An overview of batch processing
One-on-one

Your computer

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

Your computer (multiple cores)

Your program (multiple threads)

One thread
One thread
One thread
One thread
One thread

Pro tip: See Part Five of the ROOT tutorial to explore this option, or my "fast way to analyze" talk if I give it.
Multiple programs on a single computer (UNIX command “at”)

You have to remember not to submit too many jobs or you’ll overload the computer
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

Your program

Your program

Your program

Your program

Your program

Your program

on hold

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


Full manual

https://htcondor.readthedocs.io/en/latest/

• 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

Batch node

Batch node

Your program
Your program
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 will halt a queue in favor of an interactive program.
Condor managing multiple programs on multiple computers with multiple configurations

Submit machine → Condor master

Condor pool

Batch node
Batch node
Batch node
Batch node

Your program
Your program
Your program
Your program

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

Condor pool

Condor master

Submit machine

Your requirements (job ClassAd)

What a node offers (machine ClassAd)

Batch node

Batch node

Batch node

Batch node

on hold

Your program

Your program

Your program

Your program

Your program

on hold

Your program

Your program

Your program

Your program

Your program
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
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What we *don’t* do
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.

What we do

Your server

File server
Particle-Physics Computer Systems
Linux Cluster

Administrative servers
- hypatia: administration, NIS
- hermes: DNS, batch
- shelley: backup server
- 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

File servers
- xenia
- xenia2
- serret
- ged
- vetch
- amsteram
- westside
- bleeker
- riverside

Clients and x-terms
- Workstations
- batch nodes
- student boxes

Workgroup/Login servers

Virtual machines

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

Some wrapper script

Submit machine

Condor master

node01

bigfile1.root

node02

bigfile2.root

node03

bigfile3.root

node04

bigfile4.root

node05

bigfile5.root

node06

bigfile6.root

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

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

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Full manual
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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/