

BigData Spark Hands-On 3 [part2]

launching spark on k8s

arnaud.nauwynck@gmail.com

Esilv 2024

Outline

part 1/2

- Install podman (~Docker) on local Windows/Mac/Linux
- Install Kubernetes Cluster "Kind" (=K8s in Docker)
- Install Kubernetes Tools: k9s, helm, aliases
- Install spark-operator for K8s using Helm + check/fixes
- (Optional) Launch spark-shell on Docker, in mode "--master local[*]"
- (Optional) Launch spark with "spark-submit --master k8s://localhost:port"
- Launch spark with "kubectl apply -f file.yaml"
- (Optional... and backup if local install fails) Using Azure Kubernetes

"KISS" = Keep It Stupid Simple

```
kubectl apply -f spark-pi.yaml
```

Check running

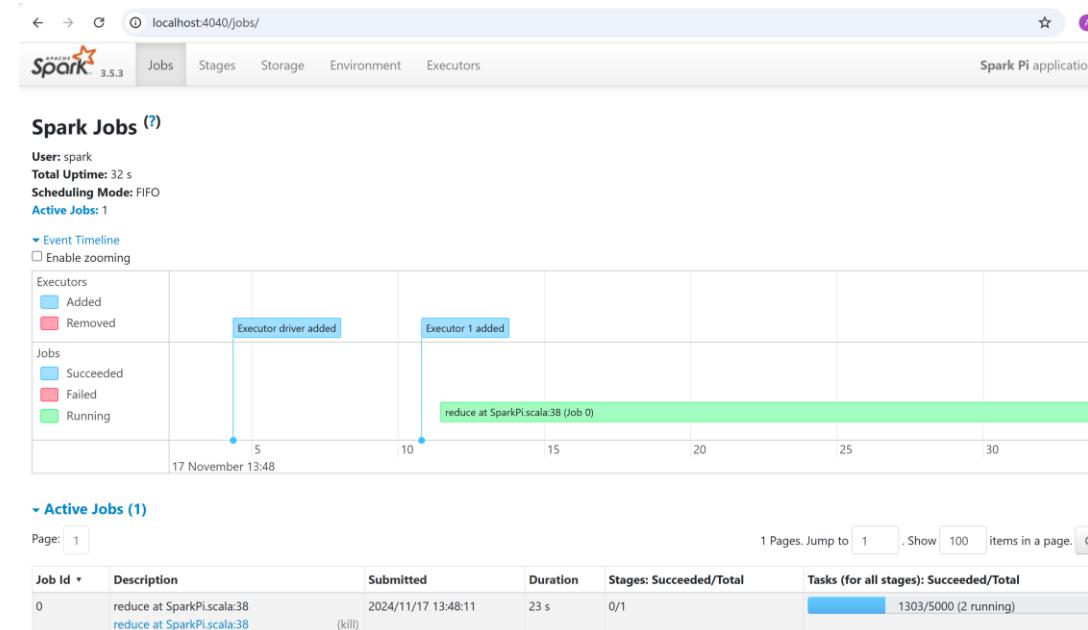
```
Invite de commandes - k9s × Invite de commandes × + ▾ Context: kind-kind-cluster
Cluster: kind-kind-cluster
User: kind-kind-cluster
K9s Rev: v0.32.6 → v0.32.7
K8s Rev: v1.27.3
CPU: n/a
MEM: n/a
<0> all <a> Attach
<1> spark-operator <ctrl-d> Delete
<2> default <d> Describe
<e> Edit
<?> Help
<shift-j> Jump Owner
Pods(default)[2]
NAME↑ PF READY STATUS RESTARTS IP NODE AGE
spark-pi-851e25933a569f05-exec-1 ● 1/1 Running 0 10.244.0.57 kind-cluster-control-plane 3m42s
spark-pi-driver ⚙ 1/1 Running 0 10.244.0.56 kind-cluster-control-plane 3m51s
```

do "port forward" 4040 (in driver pod)
-> 4040 on localhost

kubectl port-forward spark-pi-driver 4040:4040

```
C:\apps\spark\spark-on-k8s>kubectl port-forward spark-pi-driver 4040:4040
Forwarding from 127.0.0.1:4040 -> 4040
Forwarding from [::1]:4040 -> 4040
```

Then open your browser on <http://localhost:4040>



Alternative: do port-forward using K9s

select pod "spark-pi-driver", type "<CONTROL> + F", edit port number "4040", then "OK"

```
Context: kind-kind-cluster          <0> all      <a> Attach
Cluster: kind-kind-cluster         <1> spark-operator  <ctrl-d> Delete
User:   kind-kind-cluster          <2> default    <d> Describe
K9s Rev: v0.32.6 → v0.32.7        <e> Edit
K8s Rev: v1.27.3                  <?> Help
CPU:    n/a                      <shift-j> Jump Owner
MEM:   n/a

NAME↑                                     PF
spark-pi-851e25933a569f05-exec-1  ●
spark-pi-driver                         ●

<PortForward>
default/spark-pi-driver
Exposed Ports:
spark-kubernetes-driver::7078(driver-rpc
port)
spark-kubernetes-driver::7079(blockmanager)
spark-kubernetes-driver::4040(spark-ui)

Container Port: kubernetes-driver::4040
Local Port:     4040
Address:       localhost

OK      Cancel

ODE                                         AGE
ind-cluster-control-plane 8m28s
ind-cluster-control-plane 8m37s
```

It just works



Next Steps - Personnal Study

- try to relaunch several times, how to do?
- explore the internals of spark-operator + k8s pods
- change parameter to use several executors, and different cores number
- provide your own jar and className to execute
- execute a "shell" inside the spark-executor/driver to monitor unix process
- add environment variable to the driver/pod
- choose env variable _JAVA_OPTIONS to enable remote JVM debugging
then attach debugger as "remote java process"
- use ConfigMap from k8s to be visible as mounted volume files
- use "emptyDir" mount volume for shuffle files
- etc etc

Dive Deeper,
Understand the Magie
& TroubleShoot Errors

running your first "Docker" spark image

running spark image in Docker "local" mode

```
docker run -it apache/spark /opt/spark/bin/spark-shell
```

OR

```
podman run -it apache/spark /opt/spark/bin/spark-shell
```

Docker HUB spark "latest" image ? example: finding with scala2.13 (!= 2.12)

The screenshot shows a browser window on the Docker Hub website. The URL in the address bar is `hub.docker.com/r/apache/spark/tags?name=scala2.13`. The search bar at the top has "apache/spark" entered. Below the search bar, there are buttons for "Sign In" and "Sign up". The main content area displays the Apache Spark repository page. The repository name is "apache/spark" and it is sponsored by The Apache Software Foundation, last updated 20 days ago. It is categorized under "IMAGE", "DATA SCIENCE", "LANGUAGES & FRAMEWORKS", and "MACHINE LEARNING & AI". The star count is 77 and the download count is 5M+. The "Tags" tab is selected. A search bar below shows "Newest" sorted by "scala2.13". A specific tag entry for "4.0.0-preview2-scala2.13-java17-python3-r-ubuntu" is highlighted, showing its digest as `747e719b5e76`, OS/ARCH as "linux/amd64", and compressed size as 949.99 MB. To the right of this entry is a "Copy" button for the command `docker pull apache/spark:4.0.0-preview2-scala2.13-java17-pyth on3-r-ubuntu`.

spark-shell --master local[*] in Docker

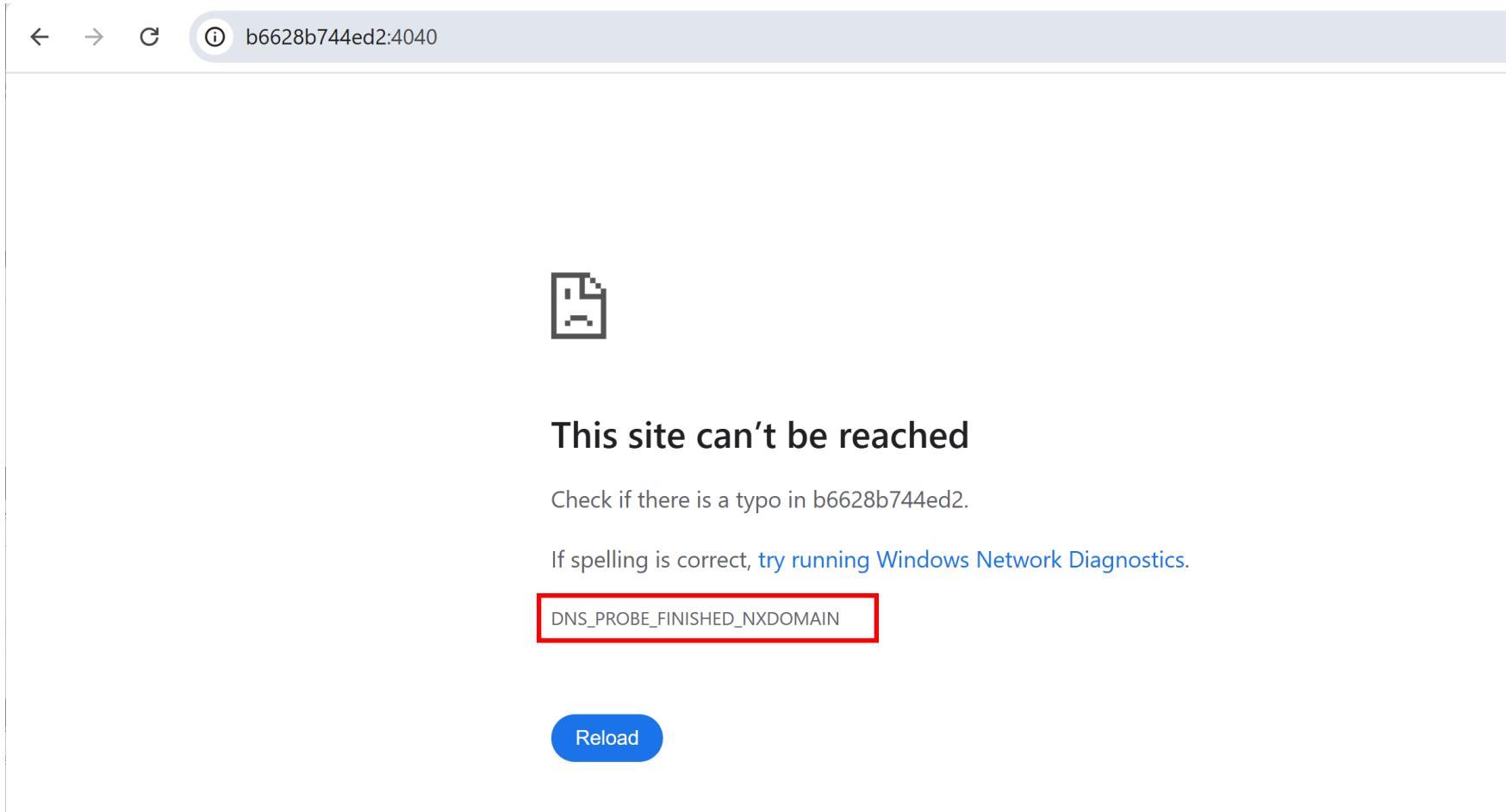
```
podman run -it apache/spark /opt/spark/bin/spark-shell
```

```
C:\Users\arnaud>podman run -it apache/spark /opt/spark/bin/spark-shell
Resolving "apache/spark" using unqualified-search registries (/etc/containers/registries.conf.d/999-podman-machine.conf)
Trying to pull docker.io/apache/spark:latest...
Getting image source signatures
Copying blob sha256:b3ef1f9e9d220aa4c081924e26f514bbafee5fecb9cb7f8e3b5b19762ce947fa
Copying blob sha256:65c79716ce2573e0cd3464a688211336d1ee703c3eef803ae4cf3438e0c64272
Copying blob sha256:560c024910bebac6b404791af28ebd48a8289303b8377d17b67fffe52754f2a
Copying blob sha256:e46bdb88e5c97485003310b142bf5c3c58bb9677087aed67152e8d6e4d5f47a
Copying blob sha256:a3fac0216367b2e208f4a4bfc080dff215045e5e498a969d03cb155bed81049d
Copying blob sha256:9cffdbb20fcf65eb28ccf57ec92b97ed19233b4e2b7bd740b0fb41b6b8de2514
Copying blob sha256:507dcc9ae5b6139e01b1192a579d474e7e307add6c6bd0a77bd8e8db09ce0687
Copying blob sha256:0c93c619e2221a853dd59e90e774c4a36a6ff11a8de381ce12627ed474bb44ef
Copying blob sha256:de58e49cfa67a5774e2ffd22ddb044f4160620fa92f6b6364f39fe53a7209c68
Copying blob sha256:4f4fb700ef54461cfa02571ae0db9a0dc1e0cdb5577484a6d75e68dc38e8acc1
Copying blob sha256:2cadc3f91afb615794f14e6146477d532a01c4499a351fe7e8a97adde84704df
Copying config sha256:d3ea4aeb842bc149cfcb143f7692273c9077b84bef2942a43aeb36ac0b8169dc
Writing manifest to image destination
Setting default log level to "WARN".
To adjust logging level use sc.setLogLevel(newLevel). For SparkR, use setLogLevel(newLevel).
24/11/16 14:07:39 WARN NativeCodeLoader: Unable to load native-hadoop library for your platform... using builtin-java classes where applicable
Spark context Web UI available at http://b6628b744ed2:4040
Spark context available as 'sc' (master = local[*], app id = local-1731766061291).
Spark session available as 'spark'.
Welcome to
```

```
Using Scala version 2.12.18 (OpenJDK 64-Bit Server VM, Java 11.0.24)
Type in expressions to have them evaluated.
Type :help for more information.
```

scala>

open SparkUI ? localhost ? temporary "vm name" not found



Need port-forward

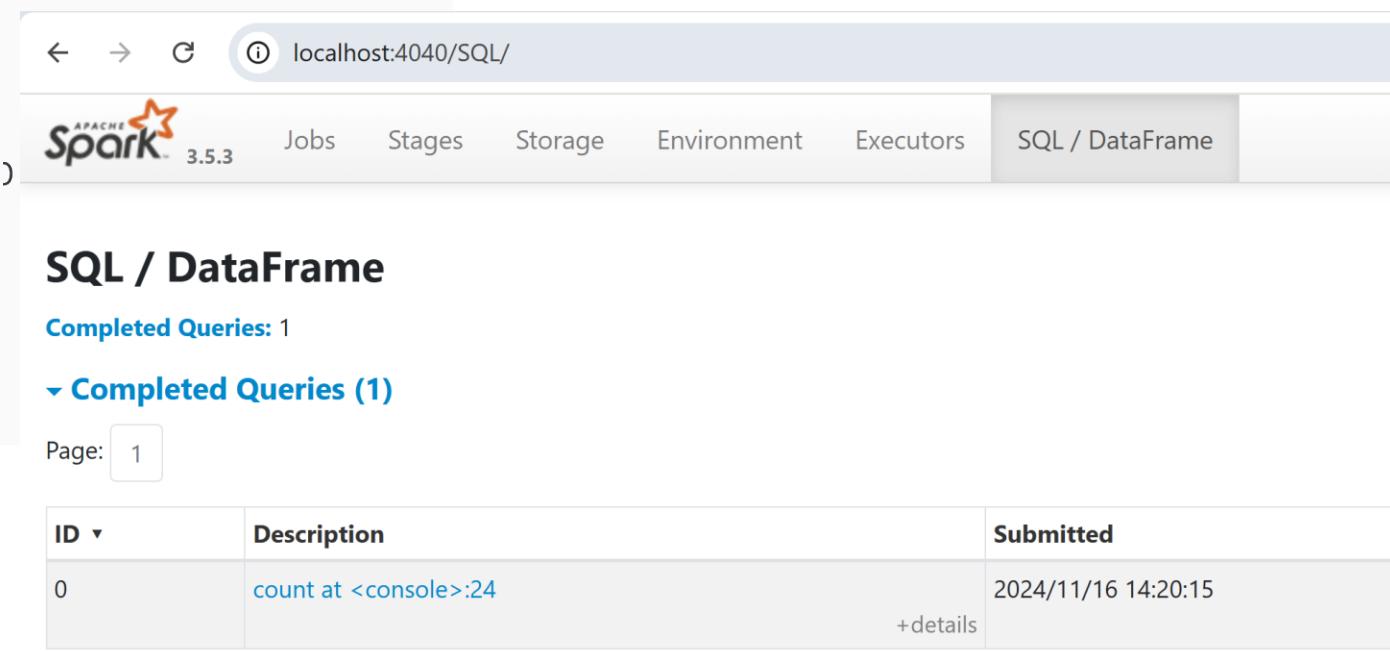
```
podman run -it -p 4040:4040 apache/spark /opt/spark/bin/spark-shell
```

```
C:\Users\arnaud>podman run -it -p 4040:4040 apache/spark /opt/spark/bin/spark-shell
Setting default log level to "WARN".
To adjust logging level use sc.setLogLevel(newLevel). For SparkR, use setLogLevel(newLevel).
24/11/16 14:18:43 WARN NativeCodeLoader: Unable to load native-hadoop library for your platform
Spark context Web UI available at http://f9dfeec3f1a0:4040
Spark context available as 'sc' (master = local[*], app id = local-1731766724994).
Spark session available as 'spark'.
Welcome to
```

```
Using Scala version 2.12.18 (OpenJDK 64-Bit Server VM, Java 11.0.24)
Type in expressions to have them evaluated.
Type :help for more information.
```

```
scala> val ds=spark.createDataset(Seq(1))
ds: org.apache.spark.sql.Dataset[Int] = [value: int]

scala> ds.count()
res0: Long = 1
```



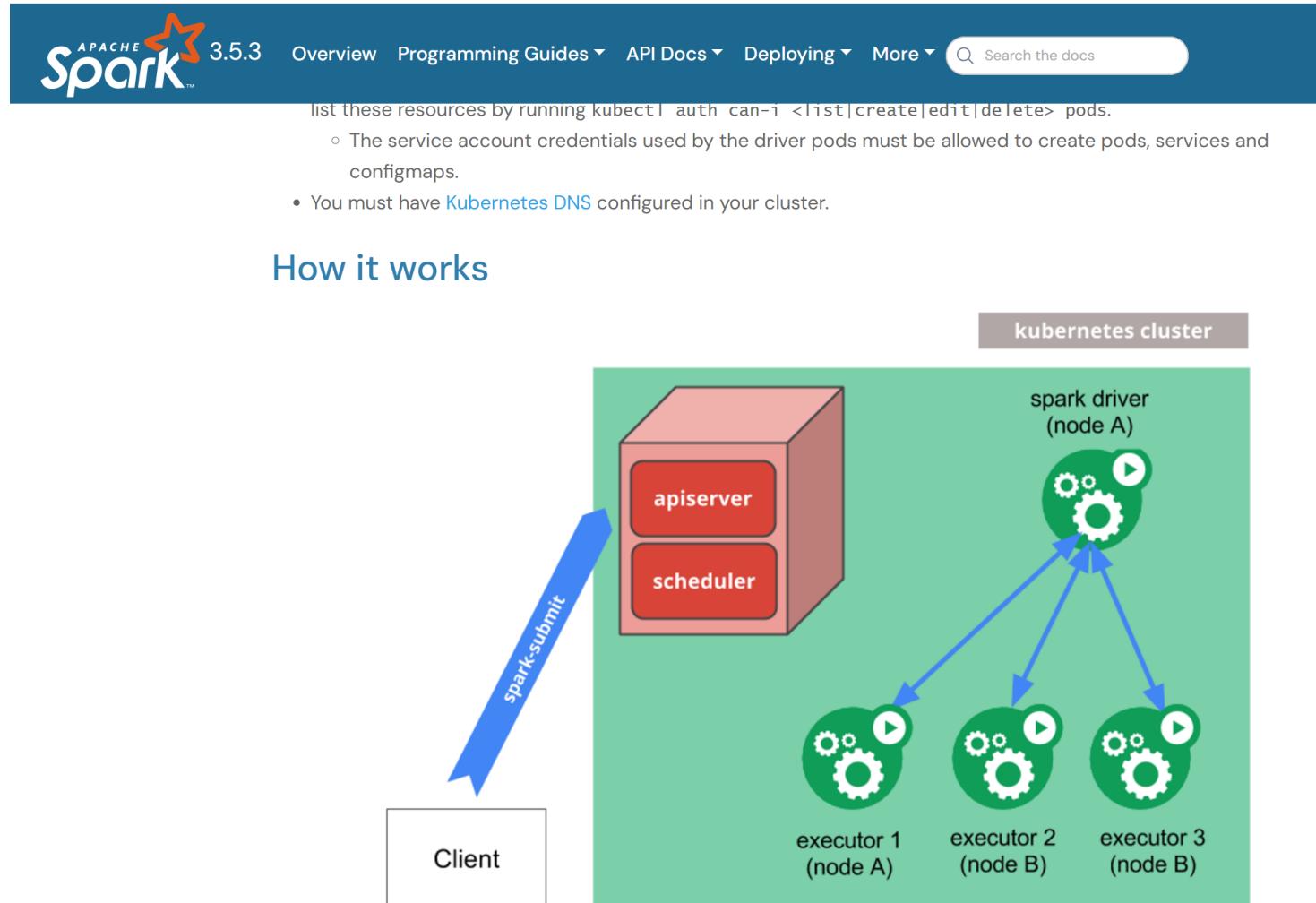
ok... running "docker java" instead of "java"

but not yet using "--master k8s://k8s-api-server"

still using "--master local[*]"

built-in in Spark (java/scala) code : --master k8s://

<https://spark.apache.org/docs/3.5.3/running-on-kubernetes.html>



kubectl cluster-info

=> local k8s Api server : port

```
$ kubectl cluster-info
Kubernetes control plane is running at https://127.0.0.1:53779
CoreDNS is running at https://127.0.0.1:53779/api/v1/namespaces/kube-system/services/kube-dns:dns/proxy

To further debug and diagnose cluster problems, use 'kubectl cluster-info dump'.
```

doc example
--master k8s://localhost:port

```
spark-submit \  
  --master k8s://https://localhost:port \  
  --deploy-mode cluster \  
  --name spark-pi \  
  --class org.apache.spark.examples.SparkPi \  
  --conf spark.kubernetes.container.image=apache/spark:latest \  
  local:///path/to/examples.jar
```

Command ... for local spark

```
spark-submit --master k8s://localhost:53779 --deploy-mode cluster --name spark-pi --class  
org.apache.spark.examples.SparkPi --conf spark.kubernetes.container.image=apache/spark:4.0.0-  
preview2-scala2.13-java17-python3-r-ubuntu local://examples/jars/spark-examples_2.13-3.5.0.jar
```

INVALID ... on purpose (can skip question, or investigate)

```
C:\apps\spark\spark-3.5.0>dir examples\jars  
Le volume dans le lecteur C s'appelle Windows-SSD  
Le numéro de série du volume est 3EFF-0F82
```

```
Répertoire de C:\apps\spark\spark-3.5.0\examples\jars  
  
09/09/2023 02:40 <DIR> .  
09/09/2023 02:40 <DIR> ..  
09/09/2023 02:40 80 424 scopt_2.13-3.7.1.jar  
09/09/2023 02:40 1 588 886 spark-examples_2.13-3.5.0.jar  
2 fichier(s) 1 669 310 octets  
2 Rép(s) 176 976 617 472 octets libres
```

```
C:\apps\spark\spark-3.5.0>spark-submit --master k8s://localhost:53779 --deploy-mode cluster --name spark-pi --class org.apache.spark.examples.SparkPi --conf spark  
.kubernetes.container.image=apache/spark:4.0.0-preview2-scala2.13-java17-python3-r-ubuntu local://examples/jars/spark-examples_2.13-3.5.0.jar
```

... PENDING ???

Pending few minutes (intermediate Warning "MountVolume failed" will be auto resolved with wait+internl retry)

```
Context: kind-kind-cluster           <c>      Copy
Cluster: kind-kind-cluster          <e>      Edit
User:   kind-kind-cluster           <n>      Next Match
K9s Rev: v0.32.6                   <shift-n> Prev Match
K8s Rev: v1.27.3                   <r>      Toggle Auto-Refresh
CPU:    n/a                         <f>      Toggle FullScreen
MEM:   n/a

Type:             Projected (a volume that contains injected data from multiple sources)
TokenExpirationSeconds: 3607
ConfigMapName:     kube-root-ca.crt
ConfigMapOptional: <nil>
DownwardAPI:       true
QoS Class:        Burstable
Node-Selectors:   <none>
Tolerations:      node.kubernetes.io/not-ready:NoExecute op=Exists for 300s
                  node.kubernetes.io/unreachable:NoExecute op=Exists for 300s

Events:
  Type    Reason     Age   From           Message
  ----  -----  ----  ----
  Normal  Scheduled  2m24s default-scheduler  Successfully assigned default/spark-pi-2b5a8b933579ffda-driver to
  kind-cluster-control-plane
  Warning FailedMount  2m25s  kubelet        MountVolume.SetUp failed for volume "spark-conf-volume-driver" : c
  onfigmap "spark-drv-17209a93357a04a6-conf-map" not found
  Normal   Pulling    2m24s  kubelet        Pulling image "apache/spark:4.0.0-preview2-scala2.13-java17-python
  3-r-ubuntu"

<pod>  <describe>
```

Diagnosing Error : K9s - pod

Context: kind-kind-cluster	<0> all	<a>	Attach
Cluster: kind-kind-cluster	<1> spark-operator	<ctrl-d>	Delete
User: kind-kind-cluster	<2> default	<d>	Describe
K9s Rev: v0.32.6		<e>	Edit
K8s Rev: v1.27.3		<?>	Help
CPU: n/a		<shift-j>	Jump Owner
MEM: n/a			

Pods (default)[1]							
NAME↑	PF	READY	STATUS	RESTARTS	IP	NODE	AGE
spark-pi-2b5a8b933579ffda-driver	●	0/1	Error	0	10.244.0.17	kind-cluster-control-plane	7m21s

K9s pod "driver" -> container "spark-kubernetes-driver"

Context: kind-kind-cluster	<a>	Attach	<f> Show PortFor...
Cluster: kind-kind-cluster	<?>	Help	
User: kind-kind-cluster	<l>	Logs	
K9s Rev: v0.32.6	<p>	Logs Previous	
K8s Rev: v1.27.3	<shift-f>	PortForward	
CPU: n/a	<s>	Shell	
MEM: n/a			

Containers (default/spark-pi-2b5a8b933579ffda-driver)[1]							
IDX↑	NAME	PF	IMAGE	READY	STATE	TARTS	
M1	spark-kubernetes-driver	●	apache/spark:4.0.0-preview2-scala2.13-java17-python3-r-ubuntu	false	Error	0	

k9s pod - container - log

... jar file not found

```
Context: kind-kind-cluster
Cluster: kind-kind-cluster
User: kind-kind-cluster
K9s Rev: v0.32.6
K8s Rev: v1.27.3
CPU: n/a
MEM: n/a
```

```
<0> tail   <6> 1h   <shift-c> Clear
<1> head    <c>      Copy
<2> 1m     <m>      Mark
<3> 5m     <ctrl-s> Save
<4> 15m    <s>      Toggle AutoSc
<5> 30m    <f>      Toggle FullSc
```



```
Logs(default/spark-pi-2b5a8b933579ffda-driver:spark-kubernetes-driver)[tail]
Autoscroll:On      FullScreen:Off      Timestamps:Off      Wrap:Off
WARNING: Using incubator modules: jdk.incubator.vector
Files local://examples/jars/spark-examples_2.13-3.5.0.jar from /jars/spark-examples_2.13-3.5.0.jar to /opt/spark/wor
Exception in thread "main" java.nio.file.NoSuchFileException: /jars/spark-examples_2.13-3.5.0.jar
        at java.base/sun.nio.fs.UnixException.translateToIOException(UnixException.java:92)
        at java.base/sun.nio.fs.UnixException.rethrowAsIOException(UnixException.java:106)
        at java.base/sun.nio.fs.UnixException.rethrowAsIOException(UnixException.java:111)
        at java.base/sun.nio.fs.UnixCopyFile.copy(UnixCopyFile.java:548)
        at java.base/sun.nio.fs.UnixFileSystemProvider.copy(UnixFileSystemProvider.java:257)
        at java.base/java.nio.file.Files.copy(Files.java:1305)
        at org.apache.spark.deploy.SparkSubmit.$anonfun$prepareSubmitEnvironment$15(SparkSubmit.scala:455)
        at scala.collection.immutable.ArraySeq.map(ArraySeq.scala:75)
        at scala.collection.immutable.ArraySeq.map(ArraySeq.scala:35)
        at org.apache.spark.deploy.SparkSubmit.downloadResourcesToCurrentDirectory$1(SparkSubmit.scala:441)
        at org.apache.spark.deploy.SparkSubmit.$anonfun$prepareSubmitEnvironment$20(SparkSubmit.scala:472)
        at scala.Option.map(Option.scala:242)
        at org.apache.spark.deploy.SparkSubmit.prepareSubmitEnvironment(SparkSubmit.scala:472)
        at org.apache.spark.deploy.SparkSubmit.org$apache$spark$deploy$SparkSubmit$$runMain(SparkSubmit.scala:965)
        at org.apache.spark.deploy.SparkSubmit.doRunMain$1(SparkSubmit.scala:203)
```

<pod>

<containers>

<logs>

"local://" means a file
already existing "inside" the image !

how to explore existing Docker Image content ? "dive"

A screenshot of a Google search results page. The search bar at the top contains the query "docker dive". Below the search bar, the "All" tab is selected, followed by other categories: Images, Videos, News, Web, Books, Finance, and Tools. The main search results section shows a card for the "wagoodman/dive" GitHub repository. The card includes the GitHub logo, the repository name "GitHub", the URL "https://github.com/wagoodman/dive", and three vertical dots indicating more options. Below the card, the repository name "wagoodman/dive: A tool for exploring each layer in ..." is displayed in blue text, which is a link. A descriptive text block follows, stating "A tool for exploring a docker image, layer contents, and discovering ways to shrink the size of your Docker/OCI image." At the bottom of the card, there are links to "Dockerfile · README.md · Issues 169 · Pull requests 37".

docker dive <<image>>



To analyze a Docker image simply run dive with an image tag/id/digest:

```
dive <your-image-tag>
```

or you can dive with docker command directly

```
alias dive="docker run -ti --rm -v /var/run/docker.sock:/var/run/docker.sock wagoodman/dive"  
dive <your-image-tag>
```

```
# for example  
dive nginx:latest
```

podman dive run -it wagoodman/dive <>

```
podman run -ti --rm -v /var/run/docker.sock:/var/run/docker.sock wagoodman/dive  
apache/spark:4.0.0-preview2-scala2.13-java17-python3-r-ubuntu
```

```
$ alias dive="podman run -ti --rm -v /var/run/docker.sock:/var/run/docker.sock wagoodman/dive"  
  
arnaud@DesktopArnaud /cygdrive/c/apps/hadoop  
$ dive apache/spark:4.0.0-preview2-scala2.13-java17-python3-r-ubuntu  
Resolving "wagoodman/dive" using unqualified-search registries (/etc/containers/registries.conf.d/999-podman-machine.conf)  
Trying to pull docker.io/wagoodman/dive:latest...  
Getting image source signatures  
Copying blob sha256:a7dfad62b2dab9e4aae65fd8fc6682e8841a6876a31a3675495f7554e93b0f46  
Copying blob sha256:cf6c0733f07b22c9a8c341023181bdb5f273c050d416bd4452bfd96589c4a5d0  
Copying blob sha256:619be1103602d98e1963557998c954c892b3872986c27365e9f651f5bc27cab8  
Copying config sha256:cf2f0c72f08544080eaf06781133b5943bace97a55d8f8fb61b32e6051712245  
Writing manifest to image destination  
Image Source: docker://apache/spark:4.0.0-preview2-scala2.13-java17-python3-r-ubuntu  
Fetching image... (this can take a while for large images)
```

dive - browse layers

```
| • Layers |-----| Current Layer Contents |-----|
| Cmp  Size  Command          Permission  UID:GID  Size  Filetree |
|   78 MB  FROM 2573e0d8158209e  -rwxrwxrwx  0:0    0 B  bin → usr/bin |
|   50 MB  RUN /bin/sh -c set -eux; apt-get update;      DEBIAN_FRONTEND drwxr-xr-x  0:0    0 B  boot |
|  280 MB  RUN /bin/sh -c set -eux;      ARCH="$(dpkg --print-architecture)" drwxr-xr-x  0:0  111 kB  dev |
|       0 B  RUN /bin/sh -c set -eux;      echo "Verifying install ...";      f -rw-----  0:0    0 B  etc |
|  4.7 kB  COPY --chmod=755 entrypoint.sh /__cacert_entrypoint.sh # buildki -rw-r--r--  0:0  3.0 kB  .pwd.lock |
|   65 kB  RUN |1 spark_uid=185 /bin/sh -c groupadd --system --gid=${spark_ drwxr-xr-x  0:0  100 B  adduser.conf |
|           -rw-r--r--  0:0  100 B  alternatives |
|           -rwxrwxrwx  0:0    0 B  README |
|           -rwxrwxrwx  0:0    0 B  awk → /usr/bin/mawk |
|           -rwxrwxrwx  0:0    0 B  nawk → /usr/bin/mawk |
|           -rwxrwxrwx  0:0    0 B  pager → /bin/more |
|           -rwxrwxrwx  0:0    0 B  rmt → /usr/sbin/rmt-tar |
|           -rwxrwxrwx  0:0    0 B  which → /usr/bin/which.debian |
|-----|
| Layer Details |-----|
ags:  (unavailable)
d:  2573e0d8158209ed54ab25c87bcdcb00bd3d2539246960a3d592a1c599d70465.tar
igest: sha256:2573e0d8158209ed54ab25c87bcdcb00bd3d2539246960a3d592a1c599d70
65
ommand:
(nop) ADD file:ebe009f86035c175ba244badd298a2582914415cf62783d510eab3a311a5
|-----|
| Image Details |-----|
image name: apache/spark:4.0.0-preview2-scala2.13-java17-python3-r-ubuntu
otal Image size: 1.9 GB
otential wasted space: 10 MB
mage efficiency score: 99 %
ount  Total Space  Path
C Quit Tab Switch view ^F Filter ^L Show layer changes ^A Show aggregated changes
|-----|
| Current Layer Contents |-----|
| Permission  UID:GID  Size  Filetree |
| drwxr-xr-x  0:0    0 B  boot |
| drwxr-xr-x  0:0    0 B  dev |
| drwxr-xr-x  0:0  111 kB  etc |
| f -rw-----  0:0    0 B  .pwd.lock |
| -rw-r--r--  0:0  3.0 kB  adduser.conf |
| drwxr-xr-x  0:0  100 B  alternatives |
| -rw-r--r--  0:0  100 B  README |
| -rwxrwxrwx  0:0    0 B  awk → /usr/bin/mawk |
| -rwxrwxrwx  0:0    0 B  nawk → /usr/bin/mawk |
| -rwxrwxrwx  0:0    0 B  pager → /bin/more |
| -rwxrwxrwx  0:0    0 B  rmt → /usr/sbin/rmt-tar |
| -rwxrwxrwx  0:0    0 B  which → /usr/bin/which.debian |
| drwxr-xr-x  0:0  8.3 kB  apt |
| drwxr-xr-x  0:0  1.4 kB  apt.conf.d |
| -rw-r--r--  0:0  92 B  01-vendor-ubuntu |
| -rw-r--r--  0:0  630 B  01autoremove |
| -rw-r--r--  0:0  182 B  70debconf |
| -rw-r--r--  0:0  44 B  docker-autoremove-suggest |
| -rw-r--r--  0:0  318 B  docker-clean |
| -rw-r--r--  0:0  27 B  docker-disable-periodic-u |
| -rw-r--r--  0:0  70 B  docker-gzip-indexes |
| -rw-r--r--  0:0  27 B  docker-no-languages |
| drwxr-xr-x  0:0    0 B  auth.conf.d |
| drwxr-xr-x  0:0    0 B  keyrings |
|-----|
```

Navigate: on Layer step,
then "->" for right pane
then "<SPACE>" for collapse dir

Layers			Current Layer Contents			
Cmp	Size	Command	Permission	UID:GID	Size	Filetree
	78 MB	FROM 2573e0d8158209e	-rwxr-xr-x	0:0	4.7 kB	__cacert_entrypoint.sh
	50 MB	RUN /bin/sh -c set -eux; apt-get update; DEBIAN_FRONTEND=non	-rwxrwxrwx	0:0	0 B	bin → usr/bin
	280 MB	RUN /bin/sh -c set -eux; ARCH="\$(dpkg --print-architecture)";	drwxr-xr-x	0:0	0 B	boot
	0 B	RUN /bin/sh -c set -eux; echo "Verifying install ..."; fileE	drwxr-xr-x	0:0	0 B	dev
	4.7 kB	COPY --chmod=755 entrypoint.sh /__cacert_entrypoint.sh # buildkit	drwxr-xr-x	0:0	468 kB	etc
	65 kB	RUN 1 spark_uid=185 /bin/sh -c groupadd --system --gid=\${spark_uid}	-rwxrwxrwx	0:0	0 B	home
	60 MB	RUN 1 spark_uid=185 /bin/sh -c set -ex; apt-get update; apt	-rwxrwxrwx	0:0	0 B	lib → usr/lib
	490 MB	RUN 1 spark_uid=185 /bin/sh -c set -ex; export SPARK_TMP="\$(mktemp -rwxrwxrwx	-rwxrwxrwx	0:0	0 B	lib32 → usr/lib32
	4.7 kB	COPY entrypoint.sh /opt/ # buildkit	-rwxrwxrwx	0:0	0 B	lib64 → usr/lib64
	0 B	WORKDIR /opt/spark/work-dir	drwxr-xr-x	0:0	0 B	libx32 → usr/libx32
			drwxr-xr-x	0:0	0 B	media
			drwxr-xr-x	0:0	0 B	mnt
			drwxr-xr-x	0:0	0 B	opt
			-rwxr-xr-x	185:185	1.4 kB	decom.sh
			-rwxr-xr-x	0:0	4.7 kB	entrypoint.sh
			drwxr-xr-x	0:0	280 kB	java
			drwxr-xr-x	185:185	490 kB	spark
			drwxr-xr-x	185:185	5.8 kB	└ R
			-rw-r--r--	185:185	154 B	└ RELEASE
			drwxr-xr-x	185:185	57 kB	└ bin
			drwxr-xr-x	185:185	1.1 MB	└ data
			drwxr-xr-x	185:185	4.2 MB	└ examples
			drwxr-xr-x	185:185	2.7 MB	└ jars
			-rw-r--r--	185:185	232 kB	└ jackson-core-asl-1.9.13.j
			-rw-r--r--	185:185	781 kB	└ jackson-mapper-asl-1.9.13
			-rw-r--r--	185:185	80 kB	└ scopt_2.13_3.7.1.jar
			-rwxrwxrwx	0:0	0 B	└ spark-examples.jar → spar
			-rw-r--r--	185:185	1.6 MB	└ spark-examples_2.13-4.0.0
			drwxr-xr-x	185:185	1.5 MB	└ src
			drwxr-xr-x	185:185	463 kB	└ jars
			drwxr-xr-x	185:185	16 kB	└ python
			drwxr-xr-x	185:185	37 kB	└ sbin
			drwxr-xr-x	185:185	11 kB	└ tests
			drwxrwxr-x	185:185	0 B	└ work-dir
			drwxr-xr-x	0:0	0 B	└ proc
			drwxr-xr-x	0:0	3.4 kB	└ root
			drwxr-xr-x	0:0	7 B	└ run
			-rwxrwxrwx	0:0	0 B	└ sbin → usr/sbin

Image name: apache/spark:4.0.0-preview2-scala2.13-javal7-python3-r-ubuntu
Total Image size: 1.9 GB
Potential wasted space: 10 MB
Image efficiency score: 99 %

Count Total Space Path

- 4 3.2 MB /var/cache/debconf/templates.dat
- 3 2.6 MB /var/cache/debconf/templates.dat-old
- 4 999 kB /var/log/dpkg.log
- 4 890 kB /var/lib/dpkg/status

^C Quit | Tab Switch view | ^F Filter | Space Collapse dir | ^Space Collapse all dir | ^O Toggle sort order | ^A Added | ^R Removed | ^M Modified | ^U Unmodified | ^B Attr

alternative:

```
docker run -it <<image>> "/bin/bash"  
( if image contains a shell )
```

```
then # cd .. ; ls ; find
```

docker run -it

```
C:\apps\spark\spark-3.5.0>podman run -it apache/spark:4.0.0-preview2-scala2.13-java17-python3-r-ubuntu /bin/bash
Resolving "apache/spark" using unqualified-search registries (/etc/containers/registries.conf.d/999-podman-machine.conf)
Trying to pull docker.io/apache/spark:4.0.0-preview2-scala2.13-java17-python3-r-ubuntu...
Getting image source signatures
Copying blob sha256:7ad3b5e04f2c57070106a37d5d44429d29123ae69ff54b93f63c101129c298d9
Copying blob sha256:7478e0ac0f23f94b2f27848fbcd804a670fb8d4bab26df842d40a10cd33059
Copying blob sha256:80584b9b4ef704ac9fe073b939107337aa86c0c2b9d7742d863bdb8f219a9463
Copying blob sha256:589e94d8e4bef4afb4cff24dc8435416fa3f42401c7ab9b0401e913516968373
Copying blob sha256:21beeebd32c0abccb0b45e99a7fd283212bb21ac4fad10c36216455082df95d0
Copying blob sha256:fcbf49cabfbfcba18d6177c1ac6c7e9330c15d3d20cbc4f88c58bd335ee450a2
Copying blob sha256:b0775d58952aef063d10d90c24833664221c93bbb444d3543830357deb36d14b
Copying blob sha256:519ab62359f396e5daecd01786e2a1ee9c3009be34b87fc5bf66328989738983
Copying blob sha256:7978e188866e12963b2cf829d0b1d08409003abbe7f0ea466622e34e53d34130
Copying blob sha256:4f4fb700ef54461cfa02571ae0db9a0dc1e0cdb5577484a6d75e68dc38e8acc1
Copying blob sha256:b0aad1ccdf6835e7740225bcb7acd0547516678a5648cabff50ed5656d8b12cd
Copying config sha256:ea79fc05d218a268153c4cd35fa3d306965c23c59232759d25aeb4862accbca7
Writing manifest to image destination

spark@4c64f3782002:/opt/spark/work-dir$ ls /opt/
decom.sh      entrypoint.sh  java/          spark/
spark@4c64f3782002:/opt/spark/work-dir$ ls /opt/spark/examples/
jars/  src/
spark@4c64f3782002:/opt/spark/work-dir$ ls /opt/spark/examples/jars/
jackson-core-asl-1.9.13.jar      scopt_2.13-3.7.1.jar           spark-examples.jar
jackson-mapper-asl-1.9.13.jar    spark-examples_2.13-4.0.0-preview2.jar
spark@4c64f3782002:/opt/spark/work-dir$ ls /opt/spark/examples/jars/
jackson-core-asl-1.9.13.jar  jackson-mapper-asl-1.9.13.jar  scopt_2.13-3.7.1.jar  spark-examples_2.13-4.0.0-preview2.jar  spark-examples.jar
spark@4c64f3782002:/opt/spark/work-dir$
```

← like "SSH" inside the pod container !

Relaunch => pod Running "spark-driver"
but Failed to launch "spark-executor"

```
spark-submit --master k8s://localhost:53779 --deploy-mode cluster --driver-memory 1g --executor-memory 1g  
--name spark-pi --class org.apache.spark.examples.SparkPi  
--conf spark.kubernetes.container.image=apache/spark:4.0.0-preview2-scala2.13-java17-python3-r-ubuntu  
local:///opt/spark/examples/jars/spark-examples.jar
```

Pods(default)[1]								
NAME	PF	READY	STATUS	RESTARTS	IP	NODE	AGE	
spark-pi-457154933592f797-driver	●	1/1	Running	0	10.244.0.20	kind-cluster-control-plane	27s	

Failure : forbidden: User "...default" can not get resource "pods"

```
Context: kind-kind-cluster  
Cluster: kind-kind-cluster  
User: kind-kind-cluster  
K9s Rev: v0.32.6  
K8s Rev: v1.27.3  
CPU: n/a  
MEM: n/a
```

```
<0> tail   <6> 1h  <shift-c> Clear  
<1> head    <c>      Copy  
<2> 1m     <m>      Mark  
<3> 5m     <ctrl-s> Save  
<4> 15m    <s>      Toggle AutoSc  
<5> 30m    <f>      Toggle FullSc
```



```
Logs(default/spark-pi-457154933592f797-driver)[tail]
```

```
Autoscroll:On    FullScreen:Off    Timestamps:Off    Wrap:On
```

```
at org.apache.spark.scheduler.cluster.k8s.KubernetesClusterManager.makeExecutorPodsAllocator(KubernetesClusterManager.scala:183)  
at org.apache.spark.scheduler.cluster.k8s.KubernetesClusterManager.createSchedulerBackend(KubernetesClusterManager.scala:137)  
at org.apache.spark.SparkContext$.org$apache$spark$SparkContext$$createTaskScheduler(SparkContext.scala:3317)  
... 19 more
```

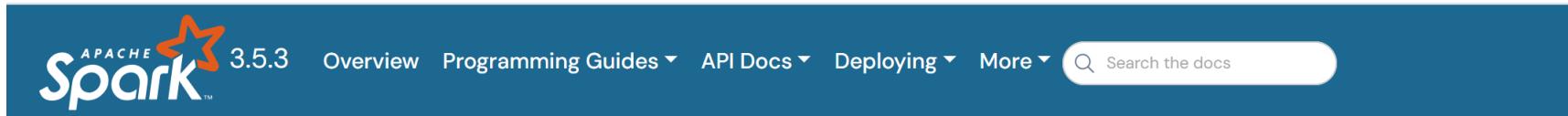
```
Caused by: io.fabric8.kubernetes.client.KubernetesClientException Failure executing: GET at: https://kubernetes.default.svc/api/v1/namespaces/default/pods/spark-pi-457154933592f797-driver. Message: pods "spark-pi-457154933592f797-driver" is forbidden: User "system:serviceaccount:default" cannot get resource "pods" in API group "" in the namespace "default". Received status: Status(apiVersion=v1, code=403, details=StatusDetails(causes=[], group=null, kind=pods, name=spark-pi-457154933592f797-driver, retryAfterSeconds=null, uid=null, additionalProperties={}), kind>Status, message=pods "spark-pi-457154933592f797-driver" is forbidden: User "system:serviceaccount:default" can not get resource "pods" in API group "" in the namespace "default", metadata=ListMeta(_continue=null, remainingItemCount=null, resourceVersion=null, selfLink=null, additionalProperties={})), reason=Forbidden, status=Failure, additionalProperties={}).
```

```
at io.fabric8.kubernetes.client.KubernetesClientException.copyAsCause(KubernetesClientException.java:238)  
at io.fabric8.kubernetes.client.dsl.internal.OperationSupport.waitForResult(OperationSupport.java:507)  
at io.fabric8.kubernetes.client.dsl.internal.OperationSupport.handleResponse(OperationSupport.java:524)
```

```
<pod>  <containers>  <logs>
```

Doc serviceAccountName

<https://spark.apache.org/docs/3.5.3/running-on-kubernetes.html>



pods. The service account used by the driver pod must have the appropriate permission for the driver to be able to do its work. Specifically, at minimum, the service account must be granted a [Role](#) or [ClusterRole](#) that allows driver pods to create pods and services. By default, the driver pod is automatically assigned the default service account in the namespace specified by `spark.kubernetes.namespace`, if no service account is specified when the pod gets created.

Depending on the version and setup of Kubernetes deployed, this default service account may or may not have the role that allows driver pods to create pods and services under the default Kubernetes [RBAC](#) policies. Sometimes users may need to specify a custom service account that has the right role granted. Spark on Kubernetes supports specifying a custom service account to be used by the driver pod through the configuration property `spark.kubernetes.authenticate.driver.serviceAccountName=<service account name>`. For example, to make the driver pod use the spark service account, a user simply adds the following option to the `spark-submit` command:

```
--conf spark.kubernetes.authenticate.driver.serviceAccountName=spark
```

To create a custom service account, a user can use the `kubectl create serviceaccount` command. For example, the following command creates a service account named `spark`:

```
$ kubectl create serviceaccount spark
```

To grant a service account a [Role](#) or [ClusterRole](#), a [RoleBinding](#) or [ClusterRoleBinding](#) is needed. To create a [RoleBinding](#) or [ClusterRoleBinding](#), a user can use the `kubectl create rolebinding` (or `clusterrolebinding` for `ClusterRoleBinding`) command. For example, the following command creates an `edit` [ClusterRole](#) in the default namespace and grants it to the `spark` service account created above:

```
$ kubectl create clusterrolebinding spark-role --clusterrole=edit --serviceaccount=default:spark --namespace=default
```

Relaunched: K9s pod - ContainerCreating

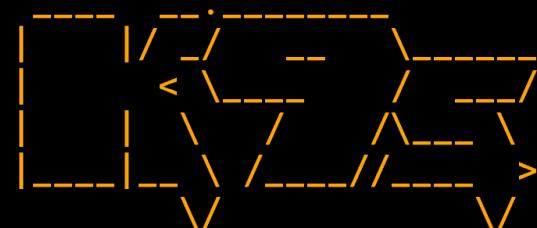
Context: kind-kind-cluster	<0> all	<a>	Attach
Cluster: kind-kind-cluster	<1> spark-operator	<ctrl-d>	Delete
User: kind-kind-cluster	<2> default	<d>	Describe
K9s Rev: v0.32.6		<e>	Edit
K8s Rev: v1.27.3		<?>	Help
CPU: n/a		<shift-j>	Jump Owner
MEM: n/a			

Pods(default)[1]								
NAME↑	PF	READY	STATUS	RESTARTS	IP	NODE	AGE	
spark-pi-2b5a8b933579ffda-driver	●	0/1	ContainerCreating	0	n/a	kind-cluster-control-plane	39s	

Relaunched: -> Running

Context: kind-kind-cluster
Cluster: kind-kind-cluster
User: kind-kind-cluster
K9s Rev: v0.32.6
K8s Rev: v1.27.3
CPU: n/a
MEM: n/a

```
<0> all           <a>      Attach
<1> spark-operator <ctrl-d> Delete
<2> default       <d>      Describe
                           <e>      Edit
                           <?>      Help
                           <shift-j> Jump Owner
```



Pods(default)[3]							
NAME	PF	READY	STATUS	RESTARTS	IP	NODE	AGE
spark-pi-b88e899335ec3fd5-exec-1	●	1/1	Running	0	10.244.0.31	kind-cluster-control-plane	5s
spark-pi-b88e899335ec3fd5-exec-2	●	1/1	Running	0	10.244.0.32	kind-cluster-control-plane	5s
spark-pi-c303c09335ec229f-driver	●	1/1	Running	0	10.244.0.30	kind-cluster-control-plane	13s

Notice : 3 pods = 1 driver + 2 * executors

Relaunched .. Completed

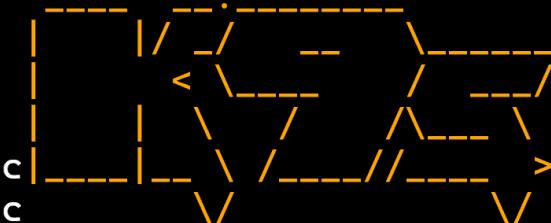
Context: kind-kind-cluster	<0> all	<a>	Attach
Cluster: kind-kind-cluster	<1> spark-operator	<ctrl-d>	Delete
User: kind-kind-cluster	<2> default	<d>	Describe
K9s Rev: v0.32.6		<e>	Edit
K8s Rev: v1.27.3		<?>	Help
CPU: n/a		<shift-j>	Jump Owner
MEM: n/a			

Pods(default)[1]							
NAME	PF	READY	STATUS	RESTARTS	IP	NODE	AGE
spark-pi-c303c09335ec229f-driver	●	0/1	Completed	0	10.244.0.30	kind-cluster-control-plane	109s

Completed - Logs

```
Context: kind-kind-cluster  
Cluster: kind-kind-cluster  
User: kind-kind-cluster  
K9s Rev: v0.32.6  
K8s Rev: v1.27.3  
CPU: n/a  
MEM: n/a
```

```
<0> tail   <6> 1h   <shift-c> Clear  
<1> head    <c>      Copy  
<2> 1m     <m>      Mark  
<3> 5m     <ctrl-s> Save  
<4> 15m    <s>      Toggle AutoSc  
<5> 30m    <f>      Toggle FullSc
```



```
Logs(default/spark-pi-c303c09335ec229f-driver)[tail]  
Autoscroll:On    FullScreen:Off    Timestamps:Off    Wrap:Off
```

```
24/11/16 17:01:37 INFO ContextHandler: Started o.s.j.s.ServletContextHandler@55c1ced9{/executors/json,null,AVAILABLE  
24/11/16 17:01:37 INFO ContextHandler: Started o.s.j.s.ServletContextHandler@11826398{/executors/threadDump,null,AVA  
24/11/16 17:01:37 INFO ContextHandler: Started o.s.j.s.ServletContextHandler@37b01ce2{/executors/threadDump/json,nul  
24/11/16 17:01:37 INFO ContextHandler: Started o.s.j.s.ServletContextHandler@1894fa9f{/executors/heapHistogram,null,  
24/11/16 17:01:37 INFO ContextHandler: Started o.s.j.s.ServletContextHandler@26a4f9ed{/executors/heapHistogram/json,  
24/11/16 17:01:37 INFO ContextHandler: Started o.s.j.s.ServletContextHandler@45287377{/static,null,AVAILABLE,@Spark}  
24/11/16 17:01:37 INFO ContextHandler: Started o.s.j.s.ServletContextHandler@250967f1{/,null,AVAILABLE,@Spark}  
24/11/16 17:01:37 INFO ContextHandler: Started o.s.j.s.ServletContextHandler@4bce62b{/api,null,AVAILABLE,@Spark}  
24/11/16 17:01:37 INFO ContextHandler: Started o.s.j.s.ServletContextHandler@53d30d23{/metrics,null,AVAILABLE,@Spark  
24/11/16 17:01:37 INFO ContextHandler: Started o.s.j.s.ServletContextHandler@1216eb3f{/jobs/job/kill,null,AVAILABLE,  
24/11/16 17:01:37 INFO ContextHandler: Started o.s.j.s.ServletContextHandler@482ba4b1{/stages/stage/kill,null,AVAILA  
24/11/16 17:01:37 INFO ContextHandler: Started o.s.j.s.ServletContextHandler@200d1a3d{/metrics/json,null,AVAILABLE,@  
Pi is roughly 3.141592653589793  
24/11/16 17:01:51 INFO Server: Stopped Server@2121d1f9{STOPPING}[11.0.23,sto=30000]  
24/11/16 17:01:51 INFO Server: Shutdown Server@2121d1f9{STOPPING}[11.0.23,sto=30000]  
24/11/16 17:01:51 INFO AbstractConnector: Stopped Spark@7e935339{HTTP/1.1, (http/1.1)}{0.0.0.0:4040}  
stream closed EOF for default/spark-pi-c303c09335ec229f-driver (spark-kubernetes-driver)
```

Scenario if/when requesting too much memory

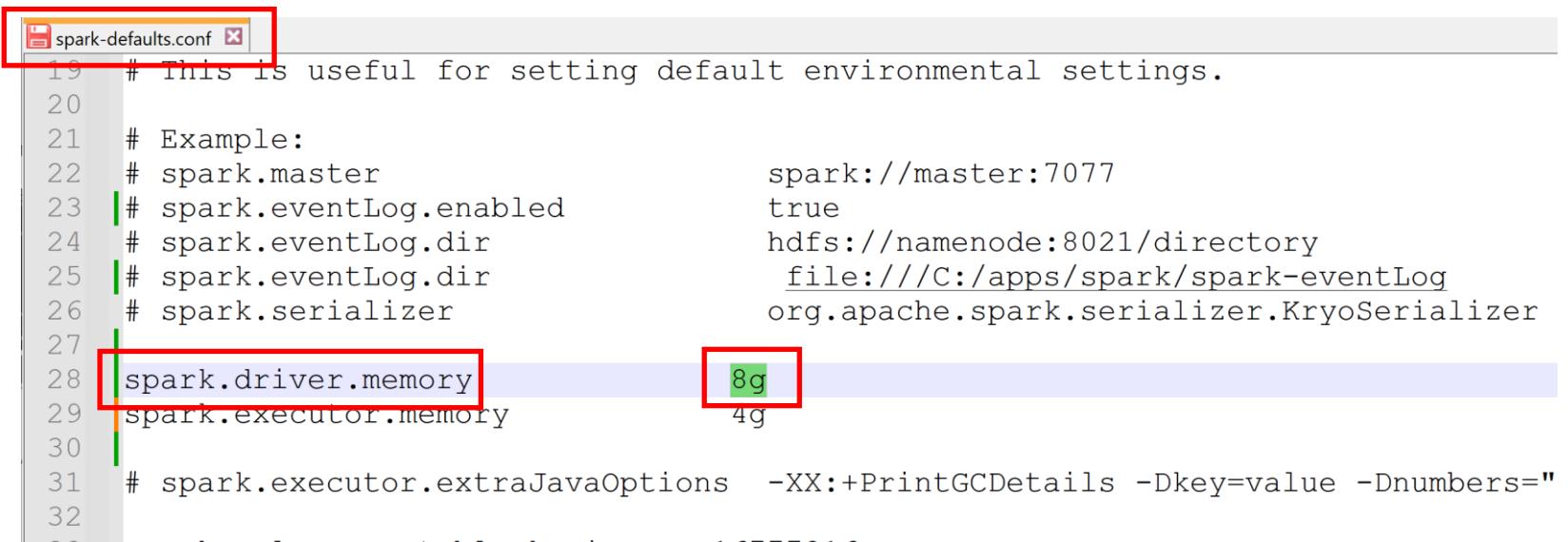
spark-submit

--driver-memory 8g

OR

config file \${SPARK_HOME}/conf/spark-default.conf

...



```
spark-defaults.conf x
19 # This is useful for setting default environmental settings.
20
21 # Example:
22 # spark.master          spark://master:7077
23 # spark.eventLog.enabled true
24 # spark.eventLog.dir    hdfs://namenode:8021/directory
25 # spark.eventLog.dir    file:///C:/apps/spark/spark-eventLog
26 # spark.serializer       org.apache.spark.serializer.KryoSerializer
27
28 spark.driver.memory     8g
29 spark.executor.memory   4g
30
31 # spark.executor.extraJavaOptions -XX:+PrintGCDetails -Dkey=value -Dnumbers="
32
33
```

check in k9s (Pending Forever)

```
Invite de commandes - k9s  ×  Invite de commandes - spark-  ×  +  ▾
```

Context: kind-kind-cluster
Cluster: kind-kind-cluster
User: kind-kind-cluster
K9s Rev: v0.32.6
K8s Rev: v1.27.3
CPU: n/a
MEM: n/a

<0> all <a> Attach
<1> spark-operator <ctrl-d> Delete
<2> default <d> Describe
<e> Edit
<?> Help
<shift-j> Jump Owner

NAME↑ Pods(default)[1] READY STATUS RESTARTS IP NODE AGE

NAME↑	Pods(default)[1]	READY	STATUS	RESTARTS	IP	NODE	AGE
spark-pi-e5feee93356cbc95-driver	●	0/1	Pending	0	n/a	n/a	63s

Debug "Pending" reason in K9s pod : "Insufficient memory"

```
Context: kind-kind-cluster          <c>      Copy
Cluster: kind-kind-cluster         <e>      Edit
User:   kind-kind-cluster          <n>      Next Match
K9s Rev: v0.32.6                  <shift-n> Prev Match
K8s Rev: v1.27.3                  <r>      Toggle Auto-Refresh
CPU:     n/a                      <f>      Toggle FullScreen
MEM:    n/a

Describe(default/spark-pi-e5fee93356cbc95-driver)

Type:      ConfigMap (a volume populated by a ConfigMap)
Name:      spark-drv-a1896093356cc21b-conf-map
Optional:  false
kube-api-access-xl6j2:
  Type:             Projected (a volume that contains injected data from multiple sources)
  TokenExpirationSeconds: 3607
  ConfigMapName:    kube-root-ca.crt
  ConfigMapOptional: <nil>
  DownwardAPI:      true
  QoS Class:        Burstable
  Node-Selectors:   <none>
  Tolerations:
    node.kubernetes.io/not-ready:NoExecute op=Exists for 300s
    node.kubernetes.io/unreachable:NoExecute op=Exists for 300s

Events:
  Type    Reason           Age    From            Message
  ----  -----           ----  --           -----
  Warning FailedScheduling 3m51s  default-scheduler  0/1 nodes are available: 1 Insufficient memory. preemption: 0
  /1 nodes are available: 1 No preemption victims found for incoming pod..

<namespace> <pod> <describe>
```

K9s node : Capacity -> Allocatable -> Free Memory?

```
Context: kind-kind-cluster          <c>      Copy
Cluster: kind-kind-cluster         <e>      Edit
User:   kind-kind-cluster          <n>      Next Match
K9s Rev: v0.32.6                  <shift-n> Prev Match
K8s Rev: v1.27.3                  <r>      Toggle Auto-Refresh
CPU:    n/a                       <f>      Toggle FullScreen
MEM:   n/a

Addresses:
  InternalIP: 10.89.0.2
  Hostname:   kind-cluster-control-plane
Capacity:
  cpu:           8
  ephemeral-storage: 1055762868Ki
  hugepages-1Gi: 0
  hugepages-2Mi: 0
  memory:        8009748Ki
  pods:          110
Allocatable:
  cpu:           8
  ephemeral-storage: 1055762868Ki
  hugepages-1Gi: 0
  hugepages-2Mi: 0
  memory:        8009748Ki
  pods:          110
System Info:
  Machine ID: 09a4834e68ca43acaaef9806cdf5289e

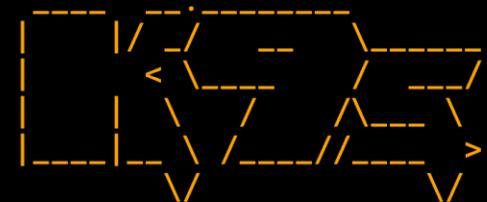
<node> <describe>

Describe(kind-cluster-control-plane)
```

k9s node - Allocated / Free memory

Context: kind-kind-cluster
Cluster: kind-kind-cluster
User: kind-kind-cluster
K9s Rev: v0.32.6
K8s Rev: v1.27.3
CPU: n/a
MEM: n/a

<c> Copy
<e> Edit
<n> Next Match
<shift-n> Prev Match
<r> Toggle Auto-Refresh
<f> Toggle FullScreen



Describe(kind-cluster-control-plane)

projectcontour	contour-d8c6f457f-k6g7g	0 (0%)	0 (0%)	0 (0%)
projectcontour	envoy-cwt2h	0 (0%)	0 (0%)	0 (0%)
spark-operator	spark-operator-controller-7779b5c66d-zc4pr	0 (0%)	0 (0%)	0 (0%)
spark-operator	spark-operator-webhook-9d465ccf5-qd5lg	0 (0%)	0 (0%)	0 (0%)
	54m			

Allocated resources:

(Total limits may be over 100 percent, i.e., overcommitted.)

Resource	Requests	Limits
cpu	950m (11%)	100m (1%)
memory	290Mi (3%)	390Mi (4%)
ephemeral-storage	0 (0%)	0 (0%)
hugepages-1Gi	0 (0%)	0 (0%)
hugepages-2Mi	0 (0%)	0 (0%)

Events: <none>

<node>

<describe>

Looks "acceptable" to run "--master k8s://"

BUT it is NOT practical:

no configMap created, no PVC, no Ingress, no Service..

=> not sufficiently exposed/integrated in k8s

Time to launch for real

using "kubectl apply -f <file.yaml>"

a.k.a. the K8s way
(instead of spark-submit)

<https://www.kubeflow.org/docs/components/spark-operator/getting-started/#configuration>

The screenshot shows the Kubeflow documentation website. The header includes the Kubeflow logo, a search bar, and navigation links for 'Cloud Native + Kubernetes AI Day' (Nov 12th, 2024, Salt Lake City, Utah), 'Docs', 'Events', and a menu icon. The left sidebar has a navigation tree with sections like 'Dashboard', 'Notebooks', 'Pipelines', 'Katib', 'Model Registry', 'Spark Operator' (which is expanded to show 'Overview', 'Getting Started', and 'User Guide'), and 'Getting Started'. The main content area features a section titled 'Running the Examples' with the sub-section 'To run the Spark PI example, run the following command:' followed by a code block: `kubectl apply -f examples/spark-pi.yaml`. A note below explains that this command configures the driver pod to use the `spark` service account to communicate with the Kubernetes API server, and provides instructions for overriding the service account name if using a Helm chart.

Running the Examples

To run the Spark PI example, run the following command:

```
kubectl apply -f examples/spark-pi.yaml
```

Note that `spark-pi.yaml` configures the driver pod to use the `spark` service account to communicate with the Kubernetes API server. You might need to replace it with the appropriate service account before submitting the job. If you installed the operator using the Helm chart and overrode `sparkJobNamespaces`, the service account name ends with `-spark` and starts with the Helm release name. For example, if you would like to run your Spark jobs to run in a namespace called `test-ns`, first make sure it already exists, and then install the chart with the command:

<https://github.com/kubeflow/spark-operator/blob/master/examples/spark-pi.yaml>

The screenshot shows a GitHub file viewer interface. The top navigation bar displays the URL: `github.com/kubeflow/spark-operator/blob/master/examples/spark-pi.yaml`. The left sidebar, titled "Files", shows a list of files in the "master" branch, including `spark-pi-prometheus.yaml`, `spark-pi-python.yaml`, `spark-pi-scheduled.yaml`, `spark-pi-ttl.yaml`, `spark-pi-volcano.yaml`, `spark-pi-yunikorn.yaml`, and `spark-pi.yaml`, which is currently selected. The main content area is titled "spark-operator / examples / spark-pi.yaml". It shows a commit by `jacobsalway` with the message "Upgrade to Spark 3.5.3 (#2202)". Below the commit, there are two tabs: "Code" (selected) and "Blame", with statistics: "42 lines (41 loc) · 1.13 KB". The code content is as follows:

```
1  #
2  # Copyright 2017 Google LLC
3  #
4  # Licensed under the Apache License, Version 2.0 (the "License");
5  # you may not use this file except in compliance with the License.
6  # You may obtain a copy of the License at
7  #
8  #     https://www.apache.org/licenses/LICENSE-2.0
9  #
10 # Unless required by applicable law or agreed to in writing, software
11 # distributed under the License is distributed on an "AS IS" BASIS,
12 # WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.
13 # See the License for the specific language governing permissions and
14 # limitations under the License.
15
16 apiVersion: sparkoperator.k8s.io/v1beta2
17 kind: SparkApplication
18 metadata:
19   name: spark-pi
20   namespace: default
21 spec:
22   type: Scala
23   mode: cluster
24   image: spark:3.5.3
25   imagePullPolicy: IfNotPresent
```

Download file + k apply

kubectl apply -f spark-pi.yaml

```
C:\apps\spark>kubectl apply -f spark-pi.yaml
sparkapplication.sparkoperator.k8s.io/spark-pi created
```

```
C:\apps\spark>
```

Step 1/3: sparkApplication status = " " (empty)

... spark-operator has not done spark-submit yet

Context: kind-kind-cluster	<0> all	<ctrl-d> Delete
Cluster: kind-kind-cluster	<1> spark-operator	<d> Describe
User: kind-kind-cluster	<2> default	<e> Edit
K9s Rev: v0.32.6		<?> Help
K8s Rev: v1.27.3		<shift-j> Jump Owner
CPU: n/a		<y> YAML
MEM: n/a		
Sparkapplications(default)[1]		
NAME↑	STATUS	ATTEMPTS
spark-pi		
START	FINISH	AGE
		15s

Step 2/3: sparkApplication status = RUNNING

Context: kind-kind-cluster
Cluster: kind-kind-cluster
User: kind-kind-cluster
K9s Rev: v0.32.6
K8s Rev: v1.27.3
CPU: n/a
MEM: n/a

```
<0> all           <ctrl-d> Delete
<1> spark-operator <d>       Describe
<2> default        <e>       Edit
                           <?>       Help
                           <shift-j> Jump Owner
                           <y>       YAML
```



Spark applications (default) [1]						
Name	Status	Attempts	Start	Finish	Age	Actions
spark-pi	RUNNING	1	2024-11-16T18:08:05Z	<no value>	3m55s	View

kubectl get sparkApplication (list) status=RUNNING

```
C:\apps\spark>kubectl get sparkApplication
NAME      STATUS    ATTEMPTS   START                      FINISH          AGE
spark-pi  RUNNING   1          2024-11-16T18:08:05Z  <no value>  5m39s
```

Step 3/3: sparkApplication status=COMPLETED

Context: kind-kind-cluster	<0> all	<ctrl-d>	Delete
Cluster: kind-kind-cluster	<1> spark-operator	<d>	Describe
User: kind-kind-cluster	<2> default	<e>	Edit
K9s Rev: v0.32.6		<?>	Help
K8s Rev: v1.27.3		<shift-j>	Jump Owner
CPU: n/a		<y>	YAML
MEM: n/a			

Sparkapplications(default)[1]					
NAME↑	STATUS	ATTEMPTS	START	FINISH	AGE
spark-pi	COMPLETED	1	2024-11-16T17:49:02Z	2024-11-16T17:51:05Z	3m55s

kubectl get sparkApplication (list) ... COMPLETED

```
C:\apps\spark>kubectl get sparkApplication
NAME      STATUS    ATTEMPTS   START                      FINISH                    AGE
spark-pi  COMPLETED 1          2024-11-16T17:26:00Z  2024-11-16T17:27:12Z  4m53s
```

kubectl apply AGAIN unchanged?
=> Does nothing

```
C:\apps\spark>kubectl apply -f spark-pi.yaml  
sparkapplication.sparkoperator.k8s.io/spark-pi unchanged
```

Unchanged => nothing is done.. K8s will not delete, nor restart anything
k apply does not "launch", it just write the desired state to be "a sparkApp should exist"

kubectl delete sparkApplication spark-pi

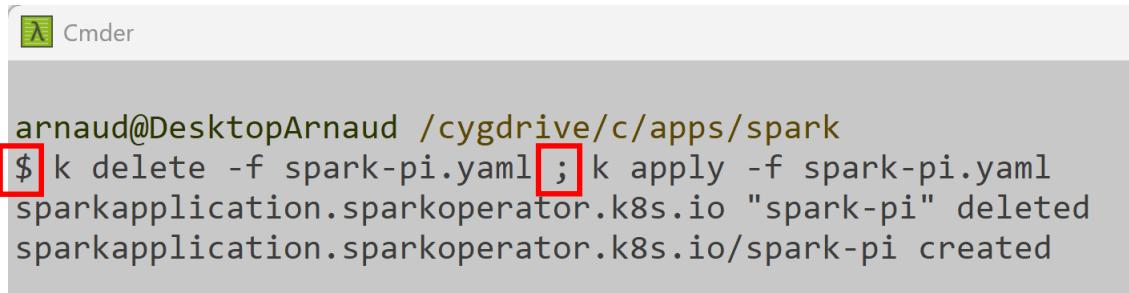
```
C:\apps\spark>kubectl delete sparkApplication spark-pi  
sparkapplication.sparkoperator.k8s.io "spark-pi" deleted
```

Notice:

- you apply using file name "spark-pi.yaml"
- you can delete the sparkApp (only it) by its type + resource name "spark-pi"
- or by full name "sparkAplication/spark-pi"
- or delete all resources from yaml file

```
C:\apps\spark>kubectl delete -f spark-pi.yaml  
sparkapplication.sparkoperator.k8s.io "spark-pi" deleted
```

force relaunch on unix Bash kubectl delete ; kubectl apply



```
arnaud@DesktopArnaud /cygdrive/c/apps/spark
$ k delete -f spark-pi.yaml ; k apply -f spark-pi.yaml
sparkapplication.sparkoperator.k8s.io "spark-pi" deleted
sparkapplication.sparkoperator.k8s.io/spark-pi created
```

NOTICE:

using unix "Bash \$" shell, you can do "cmd1 ; cmd2" to execute sequentially on 1 line
But on cmd DOS c:>, you can't use ";" !

do not use "&&" which would stop on delete error !!

It is OK if the "kubectl delete " does not find anything to delete.

on Cmd Dos : && does not work you need "--ignore-no-found=true"

```
C:\apps\spark>kubectl delete -f spark-pi.yaml && kubectl apply -f spark-pi.yaml
sparkapplication.sparkoperator.k8s.io "spark-pi" deleted
sparkapplication.sparkoperator.k8s.io/spark-pi created
```

OK when it existed:
deleted , then created

```
C:\apps\spark>kubectl delete -f spark-pi.yaml
sparkapplication.sparkoperator.k8s.io "spark-pi" deleted
```

```
C:\apps\spark>kubectl delete -f spark-pi.yaml && kubectl apply -f spark-pi.yaml
Error from server (NotFound): error when deleting "spark-pi.yaml": sparkapplications.sparkoperator.k8s.io "spark-pi" not found
```

ERROR when it did not exist:
deleted, but not re-created !

```
C:\apps\spark>kubectl delete sparkApplication spark-pi --ignore-not-found=true && kubectl apply -f spark-pi.yaml
sparkapplication.sparkoperator.k8s.io/spark-pi created
```

OK

```
C:\apps\spark>kubectl delete sparkApplication spark-pi --ignore-not-found=true && kubectl apply -f spark-pi.yaml
sparkapplication.sparkoperator.k8s.io "spark-pi" deleted
sparkapplication.sparkoperator.k8s.io/spark-pi created
```

OK

Use helper ".cmd" File script

```
relaunch-spark-pi.cmd
1 @echo OFF
2
3 echo relaunching sparkApp
4
5 echo step 1/2: kubectl delete sparkApplication spark-pi
6 kubectl delete sparkApplication spark-pi --ignore-not-found=true
7
8 echo step 2/2: kubectl apply -f spark-pi.yaml
9 kubectl apply -f spark-pi.yaml
```

```
C:\apps\spark>relaunch-spark-pi.cmd
relauncher sparkApp
step 1/2: kubectl delete sparkApplication spark-pi
sparkapplication.sparkoperator.k8s.io "spark-pi" deleted
step 2/2: kubectl apply -f spark-pi.yaml
sparkapplication.sparkoperator.k8s.io/spark-pi created
```

Next Steps

Try to change yaml file, to

- add "sparkConf" configuration
- change driver/executor config (memory, number of executors, etc..)
- add configMap + mount as volume for reading file
- add PVC
- add PVC for internal shuffling directories
- add toleration for NodePool taints
- etc etc

Try to open ingress equivalent of `http://localhost:4040` (or port-forward)
Try to attach debugger (remote debug JVM process)

Next Advanced Steps (maybe Demo in Course)

create an Azure AKS cluster

launch from local "kubectl" command to remote Azure Kubernetes

configure several NodePools

1 "on-demand" : small but "normal price" VM for the spark-driver

1 "spot" : Big memory VMs but "Spot Instance" VM for executors

port-forward `http://localhost:4040` for driver pod 4040

port-forward 5005 for remote debug from local PC in IntelliJ !!

mount volume from configMap

+ volume file from KeyVault (for password secrets)

use "managed-identity"

etc etc

Questions ?

arnaud.nauwynck@gmail.com