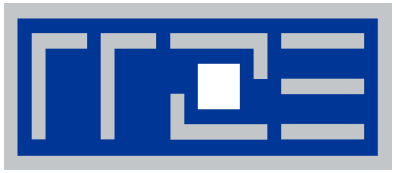

Teaching High Performance Computing to Scientists and Engineers: A Model-Based Approach

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Erlangen Regional Computing Center (RRZE)
University of Erlangen-Nuremberg
Germany

A little history of our group: HPC@RRZE

1998: First HPC consultant at RRZE

2000: Project KONWIHR – one additional consultant

2002: Two additional KONWIHR consultants

2003: First permanent position in the group

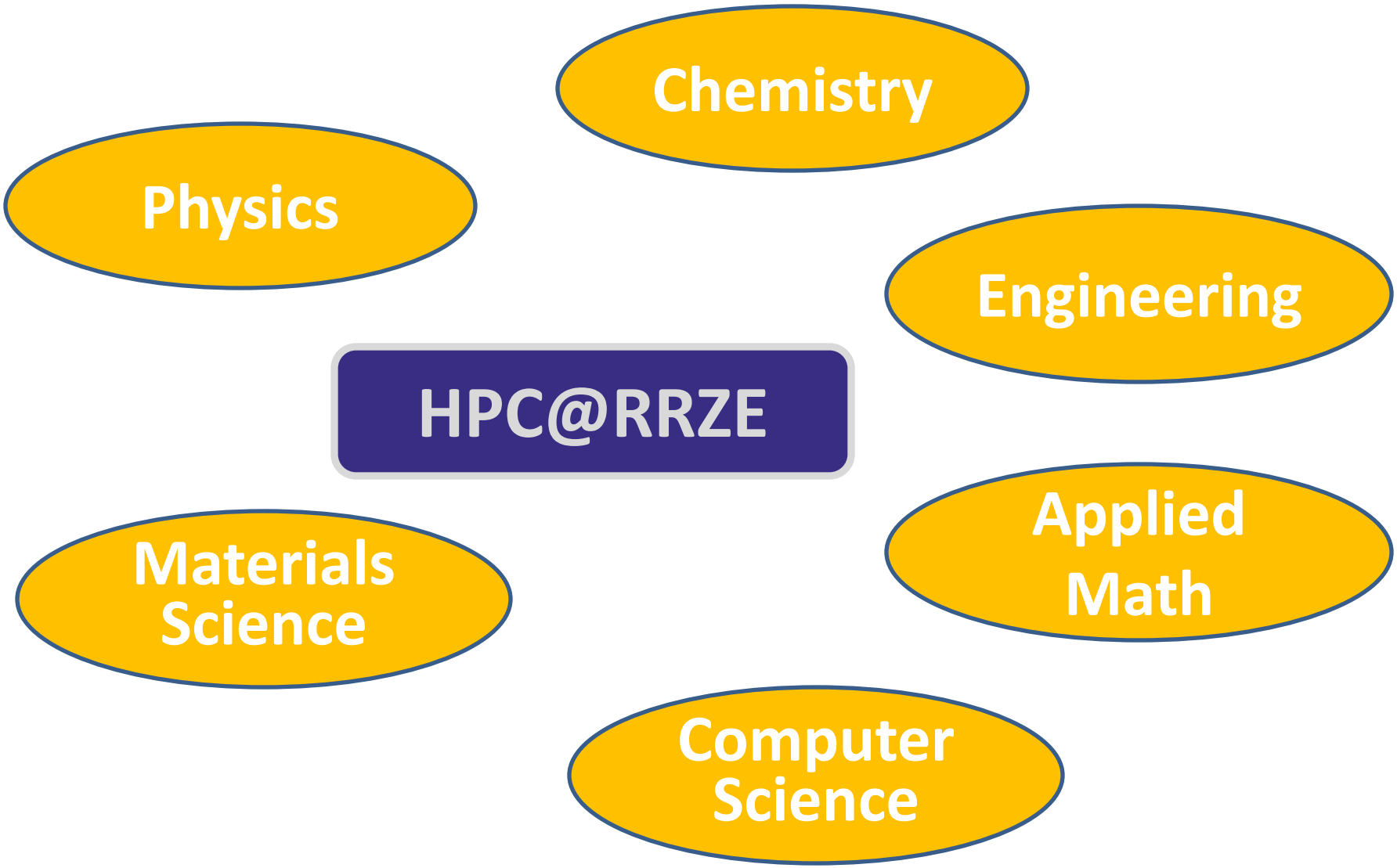
2008: Second permanent position, two PhD students

2011: Spin-off company

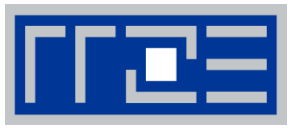
Today: One professor, three permanent positions, one postdoc, four PhD students, >90 publications

1 computer scientist

Consulting


Chemistry
Physics
Engineering
HPC@RRZE
Applied Math
Materials Science
Computer Science

Teaching activities



Supercomputing Tutorial “Multicore Optimization”

Supercomputing Tutorial “Hybrid MPI/OpenMP”

HPC@RRZE

Textbook “Introduction to High Performance Computing for Scientists and Engineers”

Lecture “Programming Techniques for Supercomputers”

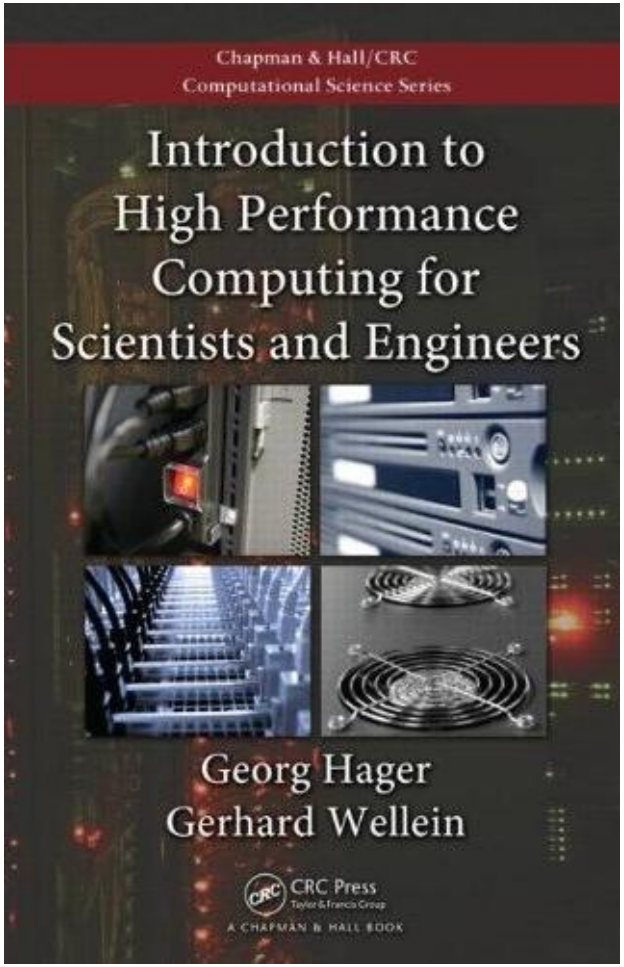
Course “Parallel Programming of High Performance Systems”

Textbook

Georg Hager and Gerhard Wellein:

Introduction to High Performance Computing for Scientists and Engineers

CRC Press, ISBN 978-1439811924
356 pages
July 2010



Model building

How do scientists write numerical software?

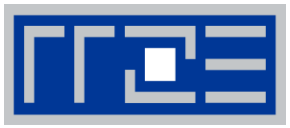
The premises

1. Parallelism necessary but not sufficient
2. Efficient use of resources is key
3. I have to know when to stop optimizing (the “good enough” point)

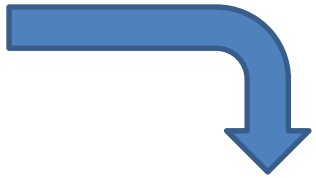
Consequence:

Performance modeling guides the way!

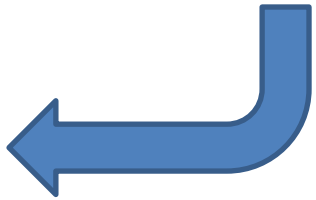
Example:
CRS Sparse Matrix-Vector Multiply

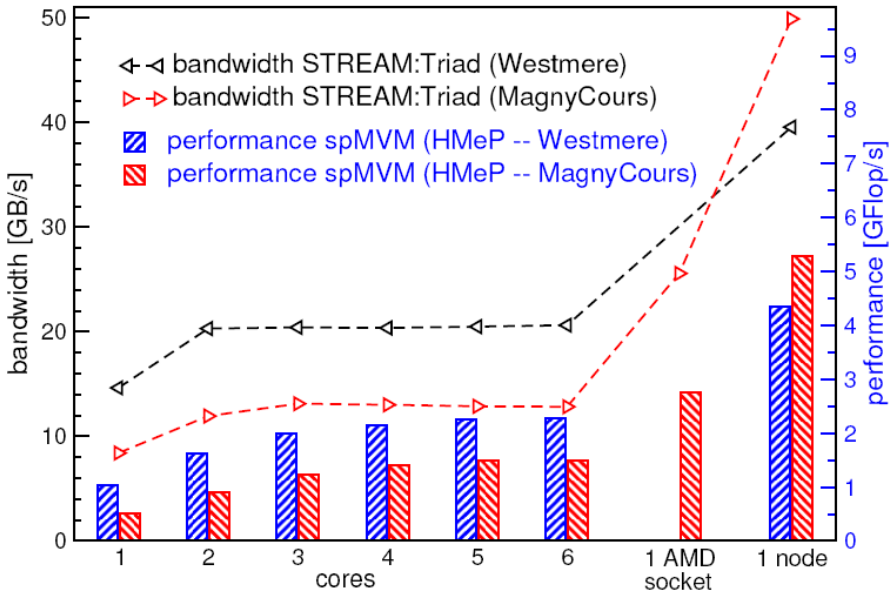


```
do i = 1,Nr
  do j = row_ptr(i), row_ptr(i+1) - 1
    C(i) = C(i) + val(j) * B(col_idx(j))
  enddo
enddo
```



$$B_{\mathrm{CRS}} = \left(\frac{12+24/N_{\mathrm{nzr}}+\kappa}{2}\right)\frac{\mathrm{bytes}}{\mathrm{flop}} = \left(6+\frac{12}{N_{\mathrm{nzr}}}+\frac{\kappa}{2}\right)\frac{\mathrm{bytes}}{\mathrm{flop}}\,.$$



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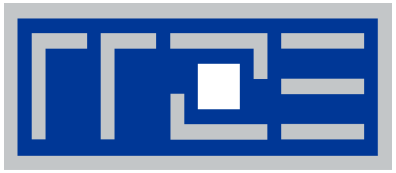
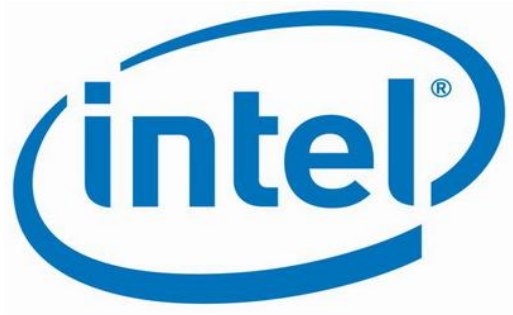



Federal Ministry
of Education
and Research

THANK YOU.


KONWIHR
II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