An overview of batch processing

30-May-2019
One-on-one

Your computer

Your program
Not to be mentioned in this talk (RDataFrame, PROOF) because they require thread-safe code

Pro tip: See Part Five of the ROOT tutorial to explore this option.
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”)
A batch system managing multiple programs on multiple computers

Your computer

Batch manager

Batch node

Batch node

Batch node

Batch node

Batch node

Your program

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
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

Your program

Your program

Your program

Your program

Your program

Your program

on hold

Submit machine

Condor master

Batch node

Batch node

Batch node

Batch node

Batch node

Batch node

Batch node

Batch node

Condor pool
Condor will halt a queue in favor of an interactive program

Diagram:
- Submit machine
- Condor master
- Batch node
- Batch node
- Batch node
- Batch node
- Batch node
- Batch node
- Batch node
- Batch node
- Batch node
- Batch node
- Batch node

Condor pool

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

someone logged in!
on hold
Condor managing multiple programs on multiple computers with multiple configurations

Submit machine

Condor master

Batch node

Batch node

Batch node

Batch node

Batch node

Batch node

Batch node

Batch node

Condor pool

Your program

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
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 **don’t** do
Resource Planning

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- Moral: Let condor transfer your files... when possible.

What we do

- Your server
  - `/home`
- File server
  - `/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
- kolya
  ATLAS
- tehanu
  VERITAS
- houston
  Neutrino
- shang
  DOE

File servers
- milne
  student files
- xenia
- xenia2
- serret
- ged
- vetch
- amsterdam
- westside
- bleecker
- riverside

Workstations
- batch nodes
- student boxes

Notes:
- <http://www.nevis.columbia.edu/linux/>
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/