Introduction to DHTC

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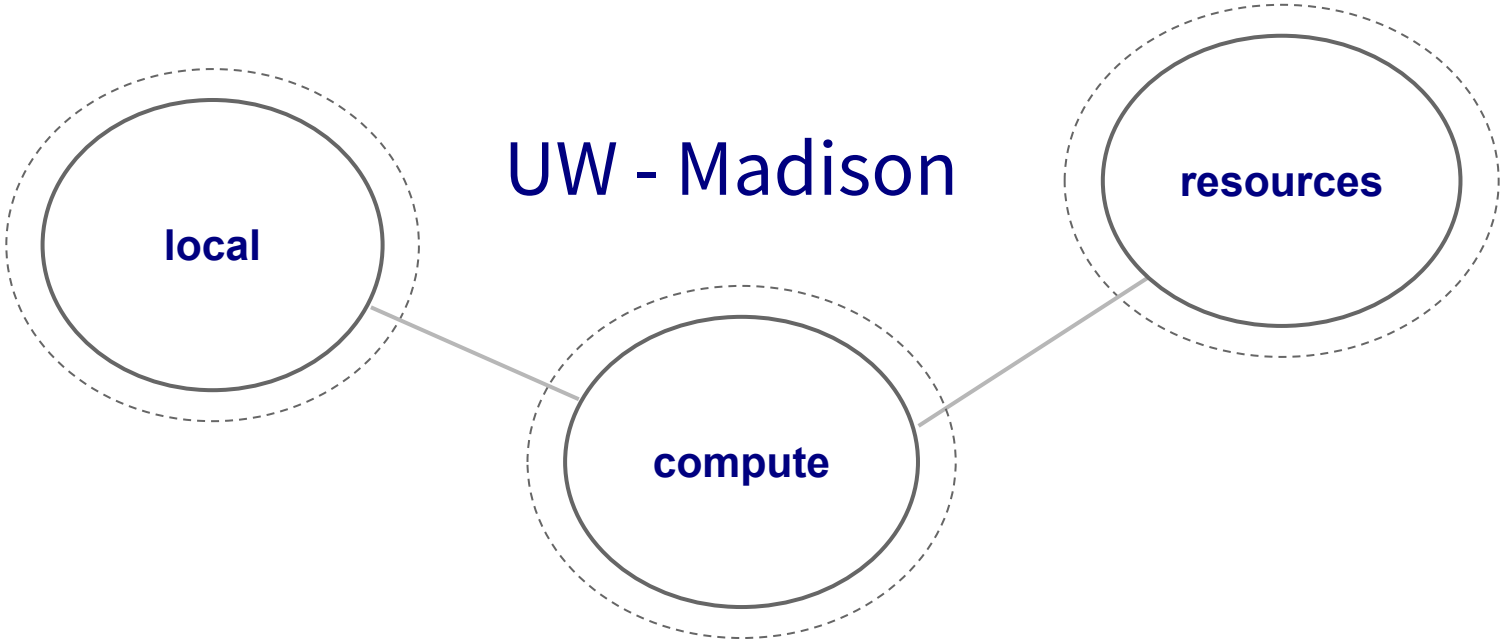
Local High Throughput Computing



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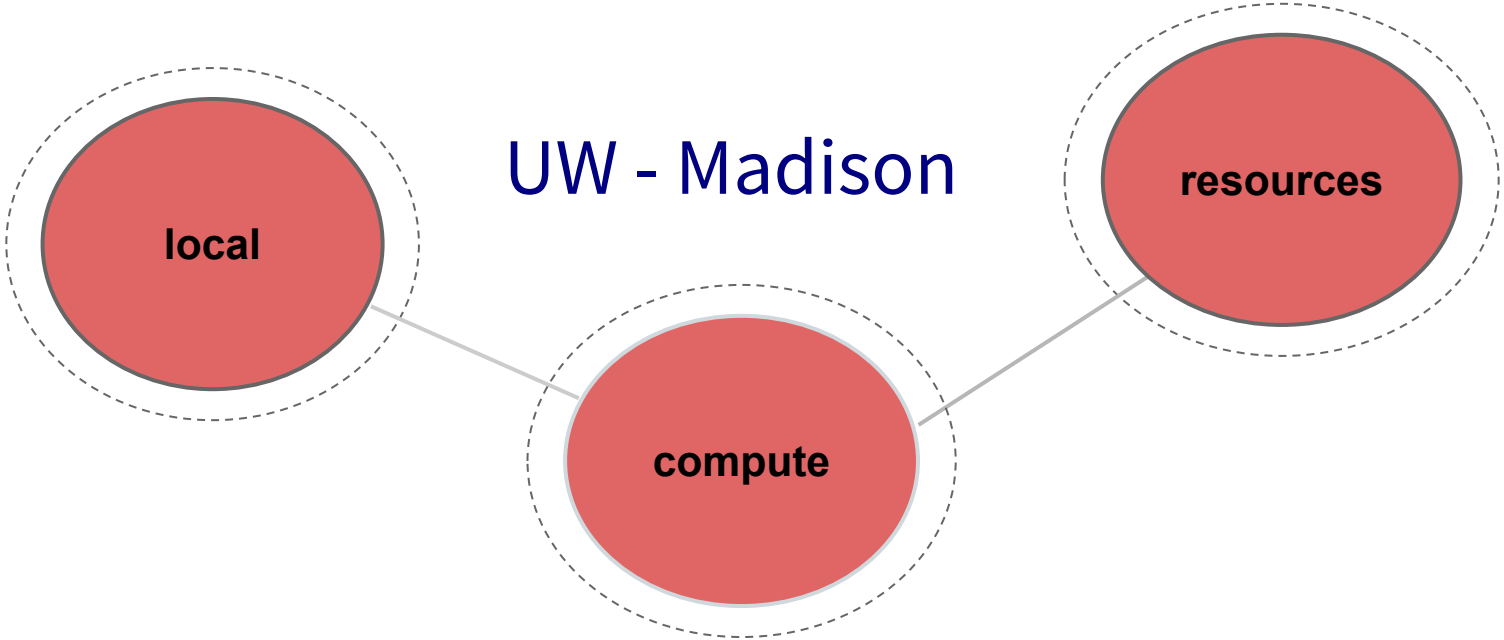


How do you get more computing resources?

#1: Buy Hardware

#1: Buy Hardware

- Great for specific hardware/privacy requirements
- Costs $$$
  - Initial cost
  - Maintenance
  - Management
  - Power and cooling
- Delivery and installation takes time
- Rack/floor space
- Obsolescence
- Plan for peak loads, pay for all loads

#2: Use the Cloud

#2: Use the Cloud - Pay per cycle

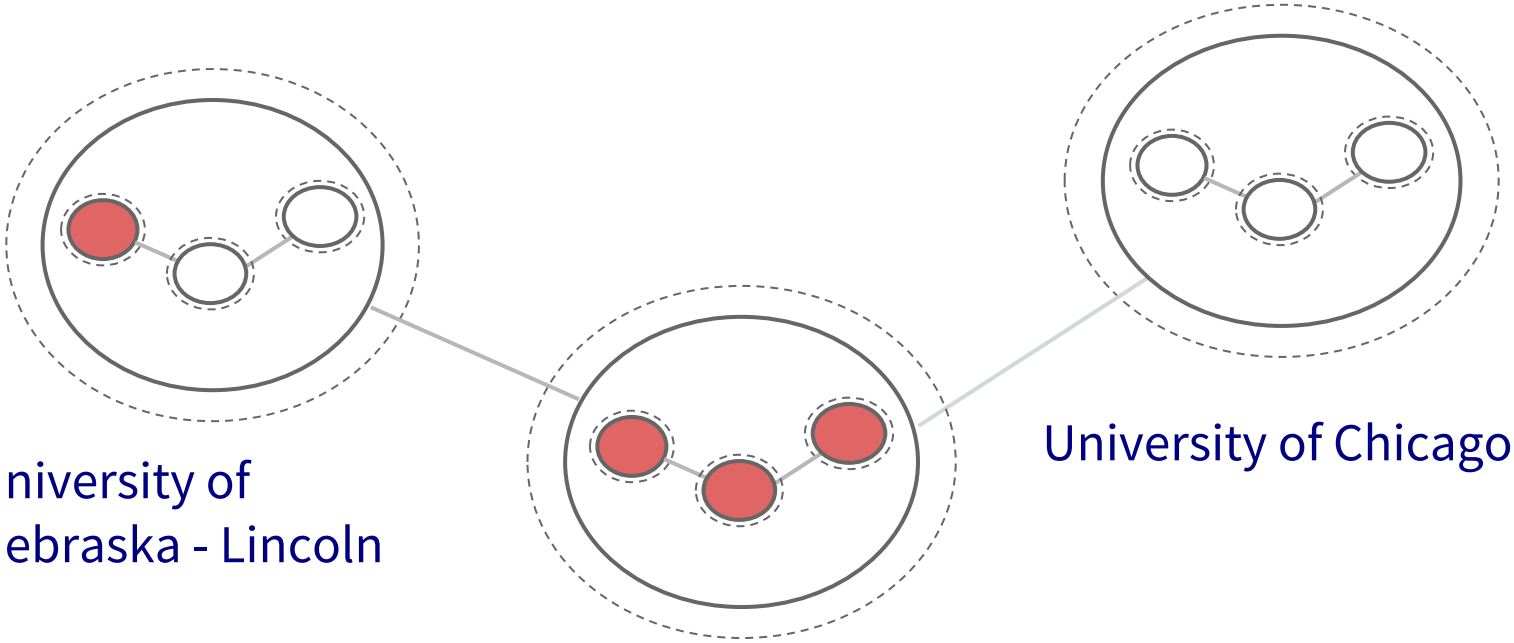
- e.g. Amazon Web Services, Google Compute Engine, Microsoft Azure, Rackspace
- Fast spin-up
- Costs $$$
- Still needs expertise + management
  - Easier than in the past with the `condor_annex` tool
- Does payment fit with your institutional or grant policies?

#2: Use the Cloud - 'Managed' clouds

- e.g. Cycle Computing, Globus Genomics
- Pay someone to manage your cloud resources — still costs $$$
- Researchers and industry have used this to great success
  - Using Docker, HTCondor, and AWS for EDA Model Development
  - Optimizations in running large-scale Genomics workloads in Globus Genomics using HTCondor
  - HTCondor in the enterprise
  - HTCondor at Cycle Computing: Better Answers. Faster.

#3: Share Resources

#3: Share Resources - Distributed HTC

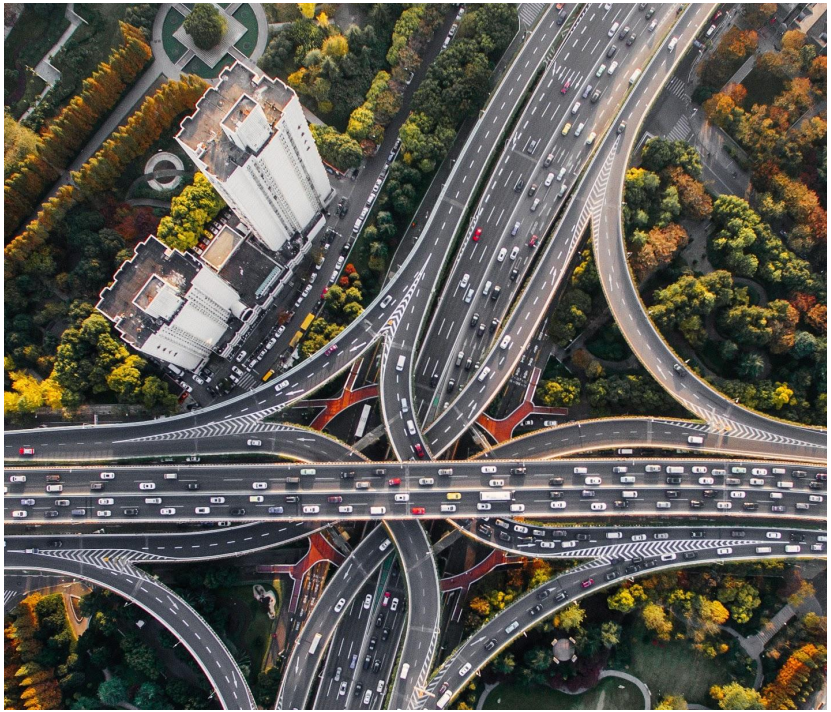


i.

Split Up Your Jobs Manually

Let’s start sharing!

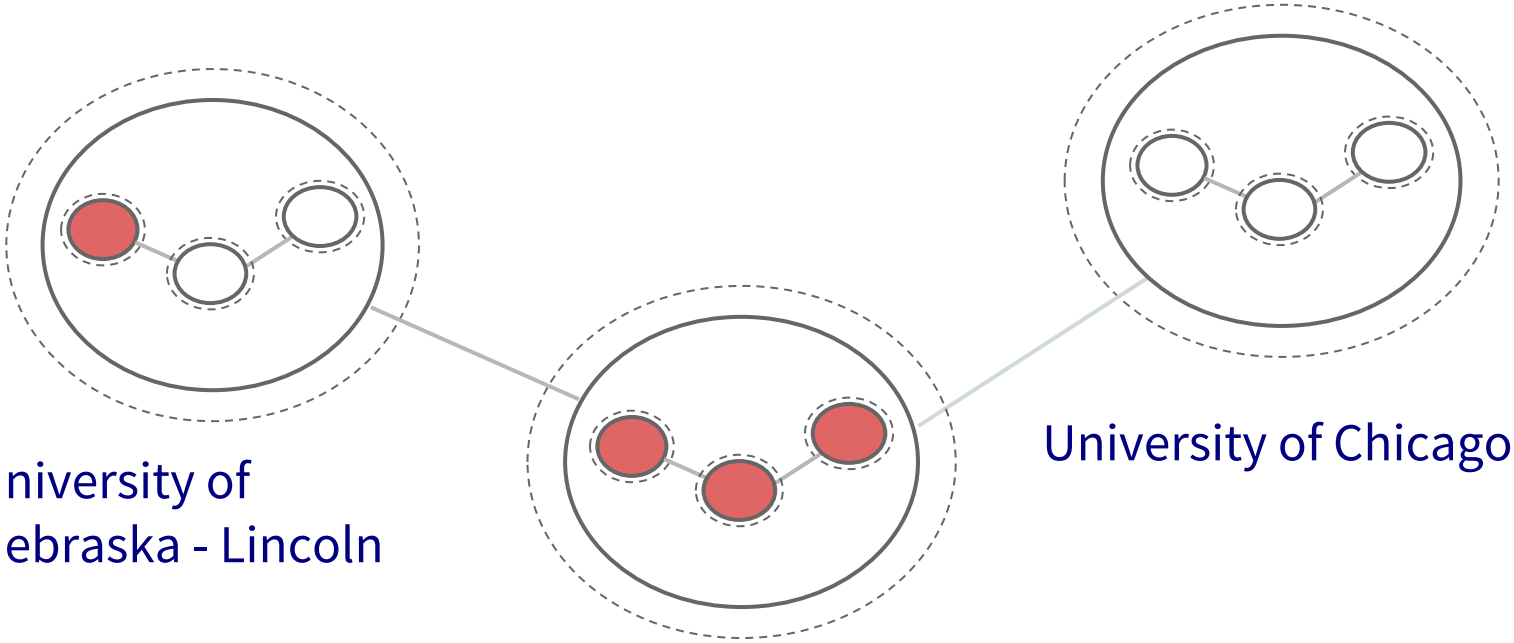
Manual Job Split



- Obtain sharing agreements
- Query each cluster for idle resources
- Split and submit jobs based on resource availability

Photo by Denys Nevozhai on Unsplash

#3: Share Resources - Distributed HTC



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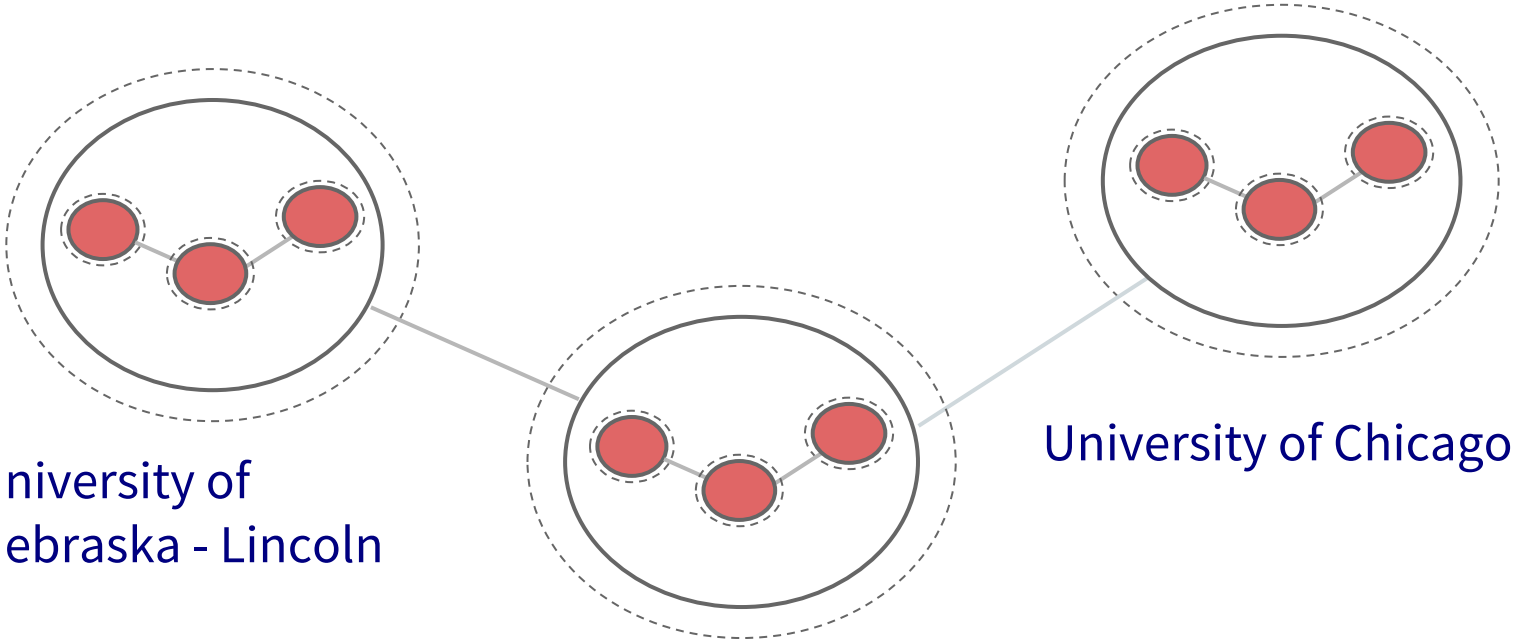


Manual Job Split - Shortcomings

- Fewer agreements = fewer potential resources
- More agreements = more account management
- Querying and partitioning is tedious and inaccurate
- Are you allowed to share? Do you have anything to share?
- Not all clusters use HTCondor — other job schedulers e.g., SLURM, PBS, etc.
- Pools are independent — workflows must be confined to a single pool

Open Science Grid

ii.

Split Up Your Jobs Automatically

Let the computers do the work

Automatic Job Split - Shortcomings

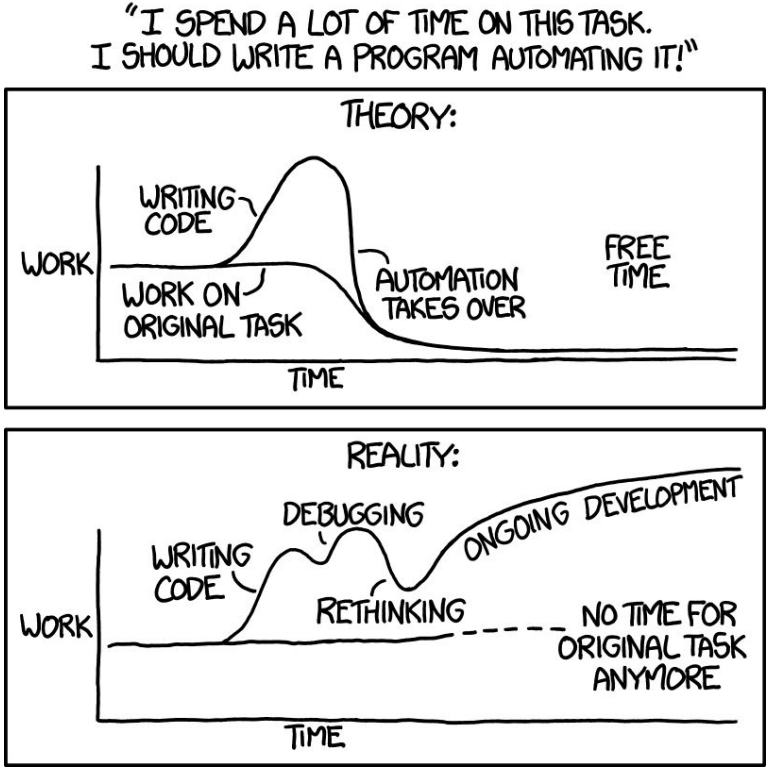
Homer: Kids: there's three ways to do things; the right way, the wrong way and the Max Power way!

Bart: Isn't that the wrong way?

Homer: Yeah, but faster!

Groening, M (Writer), Michels, P. (Director) . (1999). Homer to the Max [Television Series Episode]. In Scully, M. (Executive Producer), *The Simpsons.* Los Angeles, CA: Gracie Films

Automatic Partitions - Shortcomings



Source: https://xkcd.com/1319/

#3: Share Resources - Requirements

- Minimal account management
- No job partitioning
- DAG workflow functionality
- HTCondor only!
- No resource sharing requirements

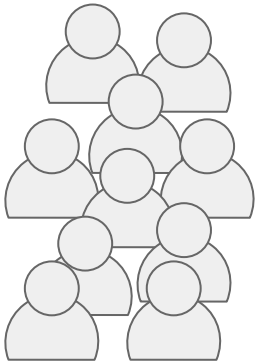
Open Science Grid

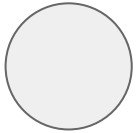
iii.

Overlay Systems

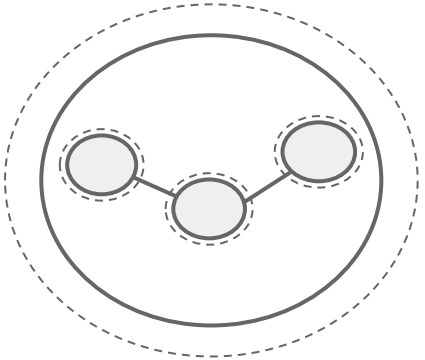
Let the OSG do the heavy lifting

The OSG Model



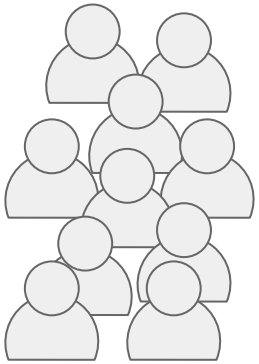


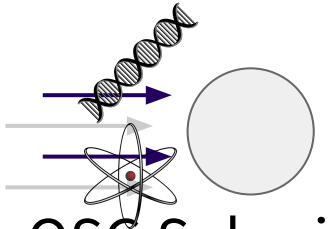
OSG Submit and CM



Cluster

The OSG Model





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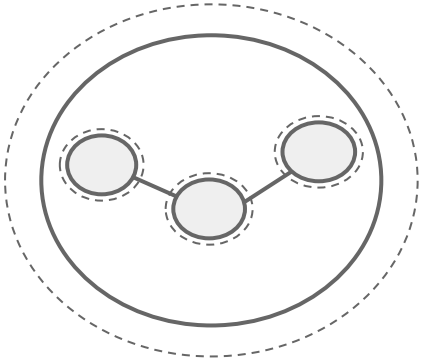
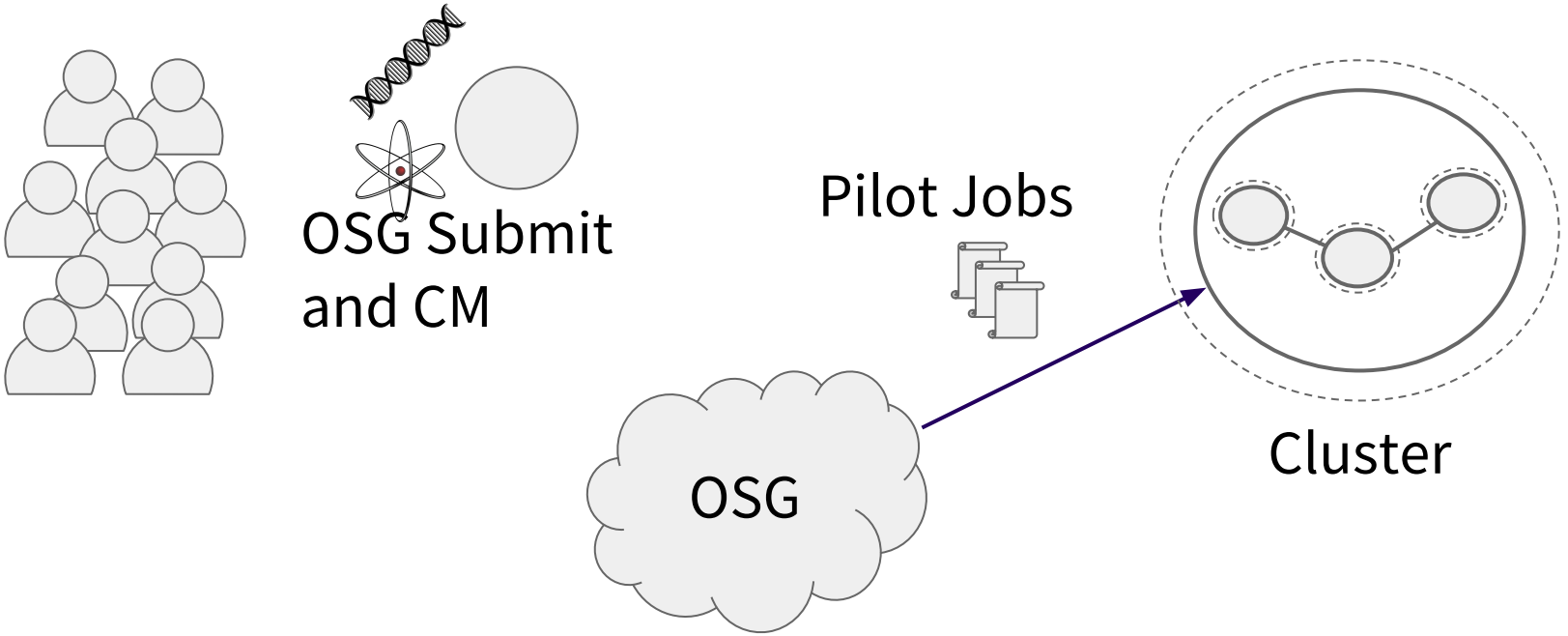


Cluster

OSG

The OSG Model



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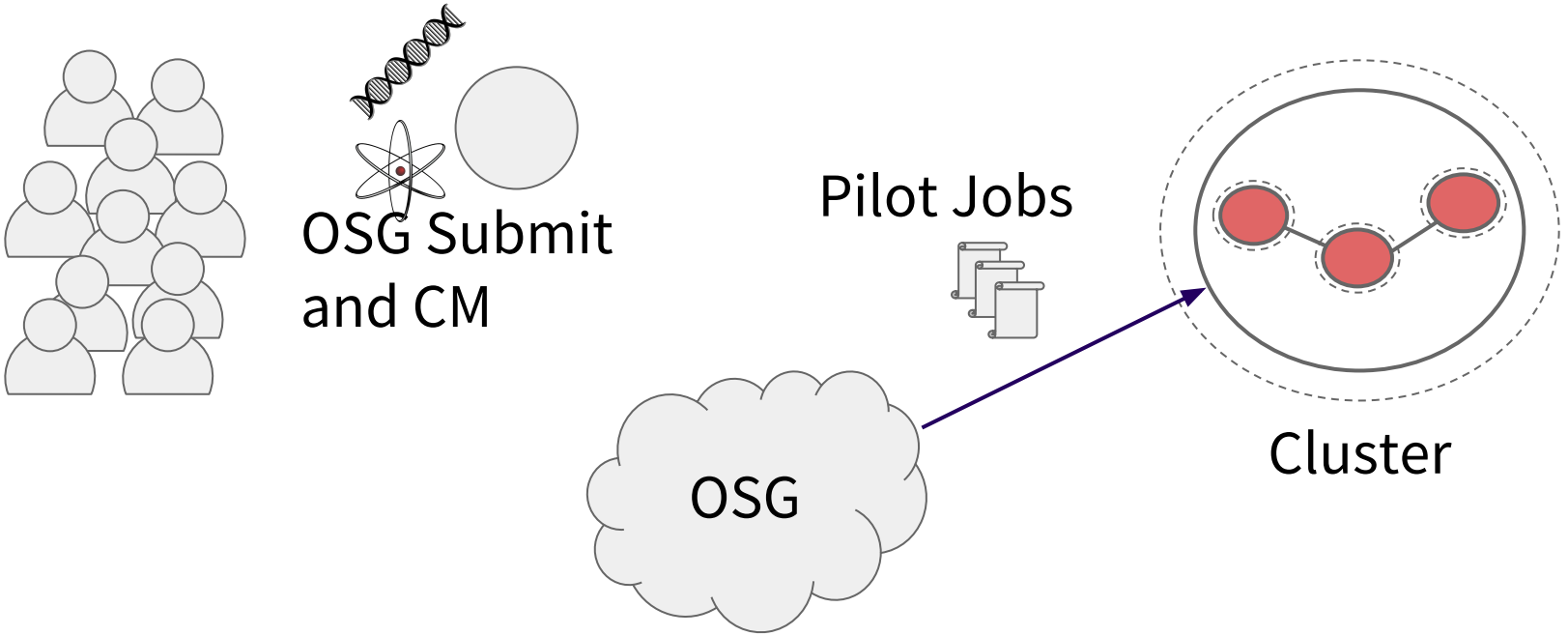
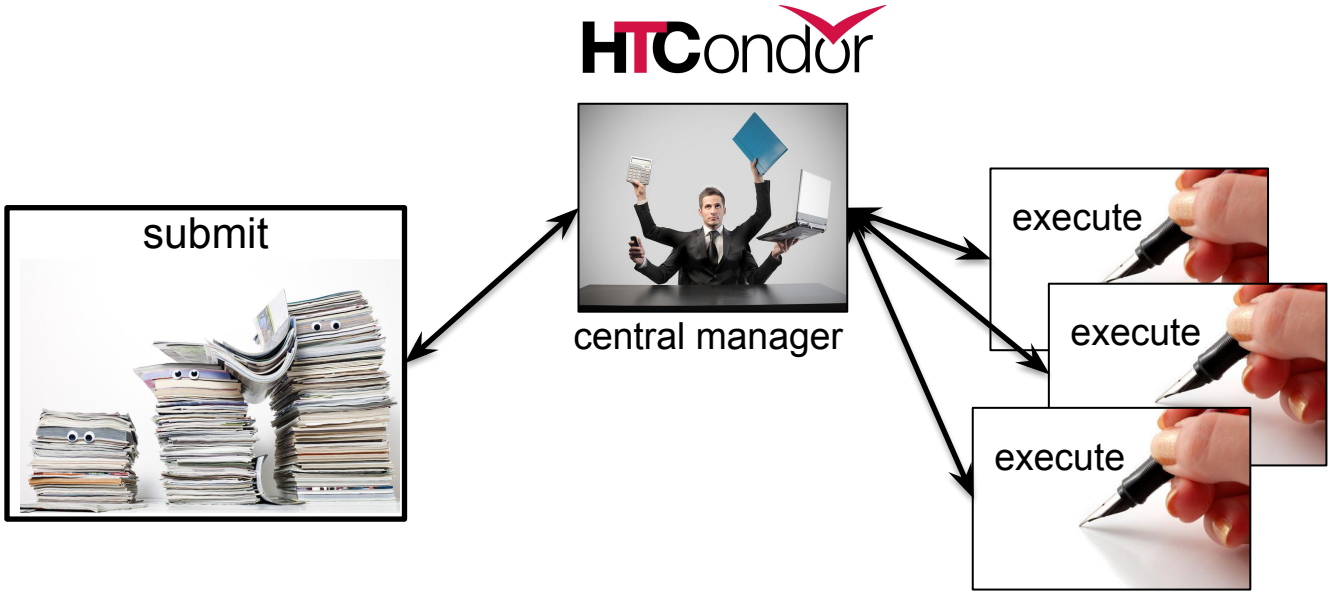


Job Matching

- On a regular basis, the central manager reviews Job and Machine attributes and matches jobs to slots.



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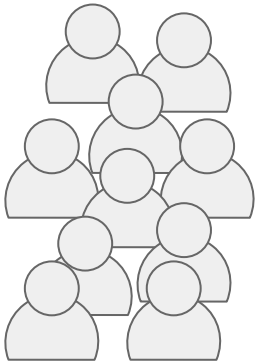

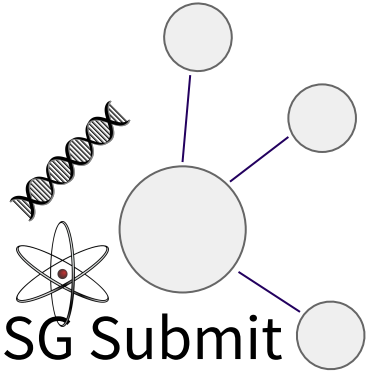

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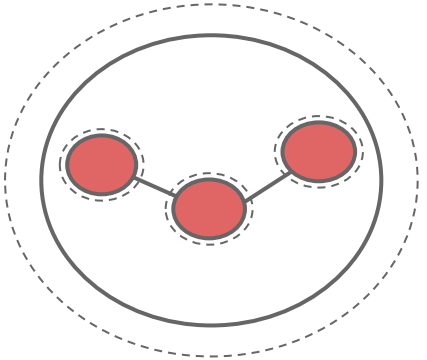

Cluster

The OSG Model - Jobs in Jobs

Photo Credit: Shereen M, Untitled, Flickr https://www.flickr.com/photos/shereen84/2511071028/ (CC BY-NC-ND 2.0)

The OSG Model

- Pilot jobs (or pilots) are special jobs
- Pilots are sent to sites with idle resources
- Pilot payload = HTCondor execute node software
- Pilot execute node reports to your OSG pool
- Pilots lease resources:
  - Lease expires after a set amount of time or lack of demand
  - Leases can be revoked!

The OSG Model - Leasing the Cloud

- What if there aren't enough idle resources?
- Combine overlay system with cloud technology
- Some of your OSG jobs may run in the cloud in the next few years
- … but this should be completely transparent to you

The OSG Model - Collection of Pools

- Your OSG pool is just one of many
- Separate pools for each Virtual Organization (VO)
- Your jobs will run on the OSG VO pool

Photo by Martin Sanchez on Unsplash

The OSG Model - Getting Access

- During the school:
  - OSG submit node at UW (exercises)
  - OSG submit node via OSG Connect (Thursday)
- After the school:
  - Both of the above
  - VO-hosted submit nodes
  - Institution integration with the OSG

Questions?