Towards Enabling Big Data and Federated Computing in the Cloud

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Lots of big data

Distributed data

‘Cloud’ resources
Big Data and Hadoop

Prominent users [edit]

Yahoo! [edit]
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 application that produces data that is used in every Yahoo! search query.[29]

There are multiple Hadoop clusters at Yahoo! and no HDFS filesystems or MapReduce jobs are split across multiple datacenters. Every Hadoop cluster is distributed, so that the clusters perform independent 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.[30] Yahoo! contributes back all work on 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 [edit]
In 2010 Facebook claimed that they had the largest Hadoop cluster in the world with 21 PB of storage.[31] On July 27, 2011 they announced the data had grown to 100 PB.[32] On November 8, 2012 they announced the warehouse grows by roughly half a PB per day.[33]

Other users [edit]
Besides Facebook and Yahoo!, many other organizations are using Hadoop to run large distributed computations. Some of the notable users include:[35]

- Amazon.com
- Ancestry.com[36]
- Akamai
- American Airlines
- AOL
- Apple[37]
- AVG
- eBay
- Electronic Arts
- Ericsson
- Hortonworks
- Federal Reserve Board of Governors
- Foursquare
- Fox Interactive Media
- Google
- Hewlett-Packard
- IBM
- ImageShack
- INM
- Intuit
- JBoss
- Last.fm
- LinkedIn[38]
- Microsoft[39]
- NetApp
- Netflix[40]
- Ooyala
- Riot Games
- Spotify
- Qualtrics
- Quatrums
- US National Security Agency (NSA)
- The New York Times
- SAP AG[41]
- SAS Institute[42]
- StumbleUpon[43]
- Twitter
- Yodlee
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

![Diagram of Hadoop-on-demand platform](image)
Hadoop example

• Edit sge-integration script

```bash
#!/bin/sh
#
## submit this script using the command below for example
## qsub -v HADOOP_HOME=$HOME/hadoop-1.0.4,JAVA_HOME=/usr hdfs-sge.cmd
#
#$ -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 script!

- Set your Hadoop Commands
- 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-namenode
- $HADOOP_HOME/bin/stop-dfs.sh

• Submit your job into SGE

```bash
:-$ qsub -v HADOOP_HOME=/home/ubuntu,JAVA_HOME=/user hdfs-sge.cmd
```
HTCondor integration

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

NeCTAR (~private)
Campus
AWS $$$
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: cmsr_
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

```
executable=myprog
universe=vanilla
arguments=Example.$(Cluster).$(Process) 100
output=results.output.$(Process)
error=results.error.$(Process)
log=results.log.$x
notification=never
should_transfer_files=YES
when_to_transfer_output = ON_EXIT
queue
```

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: cmsr_
Disk status: 0 / 0 (0%)
Worker status: Idle: 0 Available: 0 Requested: 0
Service status: Applications: 0 Data: 0

Running jobs
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