

HPCEuropa2 workshop on application porting and optimization

The goal of this workshop is that, after the course, participants will have their codes ported, compiled, profiled, tuned and ready for efficient production runs. The platform used for the course will be CSC's flagship machine, a Cray XT4/XT5 Louhi. The presented strategies are applicable to other platforms as well.

The course consists of a detailed introduction to the following topics:

- Compiling and porting codes to the Cray XT4 and Cray XT5
- Profiling and optimizing parallel codes
- Program development tools (debugging, HW counters) and libraries on Louhi

Roughly half of the course will be devoted to hands-on work on participants' own codes. We encourage everybody to bring their own laptop if possible. Attendees should preferably have applied for their own user account on Louhi before the course, however training accounts will also be provided. The lectures will be broadcast as web stream, hence you may attend the course virtually. You may also participate in the hands-on sessions remotely over an SSH connection.

Program

21/09/09 - First Day (Attendees will learn about the Cray XT architecture and its programming environment. They will have an initial understanding of potential causes of application performance bottlenecks, and how to identify some of these bottlenecks using the Cray Performance tools. The Attendees will use the performance tools to generate a profile of their application)

09:00 – 09:15	John Levesque	Introduction (flash video 39:09)	
09:15 – 09:45	John Levesque	Overview of the Cray XT Architecture	
		i. Node architecture	
		ii. Interconnect	
09:45 – 10:15	Kevin Roy	The Cray Linux Environment (flash video 46:24)	
		i. Overview	
		ii. CLE features	
		iii. CLE Programming	
		iv. The storage environment	
10:15 – 10:30	Break		
10:30 – 11:15	Luiz DeRose	Programming Environment for the Cray XT system (flash video 1:05:19)	
		i. Overview	
		ii. Modules	
		iii. Compilers (CCE and PGI)	
		iv. PE User Guide	
11:15 – 12:15	John Levesque	A methodical approach for analyzing applications (flash video 21:44)	
		i. Formulating a problem	
		ii. Potential bottlenecks	
		• Memory hierarchy (TLB & cache)	
		• Load imbalance	
		• Computation	
		• Communication	
		• I/O	
12:15 – 13:30	Lunch		
13:30 – 14:15	Heidi Poxon	Performance measurement on the Cray XT system (flash video 32:26)	
		i. Overview	
		ii. Automatic Profiling Analysis	
14:15 – 14:45	Luiz DeRose	Using Hardware Performance Counters (flash video 43:47)	
14:45 – 15:00	Break		
15:00 – 15:30	Kevin Roy	Job launching & running a batch application (flash video 23:21)	

15:30 – 17:00 Hands on Lab Profiling applications

22/09/09 - Second Day (We will finalize the presentations on how to identify performance bottlenecks. The attendees will use Cray Apprentice2 for performance visualization and will learn various optimization techniques. The attendees will start to tune their applications at the hands on lab)

09:00 – 9:30 Heidi Poxon Profile visualization with Cray Apprentice2 (demo with hands on lab) (flash video 28:46)

09:30 – 10:20 Luiz DeRose Load Imbalance Analysis (flash video 50:22)

- i. MPI Sync Time
- ii. Imbalance metrics
- iii. MPI Rank reorder

10:20 – 10:35 Break

10:35 – 11:00 Luiz DeRose How to make the best use of Cray MPI on the XT (flash video 23:33)

11:00 – 12:15 John Levesque Optimization techniques (flash video 1:09:19)

- i. Addressing memory hierarchy problems
 - Cache optimization
 - TLB Optimization
- ii. Vectorization

12:15 – 13:30 Lunch

13:30 - 13:45 Machine room visit

13:45 - 14:15 John Levesque Optimization techniques (continued) (flash video 27:47)

- iii. Pre-posting receives
- iv. Resolving scaling issues
 - Load imbalance
 - Communication
 - Computation

14:15 - 14:30 Break

14:30 – 17:00 Hands on Lab Tuning applications

17:00- SOCIAL EVENT: sauna + refreshments

23/09/09 - Third Day (The attendees will learn advanced techniques to deal with scaling problems and how to access the on-line documentation for user help. In the hands on lab the attendees will continue to tune their applications.)

09:00-09:15 Heidi Poxon Performance analysis of OpenMP Applications (flash video 10:36)

09:15 – 10:15 John Levesque Using OpenMP to mitigate scaling problems (flash video 39:42)

- i. Scaling higher with OpenMP
- ii. Improving Load imbalance with OpenMP

10:15 – 10:30 Break

10:30 – 11:00 Luiz DeRose Trace analysis (flash video 22:51)

- i. Trace file generation
- ii. Trace visualization

11:00 – 11:15 Heidi Poxon User help (flash video 17:33)

- i. Using man pages
- ii. Using pat_help
- iii. Using Cray Apprentice2 on-line documentation

11:15 – 12:00 John Levesque CAF & UPC (flash video 56:42)

12:00 – 13:30 Lunch

13:30 – 17:00 Hands on Lab Tuning applications

24/09/09 - Fourth Day (We will cover additional topics and the attendees will complete the tuning of their applications)

09:00 – 09:30	Luiz DeRose	Libraries
		i. Cray Scientific Libraries (flash video 25:53)
		ii. Debugging Tools (flash video 21:31)
10:00 - 10:05	Heidi Poxon	Fast Track Debugging (flash video 02:41)
10:10 – 11:00	Kevin Roy	I/O Optimization (flash video 53:50)
11:00 – 12:00	Hands on Lab	Tuning applications

Materials

- Roy: Cray Linux Environment
- DeRose: Using hardware performance counters
- Poxon: Profile visualization with Apprentice2
- Roy: Running on XT compute nodes
- Levesque: Removing bottlenecks to high performance
- Levesque: A methodical approach to scaling to large numbers of cores
- DeRose: How to make the best use of the MPI in the Cray XT system
- Workshop flyer
- Poxon: Performance measurement on the Cray XT system
- DeRose: Programming environment for the Cray XT system
- Levesque: XT# hardware architecture
- Roy: Achieving I/O performance
- DeRose: Cray scientific libraries
- DeRose: Cray debugging support tools
- DeRose: Trace analysis
- Levesque: Using OpenMP to remove scaling bottlenecks
- Levesque: Using Co-array Fortran
- Poxon: Documentation for the Cray Performance Toolset

Date: 21.09.2009 09:00 - 24.09.2009 12:00

Location: Premises of CSC, Keilaranta 14, Keilaniemi, Espoo.

Language: English

Lecturers: John Levesque (Cray Inc.), Luiz DeRose (Cray Inc.), Kevin Roy (Cray Inc.), Heidi Poxon (Cray Inc.)

Price: Free of charge

Registration

Registration has expired 16.09.2009 16:30

Additional information

Further information is provided by Pekka Manninen ([pekka.manninen\(at\)csc.fi](mailto:pekka.manninen(at)csc.fi), +358 50 3819 039).

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