

Introduction to OpenMP

Overview



Reusing this material



This work is licensed under a Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International License.

<https://creativecommons.org/licenses/by-nc-sa/4.0/>

This means you are free to copy and redistribute the material and adapt and build on the material under the following terms: You must give appropriate credit, provide a link to the license and indicate if changes were made. If you adapt or build on the material you must distribute your work under the same license as the original.

Note that this presentation contains images owned by others. Please seek their permission before reusing these images.

Partners



Engineering and
Physical Sciences
Research Council

Natural
Environment
Research Council



THE UNIVERSITY
of EDINBURGH



a Hewlett Packard Enterprise company





- UK National Supercomputer Service
 - managed by UKRI/EPSRC
 - to be housed, operated and supported by EPCC
 - hardware Supplied by Cray
- Training provided by the ARCHER2 Computational Science and Engineering (CSE) support team
 - 60 days per year at various locations
 - free to all academics



ARCHER2



- Full system contains 5848 nodes
 - 128 cores per node, 748,544 cores
 - 256 GB per node (512 for some large memory nodes)
 - Cray Slingshot interconnect
 - 4 Lustre filesystems (14PB)
 - 1 Burst buffer filesystem (1PB)

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 120 full-time staff
 - a range of academic research and commercial projects
 - one-year postgraduate masters in HPC 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 ARCHER2 Resources

- Upcoming courses
 - <http://www.archer2.ac.uk/training/>
- Material from past courses
 - <https://www.archer2.ac.uk/training/materials/>
- Virtual tutorials (online)
 - <https://www.archer2.ac.uk/training/online/>
- Documentation
 - <https://www.archer2.ac.uk/documentation/>

Who am I?



James Richings

j.richings@epcc.ed.ac.uk

- Applications Consultant at EPCC
- Lecture on EPCC's MSc in HPC
- Background in Theoretical Particle Physics



Other Resources

- Please fill in the feedback form!
 - <https://www.archer2.ac.uk/training/feedback/>
- General enquiries about ARCHER go to the helpdesk
 - support@archer2.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/>

Access to ARCHER2



- Your ARCHER2 ta119 project accounts
 - Small amount of budget
 - ta119 project accounts allow access to compute nodes and get our jobs to run on a larger number of cores than your laptop
 - Other ARCHER2 accounts can be used – use the short queue for quicker job turnaround
- Accounts will be closed two weeks after access ends
 - all files etc. will be deleted
 - take copies of all your work beforehand!
- Course materials (slides, exercises etc) available from ARCHER2 website
 - archived on ARCHER2 web pages for future reference

Code of Conduct

<https://www.archer2.ac.uk/training/code-of-conduct/>

- We expect all course trainers and attendees to:
 - Use welcoming and inclusive language
 - Be respectful of different viewpoints and experiences
 - Gracefully accept constructive criticism
 - Focus on what is best for the community
 - Show courtesy and respect towards other community members
- See web page for full details and incident reporting form

Funding calls



- Embedded CSE support
 - Through a series of regular calls, Embedded CSE (eCSE) support provides funding to the ARCHER2 user community to develop software in a sustainable manner to improve research on the ARCHER2 service.
 - The funding allows the employment of a Research Software Engineer (RSE) to carry out software development of ARCHER2 software.
- Scope of funding
 - Implementation of algorithmic improvements within an existing code in a portable manner
 - Improving the scalability of software on higher core counts in a portable manner
 - Improving a code to enhance sustainability and maintainability
 - Improvements to code that allow new science to be carried out on ARCHER2
 - Migrating, porting and optimising a code in significant use by an EPSRC or NERC community to run efficiently on ARCHER2 and next generation architectures. (This will be used to prioritise the NERC projects).
 - Adding new functionalities to existing codes
 - Code development to take a code from a Tier-2 (Regional) or local university cluster to ARCHER2
- See <https://www.archer2.ac.uk/ecse/> for details



Timetable – Day 1

- 10:00 - 11:50 **Lectures:** Overview, Concepts, Introduction to OpenMP
- 11:50 - 12:05 Break
- 12:05 - 13:00 **Lecture:** Parallel regions
- 13:00 - 14:00 Lunch
- 14:00 - 15:00 **Practical session**
- 15:00 - 15:30 Break
- 15:30 - 16:00 **Lecture:** Worksharing
- 16:00 - 17:00 **Practical session**

Timetable – Day 2

- 9:30 - 11:00 **Lectures:** Synchronisation, Further Topics
- 11:00 - 11:30 Break
- 11:30 - 12:30 **Practical session**
- 12:30 - 13:30 Lunch
- 13:30 - 14:30 **Lecture:** Tips, Tricks and Gotchas
- 14:30 - 14:45 Break
- 14:45 - 16:00 **Lecture:** Performance
- 16:00 - 17:00 **Practical session**

Lecture notes etc.



Go to the ARCHER2 site at <https://www.archer2.ac.uk/> and follow the links to this course under the Training tab



Practical exercises source code



To download the source code for the practical exercises, make sure you are in your **work** directory on ARCHER2, then use the following command :

```
cp /home/z19/shared/OpenMPIntro.tar .  
tar xvf OpenMPIntro.tar
```

- You can develop code and do test runs on the login nodes, but for doing accurate timing runs you should use the compute nodes.
- For submitting jobs to the short queue will be sufficient for this course so we have not set up any reservations but as we expect turnaround time for your jobs to be fast enough. However, if you are having issues let us know.

I hope you enjoy the course



- ... and *please ask questions!*