionExtension"
  "spark.sql.catalog.spark_catalog":
"org.apache.spark.sql.delta.catalog.DeltaCatalog"
restartPolicy:
  type: Never
driver:
  cores: 1
  coreRequest: "0.5"
  coreLimit: 800m
  memory: 512m
  labels:
    version: 3.4.1
  serviceAccount: spark-operator-spark
executor:
  instances: 1
  coreRequest: "1200m"
  coreLimit: 1500m
  memory: 512m
  labels:
    version: 3.4.1

```

Execução de Um Manifesto Via Spark Operator

O CRD `spark-application` acompanha todas as requisições de aplicação. Quando executamos um `apply` no manifesto, é recebida uma requisição de aplicação contendo as instruções que passamos no `yaml`.

Events							
Name	Reason	Message	Source	Sub-object	Count	First Seen	Last Seen ↑
delta-demo-task.18098200ffd19796	SparkDriverF	Driver delta-demo-task-driver is running	spark-application-controller	-	1	25.seconds.ago	25.seconds.ago
delta-demo-task.1809820089cb7dfd	SparkApplic	SparkApplication delta-demo-task was submitted successfully	spark-application-controller	-	1	27.seconds.ago	27.seconds.ago

Um pod é criado dentro do namespace selecionado para o driver

Pods									
Name	Images	Labels	Node	Status	Restarts	CPU Usage (cores)	Memory Usage (bytes)	Created ↑	
delta-demo-task-driver	alexno9/spark-job-contin	spark-app-name: delt a-demo-task spark-app-selector: s park-b34c09b5fe994 435a448ce7828653c 09 spark-role: driver Show all	testeipyter	Completed	0	708.00m	466.71Mi	2.minutes ago	⋮

Log de Execução da Aplicação

Logs from `spark-kubern...` in `delta-demo-tas...`

```
spark 23:21:11.46 INFO ==>
spark 23:21:11.47 INFO ==> Welcome to the Bitnami spark container
spark 23:21:11.47 INFO ==> Subscribe to project updates by watching https://github.com/bitnami/containers
spark 23:21:11.47 INFO ==> Submit issues and feature requests at https://github.com/bitnami/containers/issues
spark 23:21:11.48 INFO ==>
:: loading settings :: url = jar:file:/opt/bitnami/spark/jars/ivy-2.5.1.jar!/org/apache/ivy/core/settings/ivysettings.xml
Ivy Default Cache set to: /tmp/.ivy/cache
The jars for the packages stored in: /tmp/.ivy/jars
io.delta#delta-core_2.12 added as a dependency
:: resolving dependencies :: org.apache.spark#spark-submit-parent-00607397-a8ea-48f0-b167-61744bb24b0e;1.0
  confs: [default]
  found io.delta#delta-core_2.12;2.4.0 in central
  found io.delta#delta-storage;2.4.0 in central
  found org.antlr#antlr4-runtime;4.9.3 in central
downloading https://repo1.maven.org/maven2/io/delta/delta-core_2.12/2.4.0/delta-core_2.12-2.4.0.jar ...
[SUCCESSFUL ] io.delta#delta-core_2.12;2.4.0!delta-core_2.12.jar (1404ms)
downloading https://repo1.maven.org/maven2/io/delta/delta-storage/2.4.0/delta-storage-2.4.0.jar ...
[SUCCESSFUL ] io.delta#delta-storage;2.4.0!delta-storage.jar (364ms)
downloading https://repo1.maven.org/maven2/org/antlr/antlr4-runtime/4.9.3/antlr4-runtime-4.9.3.jar ...
[SUCCESSFUL ] org.antlr#antlr4-runtime;4.9.3!antlr4-runtime.jar (446ms)
:: resolution report :: resolve 5011ms :: artifacts dl 2267ms
:: modules in use:
io.delta#delta-core_2.12;2.4.0 from central in [default]
```

Demo Test com Sample spark-pi

- `kubectl apply -f https://raw.githubusercontent.com/kubeflow/spark-operator/refs/heads/master/examples/spark-pi.yaml -n processing`

```
apiVersion: sparkoperator.k8s.io/v1beta2
kind: SparkApplication
metadata:
  name: spark-pi
  namespace: default
spec:
  type: Scala
  mode: cluster
  image: spark:3.5.3
  imagePullPolicy: IfNotPresent
  mainClass: org.apache.spark.examples.SparkPi
  mainApplicationFile: local:///opt/spark/examples/jars/spark-examples.jar
  arguments:
  - "5000"
  sparkVersion: 3.5.3
  driver:
    labels:
      version: 3.5.3
    cores: 1
    memory: 512m
    serviceAccount: spark-operator-spark
  executor:
```

labels:
version: 3.5.3
instances: 1
cores: 1
memory: 512m

Logs from spark-kubern... in spark-pi-driver

```
Files local:///opt/spark/examples/jars/spark-examples.jar from /opt/spark/examples/jars/spark-examples_2.12-3.5.3.jar to /opt/spark/work-dir/spark-examples_2.12-3.5.3.jar
24/11/17 12:40:57 WARN NativeCodeLoader: Unable to load native-hadoop library for your platform... using builtin-java classes where applicable
24/11/17 12:40:58 INFO SparkContext: Running Spark version 3.5.3
24/11/17 12:40:58 INFO SparkContext: OS info Linux, 5.15.153.1-microsoft-standard-WSL2, amd64
24/11/17 12:40:58 INFO SparkContext: Java version 11.0.25
24/11/17 12:40:58 INFO ResourceUtils: =====
24/11/17 12:40:58 INFO ResourceUtils: No custom resources configured for spark.driver.
24/11/17 12:40:58 INFO ResourceUtils: =====
24/11/17 12:40:58 INFO SparkContext: Submitted application: Spark Pi
24/11/17 12:40:59 INFO ResourceProfile: Default ResourceProfile created, executor resources: Map(cores -> name: cores, amount: 1, script: , vendor: , memory -> name: offHeap, amount: 0, script: , vendor: ), task resources: Map(cpus -> name: cpus, amount: 1.0)
24/11/17 12:40:59 INFO ResourceProfile: Limiting resource is cpus at 1 tasks per executor
24/11/17 12:40:59 INFO ResourceProfileManager: Added ResourceProfile id: 0
24/11/17 12:40:59 INFO SecurityManager: Changing view acls to: spark
24/11/17 12:40:59 INFO SecurityManager: Changing modify acls to: spark
24/11/17 12:40:59 INFO SecurityManager: Changing view acls groups to:
24/11/17 12:40:59 INFO SecurityManager: Changing modify acls groups to:
24/11/17 12:40:59 INFO SecurityManager: SecurityManager: authentication disabled; ui acls disabled; users with view permissions: spark; groups with view permissions:
24/11/17 12:41:00 INFO Utils: Successfully started service 'sparkDriver' on port 7078.
24/11/17 12:41:00 INFO SparkEnv: Registering MapOutputTracker
24/11/17 12:41:00 INFO SparkEnv: Registering BlockManagerMaster
24/11/17 12:41:00 INFO BlockManagerMasterEndpoint: Using org.apache.spark.storage.DefaultTopologyMapper for getting topology information
24/11/17 12:41:00 INFO BlockManagerMasterEndpoint: BlockManagerMasterEndpoint up
24/11/17 12:41:00 INFO SparkEnv: Registering BlockManagerMasterHeartbeat
```

Logs from spark-kubern... in spark-pi-driver

```
24/11/17 12:43:17 INFO TaskSetManager: Finished task 4997.0 in stage 0.0 (TID 4997) in 10 ms on 10.244.0.125 (executor 1) (4998/5000)
24/11/17 12:43:17 INFO TaskSetManager: Starting task 4999.0 in stage 0.0 (TID 4999) (10.244.0.125, executor 1, partition 4999, PROCESS_LOCAL, 9318 bytes)
24/11/17 12:43:17 INFO TaskSetManager: Finished task 4998.0 in stage 0.0 (TID 4998) in 11 ms on 10.244.0.125 (executor 1) (4999/5000)
24/11/17 12:43:17 INFO TaskSetManager: Finished task 4999.0 in stage 0.0 (TID 4999) in 15 ms on 10.244.0.125 (executor 1) (5000/5000)
24/11/17 12:43:17 INFO TaskSchedulerImpl: Removed TaskSet 0.0, whose tasks have all completed, from pool
24/11/17 12:43:17 INFO DAGScheduler: ResultStage 0 (reduce at SparkPi.scala:38) finished in 111.263 s
24/11/17 12:43:17 INFO DAGScheduler: Job 0 is finished. Cancelling potential speculative or zombie tasks for this job
24/11/17 12:43:17 INFO TaskSchedulerImpl: Killing all running tasks in stage 0: Stage finished
24/11/17 12:43:17 INFO DAGScheduler: Job 0 finished: reduce at SparkPi.scala:38, took 112.779607 s
Pi is roughly 3.141603078283206
24/11/17 12:43:17 INFO SparkContext: SparkContext is stopping with exitCode 0.
24/11/17 12:43:17 INFO SparkUI: Stopped Spark web UI at http://spark-pi-2bf404933a229c9c-driver-svc.default.svc:4040
24/11/17 12:43:17 INFO KubernetesClusterSchedulerBackend: Shutting down all executors
24/11/17 12:43:17 INFO KubernetesClusterSchedulerBackend$KubernetesDriverEndpoint: Asking each executor to shut down
24/11/17 12:43:17 WARN ExecutorPodWatchSnapshotSource: Kubernetes client has been closed.
24/11/17 12:43:18 INFO MapOutputTrackerMasterEndpoint: MapOutputTrackerMasterEndpoint stopped!
24/11/17 12:43:18 INFO MemoryStore: MemoryStore cleared
24/11/17 12:43:18 INFO BlockManager: BlockManager stopped
24/11/17 12:43:18 INFO BlockManagerMaster: BlockManagerMaster stopped
24/11/17 12:43:18 INFO OutputCommitCoordinator$OutputCommitCoordinatorEndpoint: OutputCommitCoordinator stopped!
24/11/17 12:43:18 INFO SparkContext: Successfully stopped SparkContext
24/11/17 12:43:18 INFO ShutdownHookManager: Shutdown hook called
24/11/17 12:43:18 INFO ShutdownHookManager: Deleting directory /var/data/spark-66981fc6-b5b1-4f0c-9ea0-21af861b76dc/spark-a2a4853d-36a5-4c70-ab78-e0857c8c74df
24/11/17 12:43:18 INFO ShutdownHookManager: Deleting directory /tmp/spark-21153397-3afd-457b-8fed-ae8497ca7e17
```

Logs from Nov 17, 2024 to Nov 17, 2024 UTC

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