Parallelism & Concurrency:
Changing the Landscape of IT-Education

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November 8, 2011 – Milan, Italy
Educational Infrastructure in P&C
(basics of the project)

- Interaction with government, ministries, funding agencies.
- Tight contacts with leading IT companies and research institutes.
- Strong interuniversity collaboration.
- Body of knowledge on Parallelism & Concurrency.
- Different target groups: students, teachers,...
- Courses, textbooks, intensive practice, trainings on P&C...
- Individual work (projects) of students.
- Collective bank of exercises and tests on P&C.
- Internet university of supercomputing technology.
- National conferences and youth schools for students.
- Research on advanced computing techniques, systems, software, applications.
- PR, mass-media, Internet resources on HPC and parallel computing.
- ...

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Joint MSU&NNSU project
Body of Knowledge in P&C
(what is inside P&C area?)

• Mathematical foundations of parallel computing,
• Parallel computing systems (computer system foundations),
• Technologies of parallel programming (parallel software engineering foundations),
• Parallel methods and algorithms,
• Parallel computations, large-scale problems and problem-oriented applications.
**Informational Structure is a Key Notion**

*(matrix multiplication as an example)*

Do \( i = 1, n \)
Do \( j = 1, n \)
\[
\begin{align*}
1 & \quad A(i,j) = 0 \\
2 & \quad A(i,j) = A(i,j) + B(i,k) \cdot C(k,j)
\end{align*}
\]

\[
\begin{align*}
1 & \quad i_1 = i \\
2 & \quad j_1 = j \\
3 & \quad k_1 = k - 1
\end{align*}
\]

*In current IT – education? No.*
GAUSS elimination: method and algorithm
(informational structure)

\[ s = s + A(i,j) \cdot x(j) \]
\[ x(i) = \frac{b(i) - s}{A(i,i)} \]

\[
\begin{align*}
  &\text{do } i = n, 1, -1 \\
  &\quad s = 0 \\
  &\quad \text{do } j = n, i+1, -1 \\
  &\quad\quad s = s + A(i,j) \cdot x(j) \\
  &\quad\quad \text{end do} \\
  &\quad x(i) = \frac{b(i) - s}{A(i,i)} \\
  &\quad \text{end do}
\end{align*}
\]

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Joint MSU&NNSU project
Educational Courses and Textbooks
(elements of P&C educational infrastructure)

• Parallel computing (Vl. Voevodin, MSU).
• High Performance Scientific computing: parallel programming model, tools and performance analysis (N. Popova, V. Bakhtin, MSU).
• Introduction to Parallel Programming (V. Gergel, NNSU).
• Parallel programming tools (V. Gergel, I. Meyerov, et al. NNSU).
• New languages for parallel programming (V. Gergel, et al. NNSU).
• ...
MSU&NNSU Team: Trainings & Schools

Trainings on Intel programming tools.
Optimization and tuning of user’s applications (speed-up %5 – 400%).

Youth summer schools on parallel programming technologies

Training on Accelrys Material Studio

Joint MSU&NNSU project
MSU&NNSU Project: numbers and facts
(different forms of involving)

- Studying courses on P&C in MSU/NNSU – 400+, every year
- Intensive training in HPC areas in MSU/NNSU – 70+, every year
- Research and educational projects – 100+, every year
- Teaching of teachers at MSU/NNSU – 50+, every year
- Youth schools of MSU/NNSU – 100+ participants, every year
- Internet university on supercomputing technology – 300+, annually
- Passed through the Sigma e-testing system – 1700+
- ...

Joint MSU&NNSU project
Teaching of Teachers and Students: where?

MSU&NNSU’s educational activities are in more than 20 cities of Russia
MSU “Lomonosov” supercomputer, 2011

M.V.Lomonosov
1711 – 1765
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Contacts with leading IT-Companies
(industry collaboration)

• Joint MSU – Intel center on High Performance Computing
• Joint MSU – Intel Student Lab
• Joint NNSU – Intel center on High Performance Computing
• Joint NNSU – Intel Student Lab
• Microsoft Competence Center for High Performance Computations in NNSU
• Joint MSU – T-Platforms Center on Exascale Computing
• Agreements between MSU/NNSU and Hewlett-Packard, NVIDIA, TESIS,… on Supercomputing Education
• …
Joint MSU/NNSU-Intel student Labs and Centers on HPC
IT-Companies and Research Institutes & Edu
(special group of students on Parallel Software Development)

October, 24, 2011 – November, 14, 2011
55 students (Math, Physics, Chemistry, Biology, …)
MSU in collaboration with:
• Intel
• T-Platforms
• NVIDIA
• TESIS
• IBM
• Center on Oil&Gas Research
• Institute on Applied Mathematics, RAS
• Institute of Numerical Mathematics, RAS

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Joint MSU&NNSU project
Quarterly: “Supercomputers”
Excursions for Schools and Universities
(to supercomputing center #1 in Russia)
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Supercomputing Consortium & Education

2011: 50 full and associated members
Primary goal of the Consortium: Supercomputing Education

Commission for Modernization and Technological Development of Russia's Economy
Chairman of the commission: D. Medvedev, President of Russian Federation

Approved project of the commission: “Supercomputing Education”
Duration: 2010 – 2012
Project’s Leader: rector of MSU, academician V. Sadovnichy
Informatics Europe & Education on P&C = ?

(next steps)

- New working group within Informatics Europe: “Parallel Computing (Supercomputing) Education in Europe: State-of-Art”

- First output of WG – a survey “Supercomputing (or P&C) Education in Europe”

- Expected outputs: a roadmap and set of recommendations to universities and government agencies on curricula, bachelor/master/PhD programs, etc… to be developed to support new generations of parallel computers and parallel computing technologies.
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