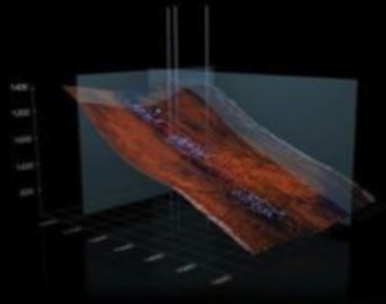
Research Computing Center
High-Performance Computing and Research Technology Services

Robin Weiss
robinweiss@uchicago.edu

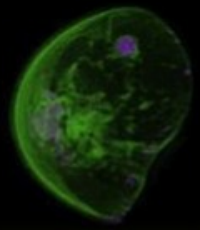
Computing – The 3rd Pillar of Science

Drug Design
Molecular Dynamics

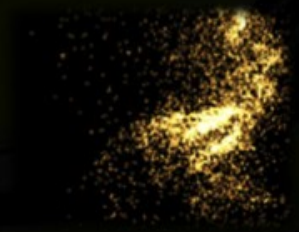


Seismic Imaging
Reverse Time Migration

Automotive Design
Computational Fluid Dynamics

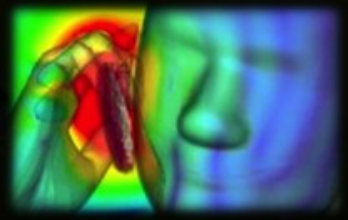


Medical Imaging
Computed Tomography

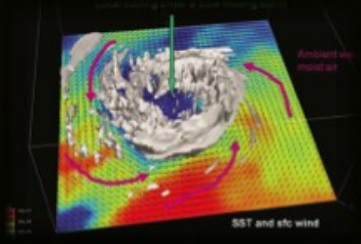


Astrophysics
n-body

Options Pricing
Monte Carlo



Product Development
Finite Difference Time Domain



Weather Forecasting
Atmospheric Physics

RCC's Mission

*The RCC mission is to **advance research and scholarship** by providing access to centrally managed high-end computing, storage and visualization resources. These resources include not just **hardware** and **software**, but also expert **technical user support**, education and training.*

Research Computing Center Services

"Provide access to hardware (computing, storage, and visualization resources), software and advanced technical support"

Hardware	Software	Technical Support
High End Computing Tightly Coupled & High Throughput	Commercial software Licensing	Scientific Computing Visualization
Research storage Data Management	Public/Community codes	Education and Training Grants
Special hardware: GPU, Shared memory, fast Network	Homegrown codes	Application Software Development

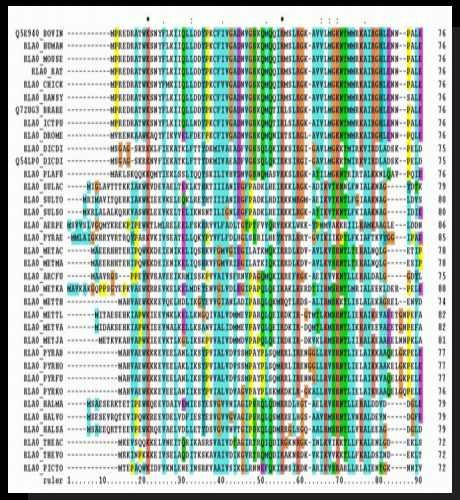
Software

18 Commercial and 186 Publicly available software are installed and maintained at RCC (341 different modules)

- **System Tools and Math Libraries**
  - Compilers: Intel, Portland, GCC
  - Debugger
  - Python, Perl, Ruby interpreters
  - SWIFT
  - MPI, MKL, FFTW, GSL, CUDA, etc.

- **Commercial software**
  - MATLAB, STATA, AMIRA, Alinea DDT, etc.

- **Domain Specific Applications**
  - chemistry
  - Biology
  - physics
  - etc.



- Use of **module system**
  - Example: *module load intel*

Workshops and Advanced Training for Chicago Researchers

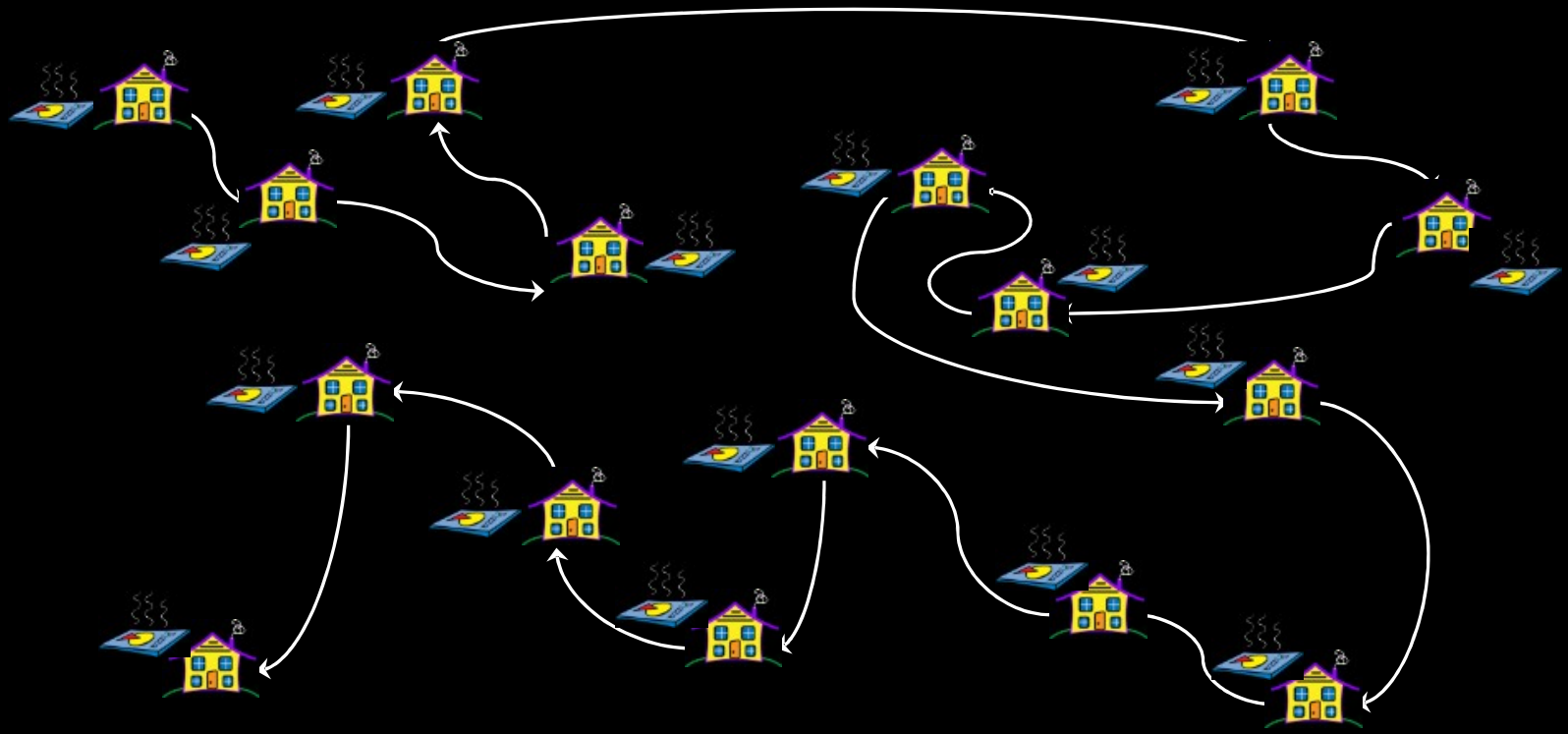
- RCC tutorials and Workshops
- Software vendors workshops
- Scheduled Workshops
  - Intro to Python
  - Intro to Linux
  - Intro to data visualization
  - Intro to OpenMP
  - Parallel programming with MPI
  - Programming with R
  - Introduction to Stata
  - Comsol Workshop
  - Python for HPC
  - GPU computing with Nvidia
  - Tips and Tricks for Midway

What is a Supercomputer?

- A very fast computer...
  ... i.e.: A Super-Computer!
- It’s all about math (A + B = ?)
- The “slowest” supercomputer does 153.4 Tflop/s
- The “fastest” does 33,862.7 Tflop/s
- (iPhone 5 does ~600 Mflop/s)

Serial Pizza Delivery

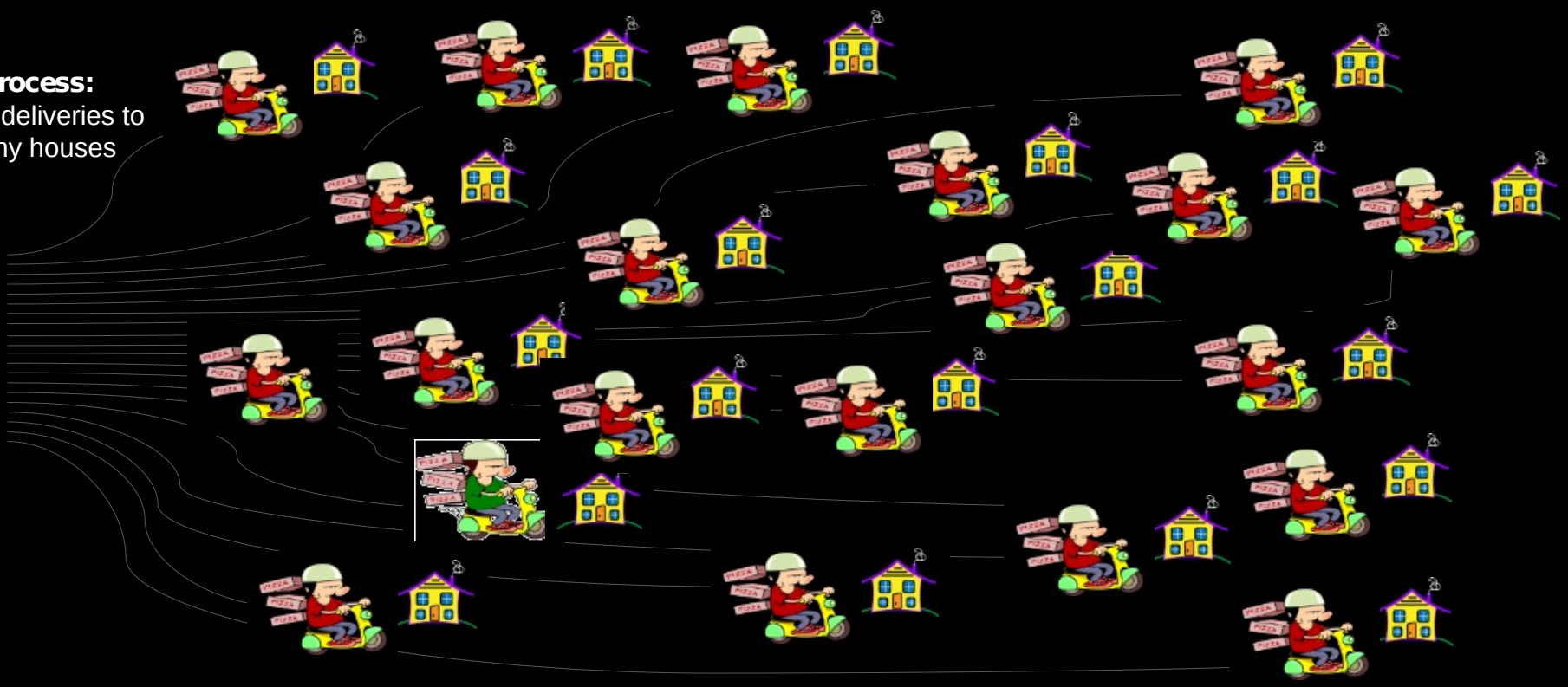
Process:
Delivery truck delivers one pizza and then moves to next house



Original Idea by Jedox
www.jedox.com

Parallel Pizza Delivery

Process:
Many deliveries to many houses



Original Idea by Jedox
www.jedox.com

So what’s the secret?

- Take advantage of parallel processing
- Supercomputers are (usually) made up of many smaller computers
  - 10’s of thousands or even millions
- Why go parallel? Because Intel has been lying to you …

… Computers have not gotten any faster in about 11 years

Pizza Delivery Problem

- The worlds faster supercomputer has 3,120,000 CPU cores
- If you have 3,120,000 drivers, you can deliver 3,120,000 pizzas at the same time

Midway Supercomputer is...

- In 2012 we were #447 in the world (80.6 Tflop/s)
- Scientific Linux 6.6
- Intel x86_64 based cluster
- ~895 Compute nodes (13,320 CPU cores)
  - Each with 16 CPUs and 32 GB memory
- 40 gbps infiniband network
  - 3-5 GB/s throughput
- ~1.5 PB storage
  - 900TB of tape backup

RCC capabilities continue to grow at Midway
RCC manages 895 nodes (13,320 cores) and 1.4 PB of storage

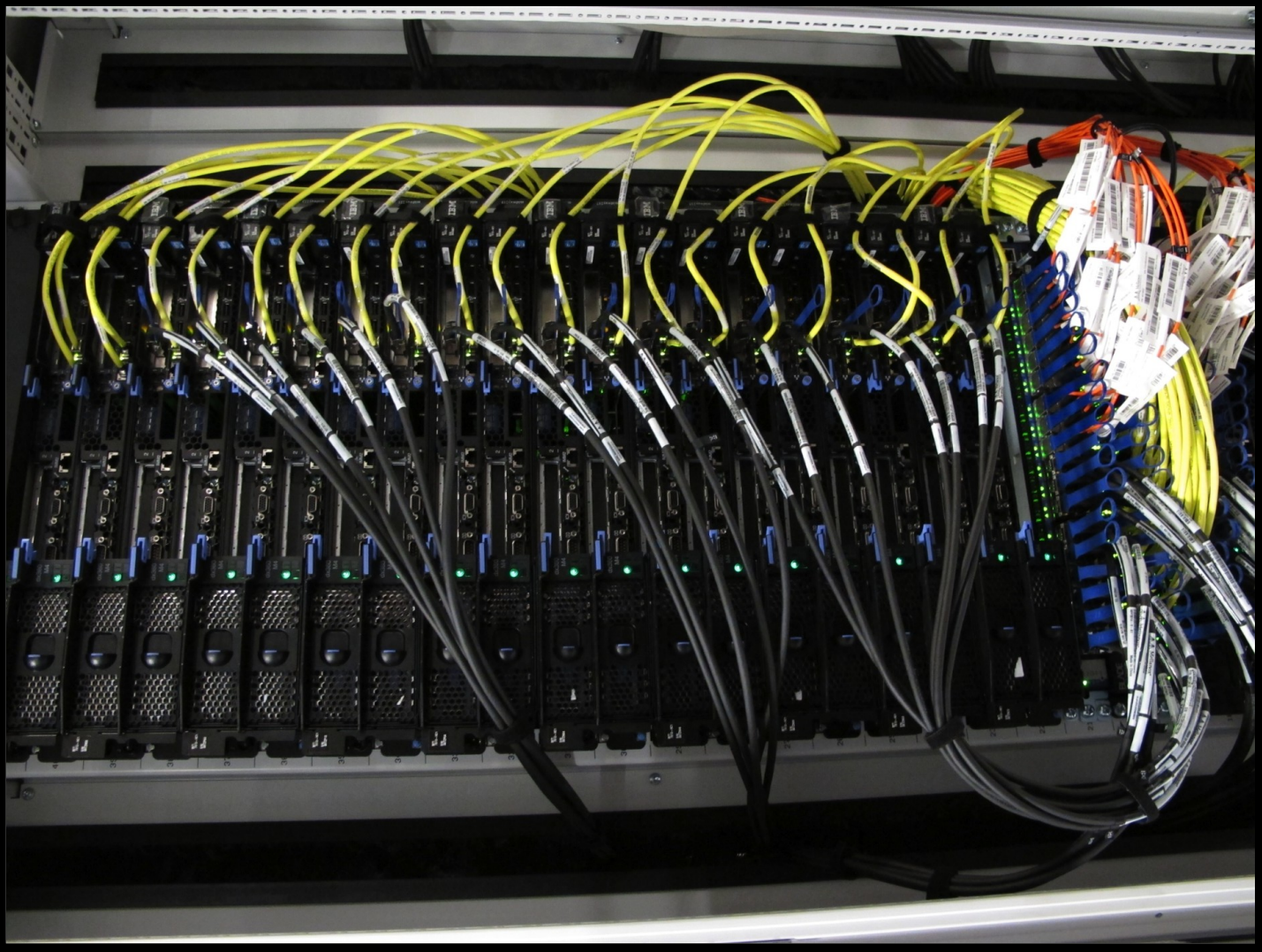
- **Compute**

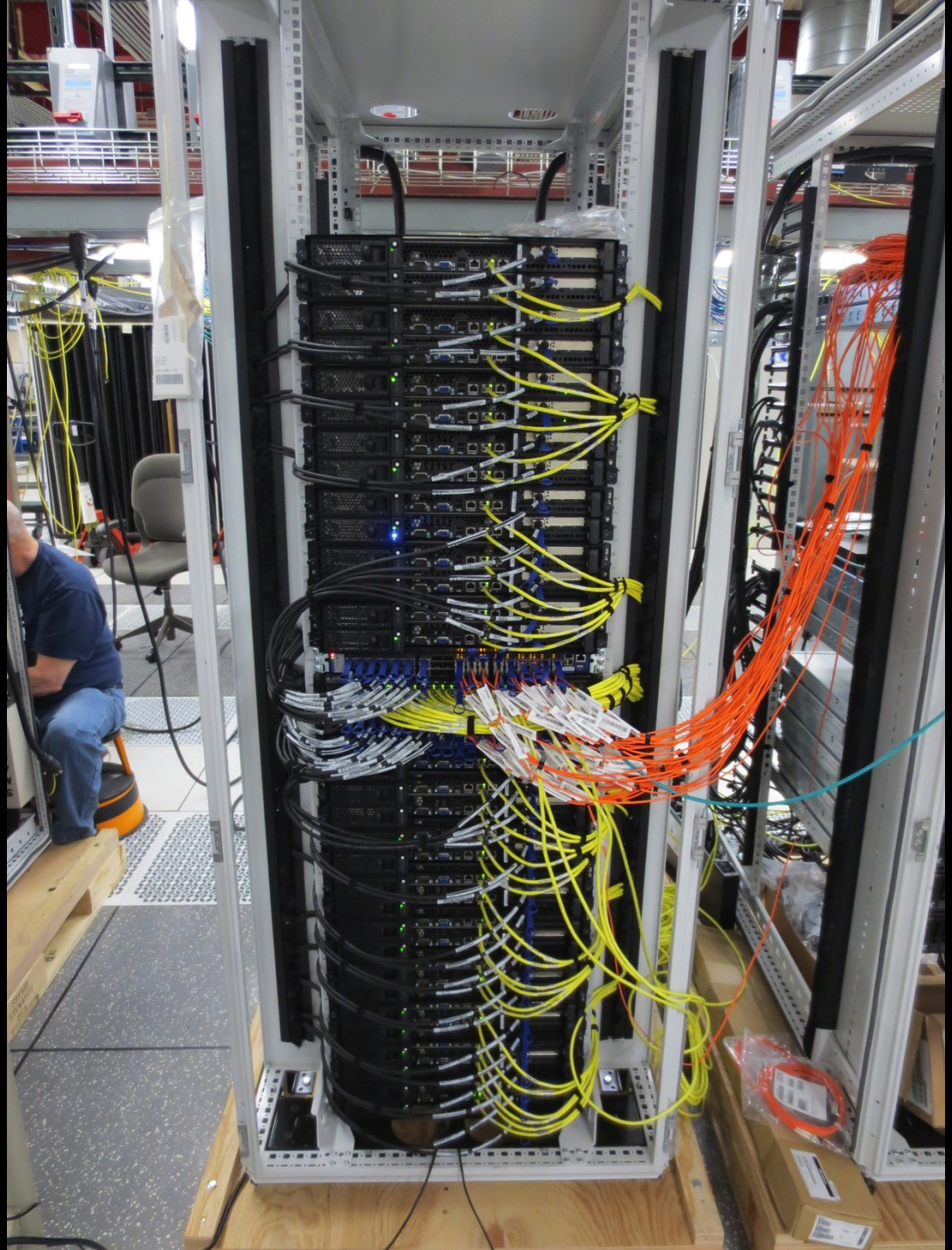
  Shared: 345 nodes
  - **329** tightly coupled infiniband nodes (5376 cores)
  - **3** loosely coupled GigE nodes (48 cores)
  - **10** NVidia GPU nodes (176 cores)
  - **3** large shared memory nodes (up to 1TB) (64 cores)

  Cluster Partnership Program: 270 nodes
  - **160** tightly coupled infiniband nodes (2836 cores)
  - **109** loosely coupled nodes (1812 cores)
  - **1** large shared memory node (24 cores)

  Cluster Partnership Program Special: **280** nodes
  - **118** tightly coupled nodes (1040 cores)
  - **162** loosely coupled nodes (1944 cores)
- **Storage**
  - High-performance storage (**96 TB** usable)
  - Capacity storage: **1.4 PB usable**
  - Cluster Partnership Program Storage: **750 TB usable**
  - Backed up and snapshotted
- **Tape Backup**
  - **900 TB** of tapes

dx360
M4
IMM2
IBM

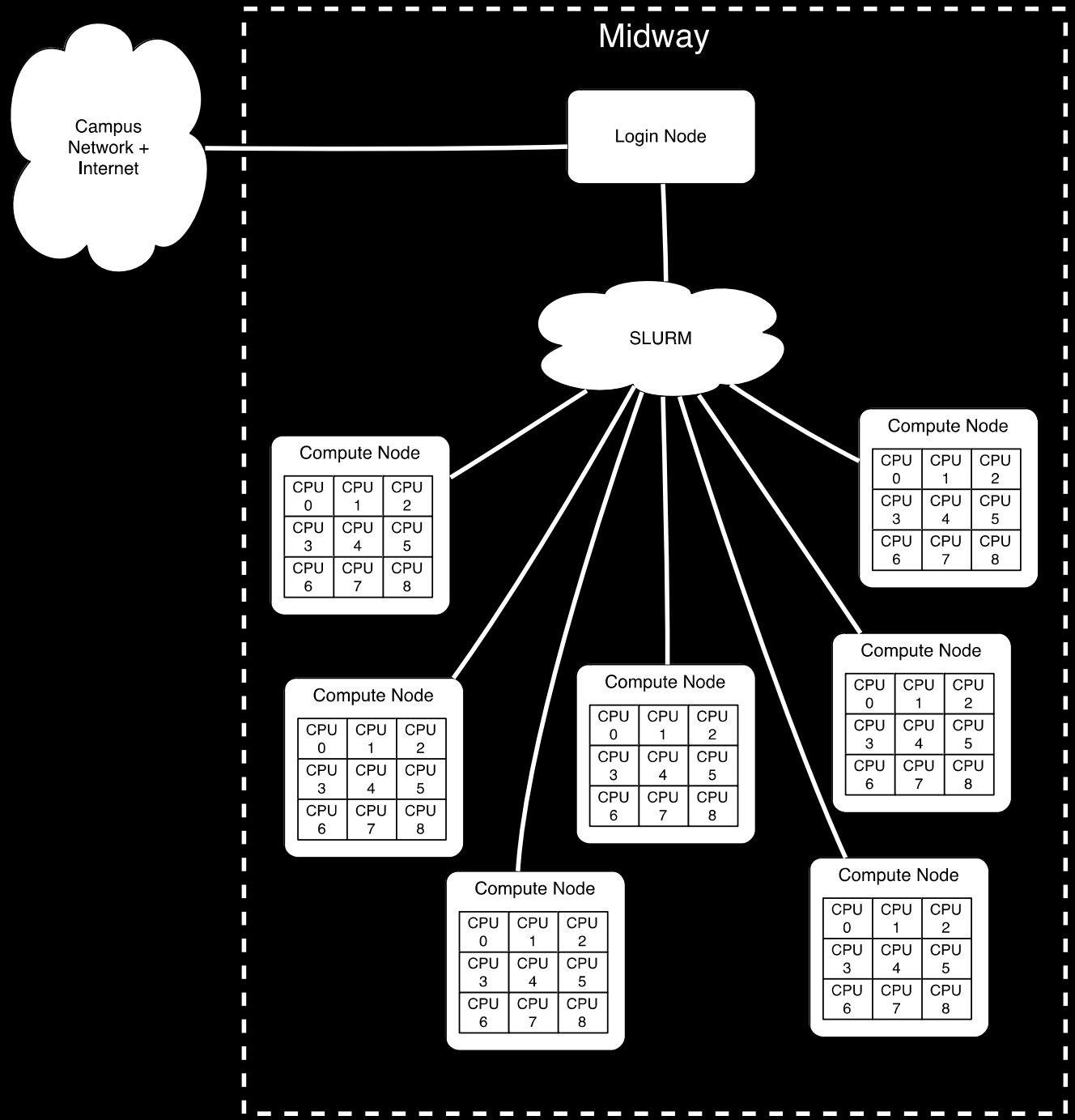




EXIT

Getting an Account

- ECON 41904 has a class account
  - All students in this class are eligible for an account during Spring 2015 quarter
- All PI-Eligible Uchicago faculty can obtain a PI account
  - Non pi-eligible Uchicago users can get an account via an RCC PI Account


Midway
Campus Network + Internet
Login Node
SLURM
Compute Node
CPU 0
CPU 1
CPU 2
CPU 3
CPU 4
CPU 5
CPU 6
CPU 7
CPU 8
Compute Node
CPU 0
CPU 1
CPU 2
CPU 3
CPU 4
CPU 5
CPU 6
CPU 7
CPU 8
Compute Node
CPU 0
CPU 1
CPU 2
CPU 3
CPU 4
CPU 5
CPU 6
CPU 7
CPU 8
Compute Node
CPU 0
CPU 1
CPU 2
CPU 3
CPU 4
CPU 5
CPU 6
CPU 7
CPU 8
Compute Node
CPU 0
CPU 1
CPU 2
CPU 3
CPU 4
CPU 5
CPU 6
CPU 7
CPU 8
Compute Node
CPU 0
CPU 1
CPU 2
CPU 3
CPU 4
CPU 5
CPU 6
CPU 7
CPU 8
Compute Node
CPU 0
CPU 1
CPU 2
CPU 3
CPU 4
CPU 5
CPU 6
CPU 7
CPU 8

Getting Help

- Email: help@rcc.uchicago.edu
- Docs: https://docs.rcc.uchicago.edu