An overview of batch processing

31-May-2018
One-on-one

Your computer

Your program
Not to be mentioned in this talk (PROOF; TDataFrame) because it requires thread-safe code

Your computer  
(multiple cores)

Your program 
(multiple threads)

One thread  One thread  One thread  One thread  One thread  One thread
Multiple programs on a single computer (UNIX command “at”)

Your computer (multiple cores)

- Your program
- Your program
- Your program
- Your program
- Your program
- Your program
A batch system managing multiple programs on a single computer (UNIX command “batch”)

Your computer (multiple cores)

Your program
Your program
Your program
Your program
Your program
Your program

on hold

Your program
Your program
Your program
Your program
Your program
Your program
A batch system managing multiple programs on multiple computers

Your computer

Batch manager

Batch node

Batch node

Batch node

Batch node

Batch node

Batch node

Your program

Your program

Your program

Your program

Your program

Your program

Your program
The standard software for managing batch systems in scientific computing is HTCondor (or just Condor)

Main web page
http://research.cs.wisc.edu/htcondor/

Quick start
http://research.cs.wisc.edu/htcondor/quick-start.html

Full manual

• We use an older version of Condor in the Nevis particle-physics systems.
• Stick to the “vanilla” universe; the “standard” universe won’t work for ROOT or any other particle-physics software (so you don’t need condor_compile).
Condor managing multiple programs on multiple computers with multiple queues

Submit machine

Condor master

Batch node
Batch node
Batch node
Batch node

Your program
Your program
Your program
Your program

Condor pool

on hold
Condor will halt a queue in favor of an interactive program

Someone logged in!
Condor managing multiple programs on multiple computers with multiple configurations

- Submit machine
- Condor master
  - Batch node
  - Batch node
  - Batch node
  - Batch node
- Condor pool
- Your program
- Your program
- Your program
- Your program
- Your program
- Your program
- Your program
- Your program

on hold
Condor uses “ClassAds” to match your requirements with what each node offers.
Resource Planning

- Condor can’t do *everything* for you.
- Think about input files (including programs) and output files and how they’ll be accessed.
- Think about disk space. “df –h” and “du –shx *” can help.
- Fun fact: The particle-physics Condor pools *can’t* see your home directory!
- Moral: Let condor transfer your files... when possible.

When you can’t let condor transfer your files, here are disk-sharing methods outside of condor:

- NFS – used at Nevis
- CVMFS – Fermilab and CERN
- Grid, BlueArc – only used at Fermilab
- AFS – obsolete, still used at CERN
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What we do

Your server

File server

/home

/share

/data
Particle-Physics Computer Systems

Linux Cluster

**Administrative servers**
- hypatia: administration, NIS
- hermes: DNS, batch
- shelley: backup server
- annex: off-site backup & mail
- notebook: Jupyter

**Workgroup/Login servers**
- franklin: Mail
- ada: web server
- sullivan: mailing-list server
- hogwarts: staff
- twiki: wiki server

**File servers**
- kolya: ATLAS
- tehanu: VERITAS
- houston: Neutrino
- shang: DOE
- milne: student files

**File servers (virtual machines)**
- xenia
- xenia2
- serret
- ged
- vetch
- amsterdam
- westside
- bleecker
- riverside

<http://www.nevis.columbia.edu/linux/>
<http://www.nevis.columbia.edu/linux/cluster-names.html>
Bringing the job to the data

Some wrapper script

requirements = (machine = node04.nevis.columbia.edu)

Submit machine

Condor master

node01

bigfile1.root

node02

bigfile2.root

node03

bigfile3.root

node04

bigfile4.root

node05

bigfile5.root

node06

bigfile6.root
Final tips

• Split up your task so each condor job takes 20-60 minutes

• If your job must be preempted, it will have to run from the beginning on the same machine that cancelled the job

• Test your job with one process before submitting it for 10,000 processes!
Resources

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Full manual

Nevis particle-physics condor guide
https://twiki.nevis.columbia.edu/twiki/bin/view/Nevis/Condor

Basic Condor@Nevis tutorial
http://www.nevis.columbia.edu/~seligman/root-class/