NATURAL ENVIRONMENT RESEARCH COUNCIL

EPSRC

Object Oriented Programming with Fortran

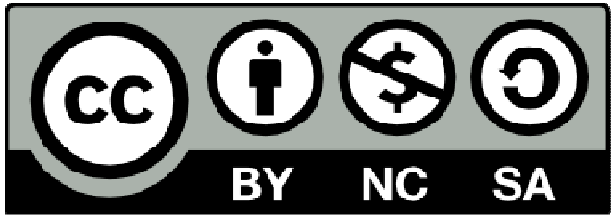
epcc

Who am I?

Adrian Jackson a.jackson@epcc.ed.ac.uk
@adrianjhpc

- I...
  - Help run training for EPCC
    - MSc
    - PRACE Advanced Training Centre
    - ARCHER training programme
    - commercial training
    - ...
- Also do HPC research
  - new parallel programming models, accelerators, performance, ...

Reusing this material



archer

epcc

THE UNIVERSITY OF EDINBURGH

NATURAL ENVIRONMENT RESEARCH COUNCIL

EPSRC

ARCHER Service

Overview and Introduction

epcc

THE UNIVERSITY OF EDINBURGH

- 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

archer

epcc

THE UNIVERSITY OF EDINBURGH

EPCC's Advanced Computing Facility

archer

epcc

THE UNIVERSITY OF EDINBURGH

ARCHER in a nutshell

- UK National Supercomputing Service
- Cray XC30 Hardware
  - Nodes based on 2×Intel Ivy Bridge 12-core processors
  - 64GB (or 128GB) memory per node
  - 4920 nodes in total (118,080 cores)
  - Linked by Cray Aries interconnect (dragonfly topology)
- Cray Application Development Environment
  - Cray, Intel, GNU Compilers
  - Cray Parallel Libraries (MPI, SHMEM, PGAS)
  - DDT Debugger, Cray Performance Analysis Tools

Storage

- /home – NFS, not accessible on compute nodes
  - For source code and critical files
  - Backed up
  - > 200 TB total
- /work – Lustre, accessible on all nodes
  - High-performance parallel filesystem
  - Not backed-up
  - > 4PB total
- RDF – GPFS, not accessible on compute nodes
  - > 20 PB Long term data storage

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/
- Get in contact if you want to collaborate
  - many staff are named RAs on research grants
  - joint research proposals
  - European project consortia
  - ...

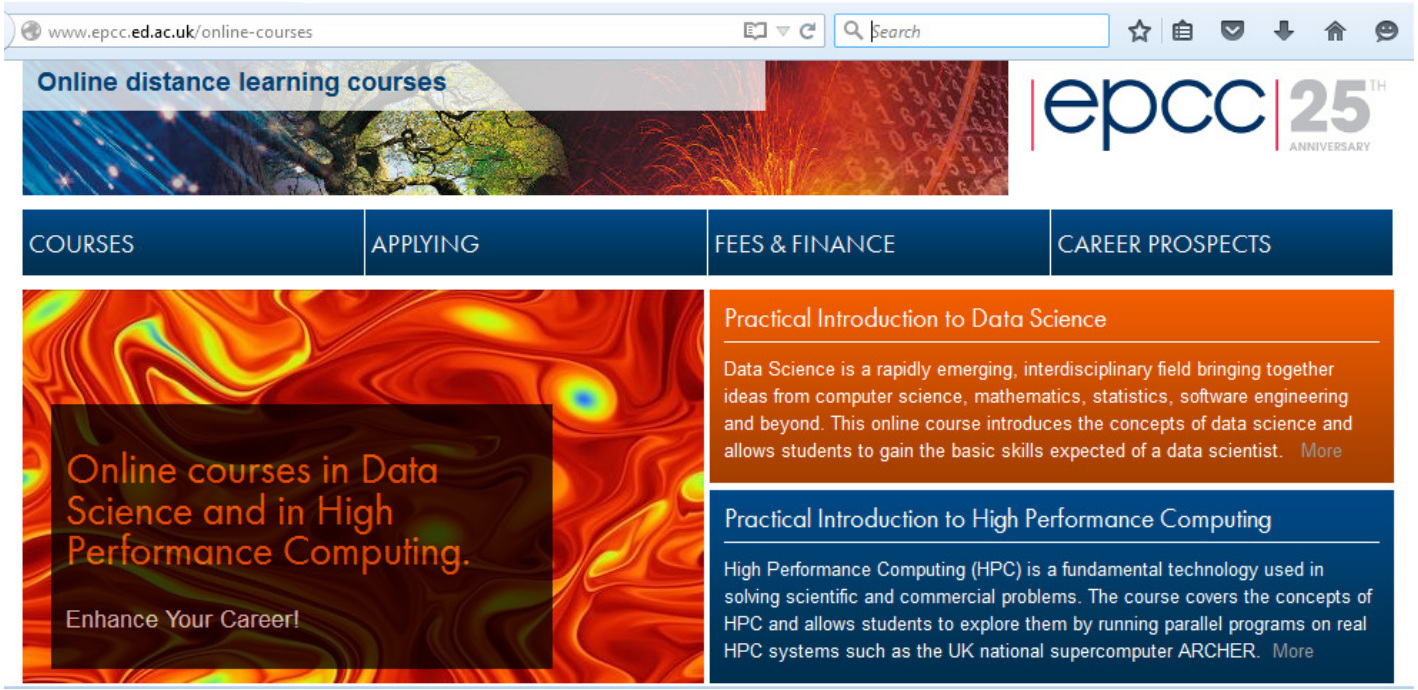
Key ARCHER Resources

- Upcoming courses
  - http://www.archer.ac.uk/training/
- Material from past courses
  - http://www.archer.ac.uk/training/past_courses.php
- Virtual tutorials (online)
  - http://www.archer.ac.uk/training/virtual/
- Documentation
  - http://www.archer.ac.uk/documentation/

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
- 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/

Online accredited courses



- Run from January to May
  - entirely online: www.epcc.ed.ac.uk/online-courses/.
  - each course is 20 credits (c.f. a 180-credit MSc)

archer

epcc

THE UNIVERSITY OF EDINBURGH

Access to ARCHER (during course)

- Guest accounts for duration of course
  - should only be used in the classroom
- 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
- You must agree to the ARCHER terms and conditions:
  - http://www.archer.ac.uk/about-archer/policies/tandc.php

Access to ARCHER (longer term)

- Various ways to apply for time on ARCHER
  - see http://www.archer.ac.uk/access/
- All require justification of resources
  - Instant Access has the lowest barrier to entry
  - designed for exploratory work, e.g. in advance of a full application
- Or take the “ARCHER Driving Test”
  - www.archer.ac.uk/training/course-material/online/driving_test.php
  - successful completion allows you to apply for an account for 12 months with an allocation of around 80,000 core-hours
  - backed up by online training materials
  - www.archer.ac.uk/training/course-material/online/

Learning Outcomes

- On completion of this course students should be able to:
  - Compile and run Fortran programs on ARCHER
  - Understand basic object-oriented concepts
  - Understand how Fortran features can be used to create object-oriented programs
  - Understand how to create modularised and well designed Fortran programs
  - Understand the performance impacts of the object oriented features in Fortran

Outline Timetable

- **Day 1**
  - 09:30 LECTURE: Introduction to Fortran
  - 10:15 PRACTICAL: Fortran programming
  - 11:00 BREAK
  - 11:30 LECTURE: Introduction to Object Oriented Programming
  - 12:00 PRACTICAL: Designing an object oriented program
  - 12:15 LECTURE: Modules
  - 13:00 BREAK: Lunch
  - 14:00 PRACTICAL: Modules
  - 14:30 LECTURE: Derived types and operators
  - 15.00 PRACTICAL: Derived types
  - 15:30 BREAK
  - 16:00 PRACTICAL: Continuing practicals
  - 16:30 CLOSE

Outline Timetable

- **Day 2**
  - 09:30 LECTURE: Classes and data visibility
  - 10:15 PRACTICAL: Fortran classes
  - 11:15 BREAK:
  - 11:45 LECTURE: Inheritance and overloading
  - 12.30 PRACTICAL: Generic classes and extensions
  - 13.00 BREAK: Lunch
  - 14.00 LECTURE: Design and performance considerations
  - 14.45 PRACTICAL: Continuing practicals
  - 15:15 BREAK:
  - 15:45 LECTURE: Further features
  - 16:15 LECTURE: Summary
  - 16:30 CLOSE