

HPC Wales Skills Academy Course Catalogue 2015

Overview

The HPC Wales' Skills Academy provides a variety of courses and workshops aimed at building skills in High Performance Computing (HPC).

Our courses are appropriate for academic, professional or organisational development, and our training programmes can be tailored to your needs to ensure you get the most benefit out of them.

The courses are typically delivered as half day, full day or as 2 day courses, across many locations in Wales at the moment.

The following catalogue provides a summary of the courses available. We continue to develop additional courses to support the use of supercomputing in industry and academia, so if you have any additional requirements then please contact us to discuss your training needs.



Introduction to High Performance Computing

Description

This course provides an overview of High Performance Computing and focuses on presenting you with examples of how HPC can be of benefit to businesses and academics. You will learn about the collaborative venture that is HPC Wales, how the teams and systems are distributed across Wales, the industry sectors we work with, and give you an overview of the Skills Academy which outlines the training opportunities available to business and academics in order to harness HPC.

Pre-Requisites

- IT Literate

Learning Outcomes

- Attendees will be made aware of various aspects of the field of High Performance Computing and how it is being used within industry and academia
- They will be able to make an assessment on the value of High Performance Computing and if it is of relevance to their business or research
- Understand HPC Wales' services including further training and contributory bursaries options, for graduates and businesses

Logistics

Duration ½ day



Using HPC Wales via the Command Line

Description

This course provides an overview of the Linux operating system with a number of practical examples of using the command line and introduces the nano, emacs, and vi text editors discussing their relative merits. The course includes access to the HPC Wales system where you will be able to experience how to prepare, compile and run a range of small applications, to introduce you to the process and commands for running jobs on the system.

Pre-Requisites

- IT Literate
- User account created on HPC Wales
- A knowledge of programming languages would be beneficial

Learning Outcomes

- Understand the Linux command line language with the associated commands and parameters
- Be able to access and use the HPC Wales services to run HPC jobs using the Linux command-line interface including how to compile and run a range of serial and parallel application codes

Logistics

Duration ½ day



Introduction to Computer Architecture

Description

This course provides an overview about how a computer is built from a conceptual level (CPU, memory, network, storage) and expand to include HPC (i.e. multiple machines, interconnects, etc). It will cover the design differences between desktop PC and HPC systems to enable people to make decisions on the types of HPC services they need.

Pre-Requisites

- IT Literate

Learning Outcomes

- Provide a fundamental understanding and be able to identify and evaluate how a High Performance Computer is configured, the components, architecture, the advantages and disadvantages of multi-node computing services, in a typical HPC Infrastructure
- Demonstrate familiarity with the different hardware architectures on which HPC can be delivered and understand the benefits of HPC as a service vs. own system development
- Understand the difference between the two main types of HPC system i.e. those with a shared global memory (ideally suited to OpenMP codes) and those with a partitioned global memory (ideally suited to MPI codes)

Logistics

Duration ½ day



Sector-Specific Uses of HPC

Description

This course provides a showcase of existing HPC application software on the HPC Wales system within a selection of scientific disciplines and industry sectors. It will demonstrate the potential use of HPC, how these applications work and what they are capable of (compared to stand-alone serial variants). The application examples provided in this course will be varied depending on the audience and will focus on specific sector/applications or multiple sectors using a few application examples for the practical exercises.

Pre Requisite:

- IT literate
- User account created on HPC Wales

Learning Outcomes:

- Understand how HPC services benefit priority sectors and scientific disciplines and how these principles can be used in industry for computational simulation, data mining, rendering and visualization
- Provides an overview of the different applications used by industry and researchers in the sectors, which are available on the HPC Wales service
- Be able to utilise these application services and run examples for a specific industry / research sector

Logistics

Duration ½ day



Software Engineering in a Cluster Environment

Description

This course teaches how to use three important tools to assist the development of software in a number of programming languages. The first tool is make which is an open source dependency-tracking build system. Make allows you to automate the complicated process of compiling large programs spread across multiple source files.

The second tool is subversion (or svn) which is an open source software versioning and revision control system. Subversion allows you to keep track of changes made to source code so that you can recover older versions of your code, or examine the history of changes made to the source code over time.

The third aspect introduces how to report bugs effectively and provides an understanding of how software developers manage bugs through their lifecycle, to resolution..

Pre-Requisites

- Knowledge of programming languages such as; C / C++ or Fortran
- Attended “Using HPC Wales via the Command Line, or experienced Linux user
- User account created on HPC Wales

Learning Outcomes

- Attendees will be able to understand and use a software versioning and revision control system, a dependency-tracking build system, and submit a bug report, as important tools and techniques used in the development of software within a number of programming languages

Logistics

Duration 1 day



Scripting Languages

Description

This course teaches how to use three important scripting languages to assist the development of complex workflows. The first scripting language is Bash which is the preferred shell on the HPC Wales systems; we will cover basic data types such as numbers and characters followed by basic calculation and comparison operations, branching, looping, arrays, subshells, and file input / output.

The second scripting language is Perl which is ideally suited to text manipulation; we will cover basic data types such as numbers and characters followed by basic calculation and comparison operations, branching, looping, arrays, subroutines, regular expressions, and file input / output.

The third scripting language is Python which has a number of add on functions for a range of scientific disciplines; we will cover basic data types such as numbers and characters, lists, dictionaries, and tuples followed by basic calculation and comparison operations, branching, looping, arrays, functions, modules, and file input / output. All three scripting languages will be supported by a range of practical examples.

Pre-Requisites

- Knowledge of programming languages such as; C / C++ or Fortran
- Attended “Using HPC Wales via the Command Line, or experienced Linux user
- User account created on HPC Wales

Learning Outcomes

- Attendees will be able to understand the use of scripting languages and be able to develop simple, Bash Perl and Python scripts.

Logistics

Duration 1 day



Debugging, Profiling and Optimising Serial Codes in a Cluster Environment

Description

This course teaches how to use a number of tools to assist in the debugging, profiling, and optimising of serial codes in a cluster environment. A range of typical bugs will be explored with practical examples on how to locate and eliminate them using both the Gnu command line debugger (GDB), and a graphical debugger (Allinea DDT).

The course includes profiling a number of serial codes in order to discover hot spots using the Gnu command line profiler (GPROF) and explores a range of optimisation strategies to improve the performance of a number of serial codes including code restructuring and compiler optimisations using the Intel compilers.

Pre-Requisites

- Knowledge of programming in C / C++ or Fortran
- Working knowledge of the Linux Command Line
- Attended the following courses or can demonstrate competency in these topics
 - Using HPC Wales via the Command Line
 - Introduction to Computer Architecture and HPC
- User account created on HPC Wales

Learning Outcomes

- Attendees will be able to debug, profile, and optimise serial codes in a cluster environment using a number of command line and graphical programs available on the HPC Wales systems
- Make informed decisions on how to improve the efficiency and write more efficient serial codes

Logistics

Duration 2 days



Thinking in Parallel

Description

This course provides an overview on how to parallelise problems in a language-agnostic way, to set the scene for using OpenMP and MPI. It also acquaints the participant with the terminology on how to develop parallel applications/codes, informs them about the issues involved when developing parallel applications/codes and enables them to decide on an approach for developing a parallel version of their own application/code.

Pre-Requisites

- Knowledge of programming in C / C++ or Fortran
- Working knowledge of the Linux Command Line
- Has attended the following courses, or can demonstrate competency in these topics
 - Using HPC Wales via the Command Line
 - Introduction to Computer Architecture and HPC
 - Software Engineering in a Cluster Environment
- User account created on HPC Wales

Learning Outcomes

- To be able to develop simple parallel applications and critically appraise issues related to parallel application development
- Develop parallel algorithms from sequential analogues
- Analyse the appropriate parallel programming language to use in HPC
- Apply and utilise appropriate software tools and methods

Logistics

Duration 1 day



Parallel Programming using OpenMP

Description

OpenMP is a standard for writing parallel codes to run on a shared memory computer, node or multi-core chip, also referred to as multi-threading. This course introduces the OpenMP compiler directives and library routines that can be added to an existing serial code and introduces the concepts and essential syntax of OpenMP, including functionality introduced at version 3.0. The course combines both theory and practical exercises and provides an overview of performance issues.

Pre-Requisites

- Ability to programming in C / C++ or Fortran and working knowledge of the Linux Command Line
- Has attended the following courses, or can demonstrate competency in these topics
 - Using HPC Wales via the Command Line
 - Introduction to Computer Architecture and HPC
 - Introduction to Debugging, Methodologies and Parallelism
- User account created on HPC Wales

Learning Outcomes

- Attendees will be able to understand how OpenMP is used to parallelise codes
- Develop parallelised versions of existing serial code using OpenMP
- Write a parallel code from scratch using OpenMP

Logistics

Duration 2 days



Parallel Programming using MPI

Description

MPI (Message Passing Interface) is the de facto standard for parallel programming, defining how concurrent processes can communicate and hence work together to complete a given task in a shorter time.

The course provides a detailed introduction to programming using MPI. It includes an in-depth look at point-to-point and collective communication, as well as introducing the useful topics of MPI derived data types, groups and communicators. It gives an overview of available message passing libraries. The course combines both theory and practical exercises.

Pre-Requisites

- Ability to programming in C / C++ or Fortran and working knowledge of the Linux Command Line
- Has attended the following courses, or can demonstrate competency in these topics
 - Using HPC Wales via the Command Line
 - Introduction to Computer Architecture and HPC
 - Introduction to Debugging, Methodologies and Parallelism
- User account created on HPC Wales

Learning Outcomes

- Attendees will be able to understand how MPI is used to parallelise codes
- Parallelise an existing serial code using MPI
- Write a parallel code from scratch using MPI

Logistics

Duration 2 days



Advanced Parallel Programming using OpenMP

Description

This element of the module follows on from the “Introduction to OpenMP” Course by completing the OpenMP 3.1 syntax. In particular the course covers detail at synchronisation and tasks, as well as considering nested parallelism. Attendees are encouraged to bring their own serial code to work on in the practical sessions.

Pre-Requisites

- Knowledge of the Linux Command Line is required
- Ability to program in C / C++ or Fortran is required
- Attended Introduction to OpenMP, or can demonstrate competency in this topic
- User account created on HPC Wales

Learning Outcomes

- To be able to utilise advanced features of OpenMP to develop complex parallel applications using OpenMP

Logistics

Duration 1 day



Advanced Parallel Programming using MPI

Description

MPI (Message Passing Interface) is the de facto standard for parallel programming, defining how concurrent processes can communicate and hence work together to complete a given task in a shorter time.

This course follows the “Introduction to MPI” and will cover some of the more advanced features of MPI, such as Cartesian topologies, as well as returning to the topics of MPI derived data types, before looking at the topic of MPI-IO, which allows multiple processors to read and write files in parallel. The course combines both theory and practical exercises.

Pre-Requisites

- Knowledge of the Linux Command Line is required
- Ability to program in C / C++ or Fortran is required
- Attended Introduction to MPI, or can demonstrate competency in this topic
- User account created on HPC Wales

Learning Outcomes

- To be able to utilise advanced features of MPI to develop complex parallel applications using MPI

Logistics

Duration 1 day



Hybrid Programming

Description

This course demonstrates how combining the two paradigms of OpenMP and MPI can be beneficial, and how best to achieve more efficient codes. The course combines both theory and practical exercises.

Pre-Requisites

- Knowledge of the Linux Command Line is required
- Ability to program in C / C++ or Fortran is required
- Attended Advanced programming in OpenMP and MPI, or can demonstrate competency in these topics
- User account created on HPC Wales

Learning Outcomes

- To be able to develop complex parallel applications using OpenMP and MPI and critically appraise issues related to choosing the most appropriate parallelisation strategy for a given computational problem.

Logistics

Duration 1 day



Debugging and Profiling Parallel Codes in a Cluster Environment

Description

This course follows on from the Introduction to Debugging, Profiling, and Optimising Serial Codes element utilising a number of tools to assist in the debugging and profiling of parallel codes in a cluster environment. A range of typical bugs will be explored with practical examples on how to locate and eliminate them using the graphical debugger, Alinea DDT.

The participant will learn how to profile a number of parallel codes in order to discover hot spots and communication patterns using the graphical profiler Scalasca, and explore a range of optimisation strategies to improve the performance of a number of parallel codes including code restructuring and compiler optimisations using the Intel compilers.

Pre-Requisites

- Knowledge of programming in C / C++ or Fortran
- Has attended the following courses, or can demonstrate competency in these topics
 - Introduction to Computer Architecture and HPC
 - Debugging, Profiling and Optimising Serial codes in a cluster environment
- User account created on HPC Wales

Learning Outcomes

- Attendees will be able to debug and profile parallel codes using a number of command line and graphical programs available on the HPC Wales systems
- Make informed decisions on how to improve the efficiency and write more efficient parallel codes

Logistics

Duration 1 day



Libraries

Description

This course demonstrates to participants how to use a range of numerical and statistical analysis features available in the NAG C/C++ and Fortran numerical libraries.

Pre-Requisites

- Knowledge of programming in C / C++ or Fortran
- Introduction to Computer Architecture and HPC
- Attended the following courses or can demonstrate competency in this topic
 - Introduction to HPC, Tools, and Scripting
 - Introduction to Debugging, Methodologies and Parallelism
- User account created on HPC Wales

Learning Outcomes

- Attendees will be able to understand how to use numerical libraries in developing parallel codes

Logistics

Duration 1 day



Visualization

Description

This course provides a range of visualization techniques used with scientific codes, showing how existing source code can be amended to make it produce output suitable for visualization. Appropriate visualization tools will be introduced including ParaView and VisIt and participants will be instructed in their operation.

Pre-Requisites

- Knowledge of HPC systems or scientific codes
- User account created on HPC Wales

Learning Outcomes

- Attendees will be to select appropriate visualization techniques to understand and interpret their data
- Use an appropriate turnkey visualization application to interactively explore their data

Logistics

Duration 1 day



Introduction to CUDA

Description

This 2 day course provides an introduction to programming NVIDIA GPUs using CUDA. It is aimed at people who want to learn to write their own CUDA code. Noting that it is typically not necessary to learn CUDA in order to use GPU accelerated packages.

Pre-Requisites

This course is targeted at individuals who are reasonably competent programmers

- Knowledge of the Linux Command Line is required
- Familiarity with programming in C / C++. Attendees should be comfortable working with pointers
- User account created on HPC Wales
- This course does not assume knowledge about parallel programming or OpenMP

Learning Outcomes

- Attendees will know the hardware and software aspects of CUDA programming, and
- Write programs which utilises the CUDA API to enhance code performance

Logistics

Duration 2 days



Introduction to Fortran

Description

Fortran is one of the key programming languages used in supercomputing. This beginner-level course teaches you how to write serial applications using the Fortran programming language.

On day one we begin by explaining how computer systems work and how basic data types such as numbers and characters are manipulated. We then cover basic calculation and comparison operations, branching (if, else, case), looping (the iterative, repeat until, and while variants of the do loop), derived data types, and arrays using a number of example applications.

On day two we begin with an overview of format descriptors, then move on to more complex example applications that make use of functions and subroutines (ways to improve the structure of the code). We then discuss reading and writing data to and from files using weather data freely available from the MET office, and introduce some of the built-in math functions.

Pre-Requisites

This course is targeted at individuals who are beginner level programmers

- Knowledge of the Linux Command Line is required
- User account created on HPC Wales

Learning Outcomes

- Attendees will be able to write and compile Fortran code

Logistics

Duration 2 days



Introduction to C/C++

Description

C/C++ is one of the key programming languages used in supercomputing. This beginner-level course teaches you how to write serial applications using the C/C++ programming language.

On day one we begin by explaining how computer systems work and how basic data types such as numbers and characters are manipulated. We then cover basic calculation and comparison operations, branching (if, else, case), looping (for, do, while), derived data types, and arrays using a number of example applications.

On day two we begin with an overview of manipulators, then move on to more complex example applications that make use of functions and libraries (ways to improve the structure of the code). We then discuss reading and writing data to and from files using weather data freely available from the MET office, and introduce some of the built-in math functions.

Pre-Requisites

This course is targeted at individuals who are beginner level programmers

- Knowledge of the Linux Command Line is required
- User account created on HPC Wales

Learning Outcomes

- Attendees will be able to write and compile C/C++ code

Logistics

Duration 2 days



Locations

We vary the venues for training delivery throughout Wales and these typically include the following locations.

- Aberystwyth
- Bangor
- Cardiff
- Pembroke
- Swansea
- Treforest
- Wrexham

When requested, we are also able to run courses at business locations where the facilities on site provide a connection to the HPC Wales supercomputing services.

Booking

To book a place on a Skills Academy course please contact info@hpcwales.co.uk

Further information

Details about the HPC Wales Skills Academy and course dates can be found on the HPC Wales Web site, or contact us via the email address below.

- www.hpcwales.co.uk
- info@hpcwales.co.uk