

# Introduction to the PDC environment



ROYAL INSTITUTE  
OF TECHNOLOGY

PDC Center for High Performance Computing

KTH, Sweden

Rossen Apostolov

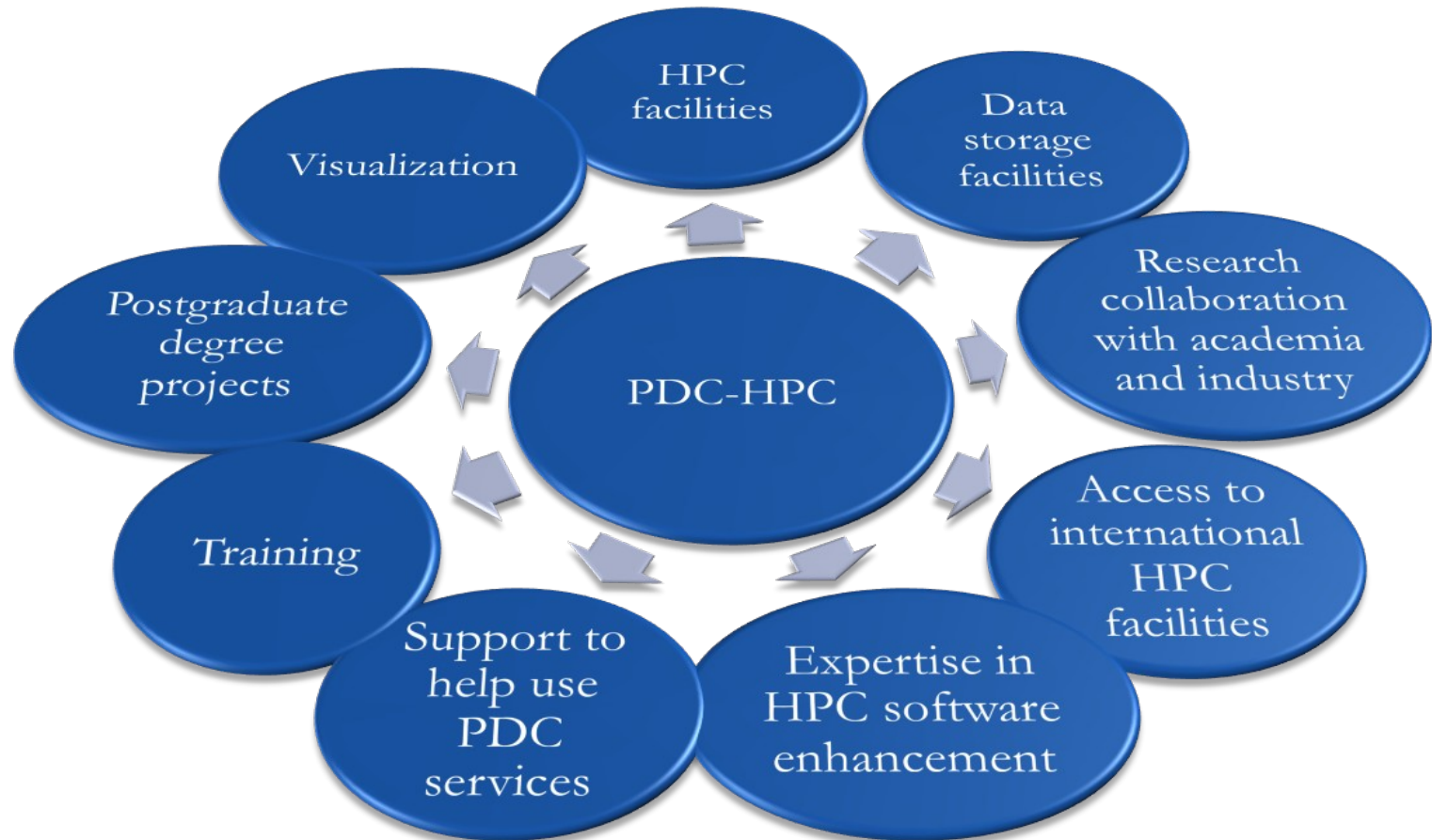
(rossen@kth.se)

Application expert at PDC

# PDC Offers...



ROYAL INSTITUTE  
OF TECHNOLOGY



# PDC for Academic Users

- Access to PDC computing and data storage facilities via the Swedish National Infrastructure for Computing (SNIC)
- Advanced and introductory user training including workshops, seminars and courses
- User support
- Application expert help
- Access to European computing facilities via PRACE Infrastructure calls
- Access to application experts at other European centers for help with scientific applications via PRACE Infrastructure calls



ROYAL INSTITUTE  
OF TECHNOLOGY

SNIC



# PDC Key Assets: First-Line Support and System Staff

## First-line support

Helps you have a smooth start to using PDC's resources and provides assistance if you need help while using our facilities



ROYAL INSTITUTE  
OF TECHNOLOGY

## System staff: System managers/administrators

Ensure that PDC's HPC and storage facilities run smoothly and securely

#	Subject	Requestors
77217	Access to VASP at Linderen	pl@snic.se
83804	Lindgren PAPI version	hans@snic.com
91223	Large amounts of "old" data in Klemming	sm@nrc.pdc.kth.se
91851	Large amounts of data in nabackup part of Klemming	h@snic.com
92017	FLEXnet error using STAR-CCM+	cm@snic.se
92920	Re: The Python import problem	bs@snic.se
94038	comsol med matlab på ferin	pe@snic.se
94096	BLACS saknas på ferin	pe@snic.se
94372	Large amount of data in file system Klemming @PDC/KTH	ra@snic.com
94373	Installing CATK and Picard	fr@snic.com
94382	Account deactivation	pe@snic.se
94383	Account deactivation	bo@snic.se

```
lama-tst@emil1-login2:~/testdir$ chmod g+w foo
total 4
drwxr-xr-x 2 lama-tst users 4096 2012-08-14 17:38 dir1
-rw-rw-r-- 1 lama-tst users 0 2012-08-14 17:38 foo
```

```
down for more than 1000 seconds:
pe 'k20n19.pdc.kth.se' down since at least 2013-04-28/16:54:59 [1806s].
Reminder - still down:
pe 'k19n12.pdc.kth.se' down since at least 2013-04-28/16:29:48 [2467s].
pe 'k22n25.pdc.kth.se' down since at least 2013-04-28/16:29:48 [3852s].
pe 'k24n01.pdc.kth.se' down since at least 2013-04-28/16:39:52 [2745s].
pe 'k24n32.pdc.kth.se' down since at least 2013-04-28/16:29:48 [2317s].
pe 'k24n45.pdc.kth.se' down since at least 2013-04-28/16:34:48 [3817s].
pe 'k25n05.pdc.kth.se' down since at least 2013-04-28/16:44:53 [2412s].
pe 'k25n01.pdc.kth.se' down since at least 2013-04-28/16:29:48 [4517s].
pe 'k25n39.pdc.kth.se' down since at least 2013-04-28/16:34:48 [3317s].
pe 'k25n48.pdc.kth.se' down since at least 2013-04-28/16:29:48 [4517s].
pe 'k26n03.pdc.kth.se' down since at least 2013-04-28/16:49:56 [2109s].
pe 'k26n13.pdc.kth.se' down since at least 2013-04-28/16:04:47 [4818s].
pe 'k26n19.pdc.kth.se' down since at least 2013-04-28/16:16:05 [4140s].
pe 'k26n24.pdc.kth.se' down since at least 2013-04-28/16:23:31 [3494s].
pe 'k26n37.pdc.kth.se' down since at least 2013-04-28/16:23:31 [3494s].
A reminder will be sent in around 86400 seconds.
```

# PDC's Key Assets: HPC Application Experts

PDC-HPC application experts hold PhD degrees in different scientific fields and are experts in HPC.

Together with researchers, they optimize, scale and enhance scientific codes for the next generation supercomputers.



ROYAL INSTITUTE  
OF TECHNOLOGY



Jonathan Vincent  
*Computational Physics*



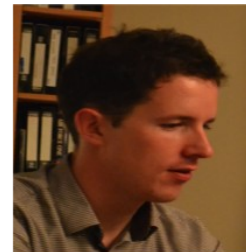
Rossen Apostolov  
*Computational Chemistry*



Michael Djurfeldt  
*Computational Neuroscience*



Henric Zazzi  
*Bioinformatics/Genetics*



Radovan Bast  
*Computational Chemistry*



Jing Gong  
*Scientific Computing*

# PDC Key Assets: Broad Range of Training



ROYAL INSTITUTE  
OF TECHNOLOGY

- PDC Summer School every year: Introduction to HPC
- Specific courses: Programming with GPGPU, Recent Advances in Distributed and Parallel Computing, Software Development Tools, Recent Advances in Cloud Computing, and many many more....
- PDC user days, PDC Open House and Pub Afternoon



# PDC Key Assets: Access to EU Facilities and Experts



ROYAL INSTITUTE  
OF TECHNOLOGY

PDC is an active partner in many international and national projects.



# PDC and Industry

PDC is working with industrial researchers and developers on major international projects that push high-performance computing to the next level.

PDC recently established a business development unit that provides consultancy and HPC services to industries.



ROYAL INSTITUTE  
OF TECHNOLOGY



**SCANIA**



# Access to PDC resources



- User account
- Time allocation (CAC)
  - Which clusters you can access
  - How many jobs you can run per month
- Time allocation requirements
  - Can be personal or shared within a group
  - Every user must belong to at least one time allocation

# Time allocations



ROYAL INSTITUTE  
OF TECHNOLOGY

- Applicant must be a senior scientist in swedish academia
- Need evidence of successful work at a medium level
- Evaluated on a technical and scientific level
- Decided by SNAC twice a year
- No formal limits

Large

- Applicant must be a senior scientist in swedish academia
- Evaluated on a technical level only
- Limits depend on machine
- Lindgren: 200 kcorehours/month

Medium

- Applicant can be a PhD student or higher
- Evaluated on a technical level only
- Limits is 5000 corehours/month

Small



**ROYAL INSTITUTE  
OF TECHNOLOGY**

# Computers at PDC

# Lindgren

## Hardware

1516 nodes

24 cores/node

2.1 GHz AMD Magny-Cours cores

32 GB RAM



ROYAL INSTITUTE  
OF TECHNOLOGY

- Intended for very large jobs (>512 core/job)
- Queue limit is 24 hours
- Runs the Moab/Torque queue system
- Partially reserved for PRACE, SCANIA, INCF
  - Large allocations: 75%
  - Medium allocations: 20%
  - Small allocations: 5%
- Lifetime: Q4 2014

# Povel

## Hardware

170 nodes

24 cores/node

AMD Opteron 2.2 GHz CPUs

32 GB RAM (P nodes)

64 Gb RAM (Q nodes)



ROYAL INSTITUTE  
OF TECHNOLOGY

- Intended for Lindgren pre/post processing
- Not allocated through SNIC
- Runs the EASY queue system
- Lifetime: Q4 2014

# Ferlin

## Hardware

512 nodes

8 cores/node

AMD Opteron 2.2 GHz CPUs

16 GB RAM

- Intended for small/long duration jobs
- Funded by KTH
  - Not allocated through SNIC
  - Only available to Stockholm affiliated PIs
- Runs the EASY queue system
- Only for small or medium allocations
- Lifetime: Q4 2014



ROYAL INSTITUTE  
OF TECHNOLOGY

# Ellen

## Hardware

single node

64 cores

Xeon E7-4830 X CPUs

1 TB RAM



ROYAL INSTITUTE  
OF TECHNOLOGY

- Intended for large memory jobs
- No proper time allocation
  - No queue system installed
  - Users book part of the machine
  - Access/time is given out sparingly

# Zorn

## Hardware

8 node GPU cluster

3 nVIDIA Tesla M2090

60 GB RAM



ROYAL INSTITUTE  
OF TECHNOLOGY

- Intended for GPU testing
- Medium allocations in general
- Runs the Moab/Torque queue system
- Can be applied for through SUPR
- Lifetime: Q1 2015



# Summary of PDC resources



ROYAL INSTITUTE  
OF TECHNOLOGY

Computers	Ellen	Ferlin	Lindgren	Povel	Zorn
Core/node	32	8	24	24	8
Nodes	1	512	1516	170 P 20 Q	
RAM (Gb)	1000	16	32	32 P 64 Q	60
Small allocations (corehours/node)	1000	5000	5000	5000	1000
Medium allocations (corehours/node)	3000	80000	200000	80000	3000
Large Allocations (corehours/month)			>200000		
Allocation via SNIC			yes		yes
Allocation via RT	yes	yes		yes	
Lifetime		Q4 2014	Q4 2014	Q4 2014	Q1 2015
Queue software		EASY	MOAB Torque	EASY	MOAB Torque
OS	CentOS6	CentOS5	SUSE/ CNL	CentOS5	CentOS6
AFS	yes	yes	Not on compute nodes	yes	yes
Lustre	yes		yes	yes	yes



ROYAL INSTITUTE  
OF TECHNOLOGY

And many more...

# Cloud computing



ROYAL INSTITUTE  
OF TECHNOLOGY



# Cloud Computing: Advantages

- **Less maintenance**

Hardware, applications and bandwidth are managed by PDC.

- **Continuous availability**

Public cloud services are available wherever you are located.

- **Scalability**

The OS, applications and data storage you need is allocated in a flexible way.

- **Elasticity**

Clouds can be scaled to meet your changing IT system demands and more hardware can easily be added

- **Expert service**

Expedient's cloud computing services are continuously monitored and maintained by PDC.



ROYAL INSTITUTE  
OF TECHNOLOGY

# Cloud Computing: Disadvantages



- **More elasticity means less control**

- **Not everything fits into the cloud**

Depending on the cloud provider, you may face restrictions on available applications, operating systems, and infrastructure options. Complicating matters more is the simple fact that not all platforms can live in the cloud.

- **Security and Confidentiality**

Cloud computing does pose the risk of increased security threats. While most companies have an up-to-date virus database, this does not make the files and information stored in the cloud immune to hackers.

- **Decreased performance...**

In comparison to cluster computing

# PDC OpenStack Cloud



ROYAL INSTITUTE OF TECHNOLOGY

ubuntu<sup>®</sup> OpenStack Dashboard Logged in as: hzazzi Settings Help Sign Out

## Instances

Project: Scilife

Filter  Filter + Launch Instance Soft Reboot Instances Terminate Instances

Instance Name	Image Name	IP Address	Size	Keypair	Status	Task	Power State	Uptime	Actions
<input type="checkbox"/> VMxlarge	ubuntu12-04-3	10.20.20.2 130.237.221.236	m1.xlarge   16GB RAM   8 VCPU   160.0GB Disk	UnivPubKey	Active	None	Running	1 week, 2 days	Create Snapshot More ▾
<input type="checkbox"/> vm3	ubuntu12-04-3	10.20.20.23 130.237.221.234	m1.small   2GB RAM   1 VCPU   20.0GB Disk	UnivPubKey	Active	None	Running	1 week, 2 days	Create Snapshot More ▾
<input type="checkbox"/> arne-test	ubuntu12-04-3	10.20.20.20 130.237.221.233	m1.small   2GB RAM   1 VCPU   20.0GB Disk	-	Active	None	Running	1 week, 3 days	Create Snapshot More ▾
<input type="checkbox"/> hz_test	ubuntu12-04-3	10.20.20.16 130.237.221.235	m1.small   2GB RAM   1 VCPU   20.0GB Disk	HenricZazzi	Active	None	Running	1 week, 4 days	Create Snapshot More ▾

Displaying 4 items

<https://www.pdc.kth.se/resources/computers/pdc-cloud>



**ROYAL INSTITUTE  
OF TECHNOLOGY**

# How to apply for a PDC account

# Apply to a SUPR account



ROYAL INSTITUTE  
OF TECHNOLOGY

- Needed if you are accessing SNIC resources
  - Lindgren
  - Zorn
- You can apply for a SUPR account at...  
[supr.snic.se](http://supr.snic.se)
- Link your SUPR account to PDC
  - Login to SUPR
  - Go to User pages
  - Check centres, if PDC not listed contact PDC support  
[www.pdc.kth.se/about/contact/support-requests](http://www.pdc.kth.se/about/contact/support-requests)



# Apply to a PDC account



- Electronic copy of your passport
- Examine the computer rules at PDC
- Which postal address the password should be sent
- Which time allocations the users will access
  - Not needed in case the users is applying for a time allocation
- You can apply for a PDC account at...  
[www.pdc.kth.se/support/accounts/user](http://www.pdc.kth.se/support/accounts/user)



**ROYAL INSTITUTE  
OF TECHNOLOGY**

# How to login

# Kerberos



ROYAL INSTITUTE  
OF TECHNOLOGY

- Is an authentication protocol originally developed at MIT
- PDC uses kerberos together with **SSH** for login
- **Ticket**
  - Proof of users identity
  - Users use password to obtain tickets
  - Tickets are cached on users computer for a specified duration
  - **Tickets should be created on your local computer**
  - As long as tickets are valid there is no need to enter password
- **Realm**
  - all resources available to access
  - example: NADA.KTH.SE
- **Principal**
  - Unique identity to which kerberos can assign tickets.
  - example: *username@NADA.KTH.SE*

# Kerberos commands

- **kinit** - proves your identity
- **klist** - list your kerberos tickets
- **kdestroy** - destroy your kerberos ticket file
- **kpasswd** - change your kerberos password



ROYAL INSTITUTE  
OF TECHNOLOGY

```
> kinit -f username@NADA.KTH.SE
> klist -Tf

Credentials cache : FILE:/tmp/krb5cc_500
Principal: username@NADA.KTH.SE
Issued          Expires          Flags Principal
Mar 25 09:45 Mar 25 19:45 FI krbtgt/NADA.KTH.SE@NADA.KTH.SE
Mar 25 09:45 Mar 25 19:45 FA afs/pdc.kth.se@NADA.KTH.SE
```

# Login using kerberos tickets



ROYAL INSTITUTE  
OF TECHNOLOGY

- Get a 7 days forwardable ticket on your local system

```
kinit -f -l 7d username@NADA.KTH.SE
```

- Forward your ticket via ssh

```
ssh username@clustername.pdc.kth.se
```

- Replace *clustername...*
  - Zorn login node: zorn.pdc.kth.se
  - Lindgren login node: lindgren.pdc.kth.se
  - Ferlin interactive nodename
- You will have reached the cluster
- **Always create a kerberos ticket on your local system**

# Login from any computer



ROYAL INSTITUTE  
OF TECHNOLOGY

- You can reach PDC from any computer or network
- The kerberos implementation heimdal can be installed on most operating systems
  - Linux
  - Windows
  - Mac
- Follow the instructions for your operating system

[www.pdc.kth.se/resources/software/login-1](http://www.pdc.kth.se/resources/software/login-1)



**ROYAL INSTITUTE  
OF TECHNOLOGY**

# File systems

# AFS

## *Andrew File System*



ROYAL INSTITUTE  
OF TECHNOLOGY

- AFS is a global file system accessible everywhere  
*/afs/pdc.kth.se/home/username 1st letter/username*
- Your home directory is located in AFS
- Oldfiles folder contain yesterdays backup of your files
- **You cannot run jobs from AFS on Lindgren**
- Follow the instructions for your operating system  
[www.pdc.kth.se/resources/software/file-transfer/file-transfer-with-afs](http://www.pdc.kth.se/resources/software/file-transfer/file-transfer-with-afs)



# Lustre



ROYAL INSTITUTE  
OF TECHNOLOGY

- Massively parallel distributed file system
- Very high performance
- **No backup**
- No personal quota. **Move your data when finished**
- Always start and run your programs in lustre
- Lindgren home directory:  
*/cfs/klemming/nobackup/username 1st letter/username*
- Zorn home directory:  
*/cfs/zorn/nobackup/username 1st letter/username*

# Types of nodes



ROYAL INSTITUTE  
OF TECHNOLOGY

- Login nodes
  - Do not run computer intensive jobs here
- Shared interactive nodes
  - Only on ferlin
  - Share nodes for running test programs
  - Should be logged into directly and not via the login node
- Exclusive interactive nodes
  - Node will be reserved just for you
  - Should be logged into directly and not via the login node
- Dedicated nodes
  - Reserve using the queue system
  - Node will be reserved just for you

# Modules

- Used to load a specific software into your environment
- **module add *software***  
loads *software*
- **module avail**  
Lists available softwares
- **module show *software***  
shows information about *software*
- **module list**  
Lists currently loaded softwares
- **module swap *frommodule tomodule***
- Swaps *frommodule* to *tomodule*



ROYAL INSTITUTE  
OF TECHNOLOGY



ROYAL INSTITUTE  
OF TECHNOLOGY

# How to run jobs

*Ferlin, Povel*

# Easy queue system



ROYAL INSTITUTE  
OF TECHNOLOGY

- Queue system to run jobs
  - Installed on ferlin, povel
- Not installed by default
- `module add easy`
- **esubmit** - to submit a job to a dedicated node
- **spusage** – list available nodes, and some information about them
- **spq** – information on what is running in the queue
- **sprelease** – cancel a job
- **spwhen** – information on when a job will start
- **spattach** – exports information about number of nodes, name of nodes...
- More information at...

[www.pdc.kth.se/resources/computers/ferlin/how-to](http://www.pdc.kth.se/resources/computers/ferlin/how-to)

# How to use Easy to run jobs



ROYAL INSTITUTE  
OF TECHNOLOGY

- To run on interactive node use...

```
spusage | grep interactive
```

- Login to the interactive node **directly from your local system**
- You can also book an interactive node for exclusive access

```
esubmit -t minutes -n nodes
```

- You will then receive an e-mail with information about the node in which you can login
- Login to the interactive node **directly from your local system**
- Submitting a job to a dedicated node

```
esubmit -t minutes -n nodes ./myprogram
```

# Prior to starting a job



ROYAL INSTITUTE  
OF TECHNOLOGY

- Get a forwardable kerberos ticket from **local computer**

```
kinit -f -l 7d username@NADA.KTH.SE
```

- Forward your ticket via ssh

```
ssh username@clustername.pdc.kth.se
```

- Copy your code to your AFS directory

***/afs/pdc.kth.se/home/u/*username****



**ROYAL INSTITUTE  
OF TECHNOLOGY**

# Compilers



# GNU Compilation

- Compile serial jobs

```
gfortran -FR -o hello hello.f  
gcc -o hello_mpi hello_mpi.c
```

- Compile MPI jobs

```
module add easy openmpi/1.4.3-gcc  
mpif90 -FR -fopenmp -o hello_mpi hello_mpi.f  
mpicc -fopenmp -o hello_mpi hello_mpi.c
```



ROYAL INSTITUTE  
OF TECHNOLOGY

# Intel Compilation

- Optimized for computers running intel infrastructure
- Compile serial jobs



ROYAL INSTITUTE  
OF TECHNOLOGY

```
module add easy i-compilers
ifort -FR -o hello hello.f
icc -o hello_mpi hello_mpi.c
```

- Compile MPI jobs

```
module add easy i-compilers openmpi/1.4.3-intel
mpif90 -FR -openmp -o hello_mpi hello_mpi.f
mpicc -openmp -o hello_mpi hello_mpi.c
```

# Portland Compilation

- Closely involved in scientific computation with general purpose GPUs



ROYAL INSTITUTE  
OF TECHNOLOGY

- Compile serial jobs

```
module add easy pgi
pgf90 -FR -o hello hello.f
pgcc -o hello_mpi hello_mpi.c
```

- Compile MPI jobs

```
module add easy pgi openmpi/1.4.3-pgi
mpif90 -FR -mp -o hello_mpi hello_mpi.f
mpicc -mp -o hello_mpi hello_mpi.c
```

# Running serial jobs



ROYAL INSTITUTE  
OF TECHNOLOGY

- Interactive node (After logging into it)

```
./MyPrg
```

- Dedicated node

```
esubmit -n 1 -t time_min ./MyPrg
```

- You will receive e-mails about your job
- **time\_min** for small jobs usually 5-15 minutes

# Running MPI Jobs

- **spattach**
  - Creates the necessary files and variables (\$SP\_PROCS, \$SP\_HOSTFILE)
  - These files and variables can be constructed manually
  - **Remember to add the EASY module**
- Interactive nodes

```
spattach -i -p number_of_nodes myUserCAC
```

- Dedicated nodes

```
spattach -t time_min -p number_of_nodes myUserCAC
```

```
mpirun -np $SP_PROCS -machinefile $SP_HOSTFILE ./MyPrg
```



ROYAL INSTITUTE  
OF TECHNOLOGY

# More information about running jobs



ROYAL INSTITUTE  
OF TECHNOLOGY

<http://www.pdc.kth.se/resources/computers/ferlin/how-to>

# Running Matlab



ROYAL INSTITUTE  
OF TECHNOLOGY

- Should normally be run in batch mode

```
module add matlab/latest
```

```
matlab -nojvm -nosplash -nodesktop < mycode.m > output.out
```

- This will take **mycode.m** and write the output to **output.out**
- More information about matlab

[www.pdc.kth.se/resources/software/installed-software/restricted-software/matlab](http://www.pdc.kth.se/resources/software/installed-software/restricted-software/matlab)

# Example Matlab script



ROYAL INSTITUTE  
OF TECHNOLOGY

```
#!/bin/bash
# Add the matlab software version
module add matlab/latest

#by default EASY job scripts start in
the same directory
#you submitted the script from

#start matlab
matlab -nojvm -nosplash -nodesktop <
mycode.m > output.out
```





ROYAL INSTITUTE  
OF TECHNOLOGY

# How to run jobs

*Lindgren, Zorn*

# Torque/MOAB queue system



ROYAL INSTITUTE  
OF TECHNOLOGY

- Queue system to run jobs
  - Installed on Lindgren and Zorn
- Installed by default, no need to load module
- **aprun** – to run jobs on an interactive node
- **qsub** – to submit a job to a dedicated node
- More information at...

[www.pdc.kth.se/resources/computers/lindgren/how-to/run](http://www.pdc.kth.se/resources/computers/lindgren/how-to/run)

# Lindgren compilers and libraries



ROYAL INSTITUTE  
OF TECHNOLOGY

- Always use the wrappers
  - `cc` (C code), `CC` (C++), `ftn` (FORTRAN)
- PrgEnv module
  - PrgEnv-pgi (PGI), PrgEnv-Intel (Intel), PrgEnv-gnu (GNU)
  - By default PGI is loaded
  - Swap it by using command...

```
module swap PrgEnv-pgi PrgEnv-other
```
- Wrappers automatically link with math libraries if their modules are loaded

```
module load xt-libsci fftw
```

  - Other libraries are lapack, blas scalapack, blacs,...

# Prior to starting a job



ROYAL INSTITUTE  
OF TECHNOLOGY

- Get a forwardable kerberos ticket

```
kinit -f -l 7d username@NADA.KTH.SE
```

- Forward your ticket via ssh

```
ssh username@clustername.pdc.kth.se
```

- Copy your code to your lustre directory

***/cfs/klemming/nobackup/u/*username****

# compilation on Lindgren



ROYAL INSTITUTE  
OF TECHNOLOGY

- Compile

```
ftn hello_serial.f90 -o hello_serial_f90  
cc hello_mpi.c -o hello_mpi_c
```

- Compile OpenMP jobs

```
cc hello_omp.c -mp -o hello_omp_c  
cc hello_omp.f90 -mp -o hello_omp_f90
```

# Run on Lindgren



ROYAL INSTITUTE  
OF TECHNOLOGY

- Serial jobs

```
aprun -n 1 ./hello_serial_f90
```

- MPI jobs

```
aprun -n 16 ./hello_mpi_c
```

- OpenMP jobs

```
export OMP_NUM_THREADS=16
```

```
aprun -n 1 -d 16 ./hello_omp_f90
```

# Run on Zorn



ROYAL INSTITUTE  
OF TECHNOLOGY

- On Zorn, setup your CUDA environment

```
module load cuda/5.5
```

- Compile

```
nvcc -o incarray incarray.cu
```

- Submit the job to the queue system

- First create a PBS job script
- Run the script

```
qsub ./batch.pbs
```

# Format of PBS job script

- Save this to batch.pbs



ROYAL INSTITUTE  
OF TECHNOLOGY

```
#PBS -N hello_cuda_job
# 5 minute wall-clock time will be given
#PBS -l walltime=5:00
#PBS -l nodes=1
module load cuda/5.0
# Change to the work directory
echo $PBS_O_WORKDIR
cd $PBS_O_WORKDIR
# Run the program
./incrarr
```



# PDC support



ROYAL INSTITUTE  
OF TECHNOLOGY

- A lot of question can be answered via our web  
[www.pdc.kth.se/support](http://www.pdc.kth.se/support)
- The best way to contact us is via e-mail  
[www.pdc.kth.se/about/contact/support-requests](http://www.pdc.kth.se/about/contact/support-requests)
  - The support request will be tracked
  - Write descriptive subject line
  - For follow ups always include support number
    - **[SNIC support #NNNNN]**
  - Do not make new support cases by replying to old tickets