Introduction to Cloud Computation

Or how I learned to get over my fears and learn love the cloud

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Overview

• Typical Model Execution
• What is a High Performance Cluster Anyway?
• Benefits of Cloud Processing
• Cloud Providers and the CBPO
• HPC Implementation at CBPO
• Cloud Computing Costs
• How we could do it better
• Cloud Providers and You
• Getting started in AWS
Typical Model Execution

• What is a model to a computer?
  • Simply put, to a computer a model is nothing more then another piece, or several pieces, of software to run.

• Can I run a model locally or on a single server?
  • Yes, well maybe or maybe not
  • Do you have days? Weeks? Or maybe even months to wait for results?

• How about on a High Performance Cluster?
  • A HPC or High Performance cluster is ideal for large jobs when combines with a job scheduler like SLURM or Torque, OpenLava, etc....
"High-Performance Computing," or HPC, is the application of "supercomputers" to computational problems that are either too large for standard computers or would take too long. A desktop computer generally has a single processing chip, commonly called a CPU. A HPC system, on the other hand, is essentially a network of nodes, each of which contains one or more processing chips, as well as its own memory. – The National Institute for Computational Sciences
Typical Model Execution HPC Edition

• Benefits of HPC Computation / Parallel Processing
  • Break large jobs into smaller tasks that can be handled by individual processing cores.
  • Run several Large processing tasks simultaneously.
  • Perform multiple modeling steps that could perform all tasks from initial data loading through processing, and potentially even post processing.
  • Thanks to lower processing times, multiple result sets can be generated much quicker.
  • Job queues allow for unattended processing.
Benefits of Cloud Processing

• Lower cost of ownership*
  • Pay only for what you use.
  • Low or no up front cost.

• Flexibility
  • Compute Resources
    • Allows for multiple configurations of systems.
    • Can be temporary or permanent.
  • Storage
    • Very large file storage at varying costs.
    • Provides for multiple data access types.

• Different Resource types
  • Software as a service
  • Infrastructure as a service
  • Platform as a service
Cloud Providers and the CBPO

• CBPO utilizes cloud resources provided by UMCES through an ongoing grant.
• After a review of all the major cloud providers (Google/Microsoft/Amazon) UMCES choose Amazon to serve as our cloud provider.
  • At the time AWS was the most mature.
  • Offered the largest array of service options.
HPC Implementation at CBPO

• Cloud Formation Cluster (CFNCluster) was used to create a base HPC cluster
  • Easily repeatable system creation.
  • Create resources from CLI application (Users or Administrators)
  • Dynamic compute node scaling based on number of tasks submitted to the cluster, or static if necessary.
  • Choice of Operating System and Job Scheduler.
  • All instances automatically customized using a ‘post install’ shell script
    • Allows for full customization of the master and compute nodes using standard bash scripting.
      • User accounts
      • Project Specific software
      • File Permissions, etc...
    • Can have different configuration sets for master/client nodes.
  • Ability to customize running cluster from AWS console, or CFNCluster application.
  • Largely a “Fork Lift” migration of the CBPO’s previous HPC environment to AWS.
CBPO Cloud “Hardware”

• 1 Master node – c4.8xlarge – 36 Core + 60GB Memory
  • 200 GB for OS and Home Directories
  • 16TB /Modeling directory
  • 2 Archive disks totaling 22TB local “cool” storage
    • Single disk Max for EC2 Local disk is 16TB

• 0-8 Compute nodes - c4.8xlarge – 36 Core + 60GB Memory
  • 15GB for OS
  • /Home, /Modeling and /opt shared from Master to Compute

• External “Cold” Storage
  • Multiple S3 ‘Buckets’ totaling ~130TB
Deploy an Elastic HPC Cluster

Access on-demand, scalable resources for your High-Performance Computing (HPC) workloads
Cloud Computing Costs

• Cost can vary depending on workload
  • Full Price 100% compute running Per Month
  • Full Price 30% compute utilized Scaling On Demand
  • Actual usage over time in CBPO – AWS Console Reports

• Reservations cost less than on-demand systems depending on usage time.
  • Reservations can span multiple systems
    • Reservations are time, not host based.

• Disk storage is not-reservable
  • Use lower priced storage whenever possible to contain costs.
  • Disk storage can quickly eat through a budget.
How we could do it better

• Running your own cluster isn’t the only way.
  • Leverage S3 for source/result data storage
    • Lowers cost of data storage
    • Multiple access methods
      • HTTP/HTTPS
      • API
      • CLI utilities
      • C/Python/Perl/Java libraries.
    • Ability to use this file system directly as part of processing depends on the processing needs/method.
  • AWS Batch
    • Amazon service utilizing Docker instances to perform HPC tasks without a master server.
    • Job Scheduler service used to send tasks to the dockerized compute containers.
    • Minimal changes to existing modeling code.
  • AWS Redshift
    • Compute cluster most normally associated with Python/Spark.
    • Simpler setup
    • Would require a full Model re-write
Cloud Providers and You

• Do you already have access to an HPC System?
• Does your organization already have a cloud provider?
• Can your budget scale with your workload?
Getting started with Amazon Web Services

• Free access to basic resources for 12 Months: https://aws.amazon.com

• Install CFNCluster: https://aws.amazon.com/getting-started/projects/deploy-elastic-hpc-cluster/

• Create or copy a CFNCluster configuration file

• Run CFN Cluster
  • Login via SSH using connection string provided at end up setup.

• Work through the 30Box model, or any code base of your choosing.

• Don’t forget to clean up / shutdown resources when you are finished.