Courses on High Performance Computing and Simulations (HPCS)

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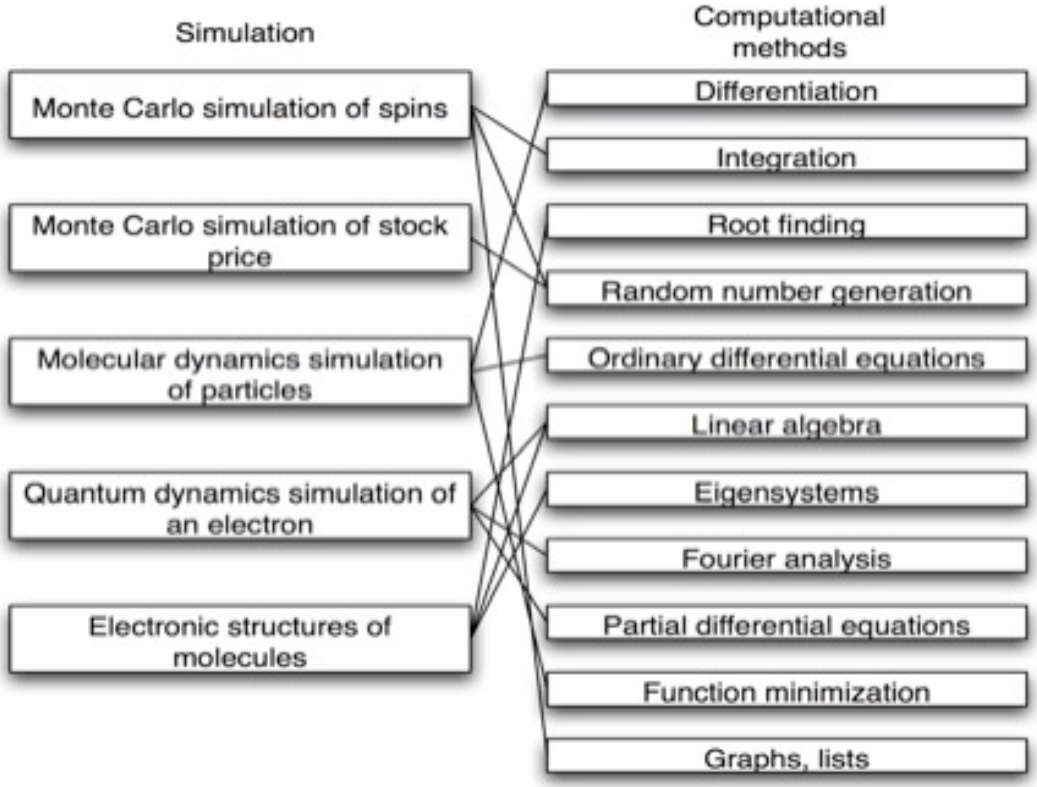
https://sites.usc.edu/cacs/teaching

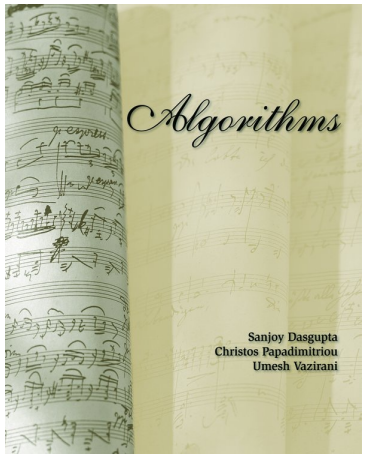
CACS HPCS Courses: Simulation!

- **PHYS516: Methods of Computational Physics (S)**
  ***Numerical methods (+ algebra & calculus)* in the context of simulations**
- **CSCI596: Scientific Computing & Visualization (26F, 27F)**
  Hands-on training on particle/continuum simulations, *parallel computing* & *scientific visualization*
  Entry level
- **CSCI653: High Performance Computing & Simulations (25F, 28F)**
  Deterministic/stochastic simulation *algorithms*, scalable parallel/distributed computing & scientific data visualization/analytics in virtual environment
  Advanced, research-oriented



	Particle model (ordinary differential equations)	Continuum model (partial differential equations)
Deterministic	molecular dynamics	computational fluid dynamics, continuum mechanics
Stochastic	Monte Carlo particle simulation	quantum Monte Carlo

Chapter 0: Prologue
Chapter 1: Algorithms with numbers
Chapter 2: Divide-and-conquer algorithms
Chapter 3: Decompositions of graphs
Chapter 4: Paths in graphs
Chapter 5: Greedy algorithms
Chapter 6: Dynamic programming
Chapter 7: Linear programming
Chapter 8: NP-complete problems
Chapter 9: Coping with NP-completeness
Chapter 10: Quantum algorithms



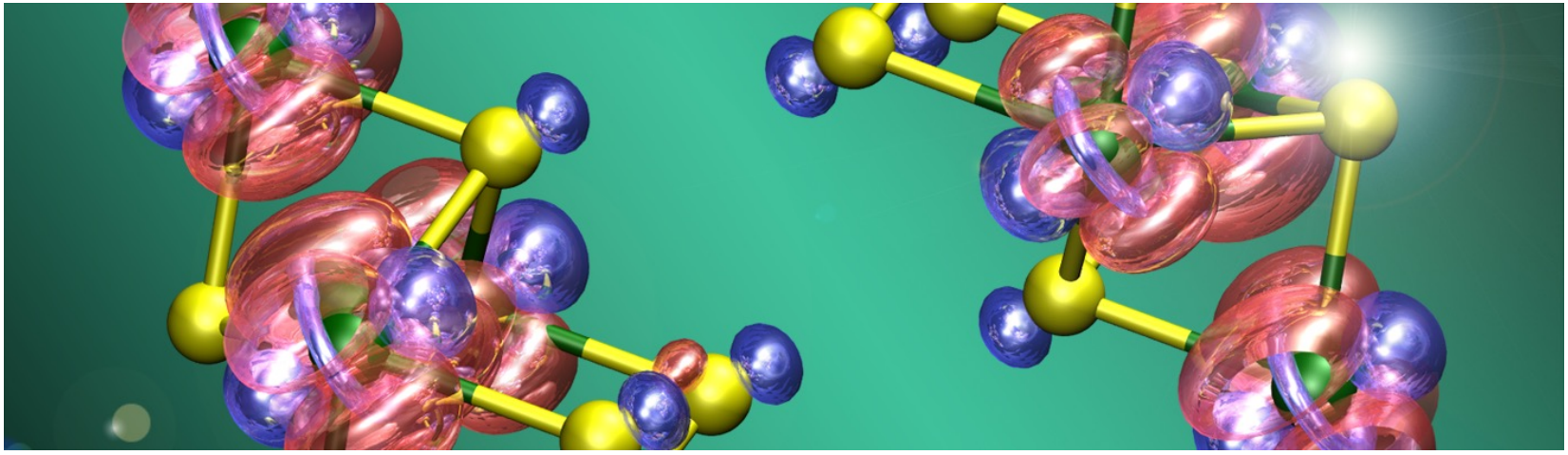
Additional HPCS Course

Detailed lecture notes are available at the course home page

Phys760: EXTREME-SCALE QUANTUM SIMULATIONS

Course Description

Computer simulation of quantum-mechanical dynamics has become an essential enabling technology for physical, chemical & biological sciences & engineering. *Quantum-dynamics simulations on extreme-scale parallel supercomputers* would provide unprecedented predictive power, but pose enormous challenges as well. This course surveys & projects algorithmic & computing technologies that will make quantum-dynamics simulations metascalable, *i.e.*, "design once, continue to scale on future computer architectures".



https://aiichironakano.github.io/phys760.html

Related Courses

- EE599: Parallel Programming: Victor Prasanna
  EE451: Parallel & Distributed Computation: Victor Prasanna

  Parallel and distributed computing using various programming models

- UC Berkeley CS267: Application of Parallel Computers

  Solve challenging science & engineering problems using high performance computing (HPC)

- Argonne Training Program on Extreme-Scale Computing (ATPESC)

  Two-week HPC bootcamp taught by world's top experts

CSCI 653 Prerequisites

1. CS596 (Scientific Computing & Visualization)

OR

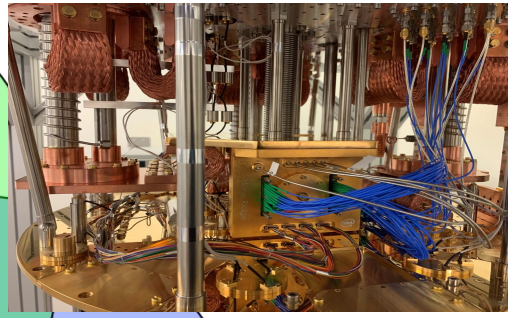
2. Basic knowledge of
   - Numerical methods (CSCI 501, PHYS 516 or equivalent)
   - Parallel computing—MPI, OpenMP, CUDA programming experience (EE 451 or equivalent)
   - 3D graphics—OpenGL programming experience (CS580 or equivalent)

CSCI 653 will apply these knowledge & techniques to simulations (or scientific/engineering applications)

Training Cyber Science Workforce

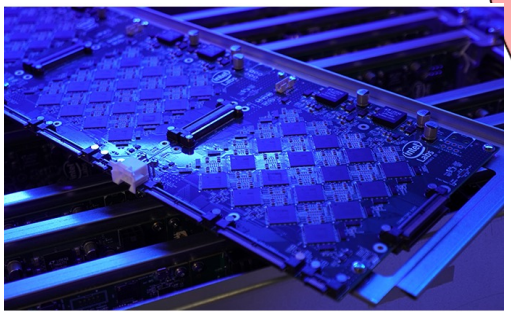
- New generation of computational scientists at the nexus of post-exascale computing, quantum computing & AI
- Unique dual-degree program at USC: Ph.D. in science or engineering, along with MS in computer science, quantum information science, or materials engineering with AI

Horse Ridge II
Quantum computer



Cybertraining on exa + quantum + AI platforms

Neuromorphic
Pohoiki Springs



Exascale
Aurora

MS in Quantum Information Science

- New MS degree in Quantum Information Science (MSQIS) started in 2021
- Required foundational courses
  1. EE 520: Introduction to Quantum Information Processing
  2. EE 514: Quantum Error Correction
  3. Phys 513 (New): Applications of Quantum Computing
- Core—at least two courses from
  1. EE 589 (New): Quantum Information Theory
  2. Phys 550 (New): Open Quantum Systems
  3. Phys 559 (New): Quantum Devices
  4. Phys 660: Quantum Information Science & Many-Body Physics
- Phys 513: Application of Quantum Computing (co-taught with Prof. Rosa Di Felice)—quantum simulations on quantum circuits & adiabatic quantum annealer (syllabus)
- Phys 516, CSCI 596, CSCI 653: Core elective for MSQIS

CARC Tutorials & Office Hours

Series of tutorials + office hours (T, 2:30-5 pm, LVL 3L) at the USC Center for Advanced Research Computing (CARC):

- **Running deep learning applications on HPC systems**
- **Julia programming for HPC**
- **...**

https://carc.usc.edu

Students registered this week will get a CARC computing account

Question on HPCS courses?