

TECNOLOGÍAS DE COMPUTACIÓN PARA DATOS MASIVOS

Entrega 1

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1 AÑADIR AL CLUSTER UN SERVIDOR DE BACKUP Y UN TIMELINESERVER

Procederemos a añadir al cluster configurado anteriormente un servidor de BackUp y un servidor TimeLineServer. Se irán explicando los pasos llevados a cabo a continuación.

1.1 SERVIDOR DE BACKUP

En primer lugar, iniciamos el clúster y en el NameNode obtenemos una captura en la que se muestren los ficheros del directorio de metadatos del NameNode. Para esto lo primero que hacemos es desplazarnos al directorio donde se encuentran estos ficheros mediante `cd /var/data/hdfs/namenode/current` y después comprobamos que ficheros hay mediante el comando `ls -all`. El resultado es el siguiente:

```

root@namenode: /var/data/hdfs/namenode/current
Archivo Acciones Editar Vista Ayuda
tcdm@tcdm-docker: ~ root@namenode: /var/data/hdfs/namenode/current
root@namenode:/var/data/hdfs/namenode/current# ls -all
total 4136
drwx----- 1 hdadmin hadoop 4096 Oct 7 16:19 .
drwxr-xr-x 1 hdadmin hadoop 4096 Sep 28 21:02 ..
-rw-r--r-- 1 hdadmin hadoop 215 Oct 7 16:19 VERSION
-rw-r--r-- 1 hdadmin hadoop 1048576 Sep 28 13:28 edits_0000000000000000001-0000000000000000001
-rw-r--r-- 1 hdadmin hadoop 1048576 Sep 28 21:02 edits_0000000000000000002-0000000000000000002
-rw-r--r-- 1 hdadmin hadoop 1048576 Sep 28 21:15 edits_0000000000000000003-00000000000000000387
-rw-r--r-- 1 hdadmin hadoop 1048576 Oct 7 16:19 edits_inprogress_00000000000000000388
-rw-r--r-- 1 hdadmin hadoop 402 Sep 28 21:02 fsimage_00000000000000000001
-rw-r--r-- 1 hdadmin hadoop 62 Sep 28 21:02 fsimage_0000000000000000001.md5
-rw-r--r-- 1 hdadmin hadoop 3835 Oct 7 16:19 fsimage_00000000000000000387
-rw-r--r-- 1 hdadmin hadoop 62 Oct 7 16:19 fsimage_00000000000000000387.md5
-rw-r--r-- 1 hdadmin hadoop 4 Oct 7 16:19 seen_txid
root@namenode:/var/data/hdfs/namenode/current#

```

Para añadir el servidor de BackUp seguimos los pasos descritos en el guión de esta entrega. En primer lugar, con el cluster funcionando, ejecutamos el comando `docker container run -ti --name backupnode --network=hadoop-cluster --hostname backupnode --cpus=1 --memory=3072m --expose 50100 -p 50105:50105 hadoop-base /bin/bash` para iniciar un nuevo Docker a partir de la imagen `hadoop-base`. Una vez que ya se ha creado este nuevo contenedor, de nombre `backupnode`, accedemos a él y creamos en el directorio raíz el directorio `/backup` mediante el comando `mkdir backup`, hacemos que el propietario sea `hdadmin` mediante el comando `chown hdadmin:hadoop /backup` y por último creamos dentro de este directorio la carpeta `dfs/name` (hacemos que el usuario `hdadmin` sea el propietario de estas carpetas también). Después, cambiamos al usuario `hdadmin` (mediante `su - hdadmin`) y después modificamos el fichero `core-site.xml` para añadir las propiedades que se nos especifican en el enunciado:

```

hdadmin@backupnode: ~/hadoop/etc/hadoop
GNU nano 4.8 core-site.xml
Unless required by applicable law or agreed to in writing, software
distributed under the License is distributed on an "AS IS" BASIS,
WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.
See the License for the specific language governing permissions and
limitations under the License. See accompanying LICENSE file.
-->

<!-- Put site-specific property overrides in this file. -->

<configuration>
  <property>
    <name>fs.defaultFS</name>
    <value>hdfs://namenode:9000</value>
    <final>true</final>
  </property>
  <property>
    <name>hadoop.tmp.dir</name>
    <value>/backup</value>
    <final>true</final>
  </property>
</configuration>
[ Wrote 30 lines ]
^G Get Help  ^O Write Out  ^W Where Is  ^K Cut Text   ^J Justify    ^C Cur Pos    M-U Undo
^X Exit      ^R Read File  ^\ Replace   ^U Paste Text ^T To Spell   ^_ Go To Line  M-E Redo

```

También añadimos las propiedades necesarias al fichero **hdfs-site.xml**:

```

hdadmin@backupnode: ~/hadoop/etc/hadoop
GNU nano 4.8 hdfs-site.xml
WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.
See the License for the specific language governing permissions and
limitations under the License. See accompanying LICENSE file.
-->

<!-- Put site-specific property overrides in this file. -->

<configuration>
  <property>
    <name>dfs.namenode.backup.address</name>
    <value>backupnode:50100</value>
    <final>true</final>
  </property>
  <property>
    <name>dfs.namenode.backup.http-address</name>
    <value>backupnode:50105</value>
    <final>true</final>
  </property>
</configuration>

```

Ahora iniciamos el servidor de backup ejecutando el comando **hdfs namenode -backup**. Unos ejemplos de los mensajes que nos da el servicio de backup, destacando aquellos en los que se ve como se hace el checkpoint, al iniciarse son los siguientes:

```

hdadmin@backupnode: ~
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hdadmin@backupnode: ~
hdadmin@namenode: /

edit=1&startTxId=3&endTxId=387&storageInfo=-66:1551021092:1632828351540:CID-bddf400e-a254-43d4-b37a-0ac0f00b7867
2021-10-07 17:28:38,729 INFO common.Util: Combined time for file download and fsync to all disks took 0,05s. The fi
le download took 0,05s at 20480,00 KB/s. Synchronous (fsync) write to disk of /backup/dfs/name/current/edits_tmp_00
0000000000000003-000000000000000387_0000000000004884995 took 0,00s.
2021-10-07 17:28:38,729 INFO namenode.TransferFsImage: Downloaded file edits_tmp_0000000000000003-00000000000000
00387_0000000000004884995 size 0 bytes.
2021-10-07 17:28:38,730 INFO namenode.TransferFsImage: Opening connection to http://namenode:9870/imagetransfer?get
edit=1&startTxId=388&endTxId=389&storageInfo=-66:1551021092:1632828351540:CID-bddf400e-a254-43d4-b37a-0ac0f00b7867
2021-10-07 17:28:38,760 INFO common.Util: Combined time for file download and fsync to all disks took 0,00s. The fi
le download took 0,00s at 0,00 KB/s. Synchronous (fsync) write to disk of /backup/dfs/name/current/edits_tmp_000000
000000000388-000000000000000389_0000000000004885088 took 0,00s.
2021-10-07 17:28:38,760 INFO namenode.TransferFsImage: Downloaded file edits_tmp_000000000000000388-00000000000000
00389_0000000000004885088 size 0 bytes.
2021-10-07 17:28:38,772 INFO namenode.Checkpointer: Checkpointer about to load edits from 4 stream(s).
2021-10-07 17:28:38,862 INFO namenode.FSImage: Reading /backup/dfs/name/current/edits_000000000000000001-000000000
0000000001 expecting start txid #1
2021-10-07 17:28:38,862 INFO namenode.FSImage: Start loading edits file /backup/dfs/name/current/edits_000000000000
0000001-00000000000000000001 maxTxnsToRead = 9223372036854775807
2021-10-07 17:28:39,195 INFO namenode.FSImage: Loaded 1 edits file(s) (the last named /backup/dfs/name/current/edit
s_00000000000000000001-00000000000000000001) of total size 1048576.0, total edits 1.0, total load time 92.0 ms
2021-10-07 17:28:40,243 INFO namenode.FSEditLogLoader: replaying edit log: 302/385 transactions completed. (78%)
2021-10-07 17:28:40,381 INFO namenode.NameCache: initialized with 0 entries 0 lookups
2021-10-07 17:28:40,382 INFO namenode.LeaseManager: Number of blocks under construction: 0
2021-10-07 17:28:40,556 INFO namenode.FSImageFormatProtobuf: Saving image file /backup/dfs/name/current/fsimage.ckpt
2021-10-07 17:28:40,556 INFO namenode.FSImageFormatProtobuf: Saving image file /backup/dfs/name/current/fsimage.ckpt

```

```

hdadmin@backupnode: ~
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hdadmin@backupnode: ~
hdadmin@namenode: /

2021-10-07 17:28:40,381 INFO namenode.NameCache: initialized with 0 entries 0 lookups
2021-10-07 17:28:40,382 INFO namenode.LeaseManager: Number of blocks under construction: 0
2021-10-07 17:28:40,556 INFO namenode.FSImageFormatProtobuf: Saving image file /backup/dfs/name/current/fsimage.ckpt
t_000000000000000000389 using no compression
2021-10-07 17:28:41,776 INFO namenode.FSImageFormatProtobuf: Image file /backup/dfs/name/current/fsimage.ckpt_00000
00000000000389 of size 3835 bytes saved in 1 seconds .
2021-10-07 17:28:41,871 INFO namenode.FSImageTransactionalStorageInspector: No version file in /backup/dfs/name
2021-10-07 17:28:41,908 INFO namenode.FSImageTransactionalStorageInspector: No version file in /backup/dfs/name
2021-10-07 17:28:42,125 INFO namenode.TransferFsImage: Image Transfer timeout configured to 60000 milliseconds
2021-10-07 17:28:42,129 INFO namenode.TransferFsImage: Sending fileName: /backup/dfs/name/current/fsimage_000000000
0000000389, fileSize: 3835. Sent total: 3835 bytes. Size of last segment intended to send: -1 bytes.
2021-10-07 17:28:42,199 INFO namenode.TransferFsImage: Uploaded image with txid 389 to namenode at http://namenode:
9870 in 0.13 seconds
2021-10-07 17:28:42,235 INFO namenode.FSImage: Going to finish converging with remaining 1 txns from in-progress st
ream org.apache.hadoop.hdfs.server.namenode.RedundantEditLogInputStream@60efa398
2021-10-07 17:28:42,236 INFO namenode.FSImage: Start loading edits file /backup/dfs/name/current/edits_inprogress_0
00000000000000390 maxTxnsToRead = 9223372036854775807
2021-10-07 17:28:42,237 INFO namenode.RedundantEditLogInputStream: Fast-forwarding stream '/backup/dfs/name/current
/edits_inprogress_000000000000000390' to transaction ID 390
2021-10-07 17:28:42,239 INFO namenode.FSImage: Loaded 1 edits file(s) (the last named /backup/dfs/name/current/edit
s_inprogress_000000000000000390) of total size 1048576.0, total edits 1.0, total load time 3.0 ms
2021-10-07 17:28:42,243 INFO namenode.FSImage: Successfully synced BackupNode with NameNode at txnid 390
2021-10-07 17:28:42,243 INFO namenode.Checkpointer: Checkpoint completed in 6 seconds. New Image Size: 3835

```

Como se puede ver en la última línea en los mensajes del servicio de backup, se nos dice que un checkpoint ha sido correctamente completado en 6 segundos.

A continuación, podemos una captura de pantalla de la interfaz web del nodo de backup:

Upgrade in progress. Not yet finalized.

Overview 'backupnode:50100' (standby)

Started:	Thu Oct 07 17:54:08 +0200 2021
Version:	3.3.1, ra3b9c37a397ad4188041dd80621bdeefc46885f2
Compiled:	Tue Jun 15 07:13:00 +0200 2021 by ubuntu from (HEAD detached at release-3.3.1-RC3)
Cluster ID:	CID-bddf400e-a254-43d4-b37a-0ac0f00b7867
Block Pool ID:	BP-441966921-172.18.0.2-1632828351540

Summary

Security is off.

Safe mode is ON. It was turned on manually. Use "hdfs dfsadmin -safemode leave" to turn safe mode off.

43 files and directories, 29 blocks (29 replicated blocks, 0 erasure coded block groups) = 72 total filesystem object(s).

Heap Memory used 44.11 MB of 58.95 MB Heap Memory. Max Heap Memory is 742.44 MB.

Non Heap Memory used 50.55 MB of 51.84 MB Committed Non Heap Memory. Max Non Heap Memory is <unbounded>.

Configured Capacity:	0 B
-----------------------------	-----

Finalmente, compararemos el contenido del directorio del backup con el directorio con los metadatos del NameNode, antes y después de que el servicio de backup se haya completado. En primer lugar, vemos el contenido del directorio con los metadatos del NameNode después de haber ejecutado el servicio de backup (anteriormente ya se mostró la captura con los contenidos de este directorio antes de ejecutar el servicio de backup):

```

hdadmin@namenode: /var/data/hdfs/namenode/current
Archivo Acciones Editar Vista Ayuda
hdadmin@backupnode: /backup/dfs/name/current
hdadmin@namenode: /var/data/hdfs/namenode/current$ ls -all
total 4140
drwx----- 1 hdadmin hadoop 4096 oct 7 17:28 .
drwxr-xr-x 1 hdadmin hadoop 4096 sep 28 21:02 ..
-rw-r--r-- 1 hdadmin hadoop 1048576 sep 28 13:28 edits_00000000000000000001-00000000000000000001
-rw-r--r-- 1 hdadmin hadoop 1048576 sep 28 21:02 edits_00000000000000000002-00000000000000000002
-rw-r--r-- 1 hdadmin hadoop 1048576 sep 28 21:15 edits_00000000000000000003-00000000000000000003
-rw-r--r-- 1 hdadmin hadoop 42 oct 7 17:28 edits_000000000000000000387-000000000000000000387
-rw-r--r-- 1 hdadmin hadoop 1048576 oct 7 17:28 edits_inprogress_000000000000000000390
-rw-r--r-- 1 hdadmin hadoop 3835 oct 7 16:19 fsimage_000000000000000000387
-rw-r--r-- 1 hdadmin hadoop 62 oct 7 16:19 fsimage_000000000000000000387.md5
-rw-r--r-- 1 hdadmin hadoop 3835 oct 7 17:28 fsimage_000000000000000000389
-rw-r--r-- 1 hdadmin hadoop 62 oct 7 17:28 fsimage_000000000000000000389.md5
-rw-r--r-- 1 hdadmin hadoop 4 oct 7 17:28 seen_txid
-rw-r--r-- 1 hdadmin hadoop 215 oct 7 16:19 VERSION
hdadmin@namenode: /var/data/hdfs/namenode/current$

```



```

hdadmin@namenode: ~/hadoop/etc/hadoop
GNU nano 4.8 yarn-site.xml
<!-- Peticiones mayores lanzan una InvalidResourceRequestException -->
<!-- Puedes aumentar o reducir este valor en funcion de la memoria de la que dispongas -->
<name>yarn.scheduler.maximum-allocation-mb</name>
<value>1953</value>
<final>true</final>
</property>
<property>
<name>yarn.timeline-service.hostname</name>
<value>timelineserver</value>
<final>true</final>
</property>
<property>
<name>yarn.timeline-service.enabled</name>
<value>true</value>
<final>true</final>
</property>
<property>
<name>yarn.system-metrics-publisher.enabled</name>
<value>true</value>
<final>true</final>
</property>
[ Wrote 60 lines ]
^G Get Help      ^O Write Out    ^W Where Is     ^K Cut Text     ^J Justify      ^C Cur Pos      M-U Undo
^X Exit          ^R Read File    ^_ Replace      ^U Paste Text   ^T To Spell     ^_ Go To Line   M-E Redo

```

Reiniciamos el servicio ResourceManager mediante el comando `yarn --daemon start resourcemanager`. Utilizamos el comando `docker container run -ti --name timelineserver --network=hadoop-cluster --hostname timelineserver --cpus=1 --memory=3072m --expose 10200 -p 8188:8188 hadoop-base /bin/bash` para iniciar un nuevo Docker en el que levantaremos el servicio TimeLineServer. En este nuevo Docker levantamos el servicio TimeLineServer mediante `yarn --daemon start timelineserver` (como usuario hdadmin). Desde el NameNode ejecutamos la aplicación del cálculo de pi con YARN (como usuario hdadmin). De esta manera, el servidor web del TimeLineServer recoge la información de la ejecución de esta tarea, como se puede ver en la siguiente captura:

ID	User	Name	Application Type	Application Tags	Queue	Application Priority	StartTime	LaunchTime	FinishTime	State	FinalStatus	Progress	Tracking UI
application_1634122747947_0001	hdadmin	QuasiMonteCarlo	MAPREDUCE		default	0	Wed Oct 13 13:06:25 +0200 2021	Wed Oct 13 13:06:27 +0200 2021	Wed Oct 13 13:07:19 +0200 2021	FINISHED	SUCCEEDED	<div></div>	History

2 AÑADIR UN NUEVO DATANODE/NODEMANAGER

2.1 CREACIÓN DE FICHEROS DE NODOS INCLUIDOS Y EXCLUIDOS

lo que haremos es crear los ficheros de incluidos y de excluidos. Para ello primero detenemos los demonios del NameNode y del ResourceManager. Después creamos los cuatro ficheros que se indican en el enunciado. En los ficheros **dfs.include** y **yarn.include** incluimos los cuatro datanodes.

A continuación, editamos el fichero **hdfs.site.xml** para añadir las siguientes propiedades:

```

hdadmin@namenode: ~/hadoop/etc/hadoop
GNU nano 4.8 hdfs-site.xml
<value>file:///var/data/hdfs/namenode</value>
<final>true</final>
</property>
<property>
  <!-- Dirección y puerto del interfaz web del namenode -->
  <name>dfs.namenode.http-address</name>
  <value>namenode:9870</value>
  <final>true</final>
</property>
<property>
  <name>dfs.hosts</name>
  <value>/opt/bd/hadoop/etc/hadoop/dfs.include</value>
  <final>true</final>
</property>
<property>
  <name>dfs.hosts.exclude</name>
  <value>/opt/bd/hadoop/etc/hadoop/dfs.exclude</value>
  <final>true</final>
</property>
</configuration>
  
```

En el fichero **yarn-site.xml** añadimos otras dos propiedades:

```

hdadmin@namenode: ~/hadoop/etc/hadoop
GNU nano 4.8 yarn-site.xml
<value>true</value>
<final>true</final>
</property>
<property>
  <name>yarn.system-metrics-publisher.enabled</name>
  <value>true</value>
  <final>true</final>
</property>
<property>
  <name>yarn.resourcemanager.nodes.include-path</name>
  <value>/opt/bd/hadoop/etc/hadoop/yarn.include</value>
  <final>true</final>
</property>
<property>
  <name>yarn.resourcemanager.nodes.exclude-path</name>
  <value>/opt/bd/hadoop/etc/hadoop/yarn.exclude</value>
  <final>true</final>
</property>
</configuration>
  
```

Para terminar, reiniciamos los demonios. Mediante el comando `grep -l datanode ./*` obtenemos los ficheros en el directorio de logs en los que aparezcan nombrados los datanodes. El resultado de este comando es el siguiente:

```

hdadmin@namenode: ~/hadoop/logs
Archivo Acciones Editar Vista Ayuda
tcdm@tcdm-docker: ~ hdadmin@namenode: ~/hadoop/logs
hdadmin@namenode:~/hadoop/logs$ grep -l datanode ./*
./hadoop-hdadmin-namenode-namenode.log
./hadoop-hdadmin-resourcemanager-namenode.log
hdadmin@namenode:~/hadoop/logs$

```

Por lo tanto, consultando en estos dos ficheros podemos ver como se han incluido al HDFS y al YARN los nodos datanode{1..4}:

```

0
The reported blocks 32 has reached the threshold 0,9990 of total blocks 32. The minimum number of live datanodes is
not required. In safe mode extension. Safe mode will be turned off automatically in 9 seconds.
2021-10-13 23:51:00,009 INFO org.apache.hadoop.hdfs.StateChange: STATE* Network topology has 1 racks and 4 datanode
s
2021-10-14 00:34:33,169 INFO org.apache.hadoop.hdfs.server.common.Util: dfs.datanode.fileio.profiling.sampling.perc
centage set to 0. Disabling file IO profiling
2021-10-14 00:34:33,178 INFO org.apache.hadoop.util.HostsFileReader: Adding a node "datanode1" to the list of inclu
ded hosts from /opt/bd/hadoop/etc/hadoop/dfs.include
2021-10-14 00:34:33,178 INFO org.apache.hadoop.util.HostsFileReader: Adding a node "datanode2" to the list of inclu
ded hosts from /opt/bd/hadoop/etc/hadoop/dfs.include
2021-10-14 00:34:33,178 INFO org.apache.hadoop.util.HostsFileReader: Adding a node "datanode3" to the list of inclu
ded hosts from /opt/bd/hadoop/etc/hadoop/dfs.include
2021-10-14 00:34:33,178 INFO org.apache.hadoop.util.HostsFileReader: Adding a node "datanode4" to the list of inclu
ded hosts from /opt/bd/hadoop/etc/hadoop/dfs.include
2021-10-14 00:34:33,193 INFO org.apache.hadoop.hdfs.server.blockmanagement.DatanodeManager: dfs.namenode.datanode.r
egistration.ip-hostname-check=true
2021-10-14 00:34:33,221 INFO org.apache.hadoop.hdfs.server.blockmanagement.BlockManagerSafeMode: dfs.namenode.safem
ode.min.datanodes = 0
The minimum number of live datanodes is not required. Safe mode will be turned off automatically once the threshold
s have been reached.
2021-10-14 00:34:35,606 INFO org.apache.hadoop.hdfs.StateChange: BLOCK* registerDatanode: from DatanodeRegistration
(172.18.0.3:9866, datanodeUuid=cd849298-da65-442b-adf7-05881f52acc9, infoPort=9864, infoSecurePort=0, ipcPort=9867,
storageInfo=lv=-57;cid=CID-bddf400e-a254-43d4-b37a-0ac0f00b7867;nsid=1551021092;c=1632828351540) storage cd849298-
da65-442b-adf7-05881f52acc9

```

```

hdadmin@namenode: ~/hadoop/logs
Archivo Acciones Editar Vista Ayuda
tcdm@tcdm-docker: ~ hdadmin@namenode: ~/hadoop/logs
Transitioned from NEW to RUNNING
2021-10-13 23:50:31,267 INFO org.apache.hadoop.yarn.server.resourcemanager.rmnode.RMNodeImpl: datanode2:41573 Node
Transitioned from NEW to RUNNING
2021-10-13 23:50:31,267 INFO org.apache.hadoop.yarn.server.resourcemanager.rmnode.RMNodeImpl: datanode1:39503 Node
Transitioned from NEW to RUNNING
2021-10-13 23:50:31,255 INFO org.apache.hadoop.yarn.server.resourcemanager.ResourceTrackerService: NodeManager from
node datanode4(cmpPort: 37317 httpPort: 8042) registered with capability: <memory:1953, vCores:4>, assigned nodeId
datanode4:37317
2021-10-13 23:50:31,451 INFO org.apache.hadoop.yarn.server.resourcemanager.scheduler.capacity.CapacityScheduler: Ad
ded node datanode3:40951 clusterResource: <memory:1953, vCores:4>
2021-10-13 23:50:31,452 INFO org.apache.hadoop.yarn.server.resourcemanager.scheduler.capacity.CapacityScheduler: Ad
ded node datanode4:37317 clusterResource: <memory:3906, vCores:8>
2021-10-13 23:50:31,454 INFO org.apache.hadoop.yarn.server.resourcemanager.scheduler.capacity.CapacityScheduler: Ad
ded node datanode2:41573 clusterResource: <memory:5859, vCores:12>
2021-10-13 23:50:31,481 INFO org.apache.hadoop.yarn.server.resourcemanager.scheduler.capacity.CapacityScheduler: Ad
ded node datanode1:39503 clusterResource: <memory:7812, vCores:16>
2021-10-14 00:34:51,377 INFO org.apache.hadoop.util.HostsFileReader: Adding a node "datanode1" to the list of inclu
ded hosts from /opt/bd/hadoop/etc/hadoop/yarn.include
2021-10-14 00:34:51,377 INFO org.apache.hadoop.util.HostsFileReader: Adding a node "datanode2" to the list of inclu
ded hosts from /opt/bd/hadoop/etc/hadoop/yarn.include
2021-10-14 00:34:51,377 INFO org.apache.hadoop.util.HostsFileReader: Adding a node "datanode3" to the list of inclu
ded hosts from /opt/bd/hadoop/etc/hadoop/yarn.include
2021-10-14 00:34:51,377 INFO org.apache.hadoop.util.HostsFileReader: Adding a node "datanode4" to the list of inclu
ded hosts from /opt/bd/hadoop/etc/hadoop/yarn.include
hdadmin@namenode:~/hadoop/logs$

```

2.2 AÑADIR UN DATANODE/NODEMANAGER

Después de haber añadido el datanode5 al fichero **dfs.include** ejecutamos el comando **hdfs dfsadmin -report** para comprobar como el nuevo contenedor no se ha añadido al HDFS. Como se muestra en la siguiente captura solo hay datanodes en activo:

```

hdadmin@namenode: ~/hadoop/etc/hadoop
Archivo Acciones Editar Vista Ayuda
tcdm@tcdm-docker: ~ hdadmin@namenode: ~/hadoop/etc/hadoop
hdadmin@namenode:~/hadoop/etc/hadoop$ hdfs dfsadmin -report
Configured Capacity: 126277681152 (117.61 GB)
Present Capacity: 72998301696 (67.98 GB)
DFS Remaining: 71976648704 (67.03 GB)
DFS Used: 1021652992 (974.32 MB)
DFS Used%: 1.40%
Replicated Blocks:
  Under replicated blocks: 0
  Blocks with corrupt replicas: 0
  Missing blocks: 0
  Missing blocks (with replication factor 1): 0
  Low redundancy blocks with highest priority to recover: 0
  Pending deletion blocks: 0
Erasure Coded Block Groups:
  Low redundancy block groups: 0
  Block groups with corrupt internal blocks: 0
  Missing block groups: 0
  Low redundancy blocks with highest priority to recover: 0
  Pending deletion blocks: 0
-----
Live datanodes (4):
Name: 172.18.0.3:9866 (datanode1.hadoop-cluster)
Hostname: datanode1
Decommission Status : Normal
Configured Capacity: 31569420288 (29.40 GB)
DFS Used: 339116032 (323.41 MB)
Non DFS Used: 11608907776 (10.81 GB)
DFS Remaining: 17994162176 (16.76 GB)

```

Sin embargo, si ejecutamos el comando **yarn node -list** vemos como sí que se ha añadido al YARN:

```

hdadmin@namenode: ~
2021-10-14 00:59:02,755 INFO client.DefaultNoHARMFailoverProxyProvider: Connecting to ResourceManager at resourcemanager/172.18.0.2:8032
2021-10-14 00:59:03,074 INFO client.AHSPProxy: Connecting to Application History server at timelineserver/172.18.0.8:10200
Total Nodes:1
Node-Id Node-State Node-Http-Address Number-of-Running-Containers
datanode5:43389 RUNNING datanode5:8042 0
hdadmin@namenode:~$

```

Tras añadir el datanode5 al fichero **dfs.include** y actualizar el NameNode vemos como ahora sí que se ha añadido al HDFS, tal y como se muestra en la siguiente captura donde podemos ver la información del datanode5 añadido:

```

Cache Remaining: 0 (0 B)
Cache Used%: 100.00%
Cache Remaining%: 0.00%
Xceivers: 0
Last contact: Thu Oct 14 01:01:15 CEST 2021
Last Block Report: Thu Oct 14 00:34:38 CEST 2021
Num of Blocks: 23

Name: 172.18.0.7:9866 (datanode5.hadoop-cluster)
Hostname: datanode5
Decommission Status : Normal
Configured Capacity: 31569420288 (29.40 GB)
DFS Used: 24576 (24 KB)
Non DFS Used: 11959304192 (11.14 GB)
DFS Remaining: 17982857216 (16.75 GB)
DFS Used%: 0.00%
DFS Remaining%: 56.96%
Configured Cache Capacity: 0 (0 B)
Cache Used: 0 (0 B)
Cache Remaining: 0 (0 B)
Cache Used%: 100.00%
Cache Remaining%: 0.00%
Xceivers: 0
Last contact: Thu Oct 14 01:01:15 CEST 2021
Last Block Report: Thu Oct 14 01:00:21 CEST 2021
Num of Blocks: 0

hdadmin@namenode:~/hadoop/etc/hadoop$

```

Finalmente, forzamos el balanceo del clúster ejecutando el comando **hdfs balancer**. Antes de ejecutar el balanceo el nodo datanode5 tiene 25 bloques:

In operation

DataNode State: All Show: 25 entries Search:

Node	Http Address	Last contact	Last Block Report	Used	Non DFS Used	Capacity	Blocks	Block pool used	Version
✓/default-rack/datanode2-9866 (172.18.0.5:9866)	http://datanode2-9866	2s	4m	131.75 MB	11 GB	29.4 GB	58	131.75 MB (0.44%)	3.3.1
✓/default-rack/datanode5-9866 (172.18.0.8:9866)	http://datanode5-9866	0s	0m	1.02 MB	11.12 GB	29.4 GB	25	1.02 MB (0%)	3.3.1
✓/default-rack/datanode3-9866 (172.18.0.6:9866)	http://datanode3-9866	2s	4m	259.99 MB	10.87 GB	29.4 GB	52	259.99 MB (0.86%)	3.3.1
✓/default-rack/datanode1-9866 (172.18.0.4:9866)	http://datanode1-9866	2s	4m	324.7 MB	10.81 GB	29.4 GB	64	324.7 MB (1.08%)	3.3.1
✓/default-rack/datanode4-9866 (172.18.0.7:9866)	http://datanode4-9866	1s	4m	263.96 MB	10.87 GB	29.4 GB	58	263.96 MB (0.88%)	3.3.1

Showing 1 to 5 of 5 entries

Previous **1** Next

La salida el balanceador de carga es la siguiente:

```

hdadmin@namenode: ~
Archivo Acciones Editar Vista Ayuda
tcdm@tcdm-docker: ~ hdadmin@namenode: ~
hdadmin@namenode:~$ hdfs balancer
2021-10-14 01:01:46,957 INFO balancer.Balancer: namenodes = [hdfs://namenode:9000]
2021-10-14 01:01:46,961 INFO balancer.Balancer: parameters = Balancer.BalancerParameters [BalancingPolicy.Node, threshold = 10.0, max idle iteration = 5, #excluded nodes = 0, #included nodes = 0, #source nodes = 0, #blockpools = 0, run during upgrade = false]
2021-10-14 01:01:46,962 INFO balancer.Balancer: included nodes = []
2021-10-14 01:01:46,962 INFO balancer.Balancer: excluded nodes = []
2021-10-14 01:01:46,962 INFO balancer.Balancer: source nodes = []
Time Stamp Iteration# Bytes Already Moved Bytes Left To Move Bytes Being Moved NameNode
2021-10-14 01:01:46,966 INFO balancer.NameNodeConnector: getBlocks calls for hdfs://namenode:9000 will be rate-limited to 20 per second
2021-10-14 01:01:48,932 INFO balancer.Balancer: dfs.namenode.get-blocks.max-qps = 20 (default=20)
2021-10-14 01:01:48,932 INFO balancer.Balancer: dfs.balancer.movedWinWidth = 5400000 (default=5400000)
2021-10-14 01:01:48,932 INFO balancer.Balancer: dfs.balancer.moverThreads = 1000 (default=1000)
2021-10-14 01:01:48,932 INFO balancer.Balancer: dfs.balancer.dispatcherThreads = 200 (default=200)
2021-10-14 01:01:48,932 INFO balancer.Balancer: dfs.balancer.getBlocks.size = 2147483648 (default=2147483648)
2021-10-14 01:01:48,932 INFO balancer.Balancer: dfs.balancer.getBlocks.min-block-size = 10485760 (default=10485760)
2021-10-14 01:01:48,932 INFO balancer.Balancer: dfs.datanode.balance.max.concurrent.moves = 100 (default=100)
2021-10-14 01:01:48,932 INFO balancer.Balancer: dfs.datanode.balance.bandwidthPerSec = 104857600 (default=104857600)
)
2021-10-14 01:01:48,940 INFO balancer.Balancer: dfs.balancer.max-size-to-move = 10737418240 (default=10737418240)
2021-10-14 01:01:48,940 INFO balancer.Balancer: dfs.blocksize = 67108864 (default=134217728)
2021-10-14 01:01:48,977 INFO net.NetworkTopology: Adding a new node: /default-rack/172.18.0.3:9866
2021-10-14 01:01:48,977 INFO net.NetworkTopology: Adding a new node: /default-rack/172.18.0.4:9866
2021-10-14 01:01:48,977 INFO net.NetworkTopology: Adding a new node: /default-rack/172.18.0.5:9866
2021-10-14 01:01:48,977 INFO net.NetworkTopology: Adding a new node: /default-rack/172.18.0.6:9866
2021-10-14 01:01:48,980 INFO balancer.Balancer: 0 over-utilized: []
2021-10-14 01:01:48,980 INFO balancer.Balancer: 0 underutilized: []
14-oct-2021 1:01:48 0 0 B 0 B 0 B 0
hdfs://namenode:9000
The cluster is balanced. Exiting...
14-oct-2021 1:01:49 Balancing took 2.59 seconds
hdadmin@namenode:~$

```

Como se puede ver se han movido 0 bytes de datos. Supongo que al estar todos los nodos muy poco llenos el balanceador considera que no es necesario enviar datos al datanode5. Si los nodos datanode{1..4} estuviesen muy llenos, sí que habrían un desbalanceo considerable en el clúster y esta operación hubiese movido algunos datos al datanode5.

3 RETIRAR UN DATANODE/NODEMANAGER

Como podemos ver, tras incluir el nodo datanode4 en los ficheros **dfs.exclude** y **yarn.exclude** y actualizar el NameNode y el ResourceManager podemos ver como el nodo aparece como decomisionado en la interfaz web del HDFS:

Datanode Information

In service (green check) Down (red circle) Decommissioning (green circle) Decommissioned (yellow circle) Decommissioned & dead (red circle)
 Entering Maintenance (green circle) In Maintenance (yellow circle) In Maintenance & dead (red circle)

Datanode usage histogram



In operation

DataNode State		All	Show	25	entries		Search:			
Node	Http Address	Last contact	Last Block Report	Used	Non DFS Used	Capacity	Blocks	Block pool used	Version	
✓/default-rack/datanode2-9866 (172.18.0.5:9866)	http://datanode2-9864	1s	4m	196.31 MB	11.18 GB	29.4 GB	<div><div></div></div> 63	196.31 MB (0.65%)	3.3.1	
✓/default-rack/datanode5-9866 (172.18.0.8:9866)	http://datanode5-9864	2s	7m	133.03 MB	11.24 GB	29.4 GB	<div><div></div></div> 49	133.03 MB (0.44%)	3.3.1	
✓/default-rack/datanode3-9866 (172.18.0.6:9866)	http://datanode3-9864	1s	12m	325.12 MB	11.05 GB	29.4 GB	<div><div></div></div> 61	325.12 MB (1.08%)	3.3.1	
✓/default-rack/datanode1-9866 (172.18.0.4:9866)	http://datanode1-9864	1s	12m	325.87 MB	11.05 GB	29.4 GB	<div><div></div></div> 59	325.87 MB (1.08%)	3.3.1	
⚠/default-rack/datanode4-9866 (172.18.0.7:9866)	http://datanode4-9864	0s	12m	264.04 MB	11.11 GB	29.4 GB	<div><div></div></div> 58	264.04 MB (0.88%)	3.3.1	

Showing 1 to 5 of 5 entries

Previous

1

Next

También podemos ver como en la interfaz web del YARN ya no aparece entre los nodos disponibles:



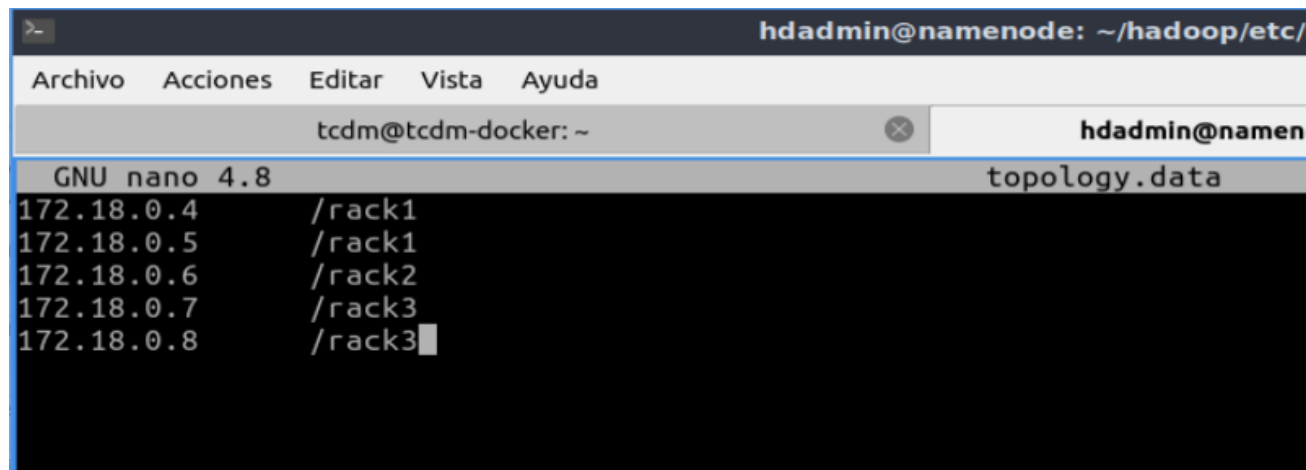
Nodes of the cluster

Cluster Metrics												
Apps Submitted	1	Apps Pending	0	Apps Running	0	Apps Completed	1	Containers Running	0	Used Resources	<memory:0 B, vCores:0>	Total Resources
												<memory:7.63 GB, vCores:16>
Reserved Res												<memory:0 B, vCores:0>
Cluster Nodes Metrics												
Active Nodes	4	Decommissioning Nodes	0	Decommissioned Nodes	1	Lost Nodes	0	Unhealthy Nodes	0			
Scheduler Metrics												
Scheduler Type	Capacity Scheduler	Scheduling Resource Type	[memory-mb (unit=Mi), vcores]	Minimum Allocation	<memory:128, vCores:1>	Maximum Allocation	<memory:1953, vCores:1>	Maximum	0			
Show	20	entries										
Node Labels	Rack	Node State	Node Address	Node HTTP Address	Last health-update	Health-report	Containers	Allocation Tags	Mem Used	Mem Avail	Phys M Used	
/default-rack		RUNNING	datanode1:40605	datanode1:8042	jue oct 14 01:35:01 +0200 2021		0		0 B	1.91 GB	74	
/default-rack		RUNNING	datanode5:39003	datanode5:8042	jue oct 14 01:34:50 +0200 2021		0		0 B	1.91 GB	74	
/default-rack		RUNNING	datanode3:36771	datanode3:8042	jue oct 14 01:35:03 +0200 2021		0		0 B	1.91 GB	74	
/default-rack		RUNNING	datanode2:39275	datanode2:8042	jue oct 14 01:35:01 +0200 2021		0		0 B	1.91 GB	74	

Showing 1 to 4 of 4 entries

4 RACK AWARENESS

Para terminar, llevamos a cabo los pasos indicados en el enunciado. El contenido del fichero **topology.data** es el siguiente:

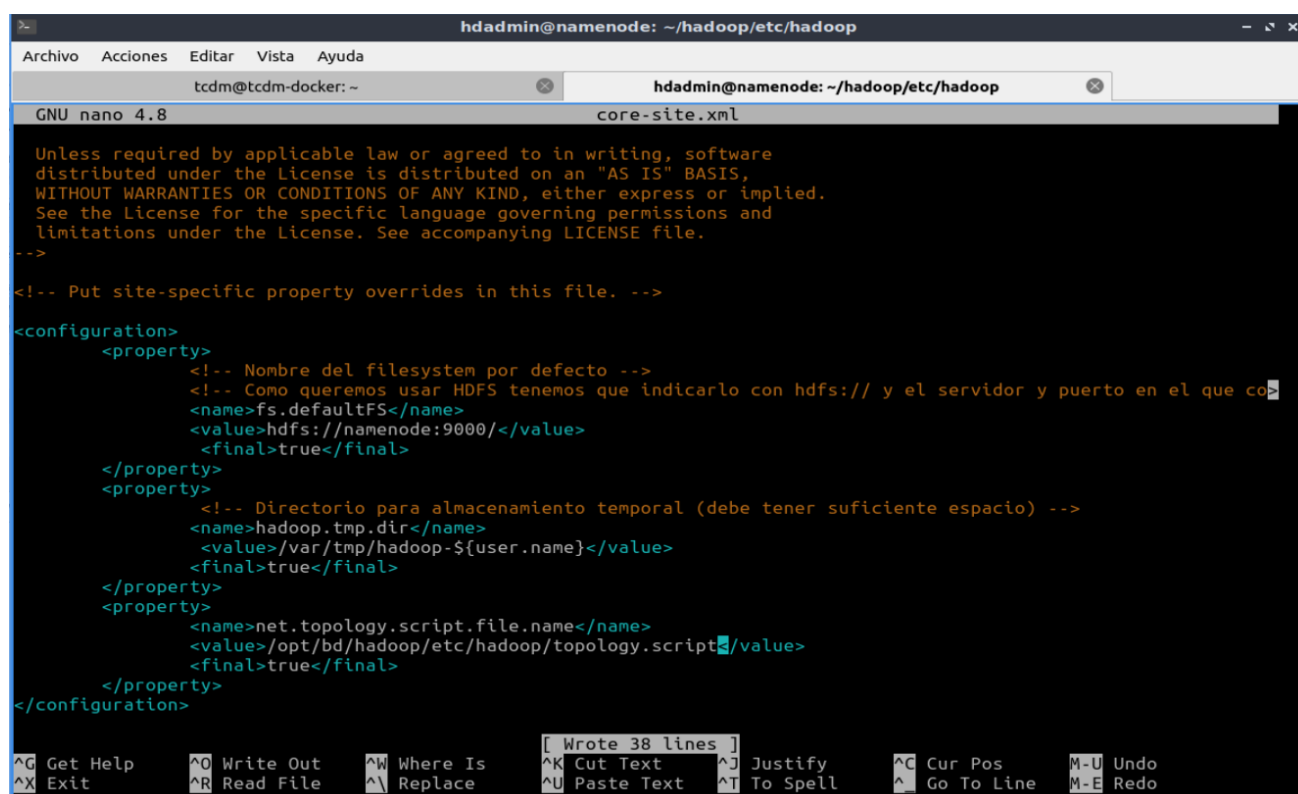


```

hdadmin@namenode: ~/hadoop/etc/
Archivo Acciones Editar Vista Ayuda
tcdm@tcdm-docker: ~ hdadmin@namenode: ~/hadoop/etc/
GNU nano 4.8 topology.data
172.18.0.4 /rack1
172.18.0.5 /rack1
172.18.0.6 /rack2
172.18.0.7 /rack3
172.18.0.8 /rack3

```

La propiedad mediante la cual indicamos el path al script creado:

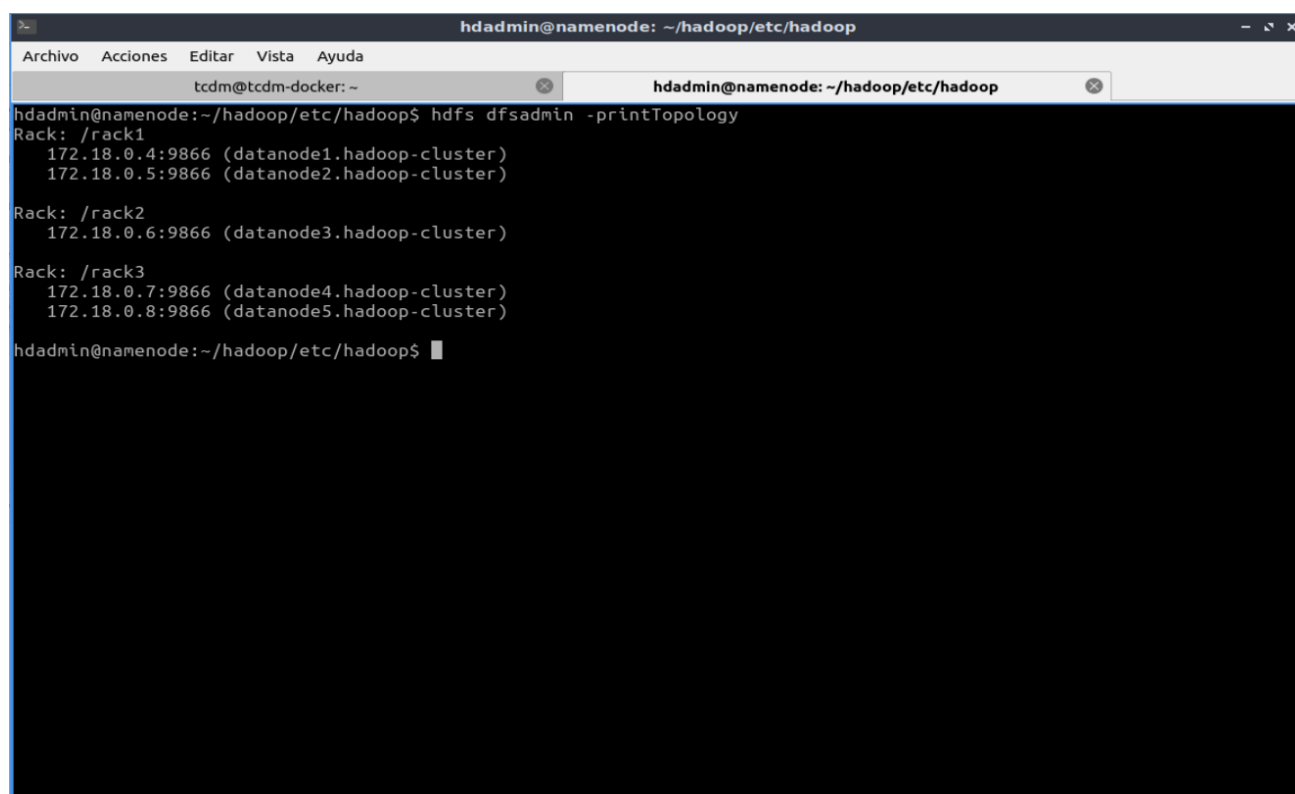


```

hdadmin@namenode: ~/hadoop/etc/hadoop
Archivo Acciones Editar Vista Ayuda
tcdm@tcdm-docker: ~ hdadmin@namenode: ~/hadoop/etc/hadoop
GNU nano 4.8 core-site.xml
Unless required by applicable law or agreed to in writing, software
distributed under the License is distributed on an "AS IS" BASIS,
WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.
See the License for the specific language governing permissions and
limitations under the License. See accompanying LICENSE file.
-->
<!-- Put site-specific property overrides in this file. -->
<configuration>
  <property>
    <!-- Nombre del filesystem por defecto -->
    <!-- Como queremos usar HDFS tenemos que indicarlo con hdfs:// y el servidor y puerto en el que co>
    <name>fs.defaultFS</name>
    <value>hdfs://namenode:9000</value>
    <final>true</final>
  </property>
  <property>
    <!-- Directorio para almacenamiento temporal (debe tener suficiente espacio) -->
    <name>hadoop.tmp.dir</name>
    <value>/var/tmp/hadoop-${user.name}</value>
    <final>true</final>
  </property>
  <property>
    <name>net.topology.script.file.name</name>
    <value>/opt/bd/hadoop/etc/hadoop/topology.script</value>
    <final>true</final>
  </property>
</configuration>
[ Wrote 38 lines ]
^G Get Help ^O Write Out ^W Where Is ^K Cut Text ^J Justify ^C Cur Pos M-U Undo
^X Exit ^R Read File ^\ Replace ^U Paste Text ^T To Spell ^_ Go To Line M-E Redo

```

Y por último, la salida del comando **hdfs dfsadmin -printTopology** en la que se ve que la distribución por racks se llevó a cabo de manera correcta:



The screenshot shows a terminal window titled "hdadmin@namenode: ~/hadoop/etc/hadoop". The terminal displays the output of the command "hdfs dfsadmin -printTopology". The output lists the topology of the HDFS cluster, showing three racks and the datanodes belonging to each rack.

```
hdadmin@namenode:~/hadoop/etc/hadoop$ hdfs dfsadmin -printTopology
Rack: /rack1
  172.18.0.4:9866 (datanode1.hadoop-cluster)
  172.18.0.5:9866 (datanode2.hadoop-cluster)

Rack: /rack2
  172.18.0.6:9866 (datanode3.hadoop-cluster)

Rack: /rack3
  172.18.0.7:9866 (datanode4.hadoop-cluster)
  172.18.0.8:9866 (datanode5.hadoop-cluster)

hdadmin@namenode:~/hadoop/etc/hadoop$
```