CS 553 Assignment 2

Ron Pyka & Jesi Merrick

Team Member Contributions

In this assignment, Ron provided his existing WordCount code from CS 451 last semester, and handled the Hadoop side of things, while Jesi worked with Swift.

Shared Memory Setup

For the single node for the shared memory program, we used a c3.large spot instance running the 64-bit Amazon Linux AMI (3.14 kernel.) Apart from installing gcc4.8 and dependencies for C++ support, there were no changes made to the initial image. The setup and running of the program for this test was very simple and did not take long. The times for running this version on 1-8 threads are included in the performance section below.

Hadoop Setup

Setting up Hadoop was fairly straightforward. I chose to go with the same 64-bit Amazon Linux AMI used in the shared memory setup (3.14 kernel) and used OpenJDK 1.7 for Java. I did not use ANT and chose to use Make instead, since that was more familiar. I also opted to use Hadoop 1.2.1 since I had worked with that last semester, and was at least a little familiar.

In Hadoop, the master acts as a dispatcher, assigning work to the various slave nodes, receiving their replies, and assigning more work until the task is completed. It also keeps track of mapping and reducing progress. Unique ports are set to various items to avoid conflicts in traffic and configuration files list out all the slaves for the master to know where to assign work, and tell the master and slaves what role each of them plays.

As for the configuration of Hadoop (for 16 nodes), on the master I changed the masters file from localhost to the master's public address and the slaves file from localhost to a list of all slaves public addresses. If I were to have less slaves, I would have put less into the slaves file. On each slave, I emptied the masters file, and changed the slaves file from localhost to the slave's own public address. On both the slaves and masters, I had to make the following changes:

conf/core-site.xml:

- fs.default.name - told all nodes where the namenode is for filesystem purposes, and the port to use (8020 assigned in this setup)
- hadoop.tmp.dir - told all nodes what the default directory would be for HDFS

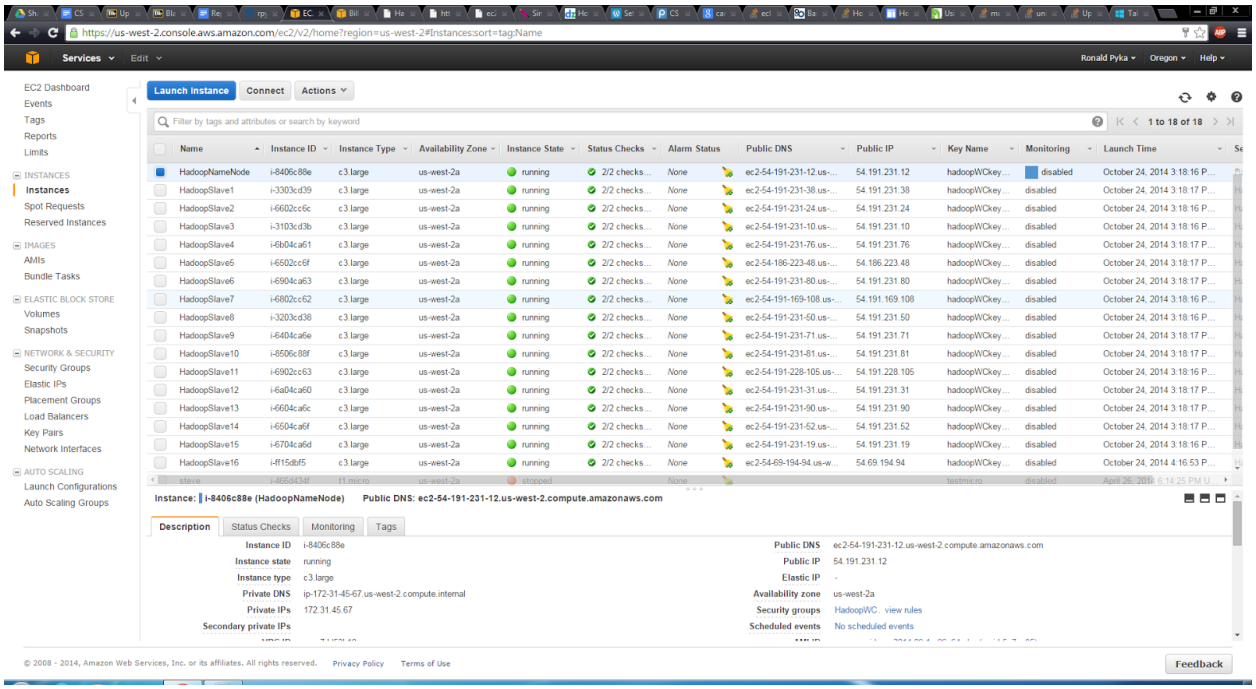
conf/hdfs-site.xml:

- dfs.permissions - this was set to ‘false’ to indicate that any user could make changes to the HDFS. Would not be good for real-world use, but simplified this assignment.
- dfs.replication - I set this to 2 (one less than default) since I did not see a need for excessive replication in such a small and quick program. Could have been increased, though.

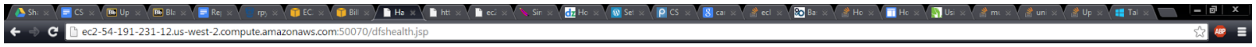
conf/mapred-site.xml:

- mapred.job.tracker - kept track of the jobtracker for mapreduce. In this case, it pointed to the single master.

Below is a screenshot of all 16 workers and the master up and running:



Also, here are screenshots of both my HDFS summary and list of active slaves:



NameNode 'ec2-54-191-231-12.us-west-2.compute.amazonaws.com:8020'

Started: Sat Oct 25 01:21:55 UTC 2014
Version: 1.2.1, r1503152
Compiled: Mon Jul 22 15:23:09 PDT 2013 by mattf
Upgrades: There are no upgrades in progress.

Browse the filesystem
Namenode Logs

Cluster Summary

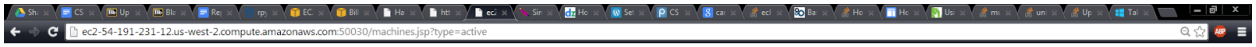
33 files and directories, 189 blocks = 222 total. Heap Size is 214 MB / 889 MB (24%)

Configured Capacity	:	320.69 GB
DFS Used	:	20.06 GB
Non DFS Used	:	32.9 GB
DFS Remaining	:	267.73 GB
DFS Used%	:	6.26 %
DFS Remaining%	:	83.48 %
Live Nodes	:	17
Dead Nodes	:	0
Decommissioning Nodes	:	0
Number of Under-Replicated Blocks	:	0

NameNode Storage:

Storage Directory	Type	State
/home/ec2-user/hdfstmp/dfs/name	IMAGE_AND_EDITS	Active

This is Apache Hadoop release 1.2.1



ec2-54-191-231-12 Hadoop Machine List

Active Task Trackers

Task Trackers															
Name	**Host**	**# running tasks**	**Max Map Tasks**	**Max Reduce Tasks**	**Task Failures**	**Directory Failures**	**Node Health Status**	**Seconds Since Node Last Healthy**	**Total Tasks Since Start**	**Succeeded Tasks Since Start**	**Total Tasks Last Day**	**Succeeded Tasks Last Day**	**Total Tasks Last Hour**	**Succeeded Tasks Last Hour**	**Seconds since heartbeat**
tracker_ec2-54-191-231-81.us-west-2.compute.amazonaws.com:localhost/127.0.0.1:43191	ec2-54-191-231-81.us-west-2.compute.amazonaws.com	0	2	2	0	0	N/A	0	63	62	63	62	0	0	572
tracker_ec2-54-191-231-24.us-west-2.compute.amazonaws.com:localhost/127.0.0.1:42508	ec2-54-191-231-24.us-west-2.compute.amazonaws.com	0	2	2	0	0	N/A	0	71	67	71	67	0	0	573
tracker_ec2-54-191-231-76.us-west-2.compute.amazonaws.com:localhost/127.0.0.1:58817	ec2-54-191-231-76.us-west-2.compute.amazonaws.com	0	2	2	0	0	N/A	0	70	65	70	65	0	0	572
tracker_ec2-54-191-231-80.us-west-2.compute.amazonaws.com:localhost/127.0.0.1:53690	ec2-54-191-231-80.us-west-2.compute.amazonaws.com	0	2	2	0	0	N/A	0	81	72	81	72	0	0	572
tracker_ec2-54-191-231-71.us-west-2.compute.amazonaws.com:localhost/127.0.0.1:43750	ec2-54-191-231-71.us-west-2.compute.amazonaws.com	0	2	2	0	0	N/A	0	71	64	71	64	0	0	572
tracker_ec2-54-69-194-94.us-west-2.compute.amazonaws.com:localhost/127.0.0.1:45010	ec2-54-69-194-94.us-west-2.compute.amazonaws.com	0	2	2	0	0	N/A	0	70	66	70	66	0	0	572
tracker_ec2-54-191-231-10.us-west-2.compute.amazonaws.com:localhost/127.0.0.1:52410	ec2-54-191-231-10.us-west-2.compute.amazonaws.com	0	2	2	0	0	N/A	0	65	62	65	62	0	0	572
tracker_ec2-54-191-231-52.us-west-2.compute.amazonaws.com:localhost/127.0.0.1:51742	ec2-54-191-231-52.us-west-2.compute.amazonaws.com	0	2	2	0	0	N/A	0	69	63	69	63	0	0	572
tracker_ec2-54-191-231-31.us-west-2.compute.amazonaws.com:localhost/127.0.0.1:59252	ec2-54-191-231-31.us-west-2.compute.amazonaws.com	0	2	2	0	0	N/A	0	68	68	68	68	0	0	572
tracker_ec2-54-191-231-19.us-west-2.compute.amazonaws.com:localhost/127.0.0.1:49813	ec2-54-191-231-19.us-west-2.compute.amazonaws.com	0	2	2	0	0	N/A	0	63	55	63	55	0	0	572
tracker_ec2-54-191-169-108.us-west-2.compute.amazonaws.com:localhost/127.0.0.1:45814	ec2-54-191-169-108.us-west-2.compute.amazonaws.com	0	2	2	0	0	N/A	0	71	63	71	63	0	0	572
tracker_ec2-54-191-231-50.us-west-2.compute.amazonaws.com:localhost/127.0.0.1:48469	ec2-54-191-231-50.us-west-2.compute.amazonaws.com	0	2	2	0	0	N/A	0	67	65	67	65	0	0	572
tracker_ec2-54-191-231-38.us-west-2.compute.amazonaws.com:localhost/127.0.0.1:51251	ec2-54-191-231-38.us-west-2.compute.amazonaws.com	0	2	2	0	0	N/A	0	0	0	0	0	0	0	64
tracker_ec2-54-186-223-48.us-west-2.compute.amazonaws.com:localhost/127.0.0.1:51629	ec2-54-186-223-48.us-west-2.compute.amazonaws.com	0	2	2	0	0	N/A	0	66	55	66	55	0	0	572
tracker_ec2-54-191-228-105.us-west-2.compute.amazonaws.com:localhost/127.0.0.1:58462	ec2-54-191-228-105.us-west-2.compute.amazonaws.com	0	2	2	0	0	N/A	0	73	72	73	72	0	0	572
tracker_ec2-54-191-231-90.us-west-2.compute.amazonaws.com:localhost/127.0.0.1:57231	ec2-54-191-231-90.us-west-2.compute.amazonaws.com	0	2	2	0	0	N/A	0	68	65	68	65	0	0	572

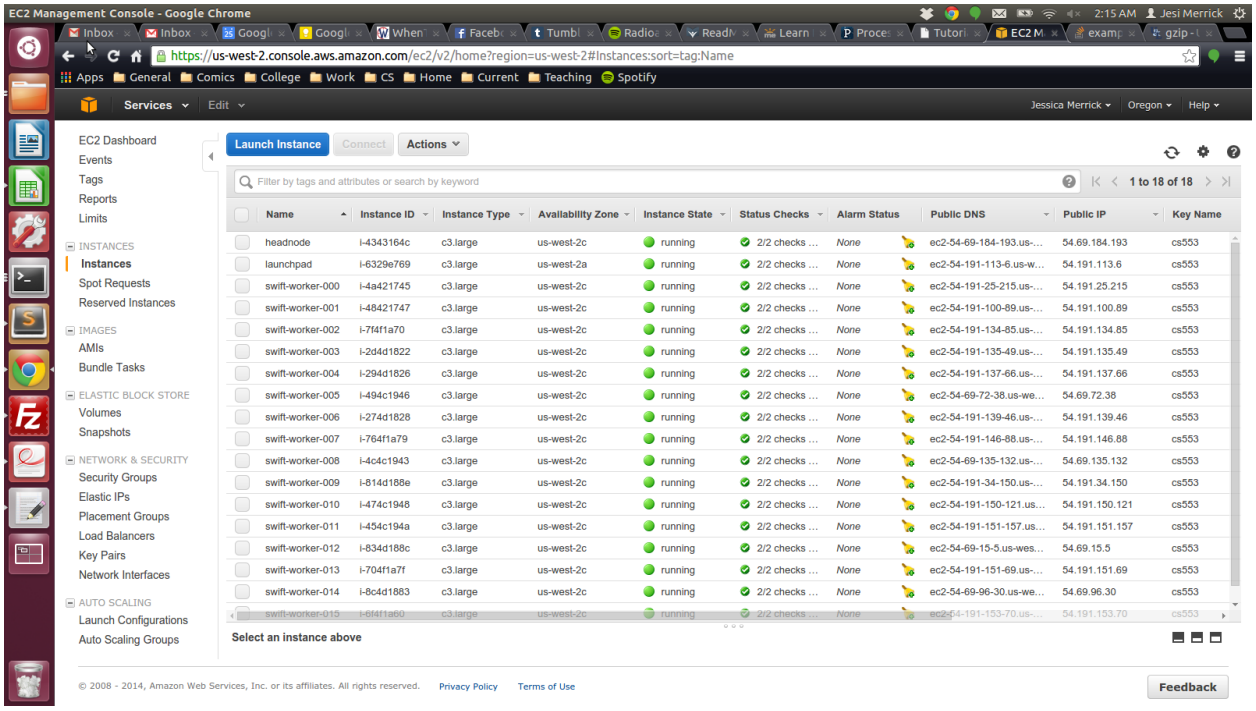
This is Apache Hadoop release 1.2.1

Swift Setup

The Swift setup was done by following the tutorial provided in the assignment description. The AMI used for all the nodes was Ubuntu Server 14.04 LTS. A launchpad instance is used, as in the tutorial, to determine the configurations of the head node and the workers node, and launch them by command. Additionally, an extra volume of 22GB was mounted to the head node (after it was created) in order to handle the larger data set. This step is not necessary for the workers, as the file is split before it is sent to them.

There were some difficulties in the swift setup. The first major block was with starting up the head node and the workers node as the tutorial indicated, but initially they could not connect. It was necessary to create a group in the IAM controls for the IAM user that is used in the tutorial. Additionally, the default configuration for the instances including only 8GB. This was not acceptable, as the large dataset is 10GB. As mentioned, this was resolved by mounting a new volume of 22GB to the head node, which was the only instance that had to handle the collective amount of the dataset.
There were a few smaller issues, such as the swift program never finishing. The only clear solution to this seemed to be to restart all the instances.

A screenshot of the the launchpad instance, the head node instance, and 16 worker instances:



Performance

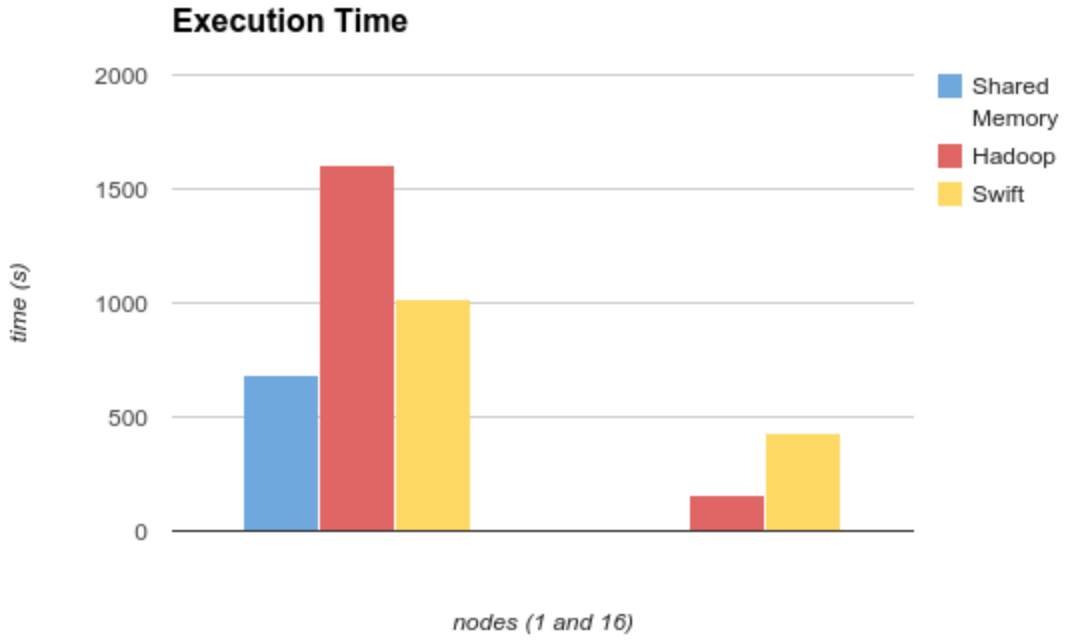
Below are comparisons of performance for various numbers of threads for the shared memory program, as well as a comparison between all three on one node and hadoop and swift on 16 nodes.

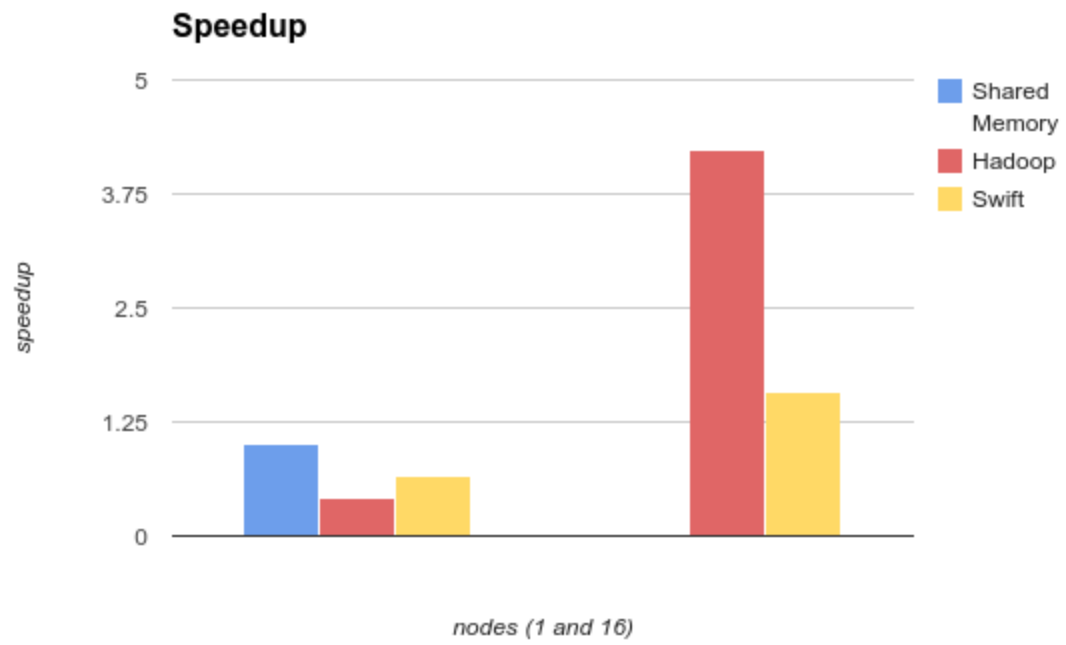
Shared Memory Performance

Threads	Time (in seconds)	Speedup
1	821.1 s	1
2	680.7 s	1.206
4	685.7 s	1.197
8	691.7 s	1.187

Comparison of all approaches

	Time (in seconds)	Speedup
Shared Memory	680.7 s	1
Hadoop (1 node)	1604.2 s	0.424
Swift (1 node)	1020.4 s	0.667
Hadoop (16 nodes)	160.8 s	4.233
Swift (16 nodes)	429.35 s	1.585


Execution Time
2000
1500
1000
500
0
time (s)
Shared Memory
Hadoop
Swift
nodes (1 and 16)


Speedup
5
3.75
2.5
1.25
0
speedup
Shared Memory
Hadoop
Swift
nodes (1 and 16)

When only one node is used, shared memory count has the best performance over Hadoop and Swift. This makes sense, since the benefit of Hadoop and Swift comes from how they distribute the work over multiple nodes. At one node, Hadoop and Swift show their overhead, which is normally acceptable due to improved performance with multiple nodes. Here, shared memory count does not have the same overhead, and so performs better.

If we compare Hadoop and Swift at one nodes to sixteen nodes, we see a significant increase in performance. Both Hadoop and Swift split up the work of word count in their own way, which obviously would improve over running word count sequentially (one node). Hadoop is better suited for the word count task however, and shows this in its performance over Swift.

With a continued increase in the number of nodes, we can expect Hadoop to continue to perform the best.