High-Performance Computing on Multi- and Manycore Processors

<table>
<thead>
<tr>
<th>Module-No./Abbreviation</th>
<th>Credits</th>
<th>Workload</th>
<th>Term</th>
<th>Frequency</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE-WP25/HPCM</td>
<td>6 CP</td>
<td>180 h</td>
<td>2\textsuperscript{nd} Sem.</td>
<td>Summer term</td>
<td>1 Semester</td>
</tr>
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<thead>
<tr>
<th>Courses</th>
<th>Contact hours</th>
<th>Self-Study</th>
<th>Group Size:</th>
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</thead>
<tbody>
<tr>
<td>High-Performance Computing on Multi- and Manycore Processors</td>
<td>4 SWS (60 h)</td>
<td>120 h</td>
<td>No Restrictions</td>
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Prerequisites
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Learning goals / Competences
After successfully completing the module, the students
- are enabled to design and create programs for multi- and manycore processors,
- can critically evaluate multi-threaded programs and shared-memory access patterns,
- are able to survey advanced scientific topics independently and present their findings.

Content
The lecture addresses parallelization for multi- and manycore processors. Thread-based programming concepts ( pthreads, C++11 threads, OpenMP, OpenCL) are introduced and best-practice implementation aspects are highlighted based on applications from scientific computing.

In the first part, the lecture provides an overview on relevant data structures, solver techniques and programming patterns from scientific computing. An introduction to multi-threading programming on multicore systems is then provided with special attention to shared-memory aspects. Parallelization patterns are discussed and highlighted. Numerical experiments and self-developed software implementations are used to discuss and illustrate the presented content.

In the second part, students are assigned advanced topics for shared-memory computation from the engineering science including finite element methods and artificial intelligence. Based on a scientific paper, students present their topic to the lecture audience in form of a beamer presentation and numerical illustrations.

Teaching methods / Language
Lecture (2h / week), Exercises (2h / week) / English

Mode of assessment
Homework (100%, Presentation)

Requirement for the award of credit points
Successful homework including presentation, Q&A session after presentation

Module applicability
MSc. Computational Engineering, MSc. Bauingenieurwesen, MSc. Angewandte Informatik

Weight of the mark for the final score
6 %

Module coordinator and lecturer(s)
Prof. Dr. A. Vogel, Assistants

Further information

Master's program Computational Engineering - Module Handbook
last updated March 2022