Introduction

Hadoop is a Java-based programming framework that supports the processing and storage of extremely large datasets on a cluster of inexpensive machines. It was the first major open source project in the big data playing field and is sponsored by the Apache Software Foundation.

Hadoop 2.7 is comprised of four main layers:

- **Hadoop Common** is the collection of utilities and libraries that support other Hadoop modules.
- **HDFS**, which stands for Hadoop Distributed File System, is responsible for persisting data to disk.
- **YARN**, short for Yet Another Resource Negotiator, is the "operating system" for HDFS.
- **MapReduce** is the original processing model for Hadoop clusters. It distributes work within the cluster or map, then organizes and reduces the results from the nodes into a response to a query. Many other processing models are available for the 2.x version of Hadoop.

Hadoop clusters are relatively complex to set up, so the project includes a stand-alone mode which is suitable for learning about Hadoop, performing simple operations, and debugging.

In this tutorial, we'll install Hadoop in stand-alone mode and run one of the example example MapReduce programs it includes to verify the installation.

Prerequisites

To follow this tutorial, you will need:

- **An Ubuntu 16.04 / 18.04 server with a non-root user with `sudo` privileges**: You can learn more about how to set up a user with these privileges in our Initial Server Setup with Ubuntu 16.04 guide.

Once you've completed this prerequisite, you're ready to install Hadoop and its dependencies.

Before you begin, you might also like to take a look at An Introduction to Big Data Concepts and Terminology or An Introduction to Hadoop

Step 1 — Installing Java

To get started, we'll update our package list:

```
sudo apt-get update
```

Next, we'll install OpenJDK, the default Java Development Kit on Ubuntu 16.04 /18.04.

```
sudo apt-get install default-jdk
```

Once the installation is complete, let's check the version.

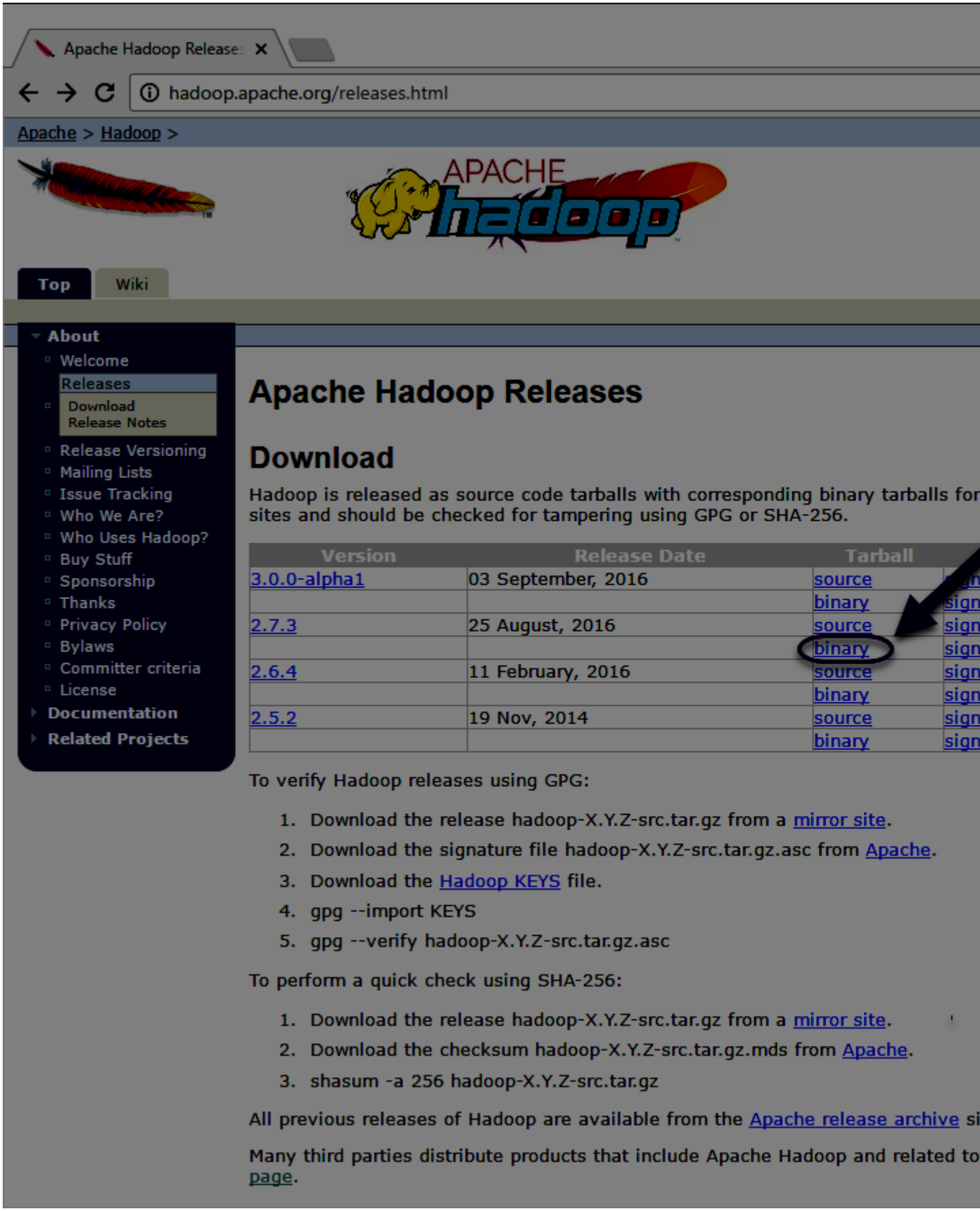
```
java -version
```

```
Output
openjdk version "1.8.0_91"
OpenJDK Runtime Environment (build 1.8.0_91-8u91-b14-3ubuntu1~16.04.1-b14)
OpenJDK 64-Bit Server VM (build 25.91-b14, mixed mode)
```

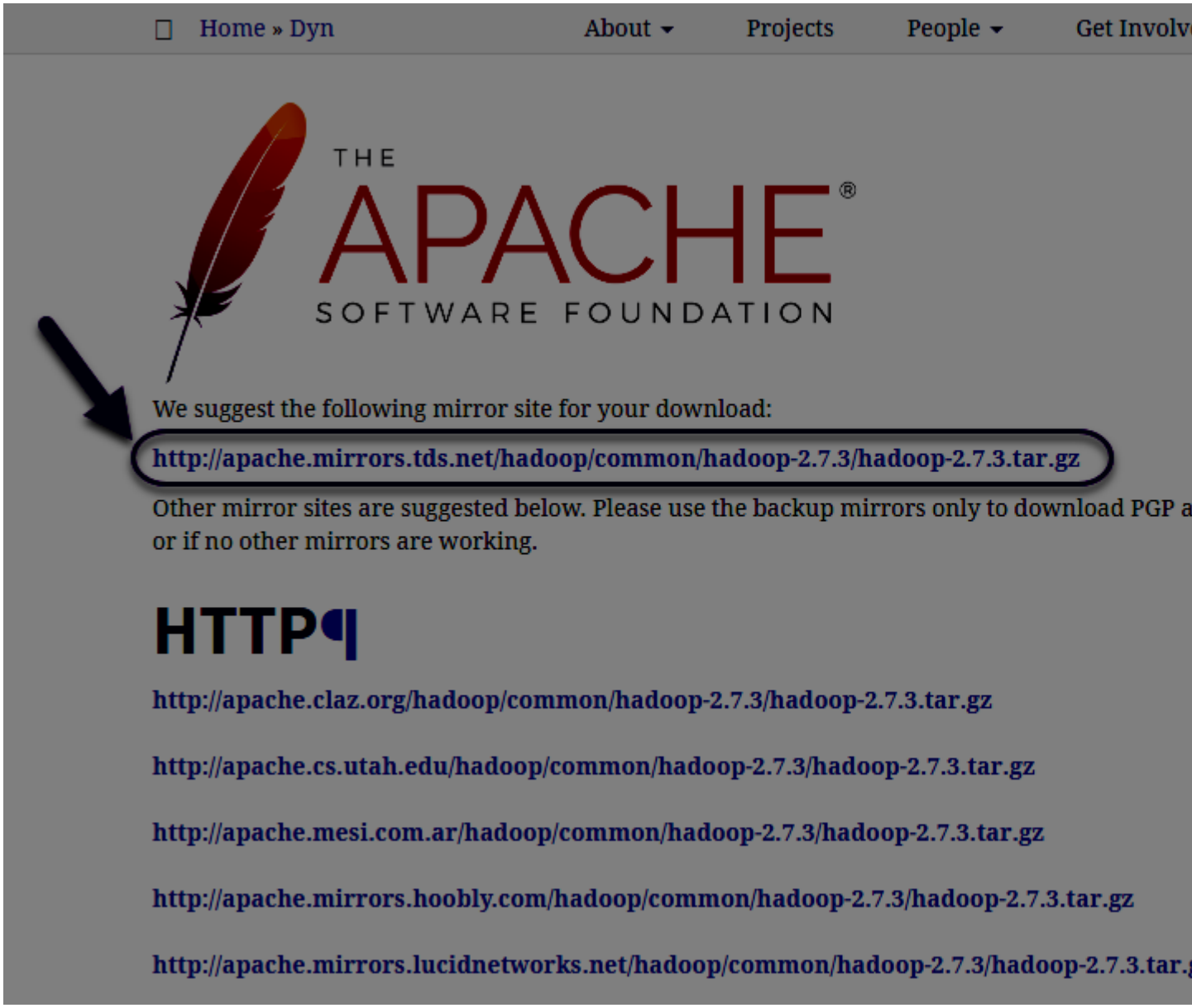
This output verifies that OpenJDK has been successfully installed. You may get a new version on your machine.

Step 2 — Installing Hadoop

With Java in place, we'll visit the Apache Hadoop Releases page to find the most recent stable release. Follow the binary for the current release:



On the next page, right-click and copy the link for the latest stable release binary.

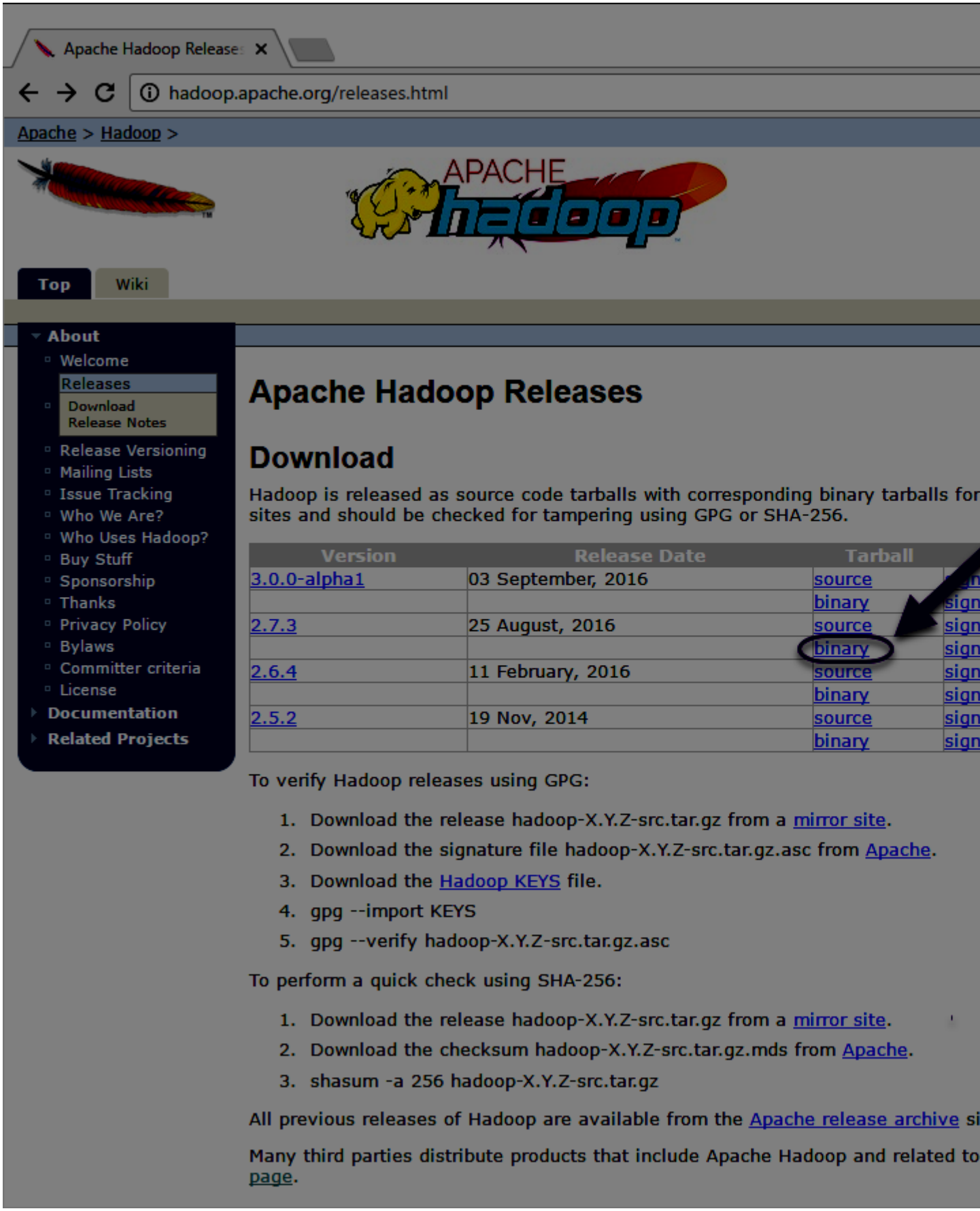


On the server, we'll use `wget` to fetch it:

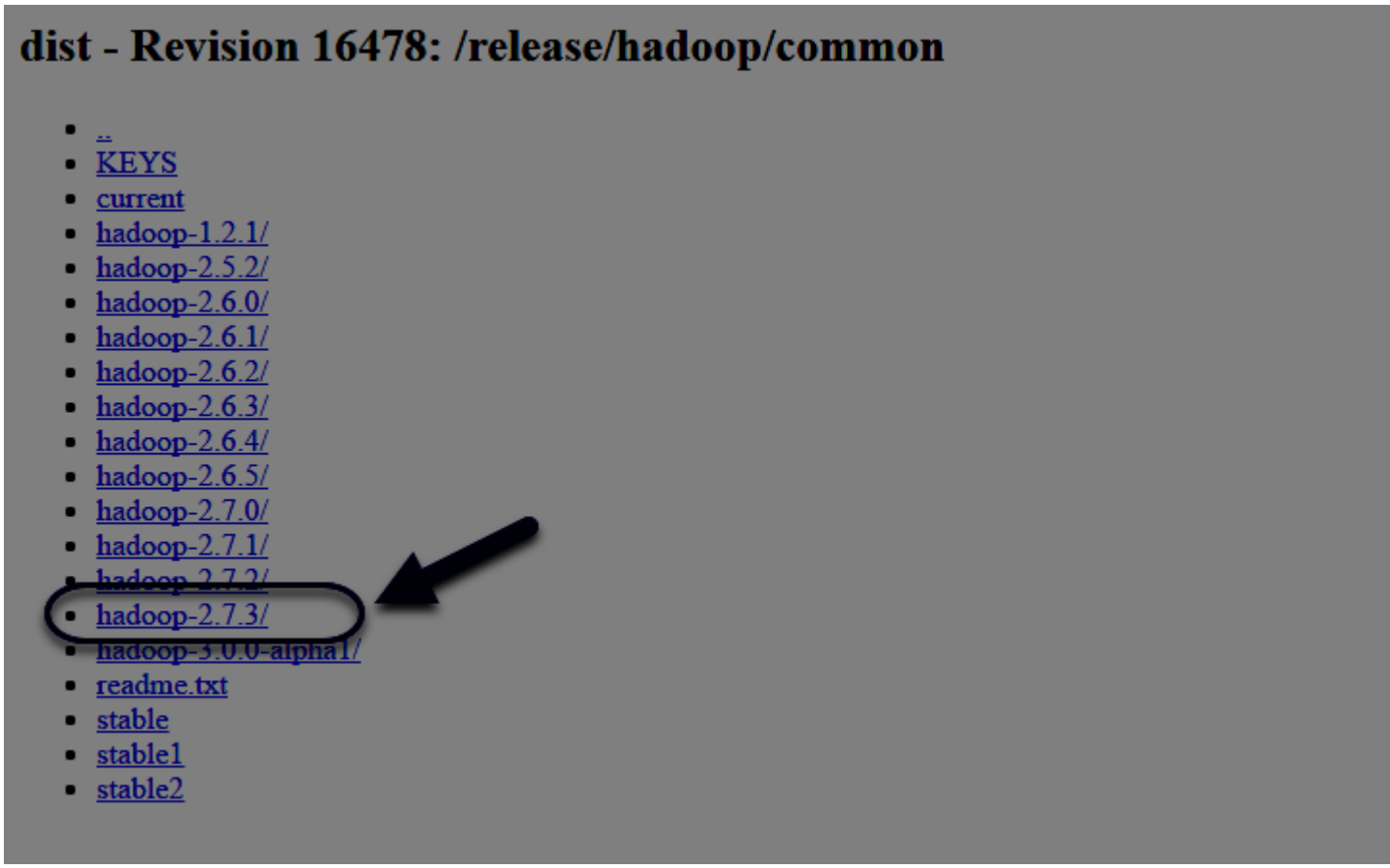
```
wget http://apache.mirrors.tds.net/hadoop/common/hadoop-2.7.3/hadoop-2.7.3.tar.gz
```

Note: The Apache website will direct you to the best mirror dynamically, so your URL may not match the URL above.

In order to make sure that the file we downloaded hasn't been altered, we'll do a quick check using SHA-256. Return the releases page, then follow the Apache link:


Apache Hadoop Release
hadoop.apache.org/releases.html
Apache > Hadoop >
APACHE hadoop
Top
Wiki
About
Welcome
Releases
Download
Release Notes
Release Versioning
Mailing Lists
Issue Tracking
Who We Are?
Who Uses Hadoop?
Buy Stuff
Sponsorship
Thanks
Privacy Policy
Bylaws
Committer criteria
License
Documentation
Related Projects
Apache Hadoop Releases
Download
Hadoop is released as source code tarballs with corresponding binary tarballs for
sites and should be checked for tampering using GPG or SHA-256.
Version
Release Date
Tarball
3.0.0-alpha1
03 September, 2016
source
binary
2.7.3
25 August, 2016
source
binary
2.6.4
11 February, 2016
source
binary
2.5.2
19 Nov, 2014
source
binary
To verify Hadoop releases using GPG:
1. Download the release hadoop-X.Y.Z-src.tar.gz from a mirror site.
2. Download the signature file hadoop-X.Y.Z-src.tar.gz.asc from Apache.
3. Download the Hadoop KEYS file.
4. gpg --import KEYS
5. gpg --verify hadoop-X.Y.Z-src.tar.gz.asc
To perform a quick check using SHA-256:
1. Download the release hadoop-X.Y.Z-src.tar.gz from a mirror site.
2. Download the checksum hadoop-X.Y.Z-src.tar.gz.mds from Apache.
3. shasum -a 256 hadoop-X.Y.Z-src.tar.gz
All previous releases of Hadoop are available from the Apache release archive si
Many third parties distribute products that include Apache Hadoop and related to
page.

Enter the directory for the version you downloaded:



Finally, locate the `.mds` file for the release you downloaded, then copy the link for the corresponding file:

Again, we'll right-click to copy the file location, then use `wget` to transfer the file:

```
wget https://dist.apache.org/repos/dist/release/hadoop/common/hadoop-
2.7.3/hadoop-2.7.3.tar.gz.mds
```

Then run the verification:

```
shasum -a 256 hadoop-2.7.3.tar.gz

Output
d489df3808244b906eb38f4d081ba49e50c4603db03efd5e594a1e98b09259c2  hadoop-
2.7.3.tar.gz
```

Compare this value with the SHA-256 value in the `.mds` file:

```
cat hadoop-2.7.3.tar.gz.mds
```

~/hadoop-2.7.3.tar.gz.mds

```
...
hadoop-2.7.3.tar.gz: SHA256 = D489DF38 08244B90 6EB38F4D 081BA49E 50C4603D
B03EFD5E 594A1E98 B09259C2
...
```

You can safely ignore the difference in case and the spaces. The output of the command we ran against the file we downloaded from the mirror should match the value in the file we downloaded from apache.org.

Now that we've verified that the file wasn't corrupted or changed, we'll use the `tar` command with the `-x` flag to extract, `-z` to uncompress, `-v` for verbose output, and `-f` to specify that we're extracting from a file. Use tab-completion or substitute the correct version number in the command below:

```
tar -xzvf hadoop-2.7.3.tar.gz
```

Finally, we'll move the extracted files into `/usr/local`, the appropriate place for locally installed software. Change the version number, if needed, to match the version you downloaded.

```
sudo mv hadoop-2.7.3 /usr/local/hadoop
```

With the software in place, we're ready to configure its environment.

Step 3 — Configuring Hadoop's Java Home

Hadoop requires that you set the path to Java, either as an environment variable or in the Hadoop configuration file.

The path to Java, `/usr/bin/java` is a symlink to `/etc/alternatives/java`, which is in turn a symlink to default Java binary. We will use `readlink` with the `-f` flag to follow every symlink in every part of the path, recursively. Then, we'll use `sed` to trim `bin/java` from the output to give us the correct value for `JAVA_HOME`.

To find the default Java path

```
readlink -f /usr/bin/java | sed "s:bin/java::"

Output
/usr/lib/jvm/java-8-openjdk-amd64/jre/
```

You can copy this output to set Hadoop's Java home to this specific version, which ensures that if the default Java changes, this value will not. Alternatively, you can use the `readlink` command

dynamically in the file so that Hadoop will automatically use whatever Java version is set as the system default.

To begin, open `hadoop-env.sh`:

```
sudo nano /usr/local/hadoop/etc/hadoop/hadoop-env.sh
```

Then, choose one of the following options:

Option 1: Set a Static Value

/usr/local/hadoop/etc/hadoop/hadoop-env.sh

```
 . . .
#export JAVA_HOME=${JAVA_HOME}
export JAVA_HOME=/usr/lib/jvm/java-8-openjdk-amd64/jre/
 . . .
```

Option 2: Use Readlink to Set the Value Dynamically

/usr/local/hadoop/etc/hadoop/hadoop-env.sh

```
 . . .
#export JAVA_HOME=${JAVA_HOME}
export JAVA_HOME=$(readlink -f /usr/bin/java | sed "s:bin/java::")
 . . .
```

Note: With respect to Hadoop, the value of `JAVA_HOME` in `hadoop-env.sh` overrides any values that are set in the environment by `/etc/profile` or in a user's profile.

Step 4 — Running Hadoop

Now we should be able to run Hadoop:

```
/usr/local/hadoop/bin/hadoop

Output
Usage: hadoop [--config confdir] [COMMAND | CLASSNAME]
  CLASSNAME            run the class named CLASSNAME
 or
  where COMMAND is one of:
  fs                   run a generic filesystem user client
  version              print the version
  jar <jar>            run a jar file
                       note: please use "yarn jar" to launch
                             YARN applications, not this command.
  checknative [-a|-h]  check native hadoop and compression libraries
availability
  distcp <srcurl> <desturl> copy file or directories recursively
  archive -archiveName NAME -p <parent path> <src>* <dest> create a hadoop
archive
  classpath            prints the class path needed to get the
  credential           interact with credential providers
                       Hadoop jar and the required libraries
  daemonlog            get/set the log level for each daemon
```

The help means we've successfully configured Hadoop to run in stand-alone mode. We'll ensure that it is functioning properly by running the example MapReduce program it ships with. To do so,

create a directory called `input` in our home directory and copy Hadoop's configuration files into it to use those files as our data.

```
mkdir ~/input
cp /usr/local/hadoop/etc/hadoop/*.xml ~/input
```

Next, we can use the following command to run the MapReduce `hadoop-mapreduce-examples` program, a Java archive with several options. We'll invoke its `grep` program, one of many examples included in `hadoop-mapreduce-examples`, followed by the input directory, `input` and the output directory `grep_example`. The MapReduce grep program will count the matches of a literal word or regular expression. Finally, we'll supply a regular expression to find occurrences of the word `principal` within or at the end of a declarative sentence. The expression is case-sensitive, so we wouldn't find the word if it were capitalized at the beginning of a sentence:

```
/usr/local/hadoop/bin/hadoop jar
/usr/local/hadoop/share/hadoop/mapreduce/hadoop-mapreduce-examples-2.7.3.jar
grep ~/input ~/grep_example 'principal[.]*'
```

When the task completes, it provides a summary of what has been processed and errors it has encountered, but this doesn't contain the actual results.

```
Output
  . . .
        File System Counters
                FILE: Number of bytes read=1247674
                FILE: Number of bytes written=2324248
                FILE: Number of read operations=0
                FILE: Number of large read operations=0
                FILE: Number of write operations=0
        Map-Reduce Framework
                Map input records=2
                Map output records=2
                Map output bytes=37
                Map output materialized bytes=47
                Input split bytes=114
                Combine input records=0
                Combine output records=0
                Reduce input groups=2
                Reduce shuffle bytes=47
                Reduce input records=2
                Reduce output records=2
                Spilled Records=4
                Shuffled Maps =1
                Failed Shuffles=0
                Merged Map outputs=1
                GC time elapsed (ms)=61
                Total committed heap usage (bytes)=263520256
        Shuffle Errors
                BAD_ID=0
                CONNECTION=0
                IO_ERROR=0
                WRONG_LENGTH=0
                WRONG_MAP=0
                WRONG_REDUCE=0
        File Input Format Counters
                Bytes Read=151
        File Output Format Counters
                Bytes Written=37
```

Note: If the output directory already exists, the program will fail, and rather than seeing the summary, the ouput will look something like:

```
Output
 . . .
        at java.lang.reflect.Method.invoke(Method.java:498)
        at org.apache.hadoop.util.RunJar.run(RunJar.java:221)
        at org.apache.hadoop.util.RunJar.main(RunJar.java:136)
```

Results are stored in the output directory and can be checked by running `cat` on the output directory:

cd grep_example

```
cat part-r-00000

Output
6       principal
1       principal.
```

The MapReduce task found one occurrence of the word `principal` followed by a period and six occurrences where it was not. Running the example program has verified that our stand-alone installation is working properly and that non-privileged users on the system can run Hadoop for exploration or debugging.

Finally add the following lines to your .bashrc file and restart it again using the source command.

```
# HADOOP ENVIRONMENT VARIABLES
export HADOOP_HOME=/usr/local/hadoop
export HADOOP_CONF_DIR=/usr/local/hadoop/etc/hadoop
export HADOOP_MAPRED_HOME=/usr/local/hadoop
export HADOOP_COMMON_HOME=/usr/local/hadoop
export HADOOP_HDFS_HOME=/usr/local/hadoop
export YARN_HOME=/usr/local/hadoop
export PATH=/usr/local/hadoop/bin:$PATH

#JAVA ENV
export JAVA_HOME=/usr/local/jdk1.8.0_101
export PATH=$JAVA_HOME:$PATH
```

Conclusion

In this tutorial, we've installed Hadoop in stand-alone mode and verified it by running an example program it provided. To learn how write your own MapReduce programs, you might want to visit Apache Hadoop's MapReduce tutorial which walks through the code behind the example. When you're ready to set up a cluster, see the Apache Foundation Hadoop Cluster Setup guide.