The Hartree Centre Summer School 2015

Three Weeks – Three Subjects
Visualization – Big Data – HPC
15 June – 10 July 2015

Attend all three weeks – or pick the week that matches your research subject area

http://www.stfc.ac.uk/HCSS2015

Scientific Committee

Jack Dongarra
University of Tennessee

Kirk E. Jordan
IBM

Terry Hewitt
STFC

Only £150 per week

The registration fee includes lunches, refreshments, a conference dinner and all course materials but NOT accommodation. Rooms are available at the official Summer School hotel – the Mercure Chester – and a free shuttle will run during the Schools. These must be booked separately – details inside.

STFC Hartree Centre
SciTech Daresbury
Warrington WA4 4AD
United Kingdom
Event Details
The 2015 Hartree Centre Summer School Series will consist of three separate weeks of study - each week focussing on a specific topic. You may attend all three weeks, or pick the week most relevant to your area of study. Each week is limited to 45 registrations.

- **Week 1:** 15-19 June *“Visualization”*
  **Leaders:** Hank Childs (LBL, Oregon) Hamish Carr (Leeds) - Learn the skills necessary to develop applications that enable you to assimilate complex information quickly and easily and discover the latest visualization tools.

- **Week 2:** 29 June – 3 July *“Big Data”*
  **Leaders:** Nicole Barry (IBM) Chris Williams (IBM) - Learn about the opportunities and challenges that Big Data & Analytics presents including the chance to get hands on.

- **Week 3:** 6-10 July *“High Performance Computing”*
  **Leaders:** Jack Dongarra (Tennessee) Kirk E. Jordan (IBM) - Learn the skills necessary to develop applications that run on the top 20 machines of the Top500 list, now and in the future.

Target Audience and Pre-Requisites
The Summer Schools are aimed at researchers in academia and industry encountering complex application problems that require significant HPC / Visualization / Big Data resources. Typically the attendee will be nearing completion, or will have already obtained, a PhD (or equivalent) in a scientific or engineering discipline that uses computation as a tool and will have some experience of programming in high level programming language (e.g., Fortran, C, C++). There will be some experience of parallel programming (e.g., MPI, OpenMP, or CUDA) or Visualization or Big Data, an understanding of mathematical and computational methods for the solution of partial differential equations plus an understanding of an application area.

Fee Info
The Summer School series consists of three separate weeks of study. Fees are £150 per week. You may attend separate weeks or all three weeks. Your total registration fee will be calculated after you have selected the weeks you want to attend on the registration form. Accommodation is NOT included in your fees. We have an official Summer School hotel – the Mercure Chester – and we will be providing a free shuttle to and from this hotel during the Summer School. However you must make your own booking if accommodation is required. If you choose to stay in a different hotel then transport will not be provided. Details of how to make your accommodation booking are included on the final page.

Registration
To register please visit the Summer School web page and follow the links to the online registration form: [http://www.stfc.ac.uk/HCSS2015](http://www.stfc.ac.uk/HCSS2015)

Scientific Organising Committee
Jack Dongarra (University of Tennessee)
Kirk E. Jordan (IBM)

Local Organising Committee
Damian Jones (STFC)
Terry Hewitt (STFC)

STFC Hartree Centre
SciTech Daresbury
Warrington WA4 4AD
United Kingdom
Week One: 15-19 June 2015

VISUALIZATION

Course Summary
Learn the skills necessary to develop applications that enable you to assimilate complex information quickly and easily and discover the latest visualization tools.

This Summer School is aimed at those who need to use visualization as a tool in their workflow, be it simulation and modelling or Big Data.

Practical sessions on state of the art visualizations walls, and workstations, are included in the programme.

Academic Leads
Hank Childs (University of Oregon, USA)
Hamish Carr (Leeds University, UK)

Topics
- Introduction to Visualization
- Visualization using MATLAB
- Visualization with VTK
- Parallel Visualization
- Visualization Applications
- Visit & Applications
- Topology/Feature Analysis
- Future Directions

Lecturers include Bob Laramee (Swansea University, UK), Dave Pugmire (Oak Ridge National Laboratory, USA) and Valerio Pascucci (University of Utah, USA)
### Summer School 2015
#### “Visualization”
#### 14 – 19 June 2015

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**Arrival and Check-In at Hotel**

**Official Summer School Dinner**

Vouchers can be used in the restaurant, Waterside café or Laboratory shop.

**Future Directions** *(Valerio Pasucci, Hamish Carr)*

**Q & A Session**
Summary of Lectures

Introduction to Visualisation: A survey of basic techniques in computer-supported visualisation, including discussion of perceptual issues, hardware constraints, mathematical models, visual mappings, standard visualisation techniques, with the focus on usage of techniques rather than their implementation. Particular emphasis will be placed on techniques applicable to scalar, vector and tensor fields, as these are the most common outputs in HPC simulations. Practical work will be based around the basic visualisation tools in Matlab.

Visualisation with VTK: An introduction to VTK, the most common visualisation toolkit. Content will include introduction of VTK’s pipelined model, details on how to load data, assemble a visualisation pipeline, perform and computational and visual transformations, with operations performed in serial rather than in parallel.

Parallel Visualisation: Discussion of parallel visualisation approaches. Hands on exercises build on previous VTK exercises, but extended to operate in parallel, to build bigger visualisations on HPC clusters.

Visualisation Applications: Effective visualisation depends not only on techniques, libraries and toolkits, but also on disciplined collaborative work between visualisation specialists, HPC specialists and domain scientists, deploying in-depth knowledge about the domain, effective visualisations and machine performance to deliver insight and understanding about data. This session will canvass approaches to collaboration, common themes in collaborative visualisation, and best practices for maximum effect of visualisation in computational sciences.

Visit & Applications: While VTK is the most widely deployed toolkit in visualisation, many recent applications in the US national laboratory system use a VTK-based application, Visit. This session will show how to apply visualisation techniques to application problems in the context of Visit, with a particular emphasis on process rather than content.

Topology / Feature Analysis: As data has scaled beyond human capacity, visualisation has increasingly relied on feature extraction and analysis for scientific insight. Due to the fundamentally continuous nature of most scientific data, tools developed over the last two decades have emphasised the use of formal analysis in the form of computational topology to extract features such as minima, maxima, gradient flow cells, boundary structures, flow separation and stagnation. This session will give an overview of these techniques, emphasising intuitive understandings rather than algorithmic details.

Future Directions: As with HPC in general, visualisation is still a developing field, but several future directions are already visible. Visualisation platforms are re-migrating from commodity desktop workstations to custom workstations and clusters, in order to maximise visual throughput and analytical capacity. Likewise, the rise of extreme (PB-EB) data sets refocusses the attention on systems questions as well as visual questions, including the need to use HPC compute power in interactive modes. Reinforcing this are the tendencies to use variable and adaptive meshes and provide user input in the form of computational steering. Combining this with the limits of data transport and storage capability mean that many visualisation tasks are better performed in parallel with numerical computation rather than as a discrete post-processing stage.
The Hartree Centre
Summer School Series 2015

Week Two: 29 June – 3 July 2015

BIG DATA

Course Summary
Learn about the opportunities and challenges that Big Data & Analytics presents including the chance to get hands on.

This Summer School is aimed at those who wish to get started in the emerging world of Big Data and Analytics. As well as plenty of opportunity to try out some of the tools and techniques in hands-on lab exercises you will also hear about the wide variety of applications and styles of Big Data and the social implications of its use.

Tools used and discussed will include Hadoop, IBM SPSS Modeller and IBM Streams. There will also be an opportunity to try some open source tools.

Some of the practical sessions will make use of the recently installed Big Data cluster at the Hartree Centre.

Academic Leads
Nicole Barry (IBM)
Chris Williams (IBM)

Topics

- Big Data and Analytics
- Data Warehousing and Business Intelligence
- Hadoop – Overview and Hands-On Session
- Social Media Analytics
- Data in Motion and Predictive Analytics
- SPSS Modeller Hands-On Session
- Cognitive Computing and IBM Watson
- Visualization and Presentation

STFC Hartree Centre
SciTech Daresbury
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Course Summary
Learn the skills necessary to develop applications that run on the top 20 machines of the Top500 list, now and in the future.

This Summer School is aimed at those who need program simulation and modelling applications on state of the art supercomputers. Discover the architectures and the best technologies to use.

Practical sessions on a 132,000 core BG/Q and a 20,000 core Intel Xeon cluster, with Intel Phis and NVidia GPUs are included in the programme.

Academic Leads
Jack Dongarra (University of Tennessee, USA)
Kirk E. Jordan (IBM, USA)

Topics
- HPC from start to finish
- HPC Architectures: Yesterday, Today & Tomorrow
- Numerical Linear Algebra in a Parallel World
- Programming in MPI
- Programming in OpenMP
- Programming in Parallel
- BigData
- Visualization
- Computational Steering

Lecturers include Olivier Tardieu (IBM, USA), Vitali Morozov (Argonne), Mike Heroux (Sandia), Christian Terboven (Aachen University) and John Brooke (Manchester University)
# Summer School 2015

**“High Performance Computing”**

6 – 10 July 2015

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### Schedule

**Bus to Laboratory** *(Leaving Mercure hotel reception at 08:15)*

- **09:00**
  - HPC Start to Finish *(Jack Dongarra)*
  - HPC Start to Finish *(Jack Dongarra)*
  - MPI *(Vitali Morozov)*
  - HPC Architectures *(Kirk E. Jordan)*
  - HPC Start to Finish *(Jack Dongarra)*

- **10:00**
  - Programming in Parallel *(Oliver Tardieu)*
  - Programming in Parallel *(Oliver Tardieu)*
  - Computational Steering *(John Brooke)*
  - Practical Session
  - Numerical Linear Algebra *(Mike Heroux)*

**Tea / Coffee Break**

- **11:30**
  - Programming in Parallel *(Oliver Tardieu)*
  - Practical Session
  - Open MP *(Christian Terboven)*
  - HPC Architectures *(Kirk E. Jordan)*
  - HPC Architectures *(Kirk E. Jordan)*

**LUNCH**

- Vouchers can be used in the restaurant, Waterside café or Laboratory shop

**13:30**

- Practical Session
  - Open MP *(Christian Terboven)*
  - Practical Session
  - Numerical Linear Algebra *(Mike Heroux)*

**14:00**

- Open MP *(Christian Terboven)*
  - MPI *(Vitali Morozov)*
  - MPI *(Vitali Morozov)*
  - Practical Session

**Tea / Coffee Break**

- **16:00**
  - Visualization *(TBC)*
  - Computational Steering *(John Brooke)*
  - Big Data *(TBC)*
  - Numerical Linear Algebra *(Mike Heroux)*

**17:00**

- Practical Session
  - Practical Session
  - Travel to Meal
  - Practical Session

**18:00**

- Bus to Hotel
- Bus to Hotel
- Bus to Hotel

**Official Summer School Dinner**
Accommodation
The official Hartree Centre Summer School hotel is the Mercure Hotel in Chester.

Accommodation is NOT included with your registration for the Summer Schools.

Rooms can be booked online here... http://businesstravel.accorhotels.com/gb/home/index.shtml.
Instructions and the relevant codes needed to obtain our negotiated rates can be found on the Summer School web site... https://eventbooking.stfc.ac.uk/news-events/hartree-summer-schools-2015.
A free shuttle will run between the Mercure Hotel and Daresbury Laboratory during the Summer School. If you choose to stay in alternative accommodation then no transport will be provided.

HARTREE CENTRE SUMMER SCHOOL

MERCURE CHESTER ABBOTS WELL WHITCHURCH ROAD, CHRISTLETON. CH3 5QL

Single accommodation £75.00 to include full English breakfast
Twin/Double accommodation £85.00 to include full English breakfast
Single accommodation £90.00 to include full English breakfast and three course dinner
Twin/Double accommodation £115.00 to include full English breakfast and three course dinner

Please book accommodation at least 4 weeks before course is due to take place
Book online... http://businesstravel.accorhotels.com/gb/home/index.shtml
Telephone 0844 815 9001 (option 1) during office hours quoting course name
Email sales.mercurechester@jupiterhotels.co.uk