



Introduction to Gadi — Part II

Almost Everything About Jobs

NCI Training

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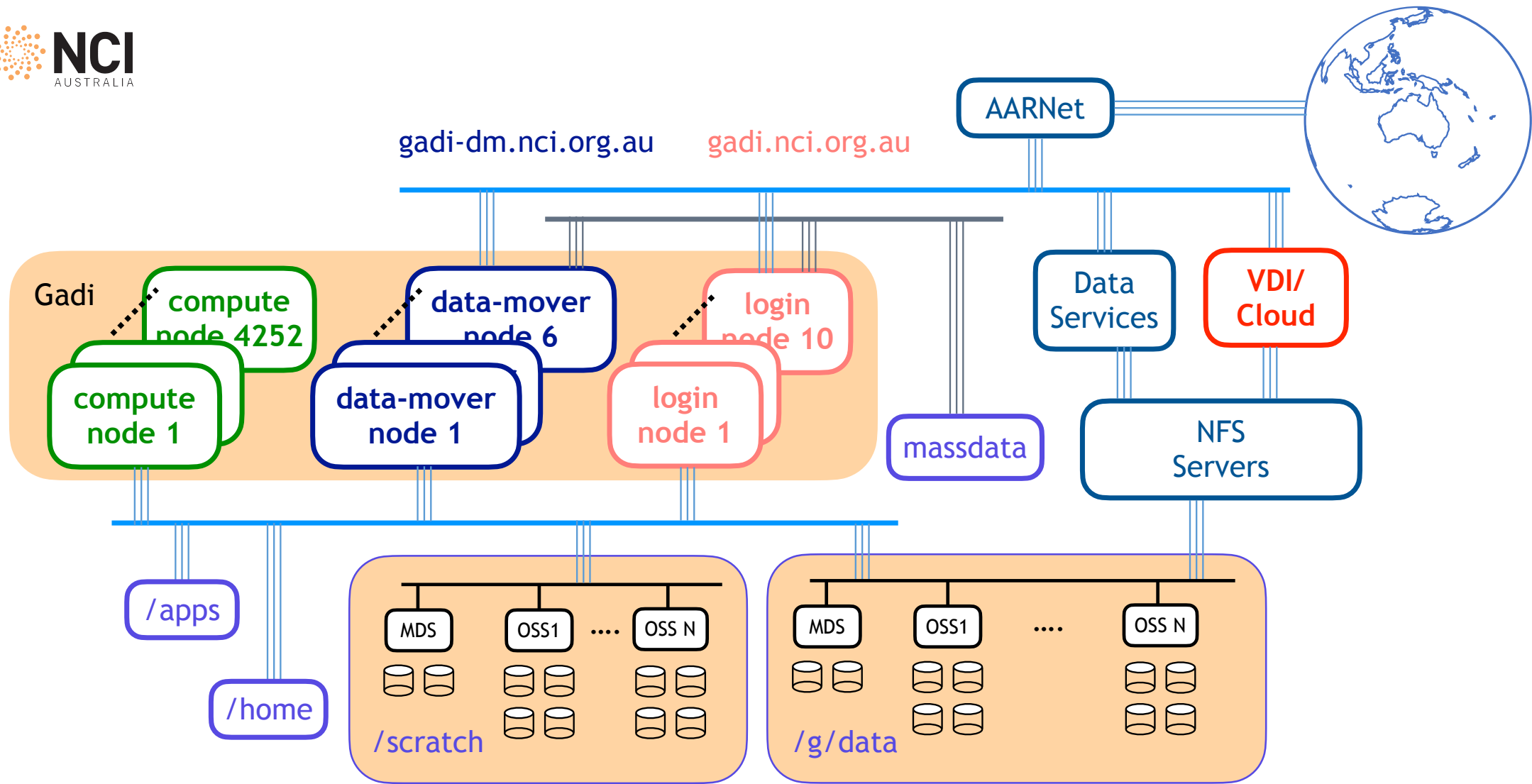
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Agenda

- Second half of [Welcome to Gadi](#) opus page
- Four sections
 - Basic workflow
 - Compute and storage grant
 - Software applications
 - Jobs
 - Submission options and status monitoring
 - Resource utilisation
- Exercise/Examples + Key points + Q&A

Basic Workflow

Resources and Basic Job Submission/Monitoring



Submit Jobs and Monitor Status

```
cp /scratch/public/yxs900/gutentag.sh ./
qsub gutentag.sh
qstat -u $USER -sw
qstat -fx <jobid>
cat <jobname>.o<jobid>
```

- qsub, qstat, qdel all launch requests to PBS server
 - run with frequency $< 1/600$ Hz
- Each job has two logs: `$PBS_JOBNAME.e$PBS_JOBID` and `$PBS_JOBNAME.o$PBS_JOBID`
- Queue, resource request (CPU, memory, walltime) \rightarrow SU cost

Job Submission Script

```
$ cat /scratch/public/yxs900/gutentag.sh
```

```
#!/bin/bash
```

```
#PBS -P c25
```

Project Ownership

```
#PBS -q copyq
```

```
#PBS -l ncpus=1
```

```
#PBS -l mem=2GB
```

```
#PBS -l walltime=02:00:00
```

Resource Requests → Reserved SU

```
#PBS -l storage=scratch/z00+gdata/c25
```

```
#PBS -l wd
```

```
hostname
```

```
export DSTDIR=/g/data/c25/yxs900/job_archive
```

```
export SOURCEDIR=/scratch/z00/yxs900/benchmarks/python/tensorflow
```

```
cp -vr $SOURCEDIR $DSTDIR > ${PBS_JOBID}.log
```

A horizontal banner image showing a colorful, abstract, and somewhat blurry microscopic view of tissue, likely stained with various dyes, showing cellular structures and patterns in shades of red, orange, yellow, blue, and purple.

Compute & Storage Grant

Schemes and Validity Period

Monitoring Project Grant and Usage

- Project compute allocation status
 - `nci_account -P $PROJECT`
- Look into schemes and per-user usage
 - `nci_account -P $PROJECT -v`
- Look at previous quarters
 - `nci_account -P $PROJECT -v -p 2020.q4`

\$ nci_account -P ab01

Usage Report: Project=ab01 Period=2021.q2

```
=====
Grant:    471.00 KSU
Used:    406.30 KSU
Reserved:  0.00 SU
Avail:    64.70 KSU
```

Storage Usage Report: Project=ab01

```
=====
Filesystem      Used      iUsed      Allocation  iAllocation
gdata1b         513.57 GB    6.00        2.00 TB     312.00 K
=====
```

\$
\$
\$
\$
\$
\$

\$ nci_account -P ab01 -p 2021.q1

Usage Report: Project=ab01 Period=2021.q1

```
=====
Grant:    548.00 KSU
Used:    524.56 KSU
Reserved:  0.00 SU
Avail:    23.44 KSU
```

Storage Usage Report: Project=ab01

```
=====
Filesystem      Used      iUsed      Allocation  iAllocation
gdata1b         513.57 GB    6.00        2.00 TB     312.00 K
=====
```

\$
\$
\$
\$
\$
\$

\$ nci_account -P ab01 -p 2021.q1 -v

Usage Report: Project=ab01 Period=2021.q1

```
=====
Grant:    548.00 KSU
Used:    524.56 KSU
Reserved:  0.00 SU
Avail:    23.44 KSU
```

```
-----
Stakeholder      Grant      Used      Avail
-----
MAS               250.00 KSU  249.65 KSU  354.93 SU
UNSW              298.00 KSU  274.92 KSU  23.08 KSU
-----
```

```
-----
User              Used      Reserved
-----
abc321            372.50 KSU  0.00 SU
xyz123            152.06 KSU  0.00 SU
-----
```

Storage Usage Report: Project=ab01

```
=====
Filesystem      Used      iUsed      Allocation  iAllocation
gdata1b         513.57 GB    6.00        2.00 TB     312.00 K
```

```
-----
Stakeholder      Allocation  iAllocation
-----
UNSW              2.00 TB     312.00 K
-----
```

Monitoring Project Grant and Usage

- Project can receive grant from multiple schemes
- Compute grant
 - 1 Service Unit (SU) supports a single CPU core job submitted to normal queue with up to 4GiB memory request to run for 30 minutes
 - Adjustment can be made on scheme approval
- Storage space on /g/data
 - hosts persistent data vs /scratch hosts temporary data
 - exists only after scheme approval vs 72 GB default on /scratch and extensible by NCI

Extended Reading <https://opus.nci.org.au/display/Help/2.2+Job+Cost+Examples>


```
$ nci-files-report -f scratch --group xy12
```

FILESYSTEM	SCAN DATE	PROJECT	GROUP	USER	SPACE USED	TOTAL SIZE	COUNT
scratch	2020-12-27	am1	xy12	xyz123	2.0G	2.0G	3968
scratch	2020-12-27	ab01	xy12	xyz123	48.0K	11.8K	21
scratch	2020-12-27	ab01	xy12	abc321	32.0K	4.8K	12
scratch	2020-12-27	xy12	xy12	xyz123	396.0K	211.8K	97
scratch	2020-12-27	xy12	xy12	abc321	29.7G	29.7G	7258

```
$ nci-files-report -f scratch --project xy12
```

FILESYSTEM	SCAN DATE	PROJECT	GROUP	USER	SPACE USED	TOTAL SIZE	COUNT
scratch	2020-12-27	xy12	c25	xyz123	2.7G	2.7G	1652
scratch	2020-12-27	xy12	xy12	xyz123	396.0K	211.8K	97
scratch	2020-12-27	xy12	xy12	abc321	29.7G	29.7G	7258

```
$ nci-files-report -f scratch --user xyz123
```

FILESYSTEM	SCAN DATE	PROJECT	GROUP	USER	SPACE USED	TOTAL SIZE	COUNT
scratch	2020-12-27	am1	xy12	xyz123	2.0G	2.0G	3968
scratch	2020-12-27	ab01	xy12	xyz123	48.0K	11.8K	21
scratch	2020-12-27	xy12	c25	xyz123	2.7G	2.7G	1652
scratch	2020-12-27	xy12	xy12	xyz123	396.0K	211.8K	97

Q&A

- To apply for grant
 - Lead CIs can contact scheme managers for topups
 - Supervisors propose project to scheme through my.nci.org.au
 - Researchers submit applications to NCMAS, ANUMAS or ALCG
- The limit of number of files and directories on Lustre file systems protects their I/O performance
- Reserved SUs
 - Calculated according to request, not usage
 - Jobs across billing boundary reserve SUs in both quarters
 - Request as close to the job usage as possible
- Other questions?

Job Submission Script

```
$ cat /scratch/public/yxs900/gutentag.sh
```

```
#!/bin/bash
```

```
#PBS -P c25
```

```
#PBS -q copyq
```

```
#PBS -l ncpus=1
```

```
#PBS -l mem=2GB
```

```
#PBS -l walltime=02:00:00
```

```
#PBS -l storage=scratch/z00+gdata/c25
```

```
#PBS -l wd
```

```
hostname
```

```
export DSTDIR=/g/data/c25/yxs900/job_archive
```

```
export SOURCEDIR=/scratch/z00/yxs900/benchmarks/python/tensorflow
```

```
cp -vr $SOURCEDIR $DSTDIR > ${PBS_JOBID}.log
```

Actual Tasks: hostname, cp

Other applications?

Applications

Software catalogue and Software Groups

Module Environment

- Try the following module commands
 - `module avail python3`
 - `module list`
 - `module show python3/3.9.2`
 - `module load python3/3.9.2` [check changes in PATH etc.]
 - `module unload python3` [check changes in PATH etc.]

```
$ module avail python3
-----/apps/Modules/modulefiles -----
python3-as-python  python3/3.7.4  python3/3.8.5  python3/3.9.2
```

```
$ module list
Currently Loaded Modulefiles:
 1) pbs
```

```
$ module show python3/3.9.2
-----
/apps/Modules/modulefiles/python3/3.9.2:

prepend-path      PATH /apps/python3/3.9.2/bin
prepend-path      C_INCLUDE_PATH /apps/python3/3.9.2/include/python3.9
prepend-path      CPLUS_INCLUDE_PATH /apps/python3/3.9.2/include/python3.9
prepend-path      CPATH /apps/python3/3.9.2/include/python3.9
prepend-path      FPATH /apps/python3/3.9.2/include/python3.9
prepend-path      LIBRARY_PATH /apps/python3/3.9.2/lib
prepend-path      LD_LIBRARY_PATH /apps/python3/3.9.2/lib
prepend-path      LD_RUN_PATH /apps/python3/3.9.2/lib
prepend-path      MANPATH /apps/python3/3.9.2/share/man
prepend-path      PKG_CONFIG_PATH /apps/python3/3.9.2/lib/pkgconfig
module            load intel-mkl/2020.3.304
conflict          python3
setenv            PYTHON3_BASE /apps/python3/3.9.2
setenv            PYTHON3_ROOT /apps/python3/3.9.2
setenv            PYTHON3_VERSION 3.9.2
module-whatis     {python3, version 3.9.2}
-----
```

```
$ module load python3/3.9.2
Loading python3/3.9.2
  Loading requirement: intel-mkl/2020.3.304
```

```
$ module list
Currently Loaded Modulefiles:
 1) pbs  2) intel-mkl/2020.3.304  3) python3/3.9.2
```

```
$ python3
Python 3.9.2 (default, Mar 29 2021, 10:41:26)
[GCC 8.3.1 20191121 (Red Hat 8.3.1-5)] on linux
Type "help", "copyright", "credits" or "license" for more information.
>>> import numpy as np
>>> np.__version__
'1.20.0'
>>> exit()
```

```
$ module load python3/3.8.5
MODULE ERROR DETECTED: GLOBALERR python3/3.8.5 cannot be loaded due to a
conflict.
(Detailed error information and backtrace has been suppressed, set
$MODULES_ERROR_BACKTRACE to unsuppress.)
```

```
Loading python3/3.8.5
ERROR: python3/3.8.5 cannot be loaded due to a conflict.
HINT: Might try "module unload python3" first.
```

Software Catalogue

- Modules on Gadi are named as <software>/<version>
 - always load a specific version of the software application under interest
 - `module load <software>` loads the default version which changes over time
- `module load` does the following
 - Modifies search/exec path
 - load prerequisite modules [intel-mkl/2020.3.304 for python3/3.9.2]
 - handle conflicts
 - configures environment to define how the application runs

Licence Module and Software Group

- Restricted Modules available to specific group of users
- Software groups control access to license modules
 - Example: matlab, ansys
- License Modules tell the application where to checkout license
- Software groups control access to applications
 - Example: vasp

```
$ module avail matlab
-----/apps/Modules/restricted-modulefiles/matlab_anu -----
matlab_licence/anu

-----/apps/Modules/restricted-modulefiles/matlab_usyd -----
matlab_licence/usyd

-----/apps/Modules/restricted-modulefiles/matlab_vu -----
matlab_licence/vu

-----/apps/Modules/restricted-modulefiles/matlab_utas -----
matlab_licence/utas

-----/apps/Modules/modulefiles -----
matlab/R2019b  matlab/R2020b
```

```
$ getfacl /apps/Modules/restricted-modulefiles/matlab_anu
getfacl: Removing leading '/' from absolute path names
# file: apps/Modules/restricted-modulefiles/matlab_anu
# owner: apps
# group: z30
user::rwx
group::rwx
group:matlab_anu:r-x
mask::rwx
other:---
```

```
$ module show matlab_licence/anu
-----
/apps/Modules/restricted-modulefiles/matlab_anu/matlab_licence/anu:

setenv          MLM_LICENSE_FILE 12345678@xxxxxxxxx.anu.edu.au
conflict        matlab_licence
module-whatis   {matlab_licence, version anu}
-----
```

```
$ module load matlab/R2020b
$ module load matlab_licence/anu
$ matlab -nodesktop -nodisplay
```

```
< M A T L A B (R) >
Copyright 1984-2020 The MathWorks, Inc.
R2020b Update 5 (9.9.0.1592791) 64-bit (glnxa64)
February 4, 2021
```

To get started, type doc.
For product information, visit www.mathworks.com.

```
>> eig(magic(3))
```

```
ans =

    15.0000
     4.8990
    -4.8990
```

```
>> exit()
```

```
$ getfacl /apps/vasp/6.1.0/bin/
getfacl: Removing leading '/' from absolute path names
# file: apps/vasp/6.1.0/bin/
# owner: apps
# group: apps
user::rwx
group::rwx
group:vasp6:r-x
mask::rwx
other:---
```


Q&A

- Join software group on my.nci.org.au
 - read project description before submit the membership request
 - wait for 30 minutes after the approval to allow membership synchronised throughout systems
- Other questions?

Jobs

More Submission Options

Submit an Interactive Job

```
qsub -I -lstorage=gdata/c25+scratch/x11,wd job.sh
```

- Add PBS directives so that the job
 - sends you email at start: `-M <abc123>@<gmail.com> -m abe`
 - waits until matlab licenses is available: `-lsoftware=matlab_<unsw>`
 - redirects STDOUT and STDERR into the specific log(s):
 - `-e err.log -o /scratch/c25/abc123/Logs/`
 - `-j eo`
 - waits until 1:55pm to start: `-a 202106171355`

Extended Reading <https://opus.nci.org.au/display/Help/PBS+Directives+Explained>

Q&A

- Why my job has waited so long [qstat -u \$USER -Esw]
 - Insufficient amount of resource: ncpus
 - Project doesn't have sufficient allocation to run job
 - Waiting for software licenses
 - Job would not finish before dedicated time
- Why my job failed [look into the error log]
 - File/directory not found [check -lstorage]
 - Exceeding jobfs/memory/walltime limit
 - Disk quota exceeded [lquota, nci-files-report, quota]
- Other questions?

Jobs

Monitoring How Well the Job Runs

Resource Utilisation Rate

```
nqstat_anu <jobID1> <jobID2> ...
```

					%CPU	WallTime	Time Lim	RSS	mem	memlim	cpus
12345678	R	abc123	x11	myTest	33	10:53:56	20:00:00	58.7GB	58.7GB	200GB	96
19145286	R	abc123	x11	atmos_ma	96	01:32:41	03:30:00	369GB	369GB	2625GB	768
19149497	R	abc123	x11	coupled.	84	00:34:25	04:30:00	320GB	320GB	1440GB	720
19149708	R	abc123	x11	netcdf_c	71	00:36:30	02:00:00	12.0GB	12.0GB	12.0GB	1
19150248	R	abc123	x11	atmos_ma	86	00:22:27	03:30:00	345GB	345GB	2625GB	768

If under use, look into the job

```
qcat -e <jobID>
```

```
qps -Lopid,nlwp,lwp,stat,sgi_p,pcpu,cputime,comm <jobID>
```

- ``qcat`` : print the job's standard streams
 - `-e/-o` for standard error/out stream
 - `-s` for submission script
- ``qps`` : take a snapshot of the current processes in the job
 - launches a ``ps`` query on each node hosting the job
 - accepts most flags ``ps`` would take

```
$ nqstat_anu 12345678
```

				%CPU	WallTime	Time Lim	RSS	mem	memlim	cpus	
12345678	R	abc123	x11	myTest	0	10:59:39	48:00:00	228MB	228MB	180GB	96

```
$ qps -Lopid,nlwp,lwp,stat,sgi_p,pcpu,cputime,comm 12345678
```

```
Node 0 (gadi-cpu-clx-2962):
```

PID	NLWP	LWP	STAT	P	%CPU	TIME	COMMAND
232633	1	232633	Ss	*	0.0	00:00:00	bash
232641	1	232641	S	*	0.0	00:00:00	pbs_demux
232682	1	232682	S	*	0.0	00:00:00	12345678.gadi-p
232697	4	232697	Sl	*	0.0	00:00:00	mpirun
232697	4	232702	Sl	*	0.0	00:00:00	mpirun
232697	4	232703	Sl	*	0.0	00:00:00	mpirun
232697	4	232704	Sl	*	0.0	00:00:00	mpirun

```
Node 1 (gadi-cpu-clx-2971):
```

PID	NLWP	LWP	STAT	P	%CPU	TIME	COMMAND
884675	3	884675	Ssl	*	0.0	00:00:00	orted
884675	3	884687	Ssl	*	0.0	00:00:00	orted
884675	3	884688	Ssl	*	0.0	00:00:00	orted

```
$ qcat -e 12345678
```

```
./myTest: error while loading shared libraries: libmkl_intel_lp64.so: cannot open  
shared object file: No such file or directory  
./myTest: error while loading shared libraries: libmkl_intel_lp64.so: cannot open  
shared object file: No such file or directory  
./myTest: error while loading shared libraries: libmkl_intel_lp64.so: cannot open  
shared object file: No such file or directory  
....
```

```
$ qcat -s 12345678
```

```
#!/bin/bash  
#PBS -N myTest  
#PBS -P c25  
#PBS -q normal  
#PBS -l walltime=48:00:00  
#PBS -l mem=180GB  
#PBS -l ncpus=96  
#PBS -l storage=gdata/c25  
#PBS -l wd  
  
module load openmpi/4.0.1  
mpirun -np $PBS_NCPUS ./myTest
```


\$ nqstat_anu 12345679

				%CPU	WallTime	Time Lim	RSS	mem	memlim	cpus	
12345679	R	abc123	x11	myTest	33	10:53:56	48:00:00	58.7GB	58.7GB	180GB	96

\$ myqps 12345679

qps

Node 0 (gadi-cpu-clx-1957):

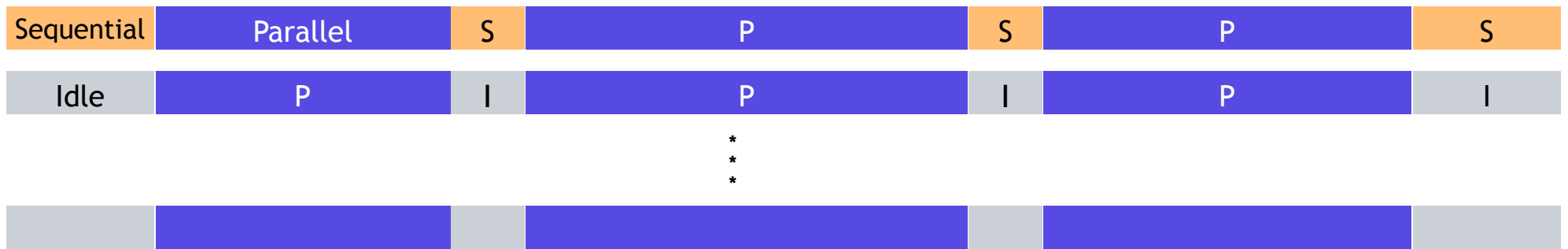
PID	NLWP	LWP	STAT	P	%CPU	TIME	COMMAND
186877	1	186877	Ss	*	0.0	00:00:00	bash
186885	1	186885	S	*	0.0	00:00:00	pbs_demux
186926	1	186926	S	*	0.0	00:00:00	12345679.gadi-p
186961	4	186961	Sl	*	0.0	00:00:00	mpirun
186961	4	186966	Sl	*	0.0	00:00:00	mpirun
186961	4	186967	Sl	*	0.0	00:00:00	mpirun
186961	4	186968	Sl	*	0.0	00:00:00	mpirun
186969	51	186969	Rl	47	90.1	09:56:32	myTest
186969	51	186972	Sl	*	0.0	00:00:00	myTest
186969	51	186975	Sl	*	0.0	00:00:00	myTest
186969	51	186978	Sl	*	0.1	00:00:50	myTest
186969	51	186980	Sl	*	32.6	03:36:20	myTest
186969	51	186981	Sl	*	32.1	03:32:56	myTest
186969	51	186982	Sl	*	32.9	03:38:02	myTest
186969	51	186983	Sl	*	33.1	03:39:17	myTest
186969	51	186984	Sl	*	33.3	03:40:34	myTest
186969	51	186985	Sl	*	32.7	03:37:01	myTest
186969	51	186986	Sl	*	32.9	03:38:07	myTest
186969	51	186987	Sl	*	33.2	03:39:55	myTest
186969	51	186988	Sl	*	32.2	03:33:36	myTest
186969	51	186989	Sl	*	32.1	03:33:06	myTest
186969	51	186990	Sl	*	32.8	03:37:37	myTest
186969	51	186991	Sl	*	33.3	03:40:34	myTest
186969	51	186992	Sl	*	32.8	03:37:33	myTest
186969	51	186993	Sl	*	33.0	03:38:57	myTest
186969	51	186994	Sl	*	32.8	03:37:06	myTest
186969	51	186995	Sl	*	32.7	03:36:59	myTest
186969	51	186996	Sl	*	32.5	03:35:26	myTest
186969	51	186997	Sl	*	32.8	03:37:36	myTest
186969	51	186998	Sl	*	32.7	03:36:36	myTest
186969	51	186999	Sl	*	32.4	03:34:42	myTest
186969	51	187000	Sl	*	31.6	03:29:19	myTest
186969	51	187001	Sl	*	32.6	03:36:03	myTest
186969	51	187002	Sl	*	32.3	03:33:55	myTest
186969	51	187003	Sl	*	33.1	03:39:09	myTest
186969	51	187004	Sl	*	32.7	03:36:36	myTest
186969	51	187005	Sl	*	33.0	03:38:30	myTest
186969	51	187006	Sl	*	33.0	03:38:28	myTest
186969	51	187007	Sl	*	33.2	03:39:45	myTest
186969	51	187008	Sl	*	33.2	03:39:59	myTest
186969	51	187009	Sl	*	32.3	03:34:23	myTest
186969	51	187010	Sl	*	33.8	03:44:10	myTest
186969	51	187011	Sl	*	32.8	03:37:39	myTest
186969	51	187012	Sl	*	33.3	03:40:27	myTest
186969	51	187013	Sl	*	32.5	03:35:44	myTest
186969	51	187014	Sl	*	32.8	03:37:40	myTest
186969	51	187015	Sl	*	32.9	03:38:15	myTest
186969	51	187016	Sl	*	33.3	03:40:45	myTest
186969	51	187017	Sl	*	33.1	03:39:29	myTest
186969	51	187018	Sl	*	32.5	03:35:23	myTest
186969	51	187019	Sl	*	33.0	03:38:32	myTest
186969	51	187020	Sl	*	32.3	03:34:22	myTest
186969	51	187021	Sl	*	32.4	03:34:33	myTest
186969	51	187022	Sl	*	32.7	03:36:36	myTest
186969	51	187023	Sl	*	33.4	03:41:14	myTest
186969	51	187024	Sl	*	33.2	03:40:24	myTest
186969	51	187025	Sl	*	32.1	03:32:52	myTest
186969	51	187026	Sl	*	33.5	03:42:04	myTest

Node 1 (gadi-cpu-clx-1975):

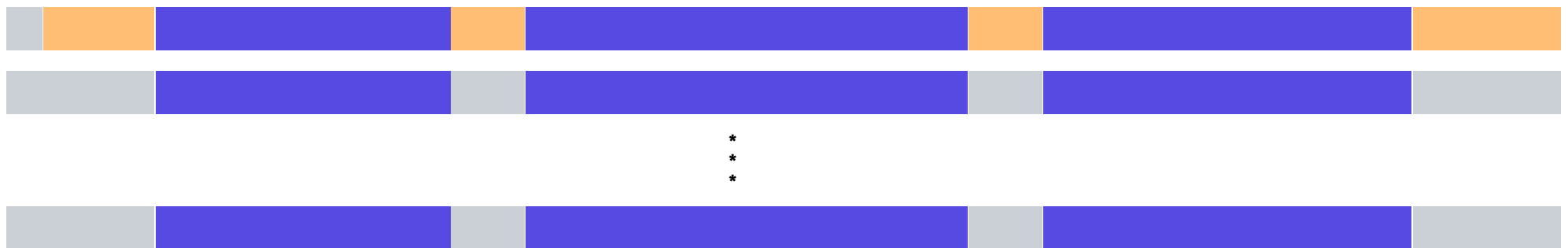
PID	NLWP	LWP	STAT	P	%CPU	TIME	COMMAND
174219	3	174219	Ssl	*	0.0	00:00:00	orted
174219	3	174231	Ssl	*	0.0	00:00:00	orted
174219	3	174232	Ssl	*	0.0	00:00:00	orted
174233	51	174233	Rl	3	88.7	09:47:10	myTest
174233	51	174236	Sl	*	0.0	00:00:00	myTest
174233	51	174239	Sl	*	0.0	00:00:00	myTest
174233	51	174242	Sl	*	0.1	00:00:51	myTest
174233	51	174244	Sl	*	31.5	03:28:34	myTest
174233	51	174245	Sl	*	31.2	03:26:32	myTest
174233	51	174246	Sl	*	31.0	03:25:46	myTest
174233	51	174247	Sl	*	31.5	03:28:41	myTest
174233	51	174248	Sl	*	31.7	03:30:12	myTest
174233	51	174249	Sl	*	31.3	03:27:16	myTest
174233	51	174250	Sl	*	30.9	03:24:32	myTest
174233	51	174251	Sl	*	31.1	03:26:24	myTest
174233	51	174252	Sl	*	31.4	03:27:57	myTest
174233	51	174253	Sl	*	31.1	03:25:51	myTest
174233	51	174254	Sl	*	30.7	03:23:32	myTest
174233	51	174255	Sl	*	31.6	03:29:31	myTest
174233	51	174256	Sl	*	31.6	03:29:31	myTest
174233	51	174257	Sl	*	31.3	03:27:34	myTest
174233	51	174258	Sl	*	31.6	03:29:41	myTest
174233	51	174259	Sl	*	31.5	03:28:43	myTest
174233	51	174260	Sl	*	31.3	03:27:15	myTest
174233	51	174261	Sl	*	31.5	03:28:31	myTest
174233	51	174262	Sl	*	31.4	03:27:50	myTest
174233	51	174263	Sl	*	31.7	03:30:09	myTest
174233	51	174264	Sl	*	31.7	03:29:51	myTest
174233	51	174265	Sl	*	31.4	03:28:21	myTest
174233	51	174266	Sl	*	31.4	03:28:06	myTest
174233	51	174267	Sl	*	31.4	03:28:16	myTest
174233	51	174268	Sl	*	31.3	03:27:45	myTest
174233	51	174269	Sl	*	31.4	03:28:10	myTest
174233	51	174270	Sl	*	31.6	03:29:09	myTest
174233	51	174271	Sl	*	31.6	03:29:38	myTest
174233	51	174272	Sl	*	31.2	03:26:37	myTest
174233	51	174273	Sl	*	31.5	03:28:45	myTest
174233	51	174274	Sl	*	31.6	03:29:41	myTest
174233	51	174275	Sl	*	31.0	03:25:45	myTest
174233	51	174276	Sl	*	31.0	03:25:25	myTest
174233	51	174277	Sl	*	31.0	03:25:37	myTest
174233	51	174278	Sl	*	31.4	03:27:53	myTest
174233	51	174279	Sl	*	31.4	03:28:02	myTest
174233	51	174280	Sl	*	31.0	03:25:15	myTest
174233	51	174281	Sl	*	31.4	03:27:53	myTest
174233	51	174282	Sl	*	31.4	03:28:13	myTest
174233	51	174283	Sl	*	31.4	03:28:18	myTest
174233	51	174284	Sl	*	31.1	03:26:11	myTest
174233	51	174285	Sl	*	31.4	03:27:50	myTest
174233	51	174286	Sl	*	31.3	03:27:44	myTest
174233	51	174287	Sl	*	31.0	03:25:33	myTest
174233	51	174288	Sl	*	31.0	03:25:35	myTest
174233	51	174289	Sl	*	31.3	03:27:22	myTest
174233	51	174290	Sl	*	31.5	03:28:44	myTest

Join-Fork Paradigm

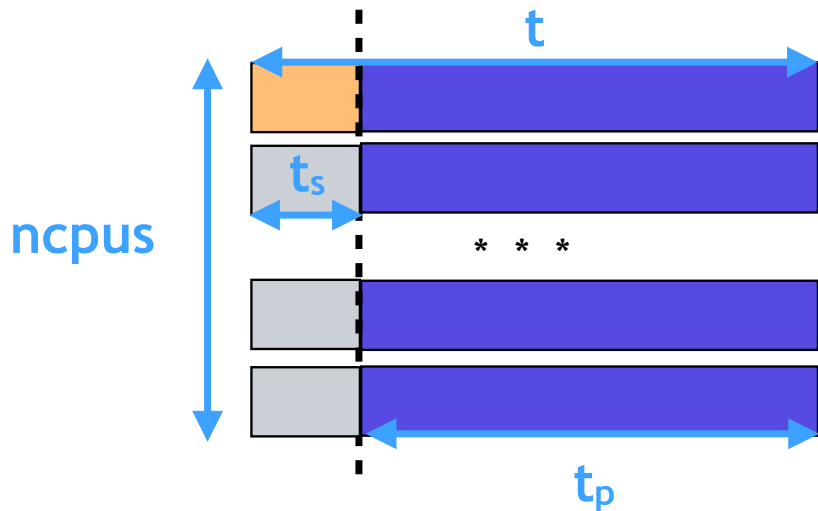
Node 0



Node 1



Theoretical CPU Utilisation Rate in a Ideal Case

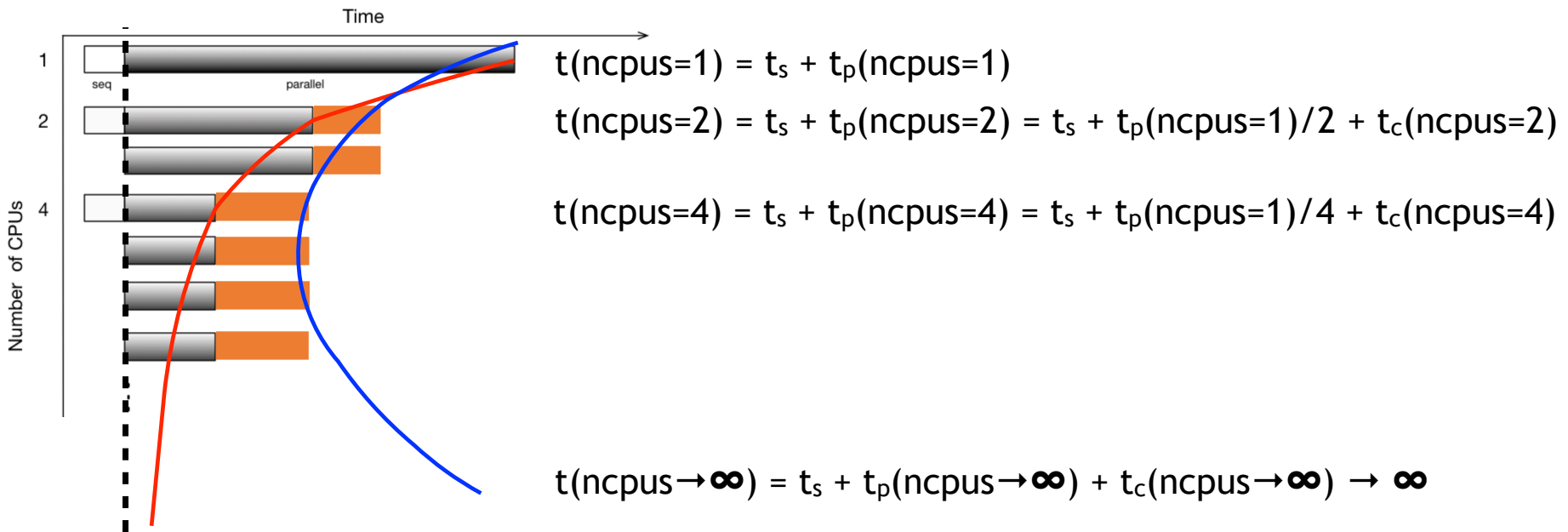


$$\eta(\text{ncpus}) = \frac{t_s + \text{ncpus} * t_p(\text{ncpus})}{\text{ncpus} * t(\text{ncpus})}$$

$\eta(\text{ncpus} \rightarrow \infty) \rightarrow 0$
given a constant $\text{ncpus} * t_p + t_s$

ncpus	tp	t	η
1	99	100	1
12	8.25	9.25	0.90
28	3.54	4.54	0.79
48	2.06	3.06	0.68
192	0.52	1.52	0.34

Execution Time Increases Beyond Sweet Spot

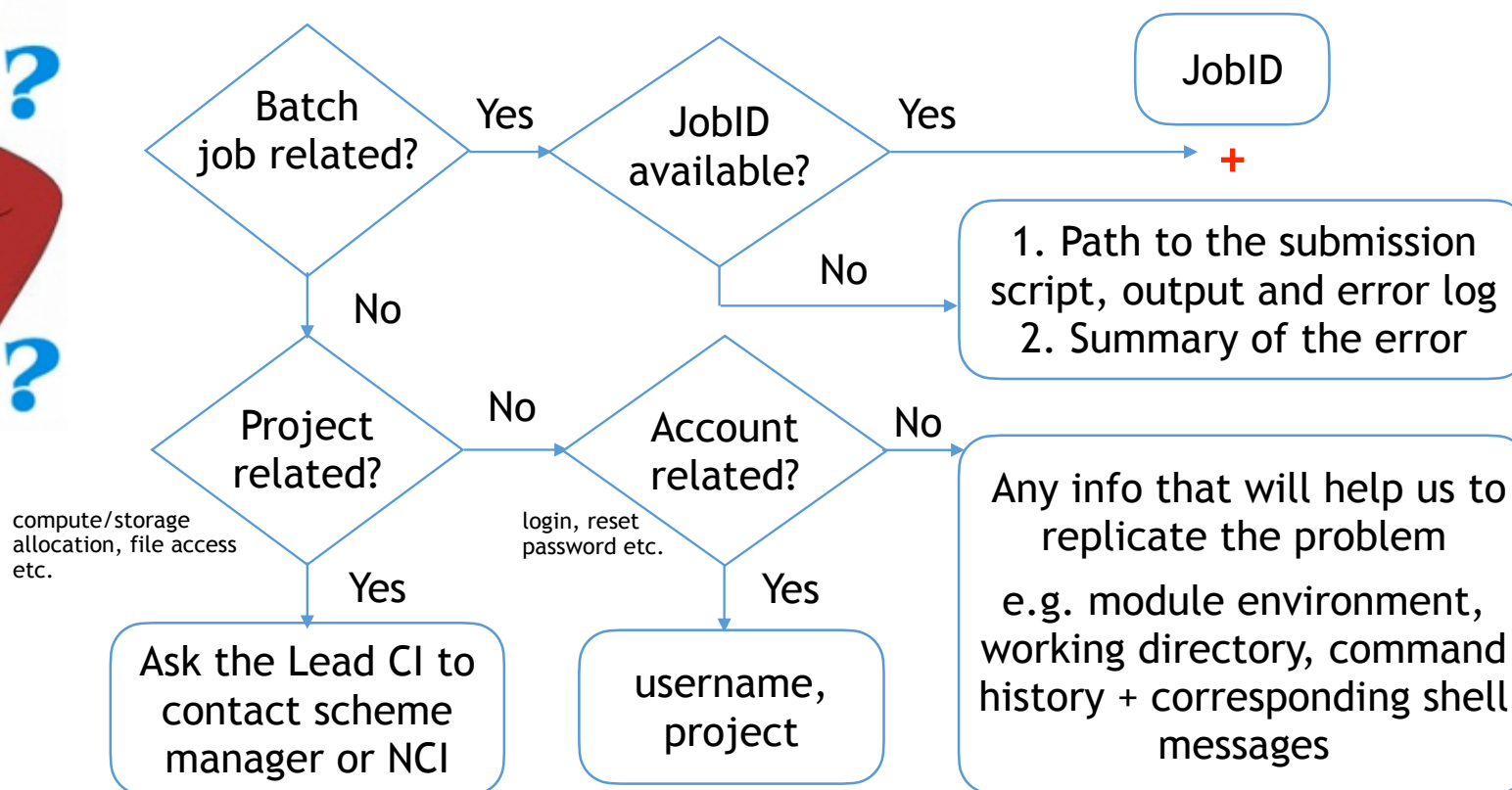




Help Desk

Asking Questions

An Example Flowchart



Any More Questions?

help@nci.org.au

A horizontal banner image showing a colorful, abstract microscopic view of tissue, likely stained with various dyes to highlight different cellular structures and components.

Thank you

Next Intro Course is coming on 8 July