Day 10: More HTCondor

Suggested reading: HTCondor 7.8 Manual:

http://research.cs.wisc.edu/htcondor/manual/v7.8/

Chapter 2: Users' Manual (at most, 2.1–2.7)

Chapter 9:

condor_q, condor_status, condor_submit, condor_prio

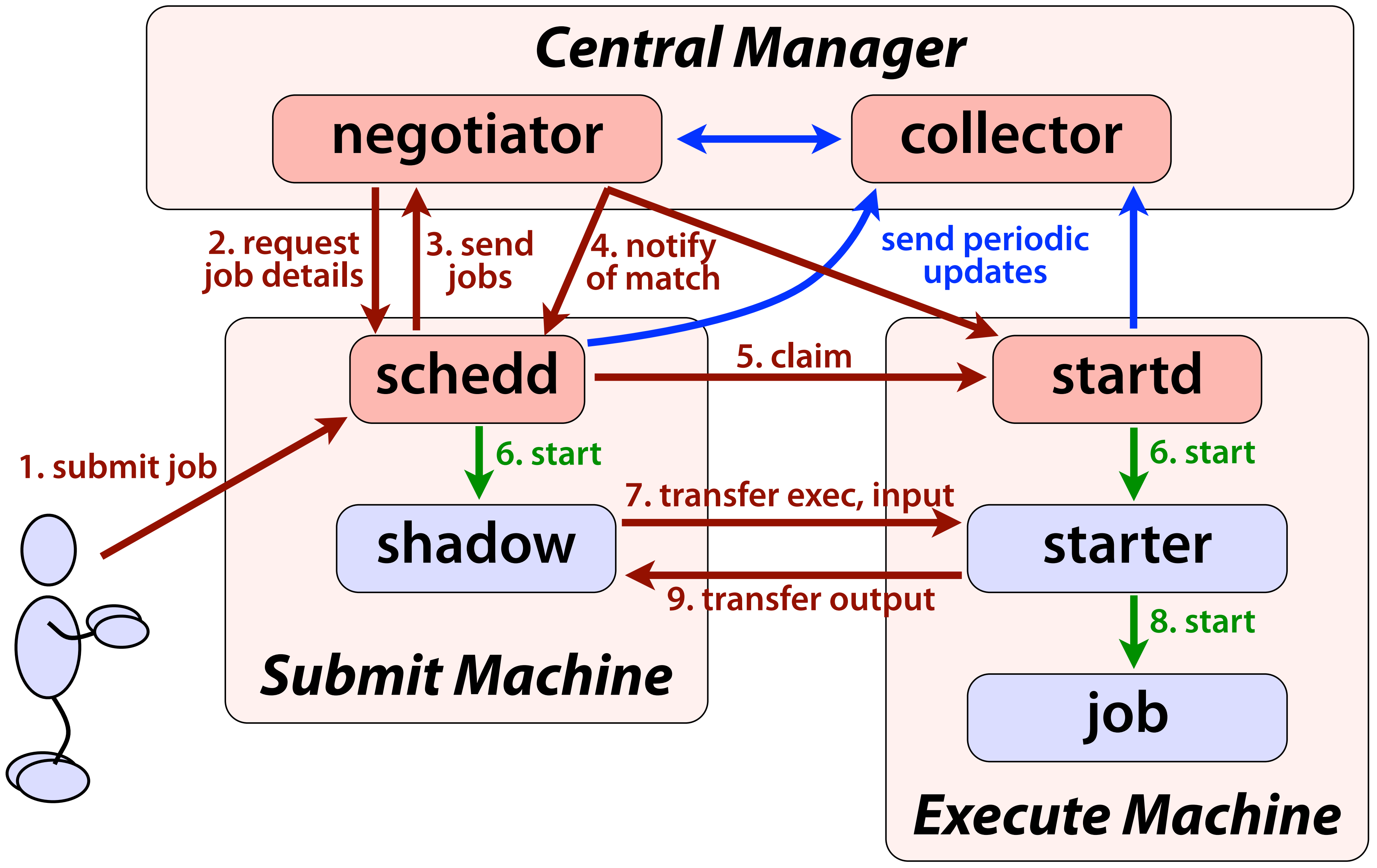
Homework Review

More Condor Background

How Does HTCondor Work?

Function	HTCondor Name	#
Track waiting/running jobs	schedd (“sked-dee”)	1+
Track available machines	collector	1
Match jobs and machines	negotiator	1
Manage one machine	startd (“start-dee”)	per machine
Manage one job (on submitter)	shadow	per job running
Manage one job (on machine)	starter	per job running

The Life of a Job



Matchmaking Revisited

- Balances
  - Job (submitter)
  - Machine (owner)
  - Pool (administrator)
- Takes into account
  - Requirements
  - Preferences
  - Policy
- But how are they represented?

ClassAds

- For job, machine, etc.
- Loosely structured
- Few required parts
- Users can extend
- Can express:
  - Facts
  - Current state
  - Requirements
  - Preferences
  - Your shoe size
- attribute = expression

```
MyType = "Job"
TargetType = "Machine"
ClusterId = 14
Owner = "cat"
Cmd = "/.../homework_09.py"
Requirements =
   (Arch == "X86_64") &&
   (OpSys == "LINUX") &&
   ...
Rank = 0.0
In = "/dev/null"
UserLog = "/.../hw09.log"
Out = "hw09.out"
Err = "hw09.err"
NiceUser = false
```

string

number

operations/
expressions

boolean

Priorities

- **Job priority**
  - Set by user (owner)
  - Is relative to ***that user's*** other jobs
  - Higher number means run sooner
- **User priority**
  - Condor calculates this priority value based on past usage
  - Determines user's potential share of machines
  - Lower number means run sooner (0.5 is minimum)
  - Results in "fair share" access to resources
- **Preemption**
  - Low priority jobs can be removed for high priority ones
  - Governed by fair-share algorithm and pool policy

What Makes a Good CHTC Job?

- Single-threaded, independent batch job
- Runs for about 10 minutes to 4 hours
  - Too short: Overhead costs predominate
  - Too long: Risk getting preempted (“bad-put”)
  - CHTC removes any job after 24 hours of runtime
- Fits lots of machines — the more, the better!
  - Few requirements: low memory, low disk
  - Scripts! (few/no OS and architecture requirements)

HTCondor Commands

condor_q: Being More Selective

```
condor_q username [...]
```

- Lists jobs *only* owned by the user(s) (e.g., yourself)

```
condor_q cluster [...]
```

- Lists all jobs in the given cluster(s)

```
condor_q cluster.process [...]
```

- Lists only the given job(s)

```
-- Submitter: submit-368.chtc.wisc.edu : <...> : ...
 ID      OWNER            SUBMITTED     RUN_TIME ST PRI SIZE CMD
  23.2   cat             11/13 15:21   0+00:00:00 I  0   0.0  explore.py
```

condor_q: ClassAd Output

```
condor_q -long cluster.process
```

- Displays complete ClassAd for each job (80+ lines)
- Great way to explore ClassAds for jobs
- Best to limit to a single job (cluster/process combo)!

```
-- Submitter: submit-368.chtc.wisc.edu : <...> : ...
PeriodicRemove = false
CommittedSlotTime = 0
Out = "explore.out.24.1"
ImageSize_RAW = 1
NumCkpts_RAW = 0
EnteredCurrentStatus = 1321219554
CommittedSuspensionTime = 0
WhenToTransferOutput = "ON_EXIT"
NumSystemHolds = 0
StreamOut = false
...
```

condor_q: Why Isn’t My Job Running?

```
condor_q -analyze cluster.process
```

- Tries to figure out if your job *can* run
- Often helpful – occasionally not – good starting pt.

```
026.000:  Run analysis summary.  Of 2072 machines,
   2072 are rejected by your job's requirements
      0 reject your job because of their own requirements
...
   No successful match recorded.
   Last failed match: Sun Nov 13 15:33:29 2011
   Reason for last match failure: no match found

WARNING:  Be advised:
   No resources matched request's constraints

The Requirements expression for your job is:
...
    Condition                          Machines Matched    Suggestion
    ---------                          ----------------    ----------
1   ( target.Memory >= 9999999 )       0                   MODIFY TO 212001
2   ( TARGET.Arch == "X86_64" )        2020
3   ( TARGET.OpSys == "LINUX" )        2020
```

condor_status: Classes of Machines

```
condor_status -avail
```

- Lists slots that are available

```
condor_status -constraint ClassAdExpr
```

- Lists slots that match constraint(s)

```
% condor_status -constraint 'Memory >= 10000'

Name                 OpSys      Arch   State     Activity LoadAv Mem   ActvtyTime

slot10@c011.chtc.w LINUX      X86_64 Claimed   Busy     6.690  12017  0+14:41:56
slot10@c013.chtc.w LINUX      X86_64 Claimed   Busy     7.980  12017  0+14:50:57
...
slot25@opt-a012.ch LINUX      X86_64 Unclaimed Idle     0.000  99111  0+21:01:43
                     Total Owner Claimed Unclaimed Matched Preempting Backfill

        X86_64/LINUX    66     2      55          9       0          0        0

               Total    66     2      55          9       0          0        0
```

condor_status: Being More Selective

```
condor_status hostname [...]
```

- Lists slots with the given hostname(s)

```
condor_status slot@hostname [...]
```

- Lists the given slot(s)

```
% condor_status c040.chtc.wisc.edu

Name                OpsSys     Arch   State     Activity LoadAv Mem   ActvtyTime

slot10@c040.chtc.w LINUX      X86_64 Claimed   Busy     7.990  12017  0+19:36:09
slot1@c040.chtc.wi LINUX      X86_64 Owner     Idle     0.000  4599   0+19:36:03
...
slot9@c040.chtc.wi LINUX      X86_64 Owner     Idle     0.020   250 47+05:24:44
                     Total Owner Claimed Unclaimed Matched Preempting Backfill

        X86_64/LINUX    10     9       1         0       0          0        0

               Total    10     9       1         0       0          0        0
```

condor_status: ClassAd Output

```
condor_status -long slot@hostname
```

- Displays complete ClassAd for each ***slot*** (120+ lines)
- Great way to understand ClassAds for ***machines***
- Best to limit to a single slot!

```
Machine = "opt-a001.chtc.wisc.edu"
DCSignalRuntime = 247.566893
EnteredCurrentState = 1321222293
JavaVersion = "1.6.0_20"
DetectedMemory = 258331
OpSysAndVer = "LINUX"
HasMPI = true
CpuIsBusy = false
LastBenchmark = 1321228954
HasVM = false
JavaVendor = "Sun Microsystems Inc."
...
```

condor_prio

```
condor_prio -p value cluster[.process] […]
```

- Sets the job priority to the given value
- Identify job(s) with 1+ user(s), cluster(s), process(es)

```
condor_prio +value cluster[.process] […]
condor_prio -value cluster[.process] […]
```

- Raise or lower the job priority by the given amount

Submit Files

Setting Priority (Again)

```
priority = integer
```

- Sets job priority right in submit file
- Default is 0
- Only affects relative priority of your jobs
- Can override using **`condor_prio`**

Notifications by Email

```
notification = Always|Complete|Error|Never
```

- When to send email
  - `Always`: job checkpoints or completes
  - `Complete`: job completes ***(default)***
  - `Error`: job completes with error
  - `Never`: do not send email

```
notify_user = email
```

- Where to send email
- Defaults to `job-owner@submit-machine`

Input Files From the Internet

```
transfer_input_files = URL[, ...]
```

- Grab input files from any available URL
- **BUT:** If the download fails, your job goes on hold
  - You don’t know when your job will run
  - Maybe that will be during server maintenance, etc.
- So, great idea, but maybe wait for retries…
  - Can always pre-fetch file yourself
  - Or, job itself can download files, and do it robustly

Requirements and Rank

```
requirements = ClassAdExpression
```

- Expression must evaluate to ***true*** to run on machine
- HTCondor adds defaults! View with **`condor_q -long`**
- See HTCondor Manual (esp. 2.5.2 & 4.1) for details

```
rank = ClassAdExpression
```

- Ranks ***matching*** machines in order by preference
- Must evaluate to a FP number, greater is preferred
  - False becomes 0.0, True becomes 1.0
  - Undefined or error values become 0.0
- Writing rank expressions is an art form

Arbitrary Attributes

```
+AttributeName = value
```

- Adds arbitrary attribute(s) to job ClassAd
- Useful in (at least) two cases:
  - Find jobs using attribute: **`condor_q -constraint`**
  - Attribute has special policy meaning in pool
- As it happens, we have a special policy…

```
+WantRHEL6Job = true
rank = (IsRHEL6 == True)
```

Resource Requests

```
request_cpus = ClassAdExpression
request_disk = ClassAdExpression
request_memory = ClassAdExpression
```

- Request minimum resources for execute machine
- May be dynamically provisioned (very advanced!)
- ***Check job log for actual usage!!!***

```
request_disk = 2000000  # in KB by default
request_disk = 2GB      # KB, MB, GB, TB

request_memory = 2000   # in MB by default
request_memory = 2GB    # KB, MB, GB, TB
```

One Submit, Many Jobs: I

- Can use **queue** statement many times
- Make changes between **queue** statements
  - Change **arguments**, **output**, **priority**, …
  - Whatever you do not explicitly change stays the same

```
executable = test.py
...
log          = test.log

output    = test-1.out
arguments = "test-input.txt 42"
queue

output    = test-2.out
arguments = "test-input.txt 43"
queue
```

One Submit, Many Jobs: II

```
queue N
```

- Submits *N* copies of the job
  - One cluster number for all copies, just as before
  - Process numbers go from 0 – (*N*–1)
- What good is having *N* copies of the same thing?
  - Randomized processes (cf. homework #8)
  - Job fetches work description from somewhere?
  - But what about overwriting output files, etc.?
- Wouldn't it be nice to have different files and/or arguments automatically applied to each job?

Separating Files by Run

```
output = program.out.$(Cluster).$(Process)
```

- Can use either/both of these variables anywhere
  - Often used in `output`, `error`, and `log` files
- Maybe use `$(Process)` in `arguments`?
  - No math on values; your program must handle as is

```
...
output    = test.$(Cluster)_$(Process).out
log       = test.$(Cluster)_$(Process).log

arguments = "test-input.txt $(Process)"
queue 10
```

Separating Directories by Run

```
initialdir = path
```

- Use ***`path`*** (instead of submit dir.) to locate files
  - I.e., **`output`**, **`error`**, **`log`**, **`transfer_input_files`**
  - *Not* **`executable`**; always relative to submit directory
- Mix with **`$(Process)`** and separate all I/O by job

```
initialdir = run-$(Process)
transfer_input_files = input-$(Process).txt
output = test.$(Cluster)-$(Process).out
log    = test.$(Cluster)-$(Process).log

arguments = "input-$(Process).txt $(Process)"
queue 10
```

Homework

Homework

- Write a little bit of Python code, lest you forget!
- Run lots of jobs from a single submit file
- Play with condor_q, condor_status, & condor_prio