

High Performance Scientific Computing (HPSC)

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Contents

- Survey on parallel computing, parallel algorithms
- Programming tools in message passing systems - MPI
- Ordinary differential equations, initial value problem,
- Boundary value problem,
- Iterative methods for the solution of linear systems
- Partial differential equations, some examples of applications (electric field, fluid flow).
- Case Study: Diffusion Equation and Heat Transfer

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Lessons

- Before this course you should be able to understand basic ideas of: linear system, matrix algebra, eigenvalues, linear least square, non-linear equations, polynomial approximation, numerical differentiation and integration.
- During this course you should obtain a knowledge on designing parallel algorithms and implementing them by using MPI communication library.
- Foundations of Partial Differential Equations will be explained and several practical problems solved in more details in order to obtain an impression how a real problem could be solved and calculation results represented.

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Labs

- Labs in the computer room after lessons. Usually the material from lessons will be tested on computers.
- MatLab will be used for testing and solving some basic and well defined problems.
- MPI parallel programs will be designed and implemented on MPICH implementation of the MPI, which is already installed on all computers in the small computer room.
- Practical examples from lessons on partial differential equations will be solved by both of the mentioned programming tools.
- Labs work should be posted in time on: [/home/scicomp/trobec/labs](http://home/scicomp/trobec/labs)

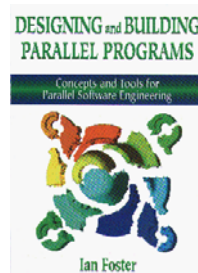
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Reference Book 1

- I.Foster: *Designing and Building Parallel Programs*, Addison-Wesley, 1996, (acronym PP is used in this course); Network version accessible on:

<http://www-unix.mcs.anl.gov/dbpp/>

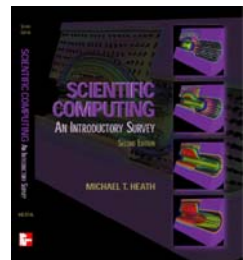


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Reference Book 2

- M.T.Heath: *Scientific Computing: An Introductory Survey*, Second Edition, McGraw Hill, New York 2001, (SC);
- *First Edition* from 1997;
- Lecture notes accessible on: <http://www.cse.uiuc.edu/heath/scicomp/notes>

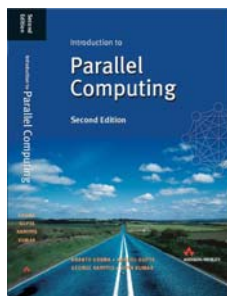


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Reference Book 3

1. A. Grama, A. Gupta, G. Karypis, V. Kumar: *Introduction To Parallel Computing*, Second edition, Addison Wesley, 2003,
2. Notes available on: <http://www.booksites.net/kumar/>



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Course Organisation

- Teaching
 - Lessons with slides (all slides on Class Web Page)
 - Practice with student presentations of solution to problems, theory, homework (announced after lessons)
 - Homework and project published on Class Web-page
- Examination and Grading
 - Homework: 20%
 - Project: 30%
 - Final written exam: 50% (see further details on Class Web Page)
- Personal communication
 - Labs, E-mail

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Homework

- Students will solve either exercises from the textbooks or problems defined by themselves.
- It is expected that seven homework assignments will be finished individually.
- The problem and results should be send by e-mail, when accepted they will be posted on the Class Web page, for other students.
- Some of the solved homework will be used in the final exam.

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Project

- Up to three students can work together on a research project,
- It has to involve an practical component—i.e. it is not a paper and pencil exercise, some working program is expected,
- Prepare the project proposal, either your own topic or a suggested one,
- Work on the project and to finish a written report including: overview, methods, results, and possible extensions.
- Projects should be send to my e-mail.

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Exam

- There will be a final written exam with books and notes, covering the complete course material.
- Questions will be selected from the review questions given for all chapters.
- Some questions will be selected from solved homework.
- Provisional exam terms:
 - June/05??;
- Homework and projects should be finished before written exam.
- Registration for the exam by e-mail at least one week before the exam term!

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Lecture and Labs Grading

- The final success measured in percentage =

$$\text{percentage of accepted homework} * \text{lecturer's grade} * 0.3 + \text{percentage of accepted project} * \text{lecturer's grade} * 0.2 + \text{percentage of solved questions on the exam} * 0.5$$
- Note: The accepted homework and project are graded on the basis of lecturer's judgement in the range from 0.6 to 1.
- Lecture grade according to the final success:

$$5 < 60\%; 60 \leq 4 < 70\%; 70 \leq 3 < 80\%; 80 \leq 2 < 90\%; 1 \geq 90\%$$
- Labs grade depends on grades of labs exercises (labwork) and homework:
 - (=Lecture grade) if more than 80% of labwork and homework accepted;
 - (=Lecture grade + 1) if all labwork, homework and project accepted.
 - (=Lecture grade - 1) if less than 80% of labwork and homework accepted.

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Provisional Scheduling

Once per month on two consecutive days:

Tuesday

- 10 - 11:30 a.m, Lessons, Room T05
- 11:45 - 12:30 p.m, Labs, Small computer room
- 14 - 15:30 p.m, Lessons, Room T05
- 15:45 - 16:30 p.m, Labs, Small computer room

and Wednesday (one hour earlier !)

- 9 - 10:30 a.m, Lessons, Room T06
 - 10:45 - 11:30 p.m, Labs, Small computer room
 - 13 - 14:30 p.m, Lessons, Room T06
 - 14:45 -15:30 p.m, Labs, Small computer room
- Details and final schedule will be arranged with students (see syllabus on Class Web for details).