Experiences with OpenMP on ScaleMP
@ RWTH Aachen University

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Agenda

- FIRE: Image Retrieval Engine
- SHEMAT-Suite: Geothermal Simulation Package
- Closing Remarks
FIRE: Flexible Image Retrieval Engine

- Image Retrieval: A set of query images is compared with all images in a (huge) database and the $k$ most similar images are returned
  - Performance comparison of common features on different databases
  - Analysis of correlation of different features
  - Nested Parallelization – Outer level: Queries, Inner level: Comparison

- Data Mining is well-suited for Shared-Memory parallelization, but hard with MPI

*Thomas Deselaers and Daniel Keysers,*

*RWTH I6: Chair for Human Language Technology and Pattern Recognition*
Nested Parallelization improves speedup by reducing the total overhead. Best effort: Speedup of 66.96 on 104 cores.

- Our system: 13 boards à 2x Intel Xeon E5420 (2.50 GHz)

- Explicit Thread Binding: `export KMP_AFFINITY=scatter`
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SHEMAT-Suite

- Geothermal Simulation Code
  - Simulating Groundwater flow, heat transfer and transport of reactive solutes
  - 3D Finite Difference Solver
  - Parameter estimation of rock properties using AD (Automatic Differentiation) Techniques → Shared-Memory Parallelization

- Outer Parallelization: Independent computations of the directional derivatives (Jacobian columns)

- Inner Parallelization: Solver based on BiCGStab with ILU(0)
SHEMAT-Suite: Machine Comparison (up to 16 threads)

- **ScaleMP**: 13x 2x Intel Xeon (2.5 GHz) + 4x AMD Barcelona (2.3 GHz)
- 4x Intel Tigerton (2.9 GHz)

**Best effort combination of Outer level : Inner level**

- ScaleMP: Fast Intel CPUs + Aggregated Memory Bandwidth
Nested OpenMP improves scalability on many cores
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Remarks

- Limited application experience so far, still work in progress.

- What’s still missing and subject to further research:
  - Experience with Performance Analysis Tools
    - Analysis of the data exchange between boards (over InfiniBand)
    - Analysis of and influence on the thread migration mechanism
  - Experience with Tuning Methodologies on ScaleMP
    - Does manual data „prefetching“ help?
    - Sometime the optimal thread binding is „surprising“: lack of binding support for nested OpenMP in the Intel compiler.
Thank you for your attention!