High Performance Scientific Computing
SS 2002, University of Salzburg
Syllabus

1. Course Details

Lectures:	Once per month on two consecutive days: Tuesday and Wednesday, 10-12 a.m. and 14-16 p.m, Rooms T05 or T06 (see detailed schedule)
Labs:	Once per month on two consecutive days: Tuesday and Wednesday, 12-13 a.m. and 16-17 p.m., Small Computer Room, (see detailed schedule)
Instructor:	Roman Trobec, Room 1.08, `roman.trobec@ijs.si`
Course Materials:	`http://www-e6.ijs.si/~roman/usalz/hpsc`
Office Hours:	During Labs

2. Textbooks

Main Texts:

1. M.T.Heath: *Scientific Computing: An Introductory Survey*, *Second Edition,* McGraw Hill, New York 2001, (SC); Lecture notes accessible on*:* `http://www.cse.uiuc.edu/heath/scicomp/notes`
2. I.Foster: *Designing and Building Parallel Programs,* Addison-Wesley, 1996, (PP); Network version accessible on*:* `http://swt.cs.tu-berlin.de/pa/dbpp`

Supplementary Text:

1. V. Kumar, A. Grama, A. Gupta, and G. Karypis: *Introduction To Parallel Computing: Design And Analysis Of Algorithms*, Benjamin/Cummings, 1994, (PC).
2. L.J.Hennessy and D.A.Patterson*: Computer Architecture: A Quantitative Approach, 2nd Edition.* Morgan Kaufmann, 1996. (CA) *(NOTE: the second edition better covers this course.)*

3. Course Overview and Objectives

This course attempts to provide a deeper understanding of the issues involved in designing and implementing parallel programs particularly in the field of partial differential equations (PDE). The course material can be seen as an upgrading of the previous course: Computeroriented Methods for Solving Differential- and Integralequations (WS 2001/2002). Besides PDE, it covers also parallel architectures, with topics ranging from hardware design to programming models, design of parallel algorithms, with topics from communication and calculation complexity to interconnection topologies, and practical implementation of parallel programs on the area of heat transfer, fluid flow and molecular dynamics. We will be discussing recent papers on scientific computing research in class, and students will perform a significant research project. After attending this course, students will understand how parallel computers work and where are their strengths and weaknesses. They will be able to develop parallel algorithms and implement parallel programs.

4. Prerequisites

The course material can be seen as an upgrading of the course: Computeroriented Methods for Solving Differential- and Integralequations (WS 2001/2002). It is focused toward students who have some background form the area of computer science, programming languages, operating systems and

mathematics. No specialised knowledge is expected from these fields. For example, the students should be familiar with variables, functions, pointers and basic control statements. They should also be familiar with the methods for the solution of linear and nonlinear system of equations and numeric differentiation and integration. If you feel uncertain about whether you have adequate preparation, please discuss this with the instructor.

5. Course Work

To pass this course, a student is expected to demonstrate knowledge and competence in the covered topics Grades will be based on homeworks, class projects and final exam. The overall grade will be determined as follows:
Solution of problems - homework: 30%
Class Project: 20%
Final Exam: 50%

Two hours of lectures (lecture notes are available on Class-web page) will be followed by one hour of student work. We are going to answer interesting review questions and solve some exercises from the textbook (review questions and exercises will be available on Class-web page).
Homework: Self initiative work is supposed here. The students can solve either the exercises from the textbooks or problems defined by themselves. It is expected that eleven homework assignments (one for each chapter) will be finished individually. The problem and results will be posted on the Class-web page to be shared among students as the material for the final exam.
Class Projects: Up to two students can work together on two class projects, that has to involve an practical component—i.e. it is not simply a paper and pencil exercise, some working program code is expected. The projects will be selected from the textbook computer problems. We encourage you to come up with your own topic for your project. You will have two months to work on the project and to finish a written report including overview of the existing methods, stressing the advantage of the implemented method (possibly a new version) and commenting the obtained results. The project results will be posted on the Class-web page and presented in class if possible.
Final Exam: The final written exam will cover the complete course material including review questions from the text book and solved homework exercises. Students can use notes and books.

6. Schedule

Table below shows the tentative schedule for High Performance Scientific Computing HPSC in Summer Semester SS 2002. There might be some variations.

Class	Date	Day	Topic	Reading	Homework/Project
1	Mar. 12	Tuesday a.m.	Parallel Architectures	CA Ch. 1-3	
2	Mar. 12	Tuesday p.m.	Design of Parallel Algorithms	PP Ch. 2	Homework-1
3	Mar. 13	Wednesday a.m.	Programming Tools	PP Ch. 5,6,7	
4	Mar. 13	Wednesday p.m.	Communication & MPI	PP Ch. 8; +	Homework-2
5	Apr. 16	Tuesday a.m.	Ordinary Differential Equations - ODE	SC Chapter 9	
6	Apr. 16	Tuesday p.m.	Case Studies 1	PP Ch. 2	Homework-3
7	Apr. 17	Wednesday a.m.	Initial Value Problem - IVP	SC Chapter 9	
8	Apr. 17	Wednesday p.m.	Case Studies 2	PP Ch. 2	Homework-4
9	May 14	Tuesday a.m.	Boundary Value Problems	SC Chapter 10	
10	May 14	Tuesday p.m.	Case Study-MD		Homework-5
11	May 15	Wednesday a.m.	Partial Differential Equations	SC Ch.11	
12	May 15	Wednesday p.m.	Iterative Solution of Linear System	+	Homework-6
13	June 11	Tuesday a.m.	Partial Differential Equations	SC Ch.11	
14	June 11	Tuesday p.m.	Case Study-Heat Transfer	+	Homework-7
15	June 12	Wednesday a.m.	First term for HPSC 02 exam	Project and Homework, due to exam	

Second term for HPSC SS 2002 exam : October 2002
Third term for HPSC SS 2002 exam : January 2003