Towards Enabling Big Data and Federated Computing in the Cloud

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BOSC 2013, Berlin
Lots of big data
Distributed data
‘Cloud’ resources
Big Data and Hadoop

Prominent users

Yahoo!

On February 19, 2008, Yahoo! Inc. launched what it claimed was the world’s largest Hadoop production application. The Yahoo! Search Webmap is a Hadoop cluster and produces data that is used in every Yahoo! Web search query.

There are multiple Hadoop clusters at Yahoo! and no HDFS filesystems or MapReduce jobs are split across multiple datacenters. Every Hadoop cluster distribution is known to include the index calculations for the Yahoo! search engine.

On June 10, 2009, Yahoo! made the source code of the version of Hadoop it runs in production available to the public. Yahoo! contributes back all the company’s developers also fix bugs and provide stability improvements internally, and release this patched source code so that other users may benefit.

Facebook

In 2010 Facebook claimed that they had the largest Hadoop cluster in the world with 21 PB of storage. On July 27, 2011 they announced the data had grown to 100 PB. On November 8, 2012 they announced the warehouse grows by roughly half a PB per day.

Other users

Besides Facebook and Yahoo!, many other organizations are using Hadoop to run large distributed computations. Some of the notable users include:

- Amazon.com
- Ancestry.com
- Akamai
- American Airlines
- AOL
- Apple
- AVG
- eBay
- Electronic Arts
- Ericsson
- Hortonworks
- Federal Reserve Board of Governors
- Foursquare
- Fox Interactive Media
- Google
- Hewlett-Packard
- IBM
- ImageShack
- ISI
Federated Computing and HTCondor

• An approach toward federated computing

• HTCondor:
  – Since 1988 at University of Wisconsin-Madison
  – High Throughput Computing on large collections distributive computing resources: *cycle scavenging*

• Gains from using HTCondor
  – Existing solution
  – Scalability
  – Reliability
  – Cost
CloudMan

- Cloud Manager for orchestrating cloud resources
- Cluster-on-the-cloud, any cloud
- Ease the process of establishing a cloud environment for bioinformatics analysis – “Galaxy on the Cloud”
- Facilitate management of IaaS services
A path forward

• Have a central manager capturing all the three functions at once:
  – CloudMan
    • Easy & ready to use cluster environment for the cloud
  – Hadoop
    • Platform for Big Data analysis
  – HTCondor
    • Central manager able to handle versatile, heterogeneous compute environments
Our Approach

- Integrate HTCondor and Hadoop into CloudMan clusters
- Single management interface
- Multiple types of workloads and infrastructures
- Make it easier to deploy necessary platform and enable
  1. Tool development
  2. Data analysis
Hadoop-on-demand platform

- **Hadoop-over-SGE**: dynamically setup at runtime
- Low and constant setup overhead
- Increase infrastructure flexibility
  - Cost
  - Workload type
Hadoop example

- Edit sge-integration script

```bash
#!/bin/sh

## Submit this script using the command below for example
## qsub -v HADOOP_HOME=/home/hadoop-1.0.2,JAVA_HOME=/usr/hdfs-sge.cmd

##
## $ -N hadoop
## $ -o /tmp/out.$JOB_ID
## $ -j y
## Change the number from 16 to 32 (4 nodes) or 64 (8 nodes)
## $ -pe mpi 2
## cwd
## No need to change this line, this line tells SGE to run jobs in hadoop.q
##
## This is a complex example...

sleep 10
$HADOOP_HOME/bin/hadoop fs -put /home/ubuntu/hadoop/hadoop/home/conf input
echo "Input file copied sleeping for 30 seconds"
sleep 30
$HADOOP_HOME/bin/hadoop jar hadoop-examples-1.0.4.jar wordcount input output
$HADOOP_HOME/bin/hadoop fs -get output $HADOOP_HOME/output.$JOB_ID
$HADOOP_HOME/bin/$stop-hadoop.sh
$HADOOP_HOME/bin/$stop-dfs.sh
```

- Submit your job into SGE
HTCondor integration

- Local jobs run via SGE
- Nodes pooled together via
  - Flocking
  - Gliding
  - Pool sharing
HTCondor example

Cluster 1 - AWS

CloudMan Console
Welcome to CloudMan. This application allows you to manage this instance cloud cluster and the services provided within. Your previous data store has been reconnected. Once the cluster has initialized, use the controls below to manage services provided by the application.

Status
Cluster name: qdr_f3
Disk status: 0 / 0 (0%)
Worker status: Idle: 1 Available: 1 Requested: 1
Service status: Applications: 1 Data: 1

Cluster 2 - NeCTAR

CloudMan Console
Welcome to CloudMan. This application allows you to manage this instance cloud cluster and the services provided within. Your previous data store has been reconnected. Once the cluster has initialized, use the controls below to manage services provided by the application.

Status
Cluster name: qdr_f3
Disk status: 0 / 0 (0%)
Worker status: Idle: 0 Available: 0 Requested: 0
Service status: Applications: 0 Data: 0

Common resource pool

Job submission script
executeEtc=mpirun
universe=vanilla
arguments=-n 4 -l h_rt=100800m -l mem=2048m -l m_mem=2048m
output=output
log=log
notification=never
should_transfer_files=auto
when_to_transfer_output=ON_EXIT

Running jobs
condor_submit myjob.submit
condor_submit myjob.submit1
condor_submit myjob.submit2
condor_submit myjob.submit3
condor_submit myjob.submit4
condor_submit myjob.submit5
condor_submit myjob.submit6
condor_submit myjob.submit7
condor_submit myjob.submit8
condor_submit myjob.submit9
condor_submit myjob.submit10
condor_submit myjob.submit11
condor_submit myjob.submit12
condor_submit myjob.submit13
condor_submit myjob.submit14
Conclusions

• Challenges
  – Data transfer & locality

• Future work
  – Streamline scaling of Condor hosts
  – Integration with Galaxy
  – Condor over Hadoop

• An architecture paper available from MIPRO 2013
  – “Support for data-intensive computing with CloudMan”

A cloud environment for distributed computing: batch; Hadoop; HTCondor
http://usecloudman.org