Grid Engine for users

Usage & productivity focus

Learning curve ahead…

- Grid Engine has a small number of command-line programs
- Most are very powerful and can be invoked in bewilderingly complex ways
  - Resource requests
  - Job arrays & dependencies
- Man pages and wikis.sun.com will be essential as you get up to speed

Exercise 01

- Goals
  - See Grid Engine in action
  - Run a few commands

Exercise 02

- Goals
  - Submitting, monitoring and naming a few batch jobs
  - The most basic job script (‘sleeper.sh’)

Exercise 03 - qrsh

- Goals
  - Run real jobs
  - “Instant” Execution via ‘qrsh’

qrsh/sqrsh - Reminder

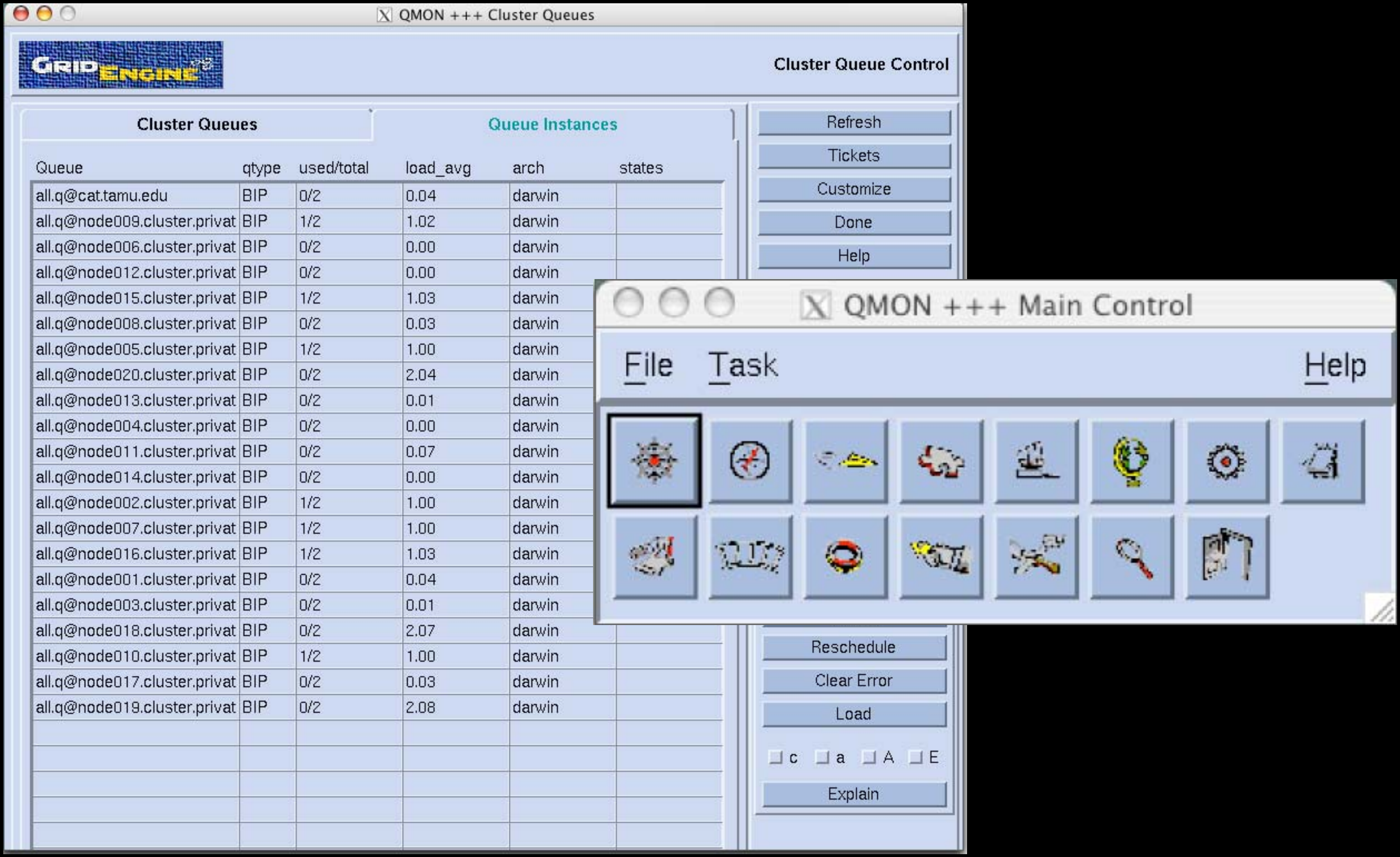
- The Grid Engine 'qrsh' program will run your command or job ASAP on the least loaded node in the system. This is a quick and lightweight way to run short jobs or even test grid engine functionality.
- Note that 'qrsh' commands will fail on clusters where there are no free job slots. These and other error conditions need to be checked for whenever 'qrsh' is used as part of a script or automated workflow.
- Use with some caution - be careful of big or resource intensive jobs

Exercise 04

- Goals
  - First intro to job dependencies
  - Trivial chaining
  - Simple binary wrapping for trivial SGE integration
  - Synchronous job submission

Summarizing basic usage

Summarizing basic usage



Queue	qtype	used/total	load_avg	arch	states
all.q@cat.tamu.edu	BIP	0/2	0.04	darwin	
all.q@node009.cluster.privat	BIP	1/2	1.02	darwin	
all.q@node006.cluster.privat	BIP	0/2	0.00	darwin	
all.q@node012.cluster.privat	BIP	0/2	0.00	darwin	
all.q@node015.cluster.privat	BIP	1/2	1.03	darwin	
all.q@node008.cluster.privat	BIP	0/2	0.03	darwin	
all.q@node005.cluster.privat	BIP	1/2	1.00	darwin	
all.q@node020.cluster.privat	BIP	0/2	2.04	darwin	
all.q@node013.cluster.privat	BIP	0/2	0.01	darwin	
all.q@node004.cluster.privat	BIP	0/2	0.00	darwin	
all.q@node011.cluster.privat	BIP	0/2	0.07	darwin	
all.q@node014.cluster.privat	BIP	0/2	0.00	darwin	
all.q@node002.cluster.privat	BIP	1/2	1.00	darwin	
all.q@node007.cluster.privat	BIP	1/2	1.00	darwin	
all.q@node016.cluster.privat	BIP	1/2	1.03	darwin	
all.q@node001.cluster.privat	BIP	0/2	0.04	darwin	
all.q@node003.cluster.privat	BIP	0/2	0.01	darwin	
all.q@node018.cluster.privat	BIP	0/2	2.07	darwin	
all.q@node010.cluster.privat	BIP	1/2	1.00	darwin	
all.q@node017.cluster.privat	BIP	0/2	0.03	darwin	
all.q@node019.cluster.privat	BIP	0/2	2.08	darwin	

chris@bioteam.net

Most useful SGE commands

- `qsub / qdel`
  - Submit jobs & delete jobs
- `qstat & qhost`
  - Status info for queues, hosts and jobs
- `qacct`
  - Summary info and reports on completed job
- `qrsh`
  - Get an interactive shell on a cluster node
  - Quickly run a command on a remote host
- `qmon`
  - Launch the X11 GUI interface

SGE Commands: ‘qstat’

```
cat:~ administrator$ qstat

job-ID  prior   name       user         state submit/start at     queue         slots ja-task-ID
-----------------------------------------------------------------------------------------------
      6 0.56000 first.sh   m010798      r     12/07/2004 10:13:34 all.q@node002 1
      3 0.56000 first.sh   m010798      r     12/07/2004 10:04:01 all.q@node005 1
     16 0.56000 hs         sga6043      r     12/07/2004 12:14:51 all.q@node007 1
      1 0.56000 gr.sh      m010798      r     12/07/2004 09:47:40 all.q@node009 1
      2 0.56000 first.sh   m010798      r     12/07/2004 10:01:01 all.q@node010 1
      5 0.56000 first.sh   m010798      r     12/07/2004 10:11:49 all.q@node015 1
      4 0.56000 first.sh   m010798      r     12/07/2004 10:08:18 all.q@node016 1
```

SGE Commands: ‘qstat -f’

```
cat:~ administrator$ qstat -f

queuename                      qtype used/tot. load_avg arch          states
----------------------------------------------------------------------------
all.q@cat.tamu.edu             BIP   0/2       0.02     darwin
----------------------------------------------------------------------------
all.q@node001.cluster.private  BIP   0/2       0.03     darwin
----------------------------------------------------------------------------
all.q@node002.cluster.private  BIP   1/2       1.00     darwin
      6 0.56000 first.sh   m010798      r     12/07/2004 10:13:34     1
----------------------------------------------------------------------------
all.q@node003.cluster.private  BIP   0/2       0.00     darwin
----------------------------------------------------------------------------
all.q@node004.cluster.private  BIP   0/2       0.01     darwin
----------------------------------------------------------------------------
all.q@node005.cluster.private  BIP   1/2       1.00     darwin
      3 0.56000 first.sh   m010798      r     12/07/2004 10:04:01     1
----------------------------------------------------------------------------
```

SGE Commands: ‘qhost’

```
cat:~ administrator$ qhost
HOSTNAME                ARCH         NCPU  LOAD  MEMTOT  MEMUSE  SWAPTO  SWAPUS
-------------------------------------------------------------------------------
global                  -               -     -       -       -       -       -
cat                     darwin          2  0.03    2.0G    1.4G     0.0     0.0
node001                 darwin          2  0.02    2.0G  227.0M     0.0     0.0
node002                 darwin          2  1.00    2.0G  274.0M     0.0     0.0
node003                 darwin          2  0.00    2.0G  273.0M     0.0     0.0
node004                 darwin          2  0.02    2.0G  275.0M     0.0     0.0
node005                 darwin          2  1.00    2.0G  274.0M     0.0     0.0
node006                 darwin          2  0.02    2.0G  274.0M     0.0     0.0
node007                 darwin          2  1.00    2.0G  326.0M     0.0     0.0
node008                 darwin          2  0.00    2.0G  271.0M     0.0     0.0
node009                 darwin          2  1.00    2.0G  274.0M     0.0     0.0
node010                 darwin          2  1.05    2.0G  275.0M     0.0     0.0
```

SGE Commands: qsub

- Used to submit job scripts to Grid Engine
  - Usage: `qsub [options] [scriptfile] [script args]`
- qsub finally accepts binaries
  - `qsub -b y /bin/hostname`
- Powerful
  - `‘man qsub’` is your friend
  - qsub usage can be as simple or as complicated as you need

- Example options
  - `-A account_string; used to group accounting info`
  - `-hold_jid job_id; holds submitted job on job_id`
  - `-l resource=value; requests a specific resource`
  - `-t n[-m[:s]]; array job`
  - `-v, -V; export some or all of your ENV variables`

qsub

General format:

```
$ qsub <qsub options> program <prog. options>
```

The simplest possible SGE submit syntax would be of this form:

```
$ qsub ./myjob.sh
```

Example: `sleeper.sh`

```
#!/bin/sh
#
# Usage: sleeper.sh [time]]
#        default for time is 60 seconds

# -- our name ---
#$ -N Sleeper
#$ -S /bin/sh

/bin/echo I am running on host `hostname`.
/bin/echo Sleeping now at: `date`

time=60
if [ $# -ge 1 ]; then
   time=$1
fi
sleep $time

echo Now it is: `date`
```

SGE embedded in jobscripts

```
#!/bin/sh
#
# Usage: sleeper.sh [time]]
#        default for time is 60 seconds

# -- SGE ARGUMENTS --
#$ -N Sleeper
#$ -S /bin/sh

/bin/echo I am running on host `hostname`.
/bin/echo Sleeping now at: `date`

time=60
if [ $# -ge 1 ]; then
   time=$1
fi
sleep $time

echo Now it is: `date`
```

Real world example

```
#!/bin/sh

# Batch-submission script for SGE (Sun GridEngine)
system

# Do we need to re-source our grid engine environment?
source /common/sge/default/common/settings.sh

## -- Chris Dagdigian; BioTeam Inc.
## -- Embedded grid engine directives follow
#$ -N %NAME%
#$ -o %DIR%/.%JOBID%.qlog.out
#$ -e %DIR%/.%JOBID%.qlog.err
#$ -P glide
#$ -hard -l glideL-impact-main=1
#$ -hard -l glideL-impact-glide=4

## -- ok back to work (Glide stuff below) ...
```

More useful ‘qsub’ arguments

- All of these can be embedded in scripts, passed via the command-line or passed via the GUI job submission tool

- `‘-A [string]’`
  - Pass a string that will end up in accounting log. Useful for post processing or grouping jobs for grouping and reporting
- `‘-m b’ or ‘-m e’`
  - Mail submitter when job begins/ends
- `‘-m a’ or ‘-m s’`
  - Mail submitter when aborted or suspended
- `‘-m n’`
  - Override all other mail options; Don’t send email for any reason

Jobs: Binaries vs. Scripts

- SGE 6 at the CLI assumes scripts
  - “qsub -b y …” to override
- SGE 6 DRMAA assumes binaries
- 2 main differences in handling
  - For scripts, SGE transfers entire file
  - For binaries, SGE just sends the path

Using Resources

- Resources can be collected together using arithmetic and Boolean operators to form very complex resource requirement strings.

-
  ```
  qsub -hard -l \ arch=solaris64,h_mem_free=800M,swap_free=50M
  ./myJob.sh
  ```
  - *Job must run on a 64 bit Solaris box with at least 800 MB of free memory and 50 MB of available swap space*

- Remember:
  - You can embed these requests in your scripts so they don't have to be typed all the time
  - Can also define "default request" files on a per-user or global level

Default / Preference Files

- Default (qsub) submission settings
  - `$SGE_ROOT/$SGE_CELL/common/sge_request`
  - `$HOME/.sge_request`
  - `$PWD/.sge_request`
- Default (qstat) monitoring settings
  - `$SGE_ROOT/$SGE_CELL/common/sge_qstat`
  - `$HOME/.sge_qstat`
- Overridden by runtime argments
  - Explicit: “qsub -clear … “

Monitoring our job with ‘qstat’

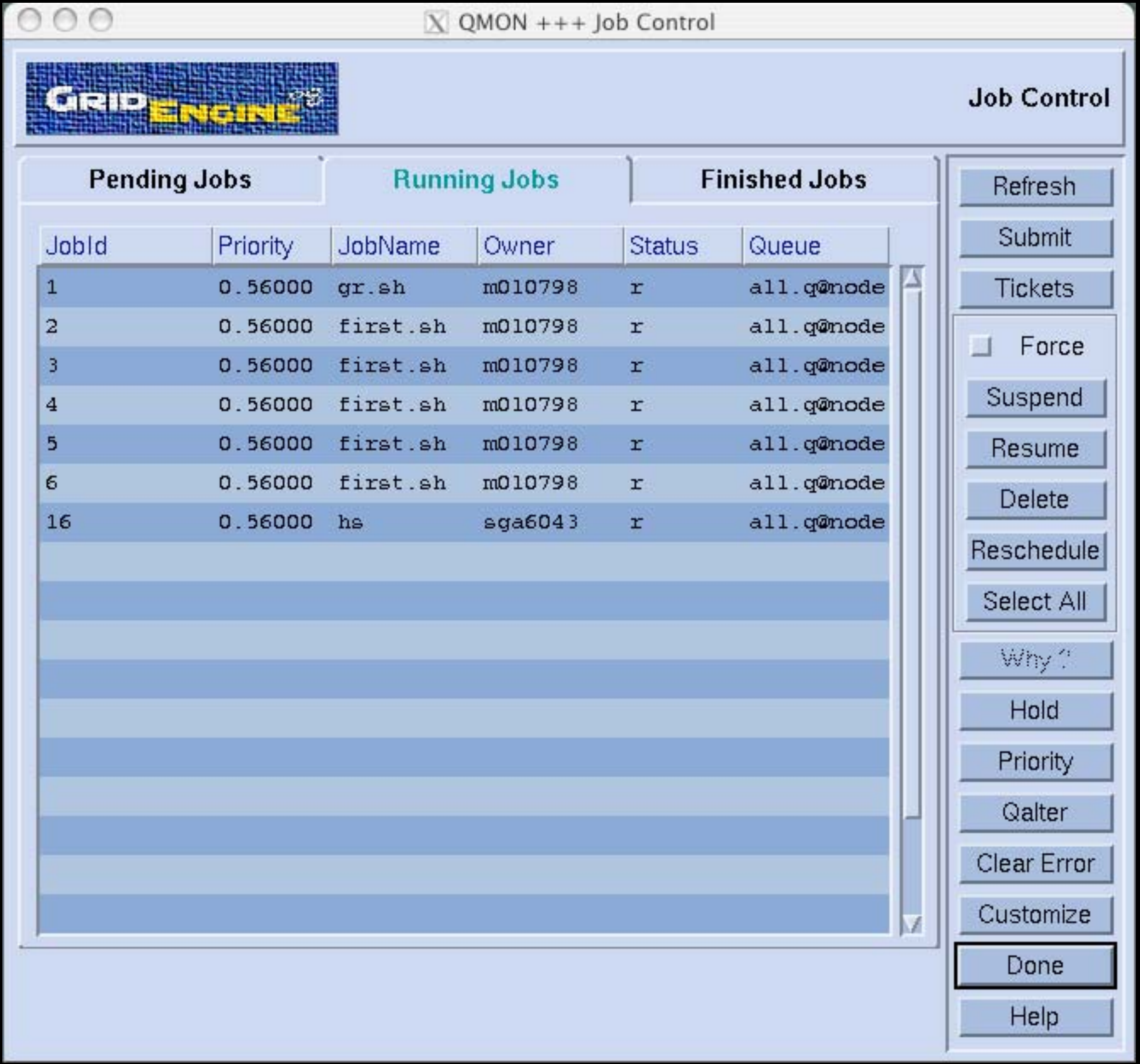
```
cat:~ administrator$ qstat

job-ID  prior   name       user         state submit/start at     queue         slots ja-task-ID
-----------------------------------------------------------------------------------------------
      6 0.56000 first.sh   m010798      r     12/07/2004 10:13:34 all.q@node002 1
      3 0.56000 first.sh   m010798      r     12/07/2004 10:04:01 all.q@node005 1
     16 0.56000 hs         sga6043      r     12/07/2004 12:14:51 all.q@node007 1
      1 0.56000 gr.sh      m010798      r     12/07/2004 09:47:40 all.q@node009 1
      2 0.56000 first.sh   m010798      r     12/07/2004 10:01:01 all.q@node010 1
      5 0.56000 first.sh   m010798      r     12/07/2004 10:11:49 all.q@node015 1
      4 0.56000 first.sh   m010798      r     12/07/2004 10:08:18 all.q@node016 1
```

Accounting data with ‘qacct’

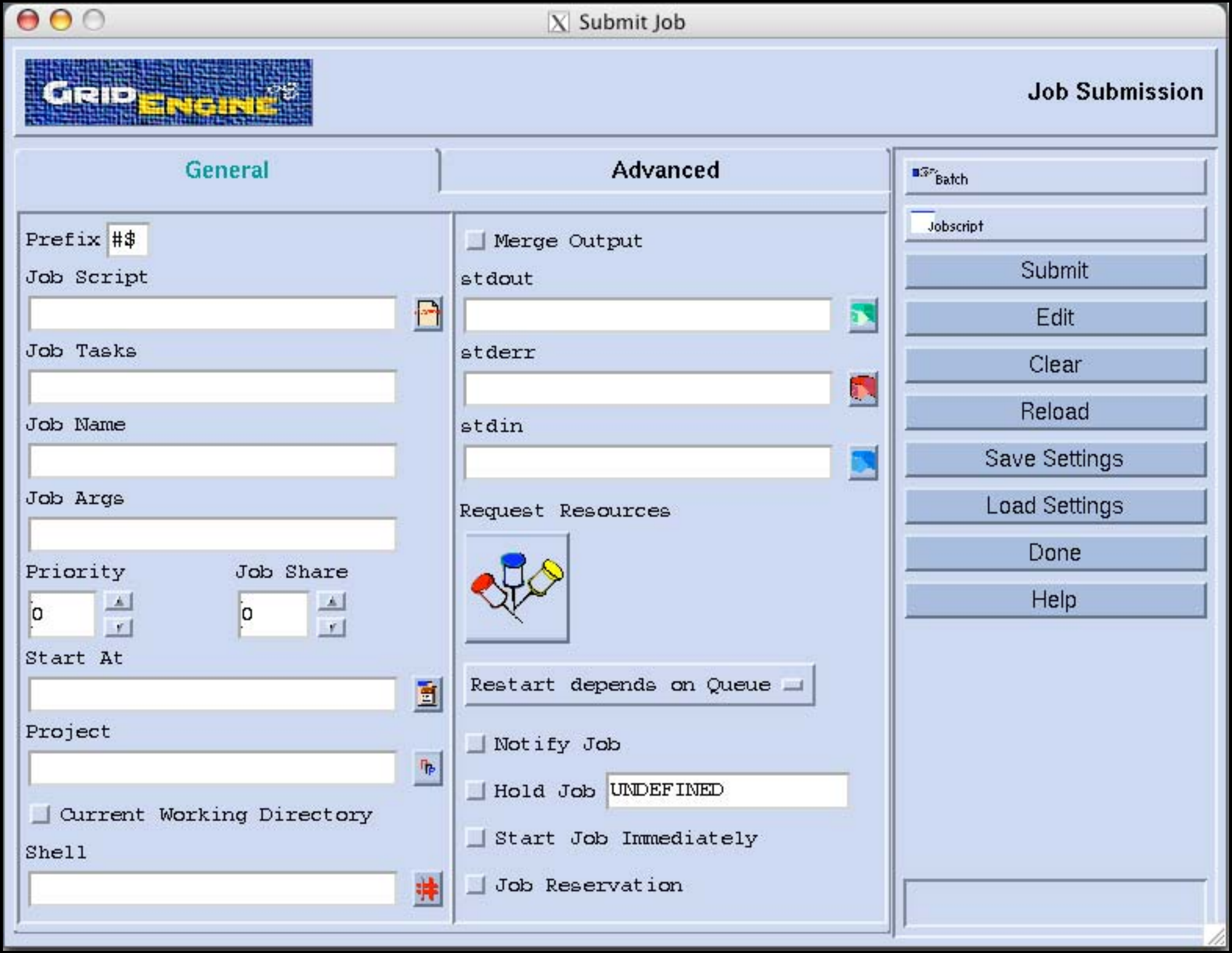
```
cat:~/sge-test administrator$ qacct -j 30
==============================================================
qname        all.q
hostname     node003.cluster.private
group        UNKNOWN
owner        administrator
project      NONE
department   defaultdepartment
jobname      hostname
jobnumber    30
taskid       undefined
account      sge
priority     0
qsub_time    Wed Dec  8 09:33:20 2004
start_time   Wed Dec  8 09:42:05 2004
end_time     Wed Dec  8 09:42:05 2004
granted_pe   NONE
slots        1
failed       0
exit_status  0
ru_wallclock 0
```

Via the ‘qmon’ GUI



JobId	Priority	JobName	Owner	Status	Queue
1	0.56000	gr.sh	m010798	r	all.q@node
2	0.56000	first.sh	m010798	r	all.q@node
3	0.56000	first.sh	m010798	r	all.q@node
4	0.56000	first.sh	m010798	r	all.q@node
5	0.56000	first.sh	m010798	r	all.q@node
6	0.56000	first.sh	m010798	r	all.q@node
16	0.56000	hs	sga6043	r	all.q@node

Submitting via the GUI



Submit Job

Job Submission

General | Advanced

Prefix #$

Job Script

Job Tasks

Job Name

Job Args

Priority 0

Job Share 0

Start At

Project

☐ Current Working Directory

Shell

☐ Merge Output

stdout

stderr

stdin

Request Resources

Restart depends on Queue

☐ Notify Job

☐ Hold Job UNDEFINED

☐ Start Job Immediately

☐ Job Reservation

Submitting jobs

- Jobs are submitted via the ‘qsub’ command
- Many factors affect how/when a job gets dispatched for execution
  - Job resource requirements
  - Availability of eligible execution hosts
  - Various job slot limits
  - Job dependency conditions
  - Fairshare or priority constraints
  - Load conditions

Submitting Jobs

- Important to note that jobs are not necessarily dispatched in the order received

Checking running or pending jobs

We use 'qstat'

```
cat:~/sge-test administrator$ qsub simple.sh
Your job 31 ("simple.sh") has been submitted.
cat:~/sge-test administrator$
cat:~/sge-test administrator$ qstat
job-ID  prior   name    user    state submit/start at     queue         slots ja-task-ID
---------------------------------------------------------------------------------------
      6 0.56 first.sh m010798     r   12/07/2004 10:13:34 all.q@node002 1
      3 0.56 first.sh m010798     r   12/07/2004 10:04:01 all.q@node005 1
     16 0.56 hs       sga6043     r   12/07/2004 12:14:51 all.q@node007 1
     31 0.00 simple.sh administr  qw  12/08/2004 10:01:24               1
```

Checking completed jobs

```
cat:~/sge-test administrator$ qacct -j 31
==============================================================
qname        all.q
hostname     node006.cluster.private
group        UNKNOWN
owner        administrator
project      NONE
department   defaultdepartment
jobname      simple.sh
jobnumber    30
taskid       undefined
account      sge
priority     0
qsub_time    Wed Dec  8 09:33:20 2004
start_time   Wed Dec  8 09:42:05 2004
end_time     Wed Dec  8 09:42:05 2004
granted_pe   NONE
slots        1
failed       0
exit_status  0
ru_wallclock 0
```

Job Status Checking: Summary

- For running or pending jobs:
  - Use the ‘`qstat`’ command

- For completed jobs:
  - Use the ‘`qacct`’ command

About System & Cluster Status

- ‘qstat -f’
  - Look for queues in alarm (‘a’) or (‘au’) state
  - Look for load averages of 99.99 percent
- ‘qhost’

Pending Jobs

- A Jobs initial state when it is submitted to SGE is PENDING.
  - Reported by ‘qstat’ as state (‘qw’)
    - (queued waiting)
- Reasons for job remaining in a pending state.
  - No free job slots
  - All queues have hit suspend or load thresholds
  - You have requested an impossible resource

qstat simple usage

- `qstat -help`
  - More usage info
- `qstat`
  - Displays current jobs in the system
- `qstat -j [job ID or joblist]`
  - Shows config and scheduler info for job
- `qstat -l [resource string]`
  - Shows jobs/queues that provide/need the resource
- `qstat -u <user>`
  - Show only jobs from that user
- `qstat -t`
  - Information on array jobs

qstat simple usage continued

- `qstat -q [queue]`
  - Show jobs running in queue
- `qstat -explain`
  - More info about the reason queue(s) in alarm state
- `qstat -f`
  - Full queue summary
- `qstat -f -ne`
  - Queue summary with empty queues ignored

Possible job states reported by qstat

- ‘t’ -- Transferring
- ‘r’ -- Running
- ‘R’ -- Restarted
- ‘s’ -- Suspended
- ‘S’ -- Suspended by the queue
- ‘T’ -- Suspend queue threshold reached
- ‘w’ -- Waiting
- ‘h’ -- Hold
- ‘e’ -- Error

Possible queue states reported by qstat

- ‘u’ -- Unknown (sge_execd or server down?)
- ‘a’ -- Alarm (load threshold reached)
- ‘A’ -- Alarm (suspend threshold reached)
- ‘s’ -- Suspended (by user or admin)
- ‘d’ -- Disabled (by user or admin)
- ‘C’ -- Suspended (by calendar)
- ‘D’ -- Disabled (by calendar)
- ‘S’ -- Suspended (by subordination)
- ‘E’ -- Error (sge_execd can’t reach shepherd)

Demo Time (#5, #6)

- Array Jobs
- Simple Workflow

05 - Array Jobs Demo

- Goal
    - See Array Jobs in action
    - Understand them (!)
        - *A huge benefit for some types of workflows*

06 - Simple Workflow Demo

- Goal
  - See a simple workflow script that uses arrays and job dependencies to perform a powerful multi-step task
- *Contrived Use case:*
  - A 10 element array job representing real scientific "work"
  - A post processing job that is dependent on completion of the "work"
  - A cleanup script that is dependent on the postprocessing step

Questions?

chris@bioteam.net

Debugging SGE problems

Debugging SGE Problems

- When you:
  - Can’t run SGE commands
    - Command not found
    - System not responding
    - Remote operation permission denied
- Try:
  - qhost and ‘qstat -f’

Debugging SGE Problems (cont.)

- Job level problems
  - Run:
  - `qsub -w v <full job request>`
- This will tell you if the job can run if
  - All slots on all queues were empty
  - All load values were ignored
- Good source of info on ‘why can’t my job be scheduled’ problems

Debugging SGE Problems (cont.)

- Job level problems with pending jobs
  - Run:
  - `qstat -j <job_id>`
- This will tell you why the job is pending and if there are any reasons why queues cannot accept the job

Debugging SGE Problems (cont.)

- Many times the problems are not SGE related
    - Permission, path or ENV problems
- Best thing to do is watch your STDERR and STDOUT
    - Use the qsub ‘-e’ and ‘-o’ switches to send output to a file that you can read
    - Use qsub ‘-eo’ to send STDOUT and STDERR to the same file (useful for debugging)

Debugging SGE Problems (cont.)

- To get email listing why a job aborted
  - Use: ‘qsub -m a user@host [rest of command] ’

Debugging SGE Problems (cont.)

- Checking exit status and seeing if jobs ran to completion without error
  - Use: ‘qacct -j <job_id>’ to query the accounting data
  - Will also tell you if the job had to be requeued onto a different queue or exechost

Final word on debugging …

- SGE Admins have many more tools
  - Scheduler trace/profile/monitoring
  - Jobdir “keep_active=true”
  - SGE debug ENV variables
- Tip:
  - Ask for help if you get stuck

More Grid Engine Usage

Jobs pending on resources...

```
[sgeadmin@portal examples]$ qstat
job-ID  prior name       user         state submit/start at     queue      master
---------------------------------------------------------------------------------
     72     0 Sleeper    sgeadmin     r     12/20/2002 01:00:38 cfa1.q     MASTER
     71     0 Sleeper    sgeadmin     r     12/20/2002 01:00:38 cfa10.q    MASTER
     67     0 Sleeper    sgeadmin     r     12/20/2002 01:00:38 cfa2.q     MASTER
     73     0 Sleeper    sgeadmin     r     12/20/2002 01:00:38 cfa3.q     MASTER
     70     0 Sleeper    sgeadmin     r     12/20/2002 01:00:38 cfa4.q     MASTER
     69     0 Sleeper    sgeadmin     r     12/20/2002 01:00:38 cfa5.q     MASTER
     66     0 Sleeper    sgeadmin     r     12/20/2002 01:00:38 cfa6.q     MASTER
     68     0 Sleeper    sgeadmin     r     12/20/2002 01:00:38 cfa7.q     MASTER
     65     0 Sleeper    sgeadmin     r     12/20/2002 01:00:22 cfa8.q     MASTER
     64     0 Sleeper    sgeadmin     r     12/20/2002 01:00:22 cfa9.q     MASTER
     74     0 Sleeper    sgeadmin     qw    12/20/2002 01:00:26
     75     0 Sleeper    sgeadmin     qw    12/20/2002 01:00:27
     76     0 Sleeper    sgeadmin     qw    12/20/2002 01:00:27
     77     0 Sleeper    sgeadmin     qw    12/20/2002 01:00:28
     78     0 Sleeper    sgeadmin     qw    12/20/2002 01:00:28
     79     0 Sleeper    sgeadmin     qw    12/20/2002 01:00:29
     80     0 Sleeper    sgeadmin     qw    12/20/2002 01:00:29
     81     0 Sleeper    sgeadmin     qw    12/20/2002 01:00:30
     82     0 Sleeper    sgeadmin     qw    12/20/2002 01:00:30
     83     0 Sleeper    sgeadmin     qw    12/20/2002 01:00:31
```

Jobs pending on resources...

```
chrisdag:tmp dag$ qstat -j 46
==============================================================
job_number:                 46
exec_file:                  job_scripts/46
submission_time:            Wed Mar 26 10:03:33 2008
owner:                      dag
uid:                        501
group:                      dag
gid:                        501
sge_o_home:                 /Users/dag
sge_o_log_name:             dag
sge_o_path:                 /opt/sge/bin/darwin-
x86:/usr/local/bin:/usr/local/sbin:/opt/bin:/opt/sbin:/opt/mysql/bin:\
/sw/bin:/sw/sbin:/usr/bin:/bin:/usr/sbin:
sge_o_shell:                /bin/bash
sge_o_workdir:              /private/tmp
sge_o_host:                 chrisdag-aliased
account:                    sge
cwd:                        /private/tmp
path_aliases:               /tmp_mnt/ * * /
hard resource_list:         arch=solaris64
mail_list:                  dag@chrisdag-aliased
notify:                     FALSE
job_name:                   Sleeper
jobshare:                   0
shell_list:                 /bin/sh
env_list:
script_file:                ./sleeper.sh
scheduling info:            queue instance "test.q@chrisdag-aliased" dropped because it is disabled
                            (-l arch=solaris64) cannot run at host "chrisdag-aliased" because it offers only
hl:arch=darwin-x86
```

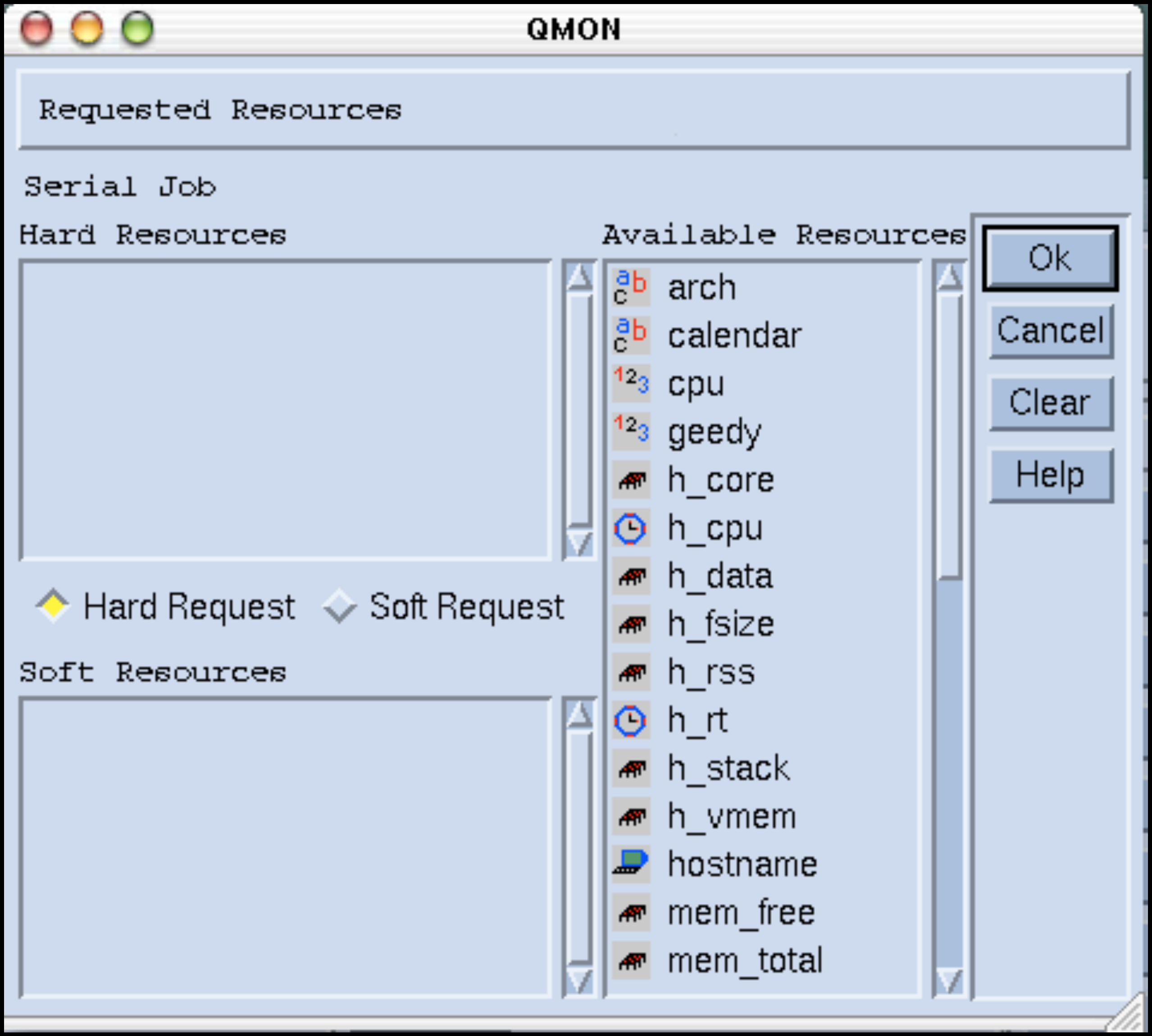
Using Resources

- Resources can be collected together using arithmetic and Boolean operators to form very complex resource requirement strings.

-
  ```
  qsub -hard -l \ arch=solaris64,h_mem_free=800M,swap_free=50M
  ./myJob.sh
  ```
  - *Job must run on a 64 bit Solaris box with at least 800 MB of free memory and 50 MB of available swap space*

- Remember:
  - You can embed these requests in your scripts so they don't have to be typed all the time
  - Can also define "default request" files on a per-user or global level

Available default resources


QMON

Requested Resources

Serial Job

Hard Resources

Available Resources

arch
calendar
cpu
geedy
h_core
h_cpu
h_data
h_fsize
h_rss
h_rt
h_stack
h_vmem
hostname
mem_free
mem_total

[✓ Hard Request] Soft Request

Soft Resources

Ok
Cancel
Clear
Help

chris@bioteam.net

Queue instance resources

```
cat:~/sge-test administrator$ qconf -se node001.cluster.private
hostname              node001.cluster.private
load_scaling          NONE
complex_values        NONE
load_values           np_load_long=0.000000,load_short=0.006836, \
                      load_medium=0.019043,load_long=0.000000,arch=darwin, \
                      num_proc=2,mem_free=1820.000000M,swap_free=0.000000M, \
                      virtual_free=1820.000000M,mem_total=2048.000000M, \
                      swap_total=0.000000M,virtual_total=2048.000000M, \
                      mem_used=228.000000M,swap_used=0.000000M, \
                      virtual_used=228.000000M,cpu=0.600000, \
                      np_load_avg=0.009522,np_load_short=0.003418, \
                      np_load_medium=0.009522,load_avg=0.019043
processors            2
user_lists            NONE
xuser_lists           NONE
projects              NONE
xprojects             NONE
usage_scaling         NONE
report_variables      NONE
```

Resources you may care about

- Example: MatLab licenses
- Handled via Grid Engine “System Complex” or “Load Sensor” mechanisms
- A FlexLM license is a special type of “user requestable, consumable resource”

Example: Licensed MatLab Jobs

- You must request the MatLab “resource”
- Assume cluster currently has 3 floating licenses:
- Usage would be:
  - `qsub -hard -l matlab=1 ./matlab-script.sh`
  - Or embedded inside a script:
  - `#$ -hard -l matlab=1`

Exercise: Array Job Example

- Array Jobs are extremely powerful
- Very efficiently handle the problem:
    - “how do I run application X many, many times with only minor changes in the command line arguments?

Exercise: Array Job example

- Why this matters
  - Grid Engine can probably handle a few tens of thousands of standalone jobs at any one time.
  - Grid Engine 6 has a design goal of handling 500,000 element job arrays

Exercise: Array Job example

- Experiment with the array job example script and input data

Lab Time (07_greedyJobs)

"How do I guarantee my job will get sole access to a compute node so it does not have to compete with another running job for resources?"

A few words on Resource Quotas

Resource Quotas

- The main enhancement to SGE 6.1
- Will likely have a significant impact
- Solves multiple issues that have been bothering SGE admins for years:
  - max_u_jobs on a per-host basis
  - Max jobs per user on a per-queue basis
  - Per user slot limits on parallel environments

Why quotas matter to users

- Good & Bad
  - Just another way for management to slow you down right?
  - Well …
    - Much potential for serious good
    - Very flexible and powerful capabilities
    - Removes the need for nasty hacks and global limis that SGE admins have had to invent over time

Why quotas matter to users

- Key message
  - Another subsystem you should be aware of
    - Like tickets & policies
  - … so you know what is going on with your jobs and workflow
  - … and so you can better communicate with the admins regarding your needs

Resource Quotas

- Syntax similar to firewall rules
- Simple Example
  - “*limit slot access to user1 and user2 on every host in the @LinuxHosts hostgroup (except for host penguin03)*”

```
{
  name          example_resource_quota_set
  enabled       true
  limit users {user1,user2} hosts {@LinuxHosts, !penguin03} to slots=1
}
```

Resource Quotas

- Syntax
  - Multiple rule sets contain one or more rules
- First matching rule from each set wins
- Strictest rule set wins
- Rules can contain
  - Wildcard (*)
  - Logical not operator (!)
  - Brackets ({})
    - Means “treat this rule as per-member” instead of as a group

Quota Command Line

- For Admins
  - qconf -[AaMmds]rqs
    - The usual “Add, modify, delete, show” arg modifiers apply
  - Wizard methods work
    - qconf -mattr resource_quota enabled false rule_1
- For Users & Admins
  - New binary “qquota” in 6.1
    - Also honors a “.sge_qquota” preference file
    - $SGE_ROOT/$CELL/common/sge_qquota
    - $HOME/.sge_qquota

Resource Quota Example 1

- “The total number of running jobs from project “killerApp” should not exceed 40”

```
{
  name                  project_limit
  description           Throttle killerApp projects to 40 concurrent
  enabled               true
  limit                 project killerApp to slots=40
}
```

Resource Quota Example 2

- “No power user should have more than 10 running jobs”

```
{
  name                 power_limit
  description          Limit all power users
  enabled              true
  limit                users {@power} to slots=10
}
```

Resource Quota Example 3

- "Total number of running jobs from power users should not exceed 40, everyone else is limited to max 5 running jobs each"

```
{
  name                  power_limit
  description           Limit all power users
  enabled               true
  limit                 users @power to slots=40
  limit                 users {*} to slots=5

}
```

Resource Quota Example 4

- "The total number of jobs without projects must not exceed 10"

```
{
  name                  nonproject_limit
  description           Limit jobs without project affiliation
  enabled               true
  limit                 projects !* to slots=10
}
```

Quota checking for users

- New program ‘qquota’
- Man page has best usage
- By default:
  - Shows you all in-play quota rules that apply to the calling user

END;

- Thanks!

chris@bioteam.net