

# Advanced OpenMP

## Overview



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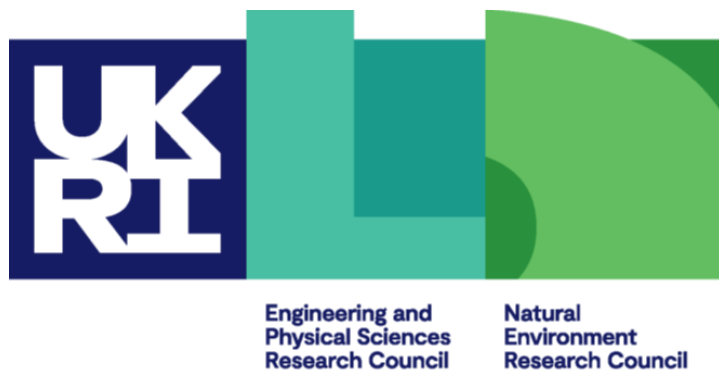
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## Partners



THE UNIVERSITY  
*of* EDINBURGH

CRAY®  
a Hewlett Packard Enterprise company





- UK National Supercomputer Service
  - managed by UKRI/EP SRC
  - 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 will be 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)
- Current system, 4 cabinets, 1024 nodes
  - One filesystem
  - No large memory nodes
  - No burst buffer filesystem





# 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 65 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 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?



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

- Senior research fellow at EPCC
- Lecture on EPCC's MSc in HPC
- EPCC's representative on the OpenMP ARB





## 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](mailto: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 `ta041` project accounts
  - Small amount of budget
  - `ta041` project accounts allow us to use a reservation to access dedicated compute nodes and get our jobs to run more quickly
  - 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



- 09:00 - 11:00 Lectures: Tasks, Nested parallelism, Memory model
- 11:00 - 11:30 Break
- 11:30 - 13:00 Practicals: Mandelbrot with nested loops, collapse, and tasks
- 13:00 - 14:00 Lunch
- 14:00 - 15:30 Lectures: OpenMP tips, tricks and pitfalls, Performance issues
- 15:30 - 16:00 Break
- 16:00 - 17:00 Practical: Performance tuning

## Timetable – Day 2



- 09:00 - 11:00 Lectures: OpenMP + MPI
- 11:00 - 11:30 Break
- 11:30 - 13:00 Practicals: OpenMP + MPI
- 13:00 - 14:00 Lunch
- 14:00 - 15:30 OpenMP 4.0/4.5 features, target offload
- 15:30 Break
- 16:00 - 17:00 Practicals – wrap-up (if required)

## 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

Direct link is

<https://github.com/EPCced/archer2-advanced-OpenMP/tree/2021-10-05>





## 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 /work/z19/shared/advomp.tar .  
tar xvf advomp.tar
```



I hope you enjoy the course



- ... and *please ask questions!*

