Running Hadoop Programs on ambari-head.csc.calpoly.edu Cluster

Overview

This document contains information that is specific to running Hadoop programs on our local cluster.

CSLVM Hadoop Cluster

At the moment `hadoop` is installed on the `ambari-head.csc.calpoly.edu` cluster, which besides `ambari-head` contains four more nodes: `ambari-node01`, `ambari-node02`, `ambari-node03`, `ambari-node04`.

All your work with the cluster will take place on `ambari-head.csc.calpoly.edu`.

To successfully run Hadoop jobs on the cluster, you need to know the following.

Location of Hadoop Binaries. The `hadoop`, `hdfs`, and `yarn` binaries are located in `/usr/bin`.

Our `Hadoop` installation is version 2.7.3

Java Hadoop Package. Core Hadoop library is available in the `hadoop-core-1.2.1.jar` jar file. The file can be downloaded from the course web page:

http://users.csc.calpoly.edu/~dekhtyar/369-Winter2019/code/hadoop-core-1.2.1.jar

Note: This file may be out of date. We will provide a new `org.apache.hadoop` implementation once we discover it.

Compiling Hadoop code. To compile a Hadoop job located in file `myJob.java`, place the `hadoop-core-1.2.1.jar` file in the directory where `myJob.java` is located and run the following command from that directory:

```
$ javac --release 8 -cp hadoop-core-1.2.1.jar myJob.java
```

Note: The Java JDK currently installed on ambari-head.csc.calpoly.edu is Version 11, and the corresponding version of Java class files for it is 55. Hadoop understands Java class files of version 52 corresponding to Java Version 8. In order to use the V11 `javac` compiler, we need to explicitly downgrade the output class files to Version 8. We do this using the `--release 8` command parameter.

Additional Note: To stop prolifiration of the `hadoop-core-1.2.1.jar` I recommend creating a ∼`userid/jars` directory, placing the jar file there, and adding the `jars` directory to the classpath.

Making a Jar of your Hadoop Job. Hadoop allows running `.class` files only on local intallations. Our `Hadoop` is installed as a three-node cluster. On such installations, all Hadoop jobs must be packaged as jars.

To create a jar for your Hadoop job, run the following command (after compiling the code):

```
$ jar cvf myJob.jar *.class
```

Alternatively, you can create a simple `manifest.txt` file with the content:

```
Main-Class: myJob
```

and create a jar file using the command:

```
$ jar cvf myJob.jar manifest.txt *.class
```

Removing `.class` files. In some situations your jar files won't execute correctly unless you remove the `.class` files after creating the jar file.

Running your Hadoop Jobs. Once you created the jar file, you can run it as follows.

```
$ hadoop jar myJob.jar myJob <hadoop job arguments>
```

The last argument of the command *before* `<hadoop job arguments>` is the Java class that contains the `public static int main()` method. If you created your jar file with a `manifest.txt` file as as discussed above, you can omit the Java class name:

```
$ hadoop jar myJob.jar <hadoop job arguments>
```

`<hadoop job arguments>` are any of the command-line arguments you need to pass to the `public static int main()` of your program. Often these are the locations of the input files and output directory.

Alternative way to compile and run Hadoop jobs

This is a **better way**. It avoids having to use `org.apache.hadoop` jars, but it does require some extra settings in your `.bashrc` file.

Basic idea. `hadoop` is a launcher of JVMs. It can be used to launch **any** java process, including `javac`. When java compiler is launched this way, the `org.apache.hadoop` package is available at compile time without the need to explicitly include it into the classpath. This requries some setup though.

Please note: the instructions below work on the `cslvm57` (and will work on `cslvm56, cslvm55` if you are given access to those) specifically.

Step 1. Setting up environment. Add the following commands to your `.bashrc` file:

```
export JAVA_HOME=/usr/lib/jvm/java-8-openjdk-amd64
export PATH=${JAVA_HOME}/bin:${PATH}
export HADOOP_CLASSPATH=${JAVA_HOME}/lib/tools.jar
```

After that, execute (from your home directory)

```
$ source .bashrc
```

This will immediately create these variables and will allow you to continue work. `.bashrc` runs automatically upon every login, so from then on, you won't need to worry about these settings.

Step 2. Compilation and creation of jar. The reason why we created `$HADOOP_CLASSPATH` variable and pointed it to Java's `tools.jar` file is because it contains `javac` in it! The Java compiler resides in the following class:

```
com.sun.tools.javac.Main
```

We can run it through `hadoop` as follows:

```
$ hadoop  com.sun.tools.javac.Main myJob.java
```

This results in compilation of `myJob.java` with `org.apache.hadoop` classes present. We can now create the jar as before:

```
$ jar cvf myJob.jar *.class
```

Step 3. Execution. The final step is the same as above:

```
$ hadoop jar myJob.jar myJob <inputParameters>
```

Additional Information

Monitoring your job. Hadoop provides a web service allowing one to monitor the status of Hadoop jobs via a browser. Because cslvm55 does not have pinholes set, this is only possible if you are currently on campus, or running a campus VPN client on your machine.

The URL for the Hadoop monitor is

http://ambari-head.csc.calpoly.edu:8088/cluster

Third party Jars. For more complex Hadoop jobs you often may need third-party Jar files to be used with the `Mapper` and/or `Reducer` code. Because the `Mapper` and `Reducer` jobs run in separate JVMs on the cluster, their classpath environments are different than the classpath envoronment of the `public static int main()`. Fortunately, Hadoop allows us to pass third-party jars to the cluster JVMs using the `-libjars` option.

The full command to run a Hadoop job from myJob.jar file that relies on a third-party jar file `foo.jar` and another third party jar file `bar.jar`:

```
$ hadoop jar myJob.jar myJob -libjars foo.jar,bar.jar <hadoop job arguments>
```