

# Advanced OpenMP

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## Overview



# Reusing this material



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- UK National Supercomputer Service, managed by EPSRC
  - housed, operated and supported by EPCC
  - hardware Supplied by Cray
- Training provided by the ARCHER Computational Science and Engineering (CSE) support team
  - 72 days per year at various locations round the UK
  - free to all academics

# What is EPCC?

- UK national supercomputer centre
  - founded in 1990 (originally Edinburgh Parallel Computing Centre)
  - a self-funding Institute at The University of Edinburgh
  - running national parallel systems since Cray T3D in 1994
  - around 80 full-time staff
  - a range of academic research and commercial projects
  - one-year postgraduate masters in HPC [www.epcc.ed.ac.uk/msc/](http://www.epcc.ed.ac.uk/msc/)
- Get in contact if you want to collaborate
  - many staff are named RAs on research grants
  - joint research proposals
  - European project consortia
  - ...

# Key ARCHER Resources

- Upcoming courses
  - <http://www.archer.ac.uk/training/>
- Material from past courses
  - [http://www.archer.ac.uk/training/past\\_courses.php](http://www.archer.ac.uk/training/past_courses.php)
- Virtual tutorials (online)
  - <http://www.archer.ac.uk/training/virtual/>
- Technical forum (online)
  - <http://www.archer.ac.uk/community/techform/>
- Documentation
  - <http://www.archer.ac.uk/documentation/>

# Who am I?

Mark Bull [markb@epcc.ed.ac.uk](mailto:markb@epcc.ed.ac.uk)

- Senior researcher at EPCC
  - Interests in parallel algorithms, parallel programming models, benchmarking, novel uses of HPC
- Lecture on EPCC's MSc in HPC
- EPCC's representative on the OpenMP ARB

# Other Resources

- Please fill in the feedback form!
  - <http://www.archer.ac.uk/training/feedback/>
- General enquiries about ARCHER go to the helpdesk
  - [support@archer.ac.uk](mailto:support@archer.ac.uk)
- EPCC runs one-year taught postgraduate masters courses
  - ***MSc in HPC*** and ***MSc in HPC with Data Science***
  - awarded by the University of Edinburgh since 2001
  - scholarships available
  - <http://www.epcc.ed.ac.uk/msc/>

# Timetable – Day 1

- 09:00 Lectures: OpenMP basics: Parallel regions, Worksharing, Synchronisation
- 11:00 COFFEE
- 11:30 Practical: Parallel regions
- 13:00 LUNCH
- 14:00 Lectures: Multicore and multithreaded CPUs, Caches, Cache coherency, NUMA
- 15:30 COFFEE
- 16:00 Practicals: Streams, Coherency
- 17:00 CLOSE



# Timetable – Day 2

- 09:00 Lectures: Tasks, Nested parallelism, Memory model
- 11:00 COFFEE
- 11:30 Practicals: Mandelbrot with nested loops, collapse, and tasks
- 13:00 LUNCH
- 14:00 Lectures: OpenMP + MPI
- 15:30 COFFEE
- 16:00 Practicals: OpenMP + MPI
- 17:00 CLOSE

# Timetable – Day 3

- 09:00 Lectures: OpenMP tips, tricks and pitfalls, Performance issues
- 11:00 COFFEE
- 11:30 Practicals: MD tuning
- 13:00 LUNCH
- 14:00 OpenMP 4.0 features, alternative APIs
- 15:30 COFFEE
- 16:00 Consultancy session: bring your own code!
- 17:00 CLOSE

# Lecture notes etc.

Go to

`http://www.archer.ac.uk/training`

and follow the links!

# Access to ARCHER

- Guest accounts for duration of course
  - can be used in the evenings while the course is running
- Accounts will be closed immediately after the course
  - all files etc will be deleted
- Take copies of all your work before course ends!
- Course materials (slides, exercises etc) available from course web page
  - archived on ARCHER web pages for future reference

# Logging on to ARCHER

You will have been given a guest account ID – referred to generically here as guestXX - and a password.

These credentials can be used to access ARCHER using

```
ssh -X guestXX@login.archer.ac.uk
```

or with the SSH client of your choice (-X ensures that graphics are routed back to your desktop).

# Practical exercises source code

To download the source code for the practical exercises, **make sure you are in your work directory on ARCHER**, then use the following command :

```
cp /home/z01/shared/advomp.tar .
```

To submit a batch job use:

```
qsub -q <reservid> <batchfile>
```

Note that **reservid** changes each day