Cluster de Hadoop en Docker
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Tarefa 1

Apartado 1

Entrega 1

Na seguinte imaxe podemos ver o output do servicio de backup, marcada en verde a última entrada onde se referencia á creación do checkpoint. No Anexo 1 inclúo a imaxe en vertical para facilitar a súa visión.
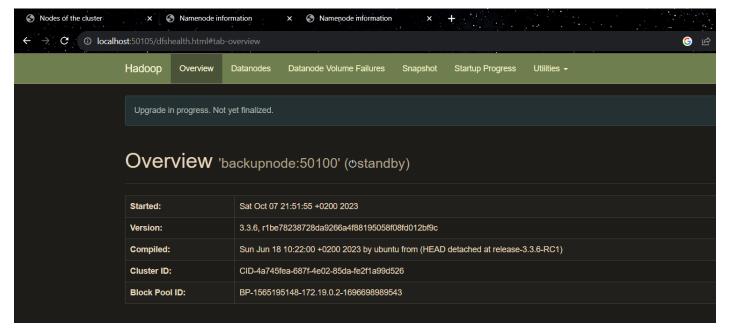

Entrega 2

A primeira imaxe representa o contido da carpeta /var/data/hdfs/namenode/current do Namenode, onde a primeira saída (enriba da liña verde) é antes de realizar o backup e a segunda saída (dentro do cadrado laranxa) mostra o estado da carpeta despois de realizar o backup:

Agora podemos os contidos de /var/data/backupnode/dfs/name/current onde podemos ver como ten ficheiros que corresponden ás "fsimage_0...371" do Namenode:

Entrega 3

Aquí podemos ver a imaxe da interface web do backup:
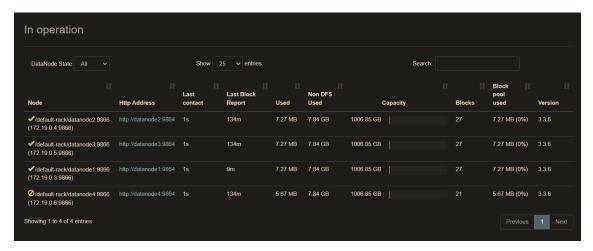

Apartado 2

Entrega 1

Este é unha imaxe da interface web do TimeLineServer despois de executar o MapReduce de calculo de pi:
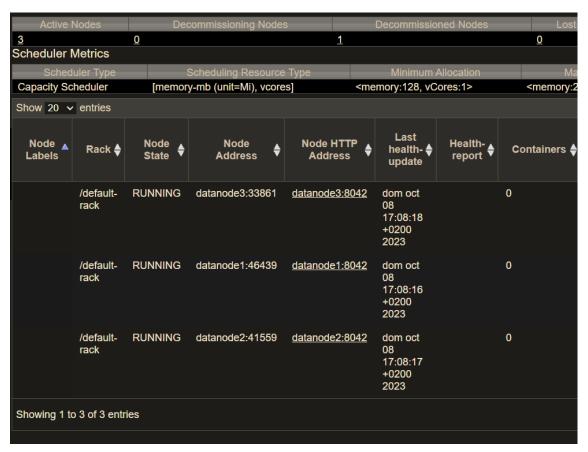
Tarefa 2

Podemos ver na interface web de HDFS que datanode4 está decomisionado:

Mentres que na interface web de YARN xa non aparece:

Tarefa 3

Entrega 1

No seguinte codigo podemos ver un extracto do output de cada comando onde se mostran os daemons namenode e resourcemanager engadindo os nodos contidos nos ficheiros .include:

```
        cat hadoop/logs/hadoop-hdadmin-namenode-namenode.log
2023-10-08 18:44:39,817 INFO org.apache.hadoop.hdfs.server.common.Util:
dfs.datanode.fileio.profiling.sampling.percentage set to 0. Disabling file IO profiling
2023-10-08 18:44:40,027 INFO org.apache.hadoop.util.HostsFileReader: Adding a node "datanode1" to the list of
included hosts from /opt/bd/hadoop/etc/hadoop/dfs.include
2023-10-08 18:44:40,028 INFO org.apache.hadoop.util.HostsFileReader: Adding a node "datanode2" to the list of
included hosts from /opt/bd/hadoop/etc/hadoop/dfs.include
2023-10-08 18:44:40,028 INFO org.apache.hadoop.util.HostsFileReader: Adding a node "datanode3" to the list of
included hosts from /opt/bd/hadoop/etc/hadoop/dfs.include
2023-10-08 18:44:40,028 INFO org.apache.hadoop.util.HostsFileReader: Adding a node "datanode5" to the list of
included hosts from /opt/bd/hadoop/etc/hadoop/dfs.include
2023-10-08 18:44:40,028 INFO org.apache.hadoop.util.HostsFileReader: Adding a node "datanode6" to the list of
included hosts from /opt/bd/hadoop/etc/hadoop/dfs.include

        cat hadoop/logs/hadoop-hdadmin-resourcemanager-namenode.log
2023-10-08 17:20:24,064 INFO org.apache.hadoop.util.HostsFileReader: Adding a node "datanode1" to the list of
included hosts from /opt/bd/hadoop/etc/hadoop/yarn.include
2023-10-08 17:20:24,064 INFO org.apache.hadoop.util.HostsFileReader: Adding a node "datanode2" to the list of
included hosts from /opt/bd/hadoop/etc/hadoop/yarn.include
2023-10-08 17:20:24,064 INFO org.apache.hadoop.util.HostsFileReader: Adding a node "datanode3" to the list of
included hosts from /opt/bd/hadoop/etc/hadoop/yarn.include
2023-10-08 17:20:24,064 INFO org.apache.hadoop.util.HostsFileReader: Adding a node "datanode5" to the list of
included hosts from /opt/bd/hadoop/etc/hadoop/yarn.include
2023-10-08 17:20:24,064 INFO org.apache.hadoop.util.HostsFileReader: Adding a node "datanode6" to the list of
included hosts from /opt/bd/hadoop/etc/hadoop/yarn.include
2023-10-08 17:20:24,065 INFO org.apache.hadoop.yarn.server.resourcemanager.NodesListManager: hostsReader
include:{datanode5,datanode6,datanode1,datanode2,datanode3} exclude:{}
```

Entrega 2

Para engadir un datanode primeiro debemos engadilo os ficheiros dfs.include e yarn.include, con un salto de liña entre cada entrada dos ficheiros:

```
nano hadoop/etc/hadoop/dfs.include:
datanodeX

nano hadoop/etc/hadoop/yarn.include:
datanodeX
```

Despois temos que recargar os servicios de hdfs e yarn coa nova información:

```
hdfs dfsadmin -refreshNodes
yarn rmadmin -refreshNodes
```

Agora levantamos a máquina que soportará o datanode creado, neste caso empregamos a imaxe creada durante a práctica "datanode-imaxe":

```
docker container run -d --name datanode5 --network=hadoop-cluster --hostname datanode5 --cpus=1 --memory=3072m --expose 8000-10000 --expose 50000-50200 datanode-image /inicio.sh
```

Por último, no meu caso tiven que refrescar de novo o servicio hdfs xa que mentres yarn detectava o datanode automaticamente hdfs non:

```
hdfs dfsadmin -refreshNodes
```

Entrega 3

Mediante o comando "hdfs balancer -threshold 1" iniciamos o balanceador de carga, obtendo o output:

```
2023-10-08 17:42:53,371 INFO balancer.Balancer: Using a threshold of 1.0
2023-10-08 17:42:53,373 INFO balancer.Balancer: namenodes  = [hdfs://namenode:9000]
2023-10-08 17:42:53,374 INFO balancer.Balancer: parameters = Balancer.BalancerParameters
[BalancingPolicy.Node, threshold = 1.0, max idle iteration = 5, #excluded nodes = 0, #included nodes = 0, #source nodes = 0, #blockpools = 0, run during upgrade = false]
2023-10-08 17:42:53,374 INFO balancer.Balancer: included nodes = []
2023-10-08 17:42:53,375 INFO balancer.Balancer: excluded nodes = []
2023-10-08 17:42:53,375 INFO balancer.Balancer: source nodes = []
Time Stamp          Iteration#  Bytes Already Moved  Bytes Left To Move  Bytes Being Moved  NameNode
2023-10-08 17:42:53,378 INFO balancer.NameNodeConnector: getBlocks calls for hdfs://namenode:9000 will be rate-limited to 20 per second
2023-10-08 17:42:54,887 INFO balancer.Balancer: dfs.namenode.get-blocks.max-qps = 20 (default=20)
2023-10-08 17:42:54,887 INFO balancer.Balancer: dfs.balancer.movedWinWidth = 5400000 (default=5400000)
2023-10-08 17:42:54,887 INFO balancer.Balancer: dfs.balancer.moverThreads = 1000 (default=1000)
2023-10-08 17:42:54,887 INFO balancer.Balancer: dfs.balancer.dispatcherThreads = 200 (default=200)
2023-10-08 17:42:54,888 INFO balancer.Balancer: dfs.balancer.getBlocks.size = 2147483648 (default=2147483648)
2023-10-08 17:42:54,888 INFO balancer.Balancer: dfs.balancer.getBlocks.min-block-size = 10485760 (default=10485760)
2023-10-08 17:42:54,888 INFO balancer.Balancer: dfs.datanode.balance.max.concurrent.moves = 100 (default=100)
2023-10-08 17:42:54,888 INFO balancer.Balancer: dfs.datanode.balance.bandwidthPerSec = 104857600 (default=104857600)
2023-10-08 17:42:54,894 INFO balancer.Balancer: dfs.balancer.max-size-to-move = 10737418240 (default=10737418240)
2023-10-08 17:42:54,894 INFO balancer.Balancer: dfs.blocksize = 67108864 (default=134217728)
2023-10-08 17:42:54,916 INFO net.NetworkTopology: Adding a new node: /default-rack/172.19.0.5:9866
2023-10-08 17:42:54,916 INFO net.NetworkTopology: Adding a new node: /default-rack/172.19.0.3:9866
2023-10-08 17:42:54,916 INFO net.NetworkTopology: Adding a new node: /default-rack/172.19.0.4:9866
2023-10-08 17:42:54,916 INFO net.NetworkTopology: Adding a new node: /default-rack/172.19.0.9:9866
2023-10-08 17:42:54,916 INFO net.NetworkTopology: Adding a new node: /default-rack/172.19.0.10:9866
2023-10-08 17:42:54,919 INFO balancer.Balancer: 0 over-utilized: []
2023-10-08 17:42:54,919 INFO balancer.Balancer: 0 underutilized: []
08-oct-2023 17:42:54          0          0 B          0 B          0 B          0  hdfs://namenode:9000
The cluster is balanced. Exiting...
08-oct-2023 17:42:54    Balancing took 1.9 seconds
```

Como podemos ver, non se moveron bloques debido a que a carga era moi baixa.

Entrega 4

Nesta imaxe podemos ver a topografía do sistema con 3 racks:

```
hdadmin@namenode:~$ hdfs dfsadmin -printTopology
Rack: /rack1
   172.19.0.4:9866 (datanode2.hadoop-cluster) In Service
   172.19.0.3:9866 (datanode1.hadoop-cluster) In Service

Rack: /rack2
   172.19.0.5:9866 (datanode3.hadoop-cluster) In Service

Rack: /rack3
   172.19.0.10:9866 (datanode6.hadoop-cluster) In Service
   172.19.0.9:9866 (datanode5.hadoop-cluster) In Service
```

Anexo 1

```
2023-10-07 21:21:43,429 INFO http.HttpServer2: Jetty bound to port 50105
2023-10-07 21:21:43,431 INFO server.Server: jetty-9.4.51.v20230217; built: 2023-02-17T08:19:37.309Z; git: b45c405e45443844e066f814ed42ae3dceacd449; jvm 1.8.0_382-8u382-ga-1-22.04.1-b05
2023-10-07 21:21:43,536 INFO server.session: DefaultSessionIdManager workerName=node0
2023-10-07 21:21:43,536 INFO server.session: No SessionScavenger set, using defaults
2023-10-07 21:21:43,538 INFO server.session: node0 Scavenging every 600000ms
2023-10-07 21:21:43,629 WARN server.AuthenticationFilter: Unable to initialize FileSignerSecretProvider, falling back to use random secrets. Reason: Could not read signature secret file: /opt/bd/hadoop-http-auth-signature-secret
2023-10-07 21:21:43,636 INFO handler.ContextHandler: Started o.e.j.s.ServletContextHandler@1097Sdd8{logs,/logs,file:///opt/bd/hadoop/logs/,AVAILABLE}
2023-10-07 21:21:43,637 INFO handler.ContextHandler: Started o.e.j.s.ServletContextHandler@57f64f5e{static,/static,file:///opt/bd/hadoop-3.3.6/share/hadoop/hdfs/webapps/static/,AVAILABLE}
2023-10-07 21:21:43,874 INFO handler.ContextHandler: Started o.e.j.w.WebAppContext@13d186db{hdfs,/,file:///opt/bd/hadoop-3.3.6/share/hadoop/hdfs/webapps/hdfs/,AVAILABLE}{file:/opt/bd/hadoop-3.3.6/share/hadoop/hdfs/webapps/hdfs}
2023-10-07 21:21:43,885 INFO server.AbstractConnector: Started ServerConnector@0c16548{HTTP/1.1, (http/1.1)}{backupnode:50105}
2023-10-07 21:21:43,885 INFO server.Server: Started @437lms
2023-10-07 21:21:43,927 INFO ipc.Server: IPC Server Responder: starting
2023-10-07 21:21:43,928 INFO ipc.Server: IPC Server listener on 50100: starting
2023-10-07 21:21:43,936 INFO namenode.NameNode: Backup Node RPC up at: backupnode/172.19.0.7:50100
2023-10-07 21:21:43,952 INFO hdfs.StateChange: STATE* Safe mode is ON.
It was turned on manually. Use "hdfs dfsadmin -safemode leave" to turn safe mode off.
2023-10-07 21:21:43,963 INFO namenode.FileJournalManager: Recovering unfinalized segments in /var/data/backupnode/dfs/name/current
2023-10-07 21:21:44,000 INFO namenode.Checkpointer: Checkpoint Period : 3600 secs (60 min)
2023-10-07 21:21:44,000 INFO namenode.Checkpointer: Transactions count is : 1000000, to trigger checkpoint
2023-10-07 21:21:44,001 INFO namenode.FSNamesystem: Starting services required for active state
2023-10-07 21:21:44,001 INFO namenode.FSDirectory: Initializing quota with 12 thread(s)
2023-10-07 21:21:44,013 INFO namenode.FSDirectory: Quota initialization completed in 11 milliseconds
name space=1
storage space=0
storage types=RAW_DISK=0, SSD=0, DISK=0, ARCHIVE=0, PROVIDED=0
2023-10-07 21:21:44,029 INFO blockmanagement.CacheReplicationMonitor: Starting CacheReplicationMonitor with interval 30000 milliseconds
2023-10-07 21:21:44,227 INFO namenode.FSEditLog: Starting log segment at txid 372
2023-10-07 21:21:44,228 INFO namenode.FSEditLog: Starting log segment at 372
2023-10-07 21:21:44,425 INFO namenode.TransferFsImage: Opening connection to http://namenode:9870/imagetransfer?getedit=1&startTxId=1&endTxId=1&storageInfo=-66:192287734:1696698989543:CID-4a745fea-687f-4e02-85da-fe2f1a99d526
2023-10-07 21:21:44,496 INFO common.Util: Combined time for file download and fsync to all disks took 0.01s. The file download took 0.01s at 7314,28 KB/s. Synchronous (fsync) write to disk of /var/data/backupnode/dfs/name/current/edits_tmp_0000000000000000001-0000000000000001_0000000000009868698 took 0,01s.
2023-10-07 21:21:44,496 INFO namenode.TransferFsImage: Downloaded file edits_tmp_0000000000000000001-0000000000000001_0000000000009868698 size 0 bytes.
2023-10-07 21:21:44,499 INFO namenode.TransferFsImage: Opening connection to http://namenode:9870/imagetransfer?getedit=1&startTxId=2&endTxId=371&storageInfo=-66:192287734:1696698989543:CID-4a745fea-687f-4e02-85da-fe2f1a99d526
2023-10-07 21:21:44,506 INFO common.Util: Combined time for file download and fsync to all disks took 0,00s. The file download took 0,00s at 42000,00 KB/s. Synchronous (fsync) write to disk of /var/data/backupnode/dfs/name/current/edits_tmp_0000000000000000002-0000000000000000371_0000000000009868772 took 0,00s.
2023-10-07 21:21:44,506 INFO namenode.TransferFsImage: Downloaded file edits_tmp_0000000000000000002-0000000000000000371_0000000000009868772 size 0 bytes.
2023-10-07 21:21:44,511 INFO namenode.Checkpointer: Checkpointer about to load edits from 2 stream(s).
2023-10-07 21:21:44,521 INFO namenode.FSImage: Reading /var/data/backupnode/dfs/name/current/edits_0000000000000000001-0000000000000000001 expecting start txid #1
2023-10-07 21:21:44,521 INFO namenode.FSImage: Start loading edits file /var/data/backupnode/dfs/name/current/edits_0000000000000000001-0000000000000000001 maxTxnsToRead = 9223372036854775807
2023-10-07 21:21:44,580 INFO namenode.FSImage: Loaded 1 edits file(s) (the last named /var/data/backupnode/dfs/name/current/edits_0000000000000000001-0000000000000000001) of total size 1048576,0, total edits 1,0, total load time 33,0 ms
2023-10-07 21:21:44,761 INFO namenode.NameCache: initialized with 0 entries 0 lookups
2023-10-07 21:21:44,761 INFO namenode.LeaseManager: Number of blocks under construction: 0
2023-10-07 21:21:44,848 INFO namenode.FSImageFormatProtobuf: Saving image file /var/data/backupnode/dfs/name/current/fsimage.ckpt_0000000000000000371 using no compression
2023-10-07 21:21:45,143 INFO namenode.FSImageFormatProtobuf: Image file /var/data/backupnode/dfs/name/current/fsimage.ckpt_0000000000000000371 of size 3686 bytes saved in 0 seconds .
2023-10-07 21:21:45,156 INFO namenode.FSImageTransactionalStorageInspector: No version file in /var/data/backupnode/dfs/name
2023-10-07 21:21:45,162 INFO namenode.FSImageTransactionalStorageInspector: No version file in /var/data/backupnode/dfs/name
2023-10-07 21:21:45,255 INFO namenode.TransferFsImage: Image Transfer timeout configured to 60000 milliseconds
2023-10-07 21:21:45,258 INFO namenode.TransferFsImage: Sending fileName: /var/data/backupnode/dfs/name/current/fsimage_0000000000000000371, fileSize: 3686. Sent total: 3686 bytes. Size of last segment intended to send: -1 bytes.
2023-10-07 21:21:45,282 INFO namenode.TransferFsImage: Uploaded image with txid 371 to namenode at http://namenode:9870 in 0.05 seconds
2023-10-07 21:21:45,295 INFO namenode.FSImage: Going to finish converging with remaining 1 txns from in-progress stream org.apache.hadoop.hdfs.server.namenode.RedundantEditLogInputStream@15d38549
2023-10-07 21:21:45,296 INFO namenode.RedundantEditLogInputStream: Fast-forwarding stream '/var/data/backupnode/dfs/name/current/edits_inprogress_0000000000000000372' to transaction ID 372
2023-10-07 21:21:45,298 INFO namenode.FSImage: Successfully synced BackupNode with NameNode at txnid 372
2023-10-07 21:21:45,298 INFO namenode.Checkpointer: Checkpoint completed in 1 seconds. New Image Size: 3686
```