

TDT 4200 Parallel Computing – Fall 2012



Instructor (Faglærer): [Assoc. Prof. Anne C. Elster](#) (ITV 410)



Teaching Assistant (Øvingsleder): Thomas Falch (ITV 411)



Student Assistant (Undervisnings assistent): Ruben Spaans (ITV 411)

Student contacts/representatives: TBD

Credits (Studiepoeng): 7,5

Examination form: Written (skriftlig) midterm: 25% and final: 50% + mandatory graded assignments (obligatoriske og tellende øvinger): 25%

Time and place:

- Mondays 08:15-10:00 in F2 (Gamle Fysikk)
- Fridays 10:15-11:00 in F6 (Gamle Fysikk)
- Recitations (Øvingstimer): Fridays 15:15-16:00 in F2
- **NO MIDTERM (se studiekatalogen)**
- **FINAL EXAM is 9am-1pm on Dec. 8, 2012** 09:00-13:00. See also [link](#) to NTNU's final exam schedule.

You have to notify the instructor at the beginning of the semester if you cannot attend all lectures.

Goal: To give the students a good understanding of how to optimize serial algorithms and programs, as well as teach them how to develop efficient programs on modern multiprocessor systems.

Prerequisites (forutsetninger): Algorithms and Datastructures and Computers and Operating Systems, or the equivalent.

Content (Innhold): Optimization of algorithms and programs for both serial and multiprocessor systems. How to choose algorithms, use of optimized libraries, compiler optimizations, and program profiling. How to take advantage of PC clusters for large computational tasks which would otherwise not fit on a single CPU/PC system, will also be covered.

Teaching form (undervisningsform): Lectures (forelesninger) and recitations/assignments (øvingstimer/øvinger).

Problem Assignments (Øvinger)

All assignments are mandatory (obligatoriske) and at least 3 (selected by instructor) count for a portion of the total grade. They must be done individually, unless otherwise specified! Plagiarism (koking) will not be tolerated.

- Assignments handed in after the deadlines without prior authorization from the instructor will not be counted unless a formal medical note can be provided.

(see Syllabus and It's Learning for details re. assignment deadlines.)

Contact the TAsto get on the initial mailing list, get a cluster account, and to make sure to receive the assignments. The first assignment will be posted on August 25 and due 8am on Thursday Sep 1. (extended deadline Sept 8)

We are now a CUDA Teaching Center so a significant portion of the course will be done in CUDA, thanks to NVIDIAs recent donations of 25 GTX480 cards.

Problem sets -- See syllabus below and It's Learning for final dates and times

Note: PA 2 deadline was extended to 8pm on Sept 15. If you did not make this deadline, contact the instructor immediately.

Note2: We may switch the order of PA6 and PA7.

- Note: You need to do PS1 before being allowed to hand in subsequent problem sets. PS1 is mandatory (obligatorisk), but will not count towards your final grade (i.e. not "tellende").

Student Photos

Photos of students will be taken and provided on-line either here on It's Learning (depending on permissions)

Lectures & Material covered (Pensum):

Pacheco's new book "An Introduction to Parallel Programming" is highly recommended for this course and now available at Tapir.

- Most of the material on MPI, OpenMP and Threading can be found in this text book
- Slides covering material from this book can be found here:
<http://www.elsevierdirect.com/v2/companion.jsp?ISBN=9780123742605>
- Source code and errata for this textbook can be found at:
<http://www.cs.usfca.edu/~peter/ipp/>

Additional material to be covered re. MPI may also be taken from:

- [MPI Home page](#)
- [MPI Tutorials](#)

An Overview of PETSc is also given. More info:

- Links to PETSc: <http://www-fp.mcs.anl.gov/petsc/>

Additional material will be presented from overheads and handouts and may be taken from:

- Wilkinson & Allen: *Parallel Programming* 2nd edition
 - slide material from Wilkenson and Allen found [here](#)
- Gerber: *"The Software Optimization Cookbook"*
- "Amdal's (& Gutavson's) Law in the Multicore Era", IEEE Computer, pp33-38, July 2008
- "Why Computer Architecture Matters: Memory Access", IEEE Computing in Science & Engineering, pp 71-74, July/Aug 2008
- MPI [slides from UNC](#)

See also *It's Learning* (NTNU's internal teaching web system) for course notes and slides. I will try to make the material also available on this site after they are "cleaned up".

Date/Lect/Recit	Topic	Assignments
Mon Aug 20 – L 1 & 2	Intro slides by Elster (see It's Learning)	
Fri Aug 24 – Lect 3	Intro contin. – NTNU SC, shared/distr mem, memory hierarchy, location, location & location What is MPI, MPI simple example (Slides on It's learning, notes on board, Pacheco Ch 1)	
Fri Aug 24 – Recit 1	PS 1 hints, C intro, Clustis, MPI intro, compiling & running MPI (Recit 1 slides on It's Learning)	PS 1 Intro (P/F) Due Thu Aug 30 @ 8pm
Mon Aug 27– Lect 4	Double lecture on C Prog. (see notes under Recitation)	
Fri Aug 31 – Lect 5	MPI intro continued (Ch 3 Pacheco, Notes on It's learning)	
Fri Aug 31 – Recit 2	PS 2 hints, Blurring and convolutions, imaging, MPI boarder exchange & derived data types	PS 2 – MPI due Sep 15, 8pm (10% of grade)
Mon Sep 3 – L6&7	Speed up, exec modeling, Flynn's taxonomy (Pacheco Ch 2, from JCM slides Lec03-05)	
Fri Sep 07 – Lect 8	MPI Topologies (JCM slides Lec 06, Pacheco Ch 3)	
Fri Sep 07 – Recit 3	C review and examples (on It's learning)	
Mon Sep 10 – L8 & 9	MPI Derived Types (JCM slides Lec07) Finite Difference codes, SOR (JCM slides Lec08 + black board)	
Fri Sep 14 – Lect 10	Memory optimizations (Handout from text) Incl. x86 arch, Pentium and Sandy Bridge internals, SSE, AVX & AVX2, Cache issues and how to avoid them. Also invited to Elster's Physics lecture in R5 at 3:15 on GPU computing	
Fri Sep 14 – Recit 4	PS 3, Euler, Fourier, DFT, FFT, SIMD	PS 3 – Optimiz. Due Sep 27, 8pm (7% of grade)
Mon Sep 17 – L11&12	Syllabus, Bit-reversal, FFT More on Optimizations incl banching , SIMD, SSE/AVX	
Fri Sep 21 – Lect 13	Threading (Ch 4) Pacheco	
Fri Sep 21 – Recit 5	PS 2 solution	
Mon Sep 24 -- L14&15	Theading and OpenMP (Pacheco Ch 4-5)	
Fri Sep 28 – Lect 16	Non-tivial examples (Pacheco Ch 6)	
Fri Sep 28 – Recit 5	PS 4 hints	PS 4 – Threading & OpenMP (P/F)

		Due Oct 11
Mon Oct 1	NO CLASS ?	
Fri Oct 5	TBD (May or may not cancel class)	
Fri Oct 5	PS 3 solutions	
Mon Oct 8 – L17 & 18	Intro to GPU & CUDA	
Fri Oct 12 – Lect 19	CUDA	
Fri Oct 12	PS 5 hints	PS 5 Intro GPU
		Due Oct 25
Mon Oct 15 – L 20 & 21	CUDA	
Fri Oct 19	NO CLASS -- Elster travelling	
Fri Oct 19	PS 4 solution, office hrs	
Mon Oct 22 – L22 & 23	CUDA	
Fri Oct 26 – Lect 24	Open CL	
Fri Oct 26	PS 6	PS 6 CUDA or Open CL/OpenACC Due Nov 1 or 8 (if CUDA, 8% of grade)
Mon Oct 29 – L 25&26	Open CL	
Fri Nov 02 – Lect 27	OpenACC?	
Fri Nov 02 – Lect 27	PS 5 solution, off. hrs	
Mon Nov 5 – L 28&29	GPU wrap-up	
Fri Nov 09	NO Lect. Recitation during class time? PS 7 hints	PS 7 CUDA or Open CL/OpenACC Due Nov 16 or 22
Mon Nov 12	NO CLASS	
Fri Nov 16	Last Recitation (during lect): PS 6 solutions	
Mon Nov 19	NO CLASS	
Fri Nov 23 – Lect 30	Class review/Spørre time (may be given following week to incl PS 7 solution)	
Saturday Dec 8, 2012	9:00-13.00 – FINAL EXAM	

ALSO CHECK "It's learning" FOR COURSE ANNOUNCEMENTS, INFORMATION RE: ASSIGNMENTS, GRADES, ETC

This Page is maintained by Dr. Anne C. Elster. – Updated: Sep 17, 2012 Comments welcome.

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