Apache Hadoop

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Hadoop Running Modes

We can use hadoop in three modes:

- ▶ *Standalone mode*: Everything runs in a single process. Useful for debugging.
- ▶ *Pseudo-distributed mode*: Multiple processes as in distributed mode but they all run on one host. Again useful for debugging distributed mode of operation before unleashing it on a real cluster.
- ▶ *Distributed mode*: "The real thing!" Multiple processes running on multiple machines.
    - ▶ These are typically multi-user Hadoop clusters with appropriate security and access controls.
    - ▶ Users can stage data in and out and run MapReduce commands. They do not have any administrative access to the cluster.

Hadoop Clusters

- *Private Production Cluster*: A dedicated set of systems, which could be hosted on-site or in the cloud, but are typically controlled only by your organization. These clusters are typically not visible outside the organization.
  - The cscluster is a dedicated cluster with the head node `cscluster00` and 8 worker nodes (`cscluster01 ... cscluster08`). The cscluster00 head node isn't visible outside of the Boise State domain.
  - Typically, the worker nodes are on a private subnet and not accessible directly outside of the head node.
- *Ad hoc Cluster*: Here we grab random machines that we have access to create a cluster on the fly, use it, and then destroy it.
- Clusters in the Clouds: Aamazon Web Services supports Hadoop and Spark clusters that are created on demand and can be scaled automatically. Microsoft Azure has similar capabilities.

Port Forwarding (aka Tunneling) to Access Hadoop Web Interface

- ► Use ssh port forwarding to enable access to Hadoop ports from a browser at home. We will need to forward ports 9870 and 8088. Let us see how to forward one port first.
- ► To forward one port, log in to `cscluster00.boisestate.edu` as follows:
  ```
  ssh -Y -L 9870:localhost:9870 cscluster00.boisestate.edu
  ```
- ► Then point browser on your local system to `localhost:9870` and you will have access to the Hadoop web interface without physical presence in the lab or the slow speed of running a browser remotely.
- ► To forward multiple ports, use multiple `-L` options as follows:
  ```
  ssh -Y -L 9870:localhost:9870 -L 8088:localhost:8088
      cscluster00.boisestate.edu
  ```
- ► To tunnel via onyx to cscluster00 from your machine (at home)!
  ```
  ssh -L 9870:localhost:9870 onyx.boisestate.edu  ssh -L
      9870:localhost:9870 cscluster00
  ```

Fully Distributed Hadoop

Normally, Hadoop runs on a dedicated cluster. In that case, the setup is a bit more complex than for the pseudo-distributed case.

- Specify hostname or IP address of the master server in the values for fs.defaultFS in core-site.xml and and mapred.job.tracker in mapred-site.xml file. These are specified as host:port pairs. The default ports are 9000 and 9001.
- Specify directories for dfs.name.dir and dfs.data.dir and dfs.replication in conf/hdfs-site.xml. These are used to hold distributed file system data on the master node and worker nodes respectively. Note that dfs.data.dir may contain a space- or comma-separated list of directory names, so that data may be stored on multiple devices.
- Specify mapred.system.dir and mapred.local.dir in conf/hadoop-site.xml. The system directory must be accessible by server and clients. The local directory determines where temporary MapReduce data is written. It also may be a list of directories.

Fully Distributed Hadoop (contd.)

▶ Specify mapred.map.tasks (default value: 2) and mapred.reduce.tasks (default value: 1) in conf/mapred-site.xml. This is suitable for local or pseudo-distributed mode only. Choosing the right number of map and reduce tasks has significant effects on performance.

▶ Default Java memory size is 1000MB. This can be changed in conf/hadoop-env.sh. This is related to the parameters discussed above.

▶ List all worker host names or IP addresses in your conf/workers file, one per line. List name of master nodes (can be more than one) in conf/masters.

Sample Config Files

- Sample core-site.xml file.
- Sample hdfs-site.xml file.
- Sample mapred-site.xml file.

References

▶ *Hadoop: An open source implementation of MapReduce.* The main
  website: http://hadoop.apache.org/.
▶ Documentation for Hadoop 3.3.6:
  https://hadoop.apache.org/docs/r3.3.6/
▶ Documentation for Hadoop Cluster Setup:
  https://hadoop.apache.org/docs/r3.3.6/hadoop-project-dist/
  hadoop-common/ClusterSetup.html