

Basics of Cluster Computing

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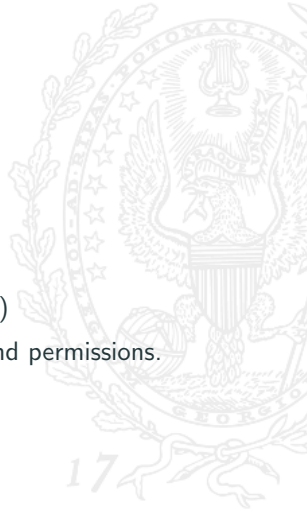
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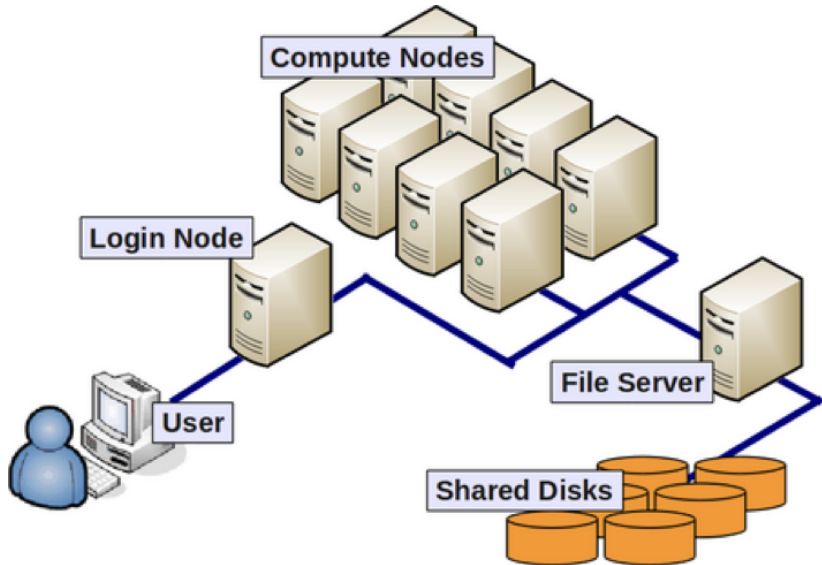


Definitions - I

- Cluster: A network of computers.
- Node: An individual computer within a cluster.
- Storage: Disks in network where data is stored.
- OS: An operating system (e.g., Linux, Windows)
- Admin: Oversees access, software installation and permissions.



Cluster

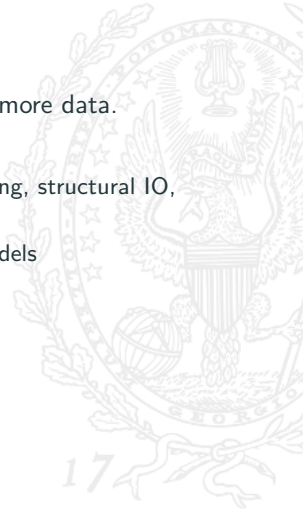


Definitions - II

- High-Performance Computing (HPC) Cluster: Cluster with better processing units (GPUs), high-speed interconnects, and optimization for parallelization.
- Graphics Processing Unit (GPU) - specialized electronic circuit designed to accelerate the rendering of graphics and perform complex mathematical calculations. (e.g. NVIDIA GPU)
- Virtual Machine (VM): isolated virtualized computing environment managed in a cluster.
- Cloud Computing: use of clusters through internet only.
- Cloud Service Provider (CSP): cloud computing environment - e.g. Amazon AWS, Microsoft Azure, Google Gcloud.

Why use clusters?

- It's much faster than your laptop and can store more data.
- You can do the following easily:
 - Estimation of complex models - machine learning, structural IO, Bayesian models, HANK
 - Monte Carlo Simulations and Agent-Based Models
 - Big data processing - image, text, graphs.
- You can automate the boring stuff.
- You can parallelize tasks.
- You can share data and code easily.



Automation



**Reading and
writing files**



**Consolidating
tasks**



**Interacting
with APIs**



Reformatting

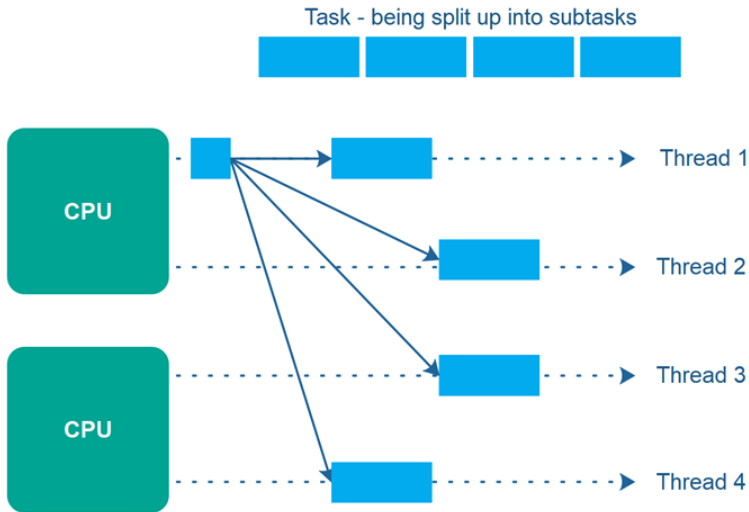


Organizing data

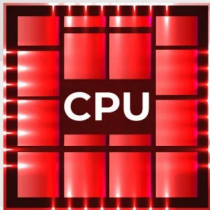


Web scraping

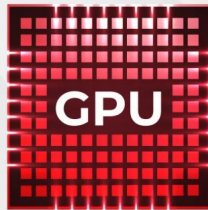
Multi-Threading



CPU vs GPU



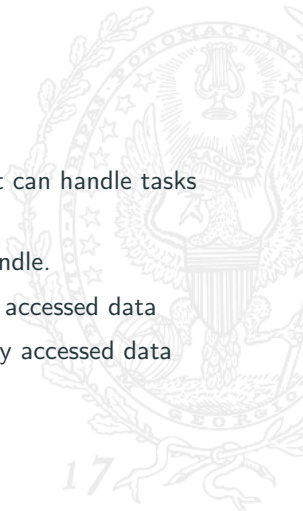
- CPUs have few strong cores
- Suited for serial workloads
- Quick access to System Memory (RAM)



- GPUs have thousands of weaker cores
- Suited for parallel workloads
- Can only access vRAM quickly

Definitions - III

- Cores: These are individual processing units that can handle tasks independently.
- Threads: Number of processes each core can handle.
- Cache: high-speed storage in core for frequently accessed data
- RAM: high-speed storage in cluster for frequently accessed data



Internal:

- “Econ Server”
- HPC

External:

- Google collab, Pro
- Gcloud, AWS, etc.



- Hostname: econ-prod-1.uis.georgetown.edu
- Owner: Prof John Rust
- Installation Steps:
 - Install GU VPN
 - Log in via Netid pwd and DUO code.
 - In terminal/command line do:
ssh NETID@econ-prod-1.uis.georgetown.edu



Working in a cluster

- Bash - file and process management
- Vim - to edit files
- nohup - to schedule jobs
- venv - virtual environments
- git - repository management



- Virtual Machine on Gcloud Compute
- Login Node: figs-controller
- GPU Nodes: gpu, gpuspot, spot
- Installation Steps:
 - Get access
 - gcloud init
 - gcloud compute ssh figs-controller
- Slurm commands - sinfo, srun, sbatch, scancel
- Slurm batch files

