

Big Data – TP1 Part 1

Using HDFS & Spark on the DCE clusters of CentraleSupélec (Data Center for Education)

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&

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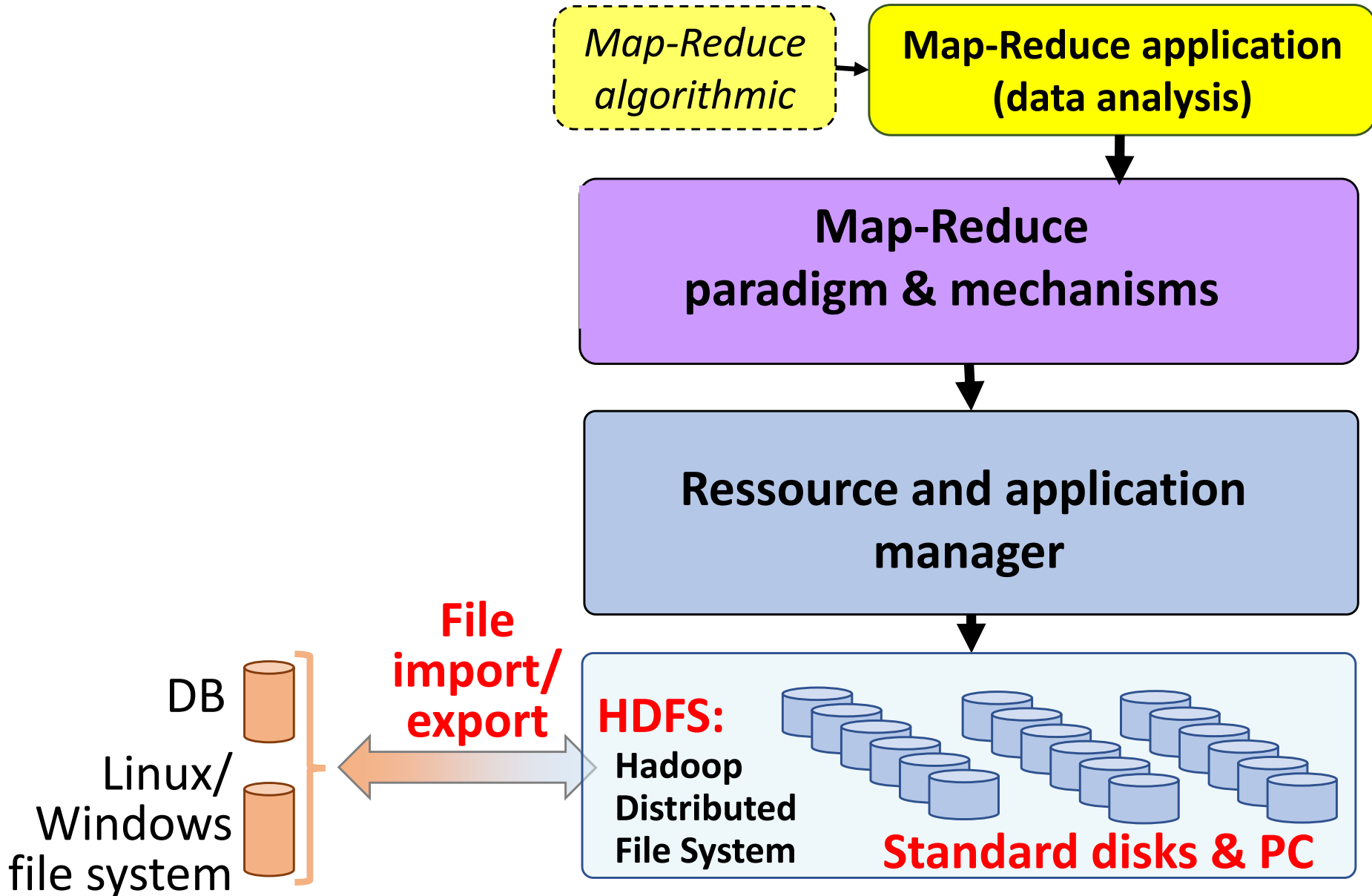
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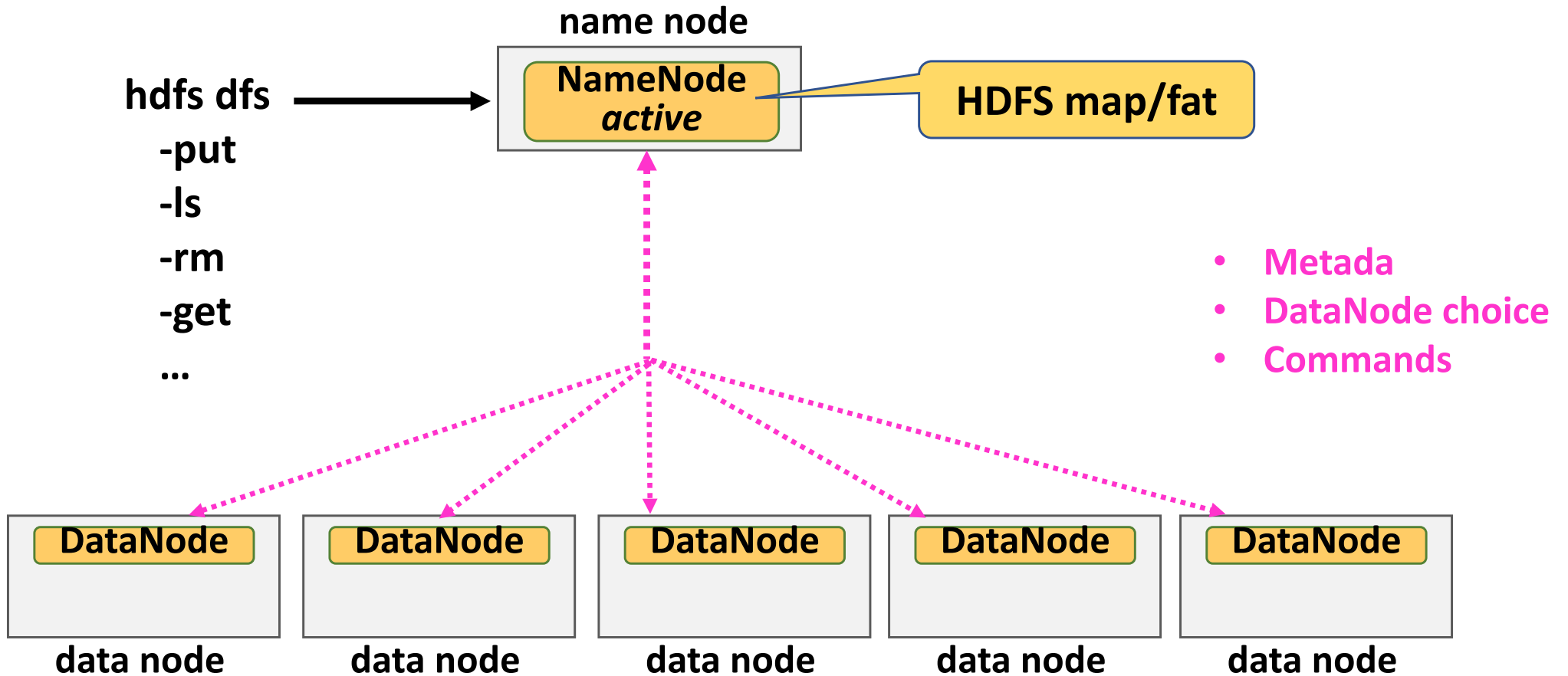
Using Spark cluster of CentraleSupelec DCE

- **HDFS principles & commands**
→ HDFS experiment
- **Spark principles & commands**
→ Spark experiment

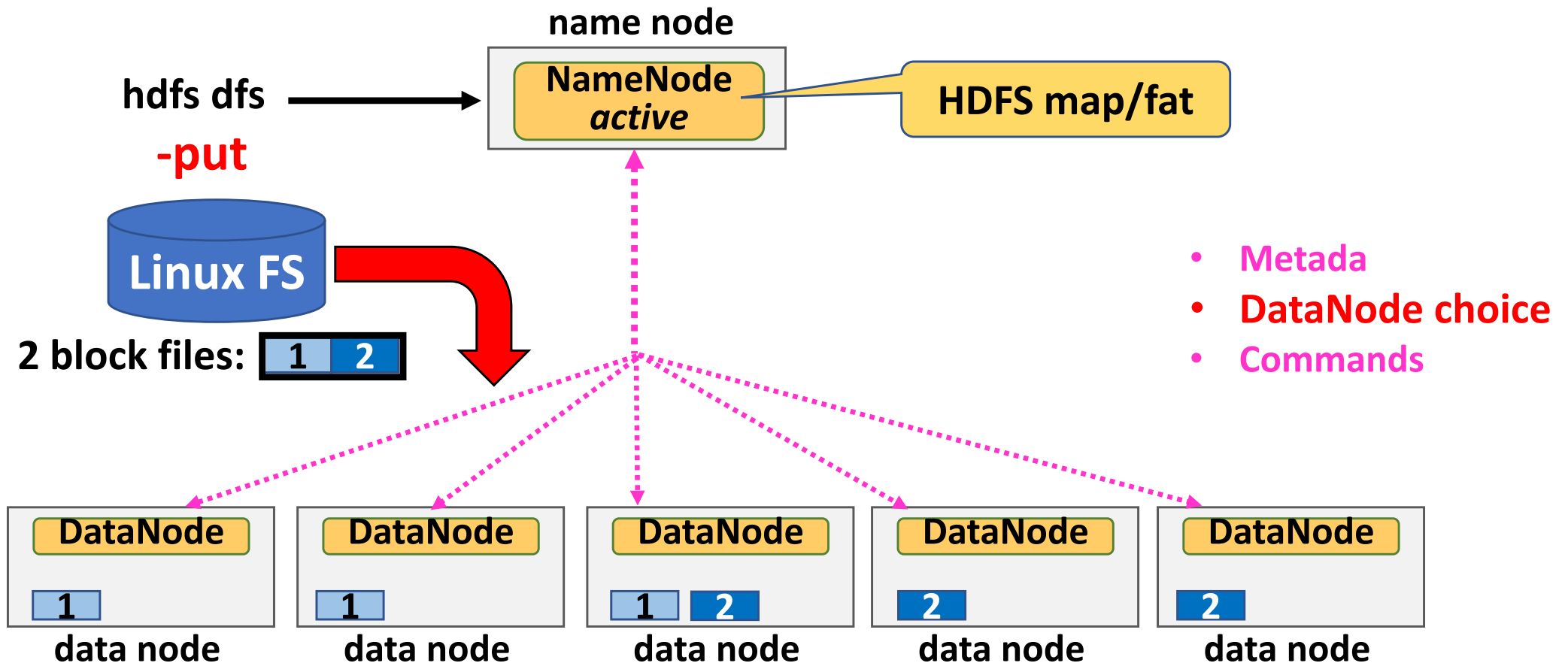
Hadoop software architecture



HDFS principles

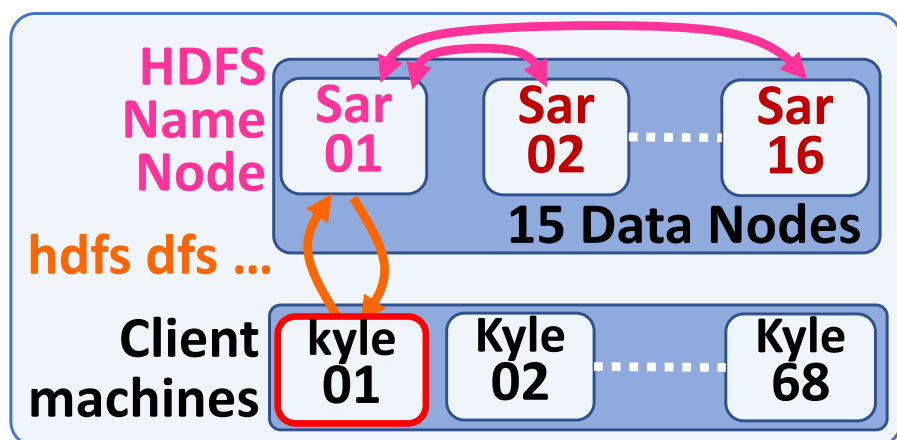


HDFS principles



- Files are splitted into data blocks (64 or 128 Mbytes)
- Each block is replicated (default: x3) to ensure fault tolerance
- The NameNode chooses the Data Nodes storing blocks and replicas

HDFS commands on DCE



HDFS NameNode service: **sar01:9000**
or: sar**17:9000**

| | |
|-----------|------------------------|
| /data | <i>Read only</i> |
| /ecm1 | |
| /ecm1_1/ | <i>R/W for ecm1_1</i> |
| ... | |
| /ecm1_15/ | <i>R/W for ecm1_15</i> |

On a cluster node (*client machine*):

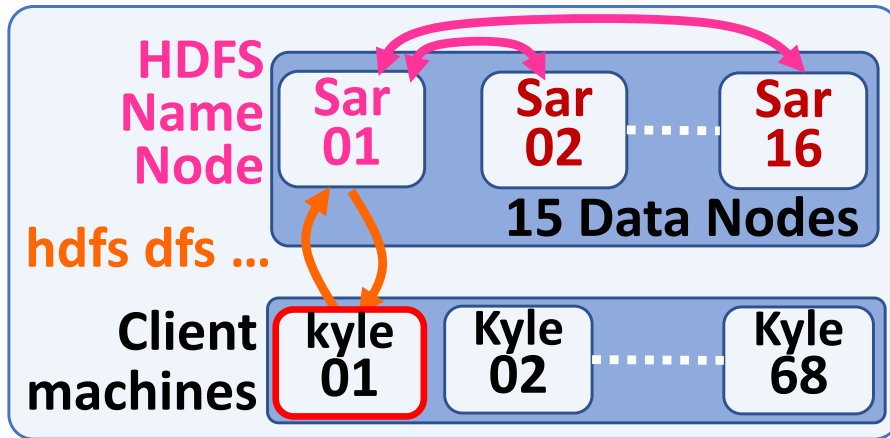
hdfs dfs -ls -h hdfs://sar01:9000/data

hadoop fs -ls -h hdfs://sar01:9000/data (alternative syntax)

Found 2 items

```
drwxrwxr-x - cpu_vialle cpu_prof 0 2019-10-18 11:23
                                                    hdfs://sar01:9000/data/sales
-rw-r--r--  3 cpu_vialle cpu_prof 568.2 K 2019-10-04 13:58
nb of replicas           size           hdfs://sar01:9000/data/sherlock.txt
```

HDFS commands on DCE



HDFS NameNode service: **sar01:9000**
or: sar**17:9000**

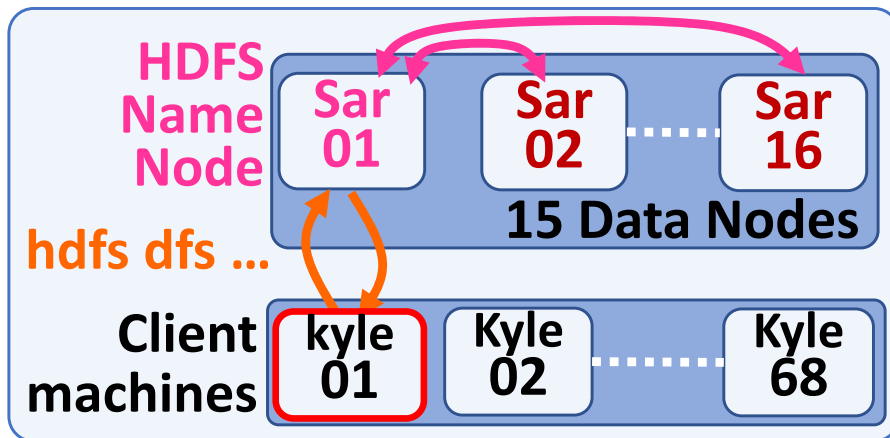
| | |
|-----------|------------------------|
| /data | <i>Read only</i> |
| /ecm1 | |
| /ecm1_1/ | <i>R/W for ecm1_1</i> |
| ... | |
| /ecm1_15/ | <i>R/W for ecm1_15</i> |

On a cluster node (*client machine*):

hdfs dfs -ls -h hdfs://sar01:9000/data/sales

```
Found 7 items
-rw-r--r--  3 cpu_vialle  cpu_prof  257.0 M  2023-09-14 10:24
                hdfs://sar01:9000/data/sales/customer_100.dat
.....
-rw-r--r--  3 cpu_vialle  cpu_prof  37.4 G  2023-09-14 10:34
                hdfs://sar01:9000/data/sales/store_sales_1_4.400.dat
-rw-r--r--  3 cpu_vialle  cpu_prof  76.3 G  2023-09-14 10:45
                hdfs://sar01:9000/data/sales/store_sales_1_4.800.dat
```

HDFS commands on DCE



HDFS NameNode service: **sar01:9000**
 or: sar**17:9000**

| | |
|-----------|------------------------|
| /data | <i>Read only</i> |
| /ecm1 | |
| /ecm1_1/ | <i>R/W for ecm1_1</i> |
| ... | |
| /ecm1_15/ | <i>R/W for ecm1_15</i> |

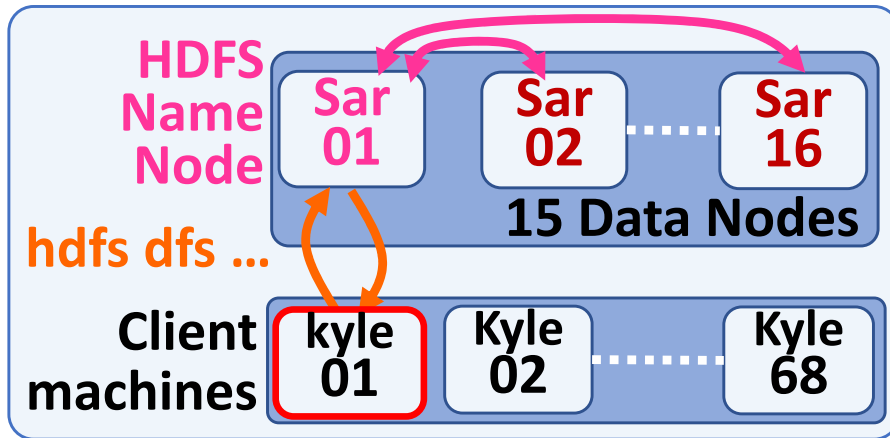
On a cluster node (*client machine*):

hdfs dfs -cat hdfs://sar01:9000/data/sherlock.txt | more

Project Gutenberg's The Adventures of Sherlock Holmes, by Arthur Conan Doyle

....

HDFS commands on DCE



HDFS NameNode service: **sar01:9000**
or: sar**17:9000**

| | |
|-----------|------------------------|
| /data | <i>Read only</i> |
| /ecm1 | |
| /ecm1_1/ | <i>R/W for ecm1_1</i> |
| ... | |
| /ecm1_15/ | <i>R/W for ecm1_15</i> |

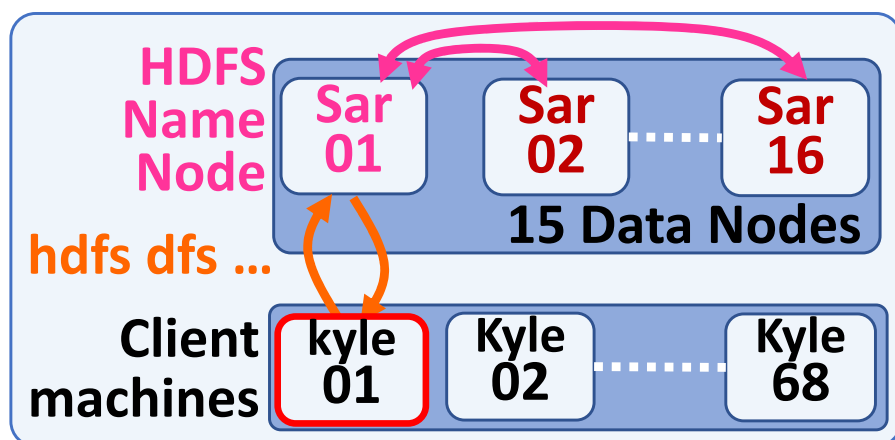
On a cluster node (*client machine*):

hdfs dfs -ls -h hdfs://sar01:9000/ecm1/ecm1_1

empty

*Use YOUR
HDFS account*

HDFS commands on DCE



HDFS NameNode service: **sar01:9000**
or: sar**17:9000**

| | |
|-----------|------------------------|
| /data | <i>Read only</i> |
| /ecm1 | |
| /ecm1_1/ | <i>R/W for ecm1_1</i> |
| ... | |
| /ecm1_15/ | <i>R/W for ecm1_15</i> |

On a cluster node (*client machine*):

```
cp ~cpu_vialle/DCE-Spark/RFC793-TCP.txt .
```

```
hdfs dfs -put RFC793-TCP.txt hdfs://sar01:9000/ecm1/ecm1_1/
```

```
hdfs dfs -ls -h hdfs://sar01:9000/ecm1/ecm1_1/
```

Found 1 items

```
-rw-r--r--  3 ecm1_1 ecm1  173.8 K 2019-10-21 01:51
```

```
hdfs://sar01:9000/ecm1/ecm1_1/RFC793-TCP.txt
```

Use YOUR HDFS account

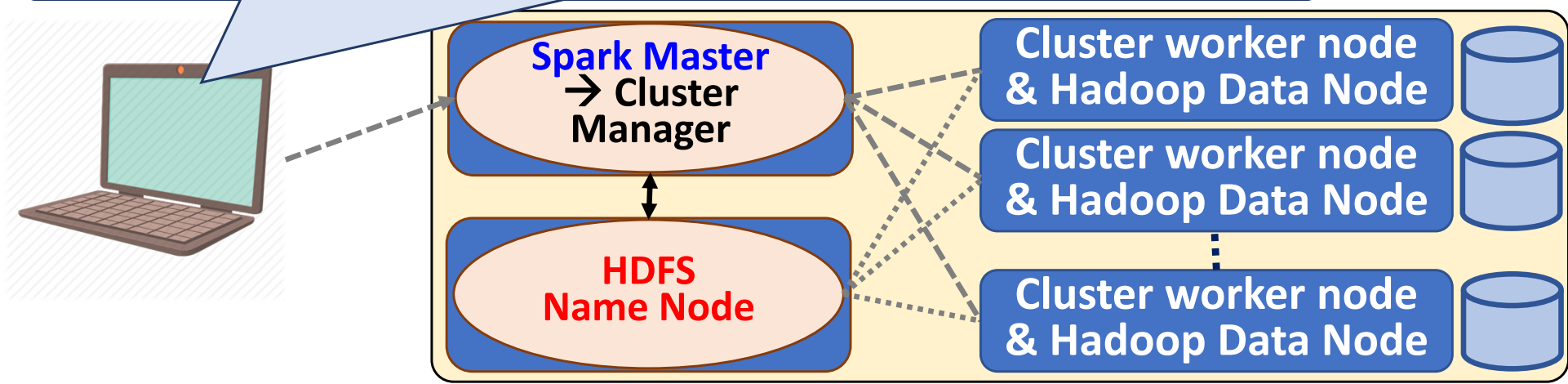
Using Spark cluster of CentraleSupelec DCE

- **HDFS principles & commands**
→ HDFS experiment
- **Spark principles & commands**
→ Spark experiment

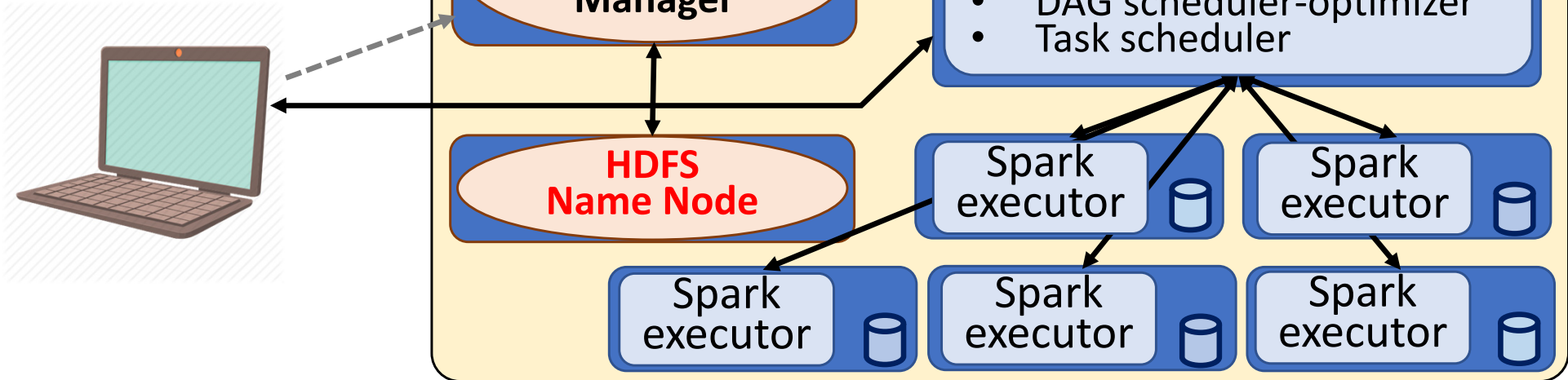
Spark deployment on top of HDFS

Spark Master as cluster manager: **standalone** mode

```
spark-submit --master spark://node:port ... myApp
```

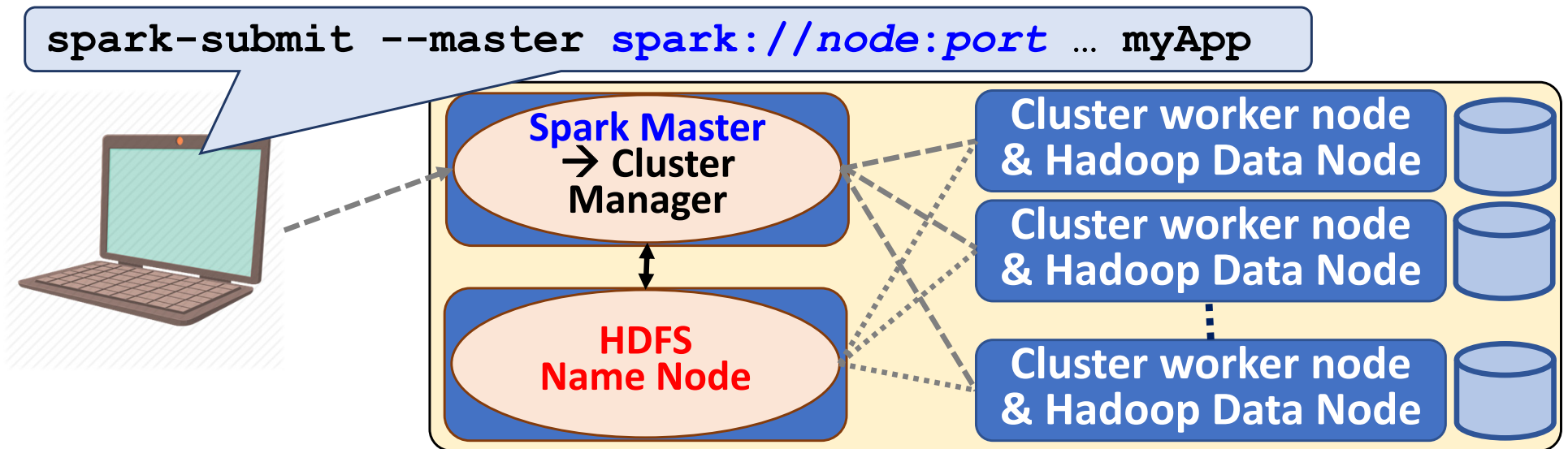


Cluster deployment mode:



Spark deployment on top of HDFS

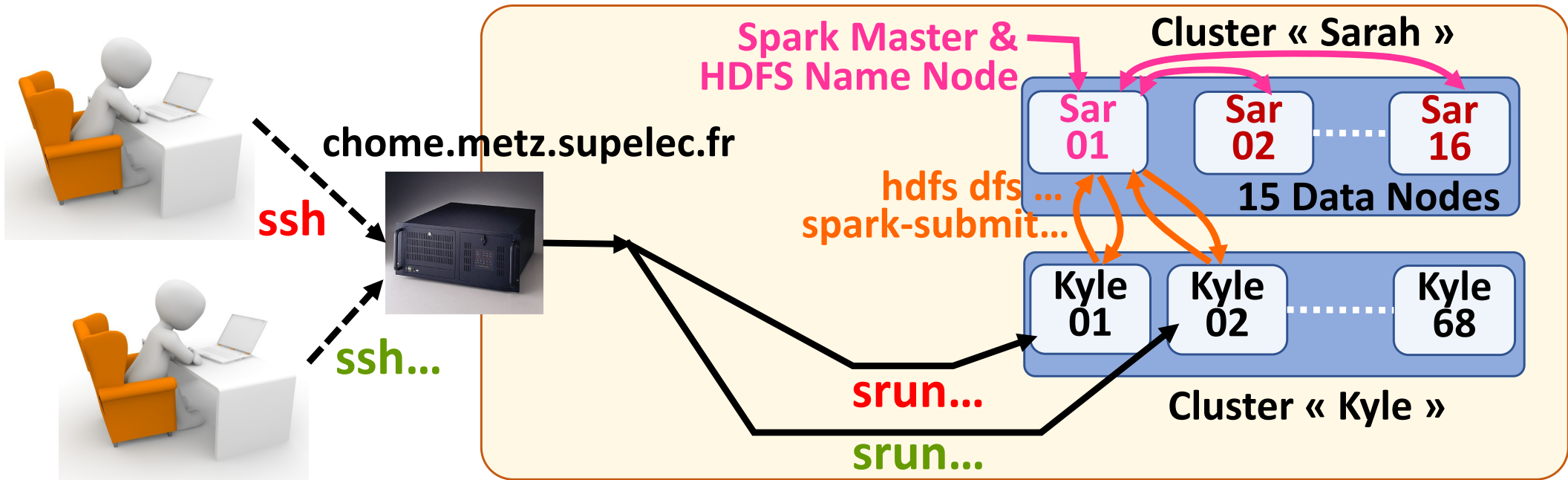
Spark Master as cluster manager: **standalone** mode



Strength and weakness of standalone mode:

- Nothing more to install (included in Spark)
- Easy to configure
- Can run different jobs concurrently
- Can not share the cluster with non-Spark applications
- Limited scheduling mechanism (unique queue)
- Can not target data nodes hosting input data to launch Executors

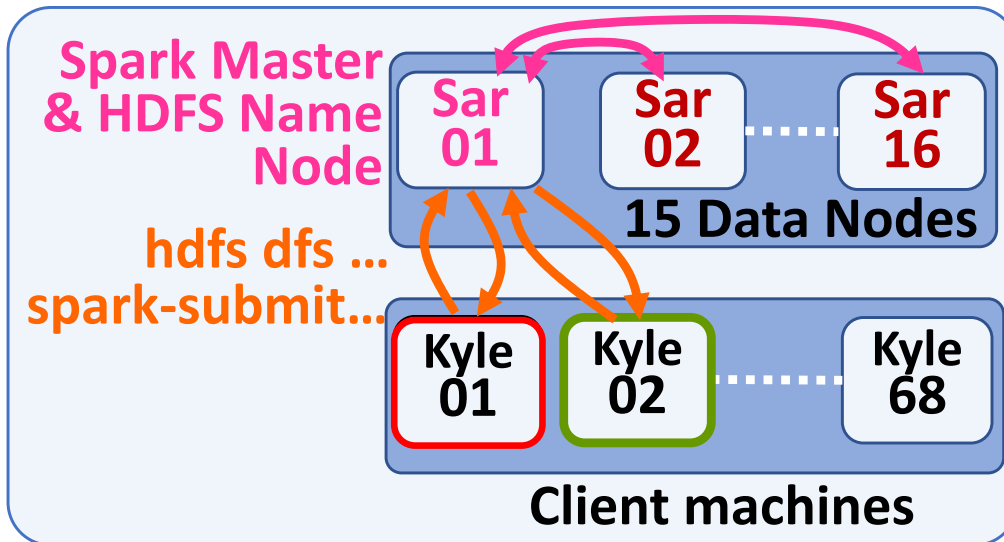
Spark-HDFS configuration on DCE



Default configuration on DCE:

- (only) 15 cores per Spark application
- 15 Data nodes
- One Spark application: 1 Executor/Data Node & 1 core/Executor
- 16 (logical) cores per node
- 16 Spark applications can run concurrently on the Spark cluster

Spark commands on DCE



HDFS NameNode service: **sar01:9000**
or: sar**17**:9000

| | |
|-----------|-----------------|
| /data | Read only |
| /ecm1 | |
| /ecm1_1/ | R/W for ecm1_1 |
| ... | |
| /ecm1_15/ | R/W for ecm1_15 |

Spark Master service: **sar01:7077**
or: sar**17**:7077

On a cluster node (*client machine*):

```
cp ~cpu_vialle/DCE-Spark/template_wc.py ./wc.py
```

→ **Edit** and update the Python code

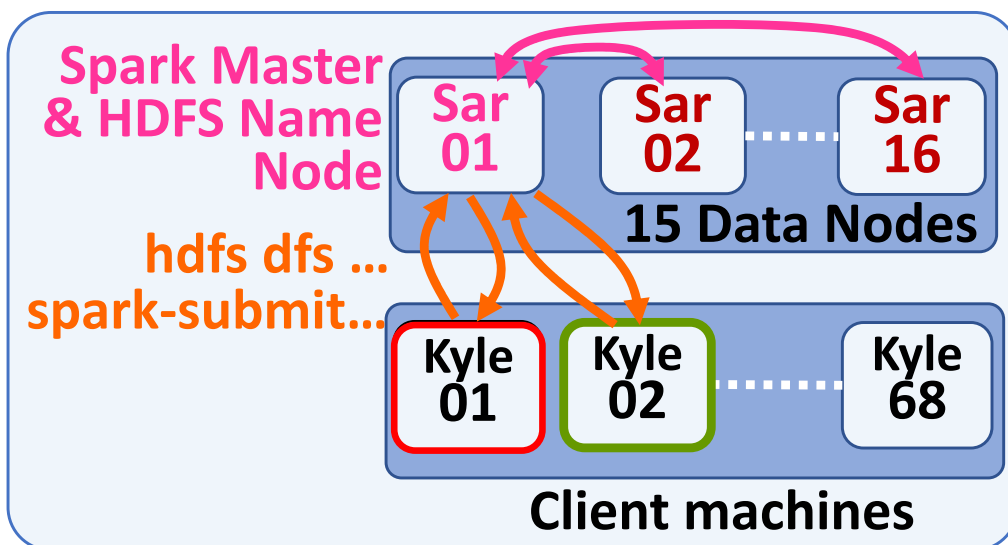
```
spark-submit --master spark://sar01:7077 wc.py
```

Use YOUR
HDFS account

```
hdfs dfs -ls -h hdfs://sar01:9000/ecm1/ecm1_1/sherlock.out
```

```
hdfs dfs -cat hdfs://sar01:9000/ecm1/ecm1_1/sherlock.out/*
```

Spark commands on DCE



HDFS NameNode service: **sar01:9000**
or: sar**17:9000**

| | |
|-----------|-----------------|
| /data | Read only |
| /ecm1 | |
| /ecm1_1/ | R/W for ecm1_1 |
| ... | |
| /ecm1_15/ | R/W for ecm1_15 |

Spark Master service: **sar01:7077**
or: sar**17:7077**

On a cluster node (*client machine*):

Re-execute your Spark application

```
spark-submit --master spark://sar01:7077 wc.py
```

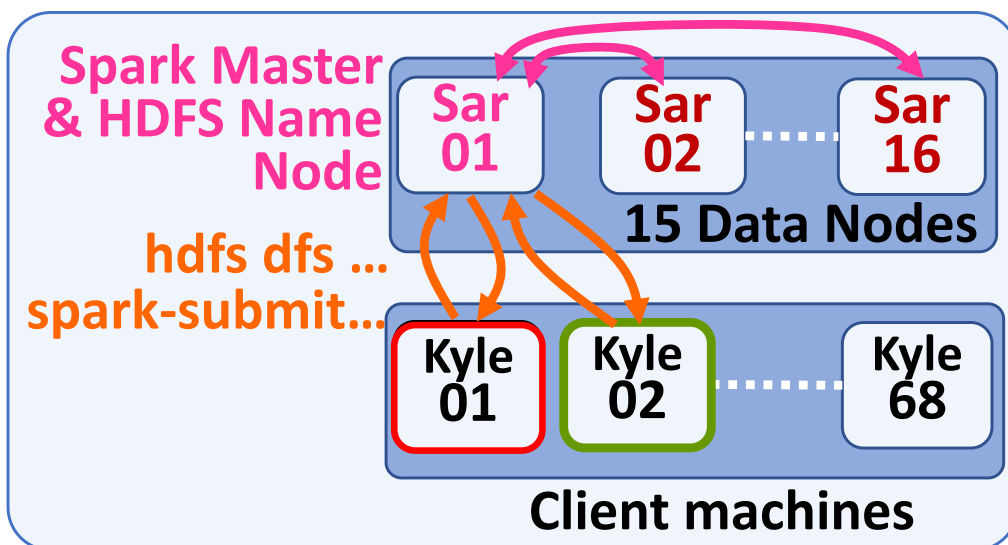
→ **ERROR** : output file already exists (and cannot overwrite)

→ Remove the output file which is a directory...

Use YOUR
HDFS account

```
hdfs dfs -rm -r hdfs://sar01:9000/ecm1/ecm1_1/sherlock.out
```


Spark commands on DCE



HDFS NameNode service: **sar01:9000**
or: sar**17:9000**

| | |
|-----------|------------------------|
| /data | <i>Read only</i> |
| /ecm1 | |
| /ecm1_1/ | <i>R/W for ecm1_1</i> |
| ... | |
| /ecm1_15/ | <i>R/W for ecm1_15</i> |

Spark Master service: **sar01:7077**
or: sar**17:7077**

Remarks (for this lab):

- Use the « **template-xx.py** » files to develop your code **xx.py** and execute your code with :

spark-submit --master spark://sar01:7077 xx.py

- Write lambda with syntax: **(lambda a, b : (a[0] + b[0], a[1] + b[1]))**
~~(lambda (v1,n1), (v2,n2) : (v1+v2,n1+n2))~~

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Questions ?