An overview of batch processing
One-on-one

Your computer

Your program
Not to be mentioned in this talk

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

Your computer
(multiple cores)

Your program
Your program
Your program
Your program
Your program
A batch system managing multiple programs on a single computer
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

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

- Submit machine
  - Condor master
    - 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
      - Your program

- Condor pool

- 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.
Condor uses “ClassAds” to match your requirements with what each node offers.

1. Submit machine
   - Your requirements (job ClassAd)
   - What a node offers (machine ClassAd)

2. Condor master
   - Condor pool
     - Batch node
     - Batch node
     - Batch node
     - Batch node
     - Batch node

3. On hold
   - Your program
   - Your program
   - Your program
   - Your program
   - Your program
   - Your program
   - 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
- AFS – obsolete, still used at CERN
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What we *don’t* do

[Diagram showing resource planning with Condor nodes and /home directory]
Resource Planning

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What we do

![Diagram showing file server and nodes](image-url)
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

Virtual machines

File servers
- kolya
  ATLAS
- tehanu
  VERITAS
- houston
  Neutrino
- shang
  DOE
- milne
  student files
- xenia
- xenia2
- serret
- ged
- vetch
- amsterdam
- westside
- bleeker
- 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/