TDDC78
Programming of Parallel Computers
- Methods and Tools

VT 2017
Course information and overview
Christoph Kessler, IDA

TDDC78 Contents
- Basic concepts of parallel computer architecture
- Parallel programming models, languages, and environments
  - Shared memory - Pthreads
  - Shared memory - OpenMP
  - Distributed memory, message passing - MPI
- Design methods for parallel programs
- Design and analysis of parallel algorithms
- Parallel scientific computing
- Tools for programming and performance analysis

TDDC78 Staff  VT 2017

- Examiner + course leader
  Christoph Kessler, IDA, christoph.kessler@liu.se
- Guest lecturer – NSC
  Peter Kjellström, NSC, peter.kjellström@liu.se
- Course assistant and lab assistant
  August Ernstsson, auguest.ernstsson@liu.se
- Lessons and lab assistant
  Lu Li, IDA, lu.li@liu.se
- Course secretary
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- Course area manager (studierektor)
  Ahmed Rezine, ahmed.rezine@liu.se

TDDC78 Organization

Course web page
- http://www.ida.liu.se/~TDDC78
Lab help chat forum (nothing else) on Lisam
  - However we can't guarantee answering by lab assistants

Structure
- Lecture series
- Lessons
- Lab series 3hp
- Written exam 3hp

TDDC78 Lecture plan (1)
- Parallel computer architecture concepts I:
  Distributed Memory, Clusters and Networks (CK)
- Parallel computer architecture concepts II:
  Memory Hierarchy; Shared Memory (CK)
- Guest Lecture: Introduction to NSC systems and NSC guided tour
  (Peter Kjellström, NSC)
- SIMD, Multithreading, Multicore, Accelerators, Hybrid Systems.
  Architectural Trends, TOP500;
  Design of parallel programs I (CK)
- Design of parallel programs II (CK)
- MPI I (CK)
- MPI II (CK)
- OpenMP I (1h) + Lesson 1 (1h): Introduction to the lab series (LL)
- OpenMP II (CK)

TDDC78 Lecture plan (2)
- OpenMP III, Advanced issues OpenMP + MPI;
  Mid-term evaluation by muddy cards
  Tools for performance analysis (CK)
- Design and analysis of parallel algorithms I (CK)
- Design and analysis of parallel algorithms II;
  Fundamental (data)parallel algorithms (CK)
- Parallel Linear Algebra Algorithms I (CK)
- Parallel Linear Algebra Algorithms II (CK), Parallel Solving of Linear Equation Systems (CK);
  Data distribution and PGAS languages (CK)
- Lesson 2: Exercises (LL)
- Loop optimization and parallelization (CK)
  Lectures/Topics in blue color overlap with TDDD56 Multicore and GPU Programming
TDDC78 Labs (1)

- NSC supercomputer platforms
  - MPI, pthreads, OpenMP and tools on Linux cluster "Triolith" triolith.nsc.liu.se
  - Part of Triolith reserved for our course during scheduled lab hours

<table>
<thead>
<tr>
<th>Lab</th>
<th>Platform</th>
<th>No.</th>
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<tbody>
<tr>
<td>Image filter</td>
<td>MPI</td>
<td>1</td>
</tr>
<tr>
<td>Stationary heat conduction</td>
<td>OpenMP</td>
<td>3</td>
</tr>
<tr>
<td>Tools</td>
<td>TotalView, Vampir</td>
<td>4</td>
</tr>
<tr>
<td>Particle simulation</td>
<td>MPI</td>
<td>5</td>
</tr>
</tbody>
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Labs (2)

- Working in pairs (lab team size=2)
  - Both be prepared for each lab session!
  - Need both be able to explain all your own code
- 4 lab groups (2 classes) all in parallel
  - Group A (Lu Li): 32 students in parallel
  - Group B (August Ernström): 32 students
  - Register for a lab group via webreg by 24 March 2017
  - Lab deadline: 24 May 2017
  - NB - Triolith accounts may be erased after 1 Sept 2017
  - No copying! Cheating will be taken seriously.

Important steps

- Proper course registration for TDDC78 required
  - If not registered, contact the director of studies ASAP!
- Follow the instructions on the course homepage to
  - create an account in SUPR
    - Requires that you have a valid LiU-ID
  - then request membership in the course project (SNIC 2017/5-12)
    - To get an account on Triolith.
    - Completely electronic procedure
    - See the instructions on the web page!
  - Do this by 24 March 2017
- Register for a lab group in webreg by 24 March 2017.
- Do not miss the NSC introduction lecture (21/3 15:15) and Lesson 1 (4/4)

Examination

- Lab series, 3 hp (ECTS)
  - Deadline: 24 May 2017
- Written exam, 3 hp (ECTS)
  - First opportunity: 3 June 2017 14:00-18:00
  - No aids allowed except:
    - English dictionary

Course literature

Mandatory
- C. Kessler: Slides Compendium, being updated before each lecture.
  - Available for registered students on the course homepage.
  - Available for registered students on the course homepage.
- Lab compendium. Online.
- Articles:

Complementary Reading

Additional references and online articles
- on the course homepage http://www.ida.liu.se/~TDDC78