

ACM/CS 114

Parallel algorithms for scientific applications

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Winter 2012

- ▶ class
 - ▶ where: 105 Annenberg
 - ▶ when: MWF from 3:00pm to 3:55pm
- ▶ instructor
 - ▶ Michael Aivazis (aivazis@caltech.edu)
 - ▶ office hours: 2-5pm, MWF
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- ▶ TA
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 - ▶ office: TBD
 - ▶ telephone: TBD

Motivations for going parallel

- ▶ why bother?
 - ▶ *speed*: there are fundamental limits to the processing power of a single processor
 - ▶ *throughput*: time to solution is critical for many problems
 - ▶ *size*: high resolution requires lots of memory
 - ▶ *availability*: the tool exists, use it
- ▶ but be careful
 - ▶ the commercial market is unstable
 - ▶ the computing environment is somewhat primitive
 - ▶ software packages and libraries are emerging slowly
 - ▶ parallel programming is not hard, but it requires *discipline*

Scope and outline

- ▶ software engineering survival skills
- ▶ algorithms and data structures
 - ▶ specification, design, analysis
- ▶ concurrency
 - ▶ computing models, memory models, synchronization
- ▶ execution environments
 - ▶ planning, staging, launching
 - ▶ monitoring
 - ▶ data harvesting, post processing, visualization
- ▶ concurrency in practice
 - ▶ embarrassingly parallel problems
 - ▶ structured uniform grids
 - ▶ unstructured grids
 - ▶ non-local problems
 - ▶ dense and sparse matrices
- ▶ advanced application design

Syllabus

- ▶ reference material
 - ▶ class notes will be posted online
 - ▶ no preferred textbook
 - ▶ suggested reading list available online
- ▶ homework
 - ▶ five assignments, each worth 10%
 - ▶ programming is required
 - ▶ they will be posted online no later than a week before they are due
 - ▶ online submission via `bzr`; details next time
- ▶ final project
 - ▶ 50% of your grade
 - ▶ must chose one, and get approval, before February 10
 - ▶ due on March 16
 - ▶ missing these deadlines will cause an incomplete grade, unless you negotiate an extension

Class resources

► resources

- web page: `http://acm114.caltech.edu`
- mailing list: `acm114-users@cacr.caltech.edu`
- computing: `shc.cacr.caltech.edu`

► requirements

- an ssh public key
- must fill out the account request form at
`http://www.cacr.caltech.edu/main/?page_id=477`

Informal survey

- ▶ computing platforms
 - ▶ windows, linux, osx; anything else?
- ▶ previous experience
 - ▶ compiled languages: C, C++, FORTRAN, FORTRAN90
 - ▶ interpreted languages: python, perl
 - ▶ environments: matlab, Mathematica
 - ▶ concurrency: threads, MPI, others?
 - ▶ development: emacs, eclipse
 - ▶ projects:
 - ▶ size: lines, people
 - ▶ practices: source control, documentation
 - ▶ target audience, release schedules
- ▶ personal objectives for this class