Introduction

This document briefly describes how to access the Hadoop cluster setup for COMP 421 and submit jobs using pig and associated basic monitoring. This is a growing document that will be revised as needed to elaborate the information provided as necessity arises, hence we recommend you to cross check the version number of this document with the one in mycourses which will always be the most up to date.

Please read this document completely before you start submitting your pig scripts !

If you copy-paste any instructions from this document, double check that the pasted text matches what is there in this document, letters like hyphen(-) , quotation (') marks etc usually get translated wrong.

Environment Setup

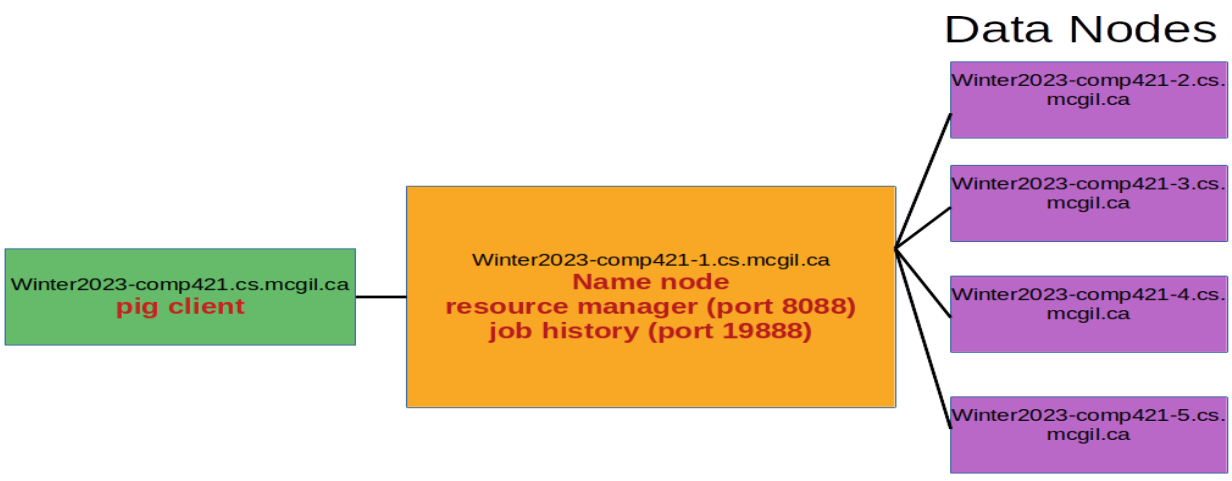
You will have to login to winter2022-comp421.cs.mcgill.ca using your SOCS account to write pig scripts. Additionally, you need to include `/data/cs421/softwares/apache/pig-0.15.0/bin` in your PATH.

```
$ PATH=/data/cs421/softwares/apache/pig-0.15.0/bin:$PATH
```

so that when you type

```
$ which pig
/data/cs421/softwares/apache/pig-0.15.0/bin/pig
```

You get the path to the pig executable.



The hadoop cluster consists of one name node (winter2023-comp421-1) and four data nodes (winter2023-comp421-2 … winter2023-comp421-5)

Please refrain from attempting to login on to the cluster nodes directly or writing scripts there. The user home filesystems in these nodes are temporary and the files created in them will disappear on system reboots !! you also do not have access to run pig in these nodes.

Execution and Monitoring

You can execute the pig commands by either writing them into a script and passing it as an argument to the pig commands

```
pig example.pig
```

Or by just typing pig, getting the grunt prompt and then typing in each command on the grunt prompt.

```
$ pig
23/03/03 17:11:06 INFO pig.ExecTypeProvider: Trying ExecType : LOCAL
23/03/03 17:11:06 INFO pig.ExecTypeProvider: Trying ExecType : MAPREDUCE
23/03/03 17:11:06 INFO pig.ExecTypeProvider: Picked MAPREDUCE as the ExecType
2023-03-03 17:11:06,612 [main] INFO  org.apache.pig.Main - Apache Pig version 0.15.0 (r1682971) compiled
Jun 01 2015, 11:44:35
2023-03-03 17:11:06,612 [main] INFO  org.apache.pig.Main - Logging error messages to:
/home/2022/jdsliv2/MyStuff/hd-2022/pig_1614809466610.log
2023-03-03 17:11:06,636 [main] INFO  org.apache.pig.impl.util.Utils - Default bootup file
/home/2022/jdsliv2/.pigbootup not found
2023-03-03 17:11:07,139 [main] INFO  org.apache.hadoop.conf.Configuration.deprecation - mapred.job.tracker
is deprecated. Instead, use mapreduce.jobtracker.address
2023-03-03 17:11:07,139 [main] INFO  org.apache.hadoop.conf.Configuration.deprecation - fs.default.name is
deprecated. Instead, use fs.defaultFS
```

```
2023-03-03 17:11:07,139 [main] INFO  org.apache.pig.backend.hadoop.executionengine.HExecutionEngine -
Connecting to hadoop file system at: hdfs://winter2023-comp421-1.cs.mcgill.ca:9000
2023-03-03 17:11:07,947 [main] INFO  org.apache.hadoop.conf.Configuration.deprecation - fs.default.name is
deprecated. Instead, use fs.defaultFS
grunt>
```

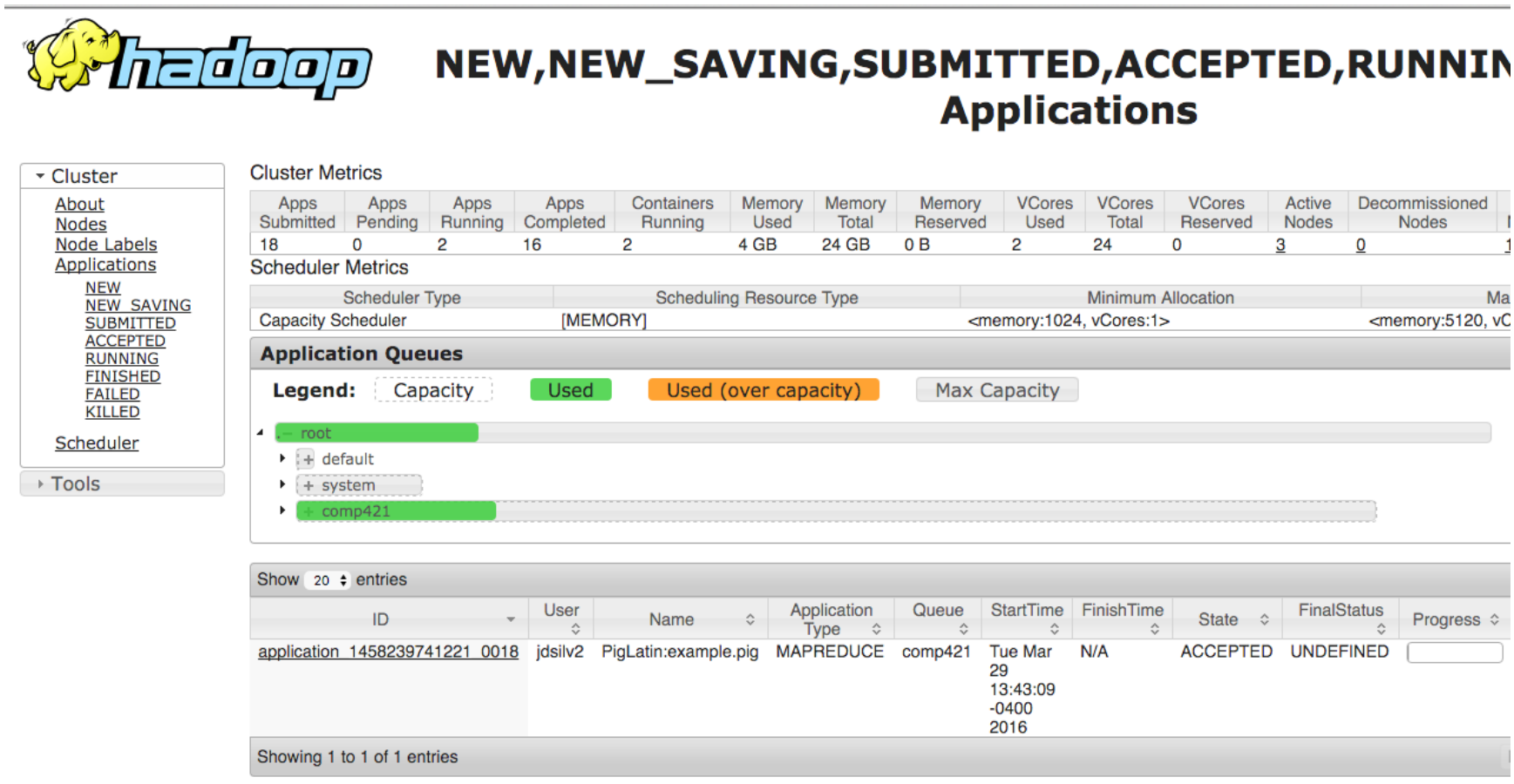
As you can see pig will output a lot of information whether you execute commands from grunt or through a pig script. Additionally, it will also capture error messages and output them into a log file which is useful for debugging later (in the above example this has been highlighted in red) . These messages produced in the pig output will be your primary source for information and debugging as most of the errors will be intercepted by the pig and will have to do with errors in pig syntax / semantics Hence you may not find any info about these on the job history logs of Hadoop as the pig would not even have submitted the job yet.

Among many informative output by pig is the SimplePigStats that tell you how start and end time of the pig script, the number of jobs involved in it and the number of Maps/Reduces run on each job.

```
2016-03-29 15:53:02,417 [main] INFO  org.apache.pig.tools.pigstats.mapreduce.SimplePigStats - Script
Statistics:

HadoopVersion     PigVersion  UserId      StartedAt   FinishedAt  Features
2.7.2 0.15.0      jdsilv2     2016-03-30 15:51:43     2016-03-30 15:53:02     ORDER_BY,FILTER,LIMIT

Success!

Job Stats (time in seconds):
JobId Maps  Reduces      MaxMapTime  MinMapTime  AvgMapTime  MedianMapTime      MaxReduceTime
      MinReduceTime      AvgReduceTime      MedianReducetime  Alias Feature      Outputs
job_1458239741221_0063  1      0      4      4      4      4      0      0      0      0      fltrd,gen,raw
      MAP_ONLY
job_1458239741221_0064  1      1      2      2      2      2      3      3      3      3      odred SAMPLER
job_1458239741221_0065  1      1      2      2      2      2      3      3      3      3      odred ORDER_BY,COMBINER
job_1458239741221_0066  1      1      3      3      3      3      3      3      3      3      odred
      hdfs://winter2022-comp421-1.cs.mcgill.ca:9000/tmp/temp-1164992124/tmp1925912064,
```

While pig will output very detailed info into the terminal about the operations it is executing, you can also check the resource manager UI to see if your job is running or is in the pending queue (which can happen if there are too many jobs in the system).
ALL WEB ACCESS BELOW NEED TO GO THROUGH MCGILL VPN !!

http://winter2023-comp421-1.cs.mcgill.ca:8088/cluster/scheduler



Further, you can use the job history UI to look at a more finer level of log messages (this is also the place you will have to go once the job is completed to check for any messages as the resource manager shows mostly information regarding jobs that are currently active). This page also displays how many maps / reduces were used for each of the jobs and is a good indication of parallelism.
http://winter2023-comp421-1.cs.mcgill.ca:19888/jobhistory

Logged in as: dr.who

JobHistory

- Application
  - About
  - Jobs
- Tools

Retired Jobs

Show 20 entries — Search:

Submit Time	Start Time	Finish Time	Job ID	Name	User	Queue	State	Maps Total	Maps Completed	Reduces Total	Reduces Completed
2016.03.29 13:42:53 EDT	2016.03.29 13:43:01 EDT	2016.03.29 13:43:07 EDT	job_1458239741221_0017	PigLatin:example.pig	jdsilv2	comp421	SUCCEEDED	1	1	0	0
2016.03.29 13:43:09 EDT	2016.03.29 13:43:17 EDT	2016.03.29 13:43:31 EDT	job_1458239741221_0018	PigLatin:example.pig	jdsilv2	comp421	SUCCEEDED	1	1	1	1
2016.03.29 13:43:35 EDT	2016.03.29 13:43:40 EDT	2016.03.29 13:43:52 EDT	job_1458239741221_0019	PigLatin:example.pig	jdsilv2	comp421	SUCCEEDED	1	1	1	1
2016.03.29 13:43:56 EDT	2016.03.29 13:44:02 EDT	2016.03.29 13:44:13 EDT	job_1458239741221_0020	PigLatin:example.pig	jdsilv2	comp421	SUCCEEDED	1	1	1	1

Showing 1 to 4 of 4 entries — First Previous 1 Next Last

It is important to note that one pig script can result in multiple mapreduce jobs (for various steps in the pig script). You will find a Job ID for each one of them in the job history UI. You can click on the link for one of your jobs to receive additional information. (shown below)

Logged in as: dr.who

MapReduce Job job_1458239741221_0017

- Application
- Job
  - Overview
  - Counters
  - Configuration
  - Map tasks
  - Reduce tasks
- Tools

Job Overview	
Job Name:	PigLatin:example.pig
User Name:	jdsilv2
Queue:	comp421
State:	SUCCEEDED
Uberized:	false
Submitted:	Tue Mar 29 13:42:53 EDT 2016
Started:	Tue Mar 29 13:43:01 EDT 2016
Finished:	Tue Mar 29 13:43:07 EDT 2016
Elapsed:	6sec
Diagnostics:	
Average Map Time	3sec

ApplicationMaster

Attempt Number	Start Time	Node	Logs
1	Tue Mar 29 13:42:58 EDT 2016	cs421-hd5:8042	logs

Task Type	Total	Complete
Map	1	1
Reduce	0	0

Attempt Type	Failed	Killed	Successful
Maps	0	0	1
Reduces	0	0	0

You can click on the logs link for more log messages.

- Application
  - About
  - Jobs
- Tools

Log Type: stderr
Log Upload Time: Tue Mar 29 13:43:14 -0400 2016
Log Length: 1703

```
Mar 29, 2016 1:43:00 PM com.sun.jersey.guice.spi.container.GuiceComponentProviderFactory register
INFO: Registering org.apache.hadoop.yarn.webapp.GenericExceptionHandler as a provider class
Mar 29, 2016 1:43:00 PM com.sun.jersey.guice.spi.container.GuiceComponentProviderFactory register
INFO: Registering org.apache.hadoop.mapreduce.v2.app.webapp.AMWebServices as a root resource class
Mar 29, 2016 1:43:00 PM com.sun.jersey.server.impl.application.WebApplicationImpl _initiate
INFO: Initiating Jersey application, version 'Jersey: 1.9 09/02/2011 11:17 AM'
Mar 29, 2016 1:43:00 PM com.sun.jersey.guice.spi.container.GuiceComponentProviderFactory getComponentProvider
INFO: Binding org.apache.hadoop.mapreduce.v2.app.webapp.JAXBContextResolver to GuiceManagedComponentProvider with the scope "Singleton"
Mar 29, 2016 1:43:01 PM com.sun.jersey.guice.spi.container.GuiceComponentProviderFactory getComponentProvider
INFO: Binding org.apache.hadoop.yarn.webapp.GenericExceptionHandler to GuiceManagedComponentProvider with the scope "Singleton"
Mar 29, 2016 1:43:01 PM com.sun.jersey.guice.spi.container.GuiceComponentProviderFactory getComponentProvider
INFO: Binding org.apache.hadoop.mapreduce.v2.app.webapp.AMWebServices to GuiceManagedComponentProvider with the scope "PerRequest"
log4j:WARN No appenders could be found for logger (org.apache.hadoop.ipc.Server).
log4j:WARN Please initialize the log4j system properly.
log4j:WARN See http://logging.apache.org/log4j/1.2/faq.html#noconfig for more info.
```

Log Type: stdout
Log Upload Time: Tue Mar 29 13:43:14 -0400 2016
Log Length: 0

Log Type: syslog
Log Upload Time: Tue Mar 29 13:43:14 -0400 2016
Log Length: 26260
Showing 4096 bytes of 26260 total. Click here for the full log.

```
ScheduledMaps:0 ScheduledReds:0 AssignedMaps:1 AssignedReds:0 CompletedMaps:1 CompletedReds:0 ContAlloc:1 ContRel:0 HostLocal:1 RackLocal:0
2016-03-29 13:43:08,027 INFO [eventHandlingThread] org.apache.hadoop.mapreduce.jobhistory.JobHistoryEventHandler: Copied to done location: hdfs://cs421-hd1.cs.mc
2016-03-29 13:43:08,030 INFO [eventHandlingThread] org.apache.hadoop.mapreduce.jobhistory.JobHistoryEventHandler: Copying hdfs://cs421-hd1.cs.mcgill.ca:9000/tmp/
2016-03-29 13:43:08,069 INFO [eventHandlingThread] org.apache.hadoop.mapreduce.jobhistory.JobHistoryEventHandler: Copied to done location: hdfs://cs421-hd1.cs.mc
2016-03-29 13:43:08,072 INFO [eventHandlingThread] org.apache.hadoop.mapreduce.jobhistory.JobHistoryEventHandler: Moved tmp to done: hdfs://cs421-hd1.cs.mcgill.c
2016-03-29 13:43:08,074 INFO [eventHandlingThread] org.apache.hadoop.mapreduce.jobhistory.JobHistoryEventHandler: Moved tmp to done: hdfs://cs421-hd1.cs.mcgill.c
2016-03-29 13:43:08,075 INFO [eventHandlingThread] org.apache.hadoop.mapreduce.jobhistory.JobHistoryEventHandler: Moved tmp to done: hdfs://cs421-hd1.cs.mcgill.c
```

Things to know

HDFS will refuse to overwrite files, this can create issues if in your pig script you are using `STORE` commands. In order to delete any such files, one possible way is to start pig interactively and then use the rm command as illustrated below.

```
pig
23/03/21 14:58:54 INFO pig.ExecTypeProvider: Trying ExecType : LOCAL
23/03/21 14:58:54 INFO pig.ExecTypeProvider: Trying ExecType : MAPREDUCE
23/03/21 14:58:54 INFO pig.ExecTypeProvider: Picked MAPREDUCE as the ExecType
2023-03-21 14:58:54,161 [main] INFO  org.apache.pig.Main - Apache Pig version 0.15.0 (r1682971) compiled
Jun 01 2022, 11:44:35
2023-03-21 14:58:54,161 [main] INFO  org.apache.pig.Main - Logging error messages to:
/home/2022/jdsilv2/MyStuff/hd/pig_1459277934159.log
2023-03-21 14:58:54,182 [main] INFO  org.apache.pig.impl.util.Utils - Default bootup file
/home/2022/jdsilv2/.pigbootup not found
2023-03-21 14:58:54,737 [main] INFO  org.apache.hadoop.conf.Configuration.deprecation - mapred.job.tracker
is deprecated. Instead, use mapreduce.jobtracker.address
2023-03-21 14:58:54,738 [main] INFO  org.apache.hadoop.conf.Configuration.deprecation - fs.default.name is
deprecated. Instead, use fs.defaultFS
2023-03-21 14:58:54,738 [main] INFO  org.apache.pig.backend.hadoop.executionengine.HExecutionEngine -
Connecting to hadoop file system at: hdfs://cs421-hd1.cs.mcgill.ca:9000
2023-03-21 14:58:55,544 [main] INFO  org.apache.hadoop.conf.Configuration.deprecation - fs.default.name is
deprecated. Instead, use fs.defaultFS
grunt> fs -ls
Found 1 items
-rw-r--r--   3 jdsilv2 supergroup       4647 2023-03-21 14:54 mapredsetup.txt
grunt> fs -rm mapredsetup.txt
2023-03-21 14:59:07,975 [main] INFO  org.apache.hadoop.fs.TrashPolicyDefault - Namenode trash
configuration: Deletion interval = 0 minutes, Emptier interval = 0 minutes.
Deleted mapredsetup.txt
grunt>
```

To copy a file from HDFS to local file system

```
grunt> copyToLocal /data2/mydata.csv  /tmp/mylocalcopy.csv
grunt>
```

To see a list of files in HDFS use ls

```
grunt> ls
```

To see contents stored in a file in HDFS, use cat commands

```
grunt> cat part-r-00000
```

To see more commands, type ? at the grunt prompt. (There's quite a bit of mismatch between what the listing provides and what grunt actually supports, so don't get engrossed in some of the complex options, they most likely are not implemented yet.)

```
grunt> ?
```

Due to a bug in the framework, some of the website links generated by the job history / resource manager web interface, will not have fully qualified hostnames and can as a result cause your browser to not find the webpage when you click on it due to DNS failure. This can be addressed by either editing the offending link in the browser to include the full name of the host, or including the IP address mapping in the hosts file of your laptop/computer from which you are using the browser as shown below (The location of hosts file is different for different operating systems, this is **/etc/hosts** for Mac and Linux operating systems . For windows it's usually **%SystemRoot%\System32\drivers\etc\hosts**

```
132.206.51.211   winter2023-comp421-1.CS.McGill.CA  winter2023-comp421-1
132.206.51.212   winter2023-comp421-2.CS.McGill.CA  winter2023-comp421-2
132.206.51.213   winter2023-comp421-3.CS.McGill.CA  winter2023-comp421-3
132.206.51.214   winter2023-comp421-4.CS.McGill.CA  winter2023-comp421-4
132.206.51.215   winter2023-comp421-5.CS.McGill.CA  winter2023-comp421-5
```

To terminate grunt shell in interactive mode, you can type quit;

```
grunt> quit;
```

If you are executing a pig script, you can do CTRL+C to terminate it.

It should also be noted that in general MapReduce jobs will run a LOT longer than typical database queries. The example pig script will take around 2 minutes and this can become longer as the number of total jobs in the system increases and your job would end up in the wait queue. There are also individual user capacity limits to ensure one user does not hog all the system resources. So if you submit multiple jobs at the same time, it might start slowing down your own throughput instead. Hence we strictly advise not to submit more than one pig script at a time. Ignoring our repeated warning can result in your id being suspended !

How to start writing your script

We encourage you to start writing your script by typing in commands one after the other in the grunt shell, so that you get immediate feedback from pig if there is an error in your statement. However, the job history manager records the commands submitted from grunt shell as “DefaultJobName” so you may not be able to easily tell apart your scripts in the history manager UI. You can explicitly set a job name for the set of commands you submit as shown below.

```
grunt> set job.name 'YourSOCSID_JobXX';
```

Once you have all the commands working as desired, you can write them into a single script file and execute them together. It should also be noticed that pig submits the jobs to Hadoop ONLY when it encounters a STORE or DUMP command.

Support and Questions

If you have questions regarding the setup, please post it in Piazza and tag assignments/a3. Do not email the cs helpdesk with issues you have on the MapReduce cluster, they are not responsible for the cluster setup.

Useful links

Basics
https://pig.apache.org/docs/r0.15.0/basic.html

How to generate some very useful diagnostic / informational outputs that you can leverage in writing answers to the general questions asked.
https://pig.apache.org/docs/r0.15.0/test.html

Oreilly’s Programming Pig ebook (Because you are insanely obsessed with Pig)
https://mcgill.on.worldcat.org/oclc/992150957