Courses on High Performance Computing and Simulations (HPCS)

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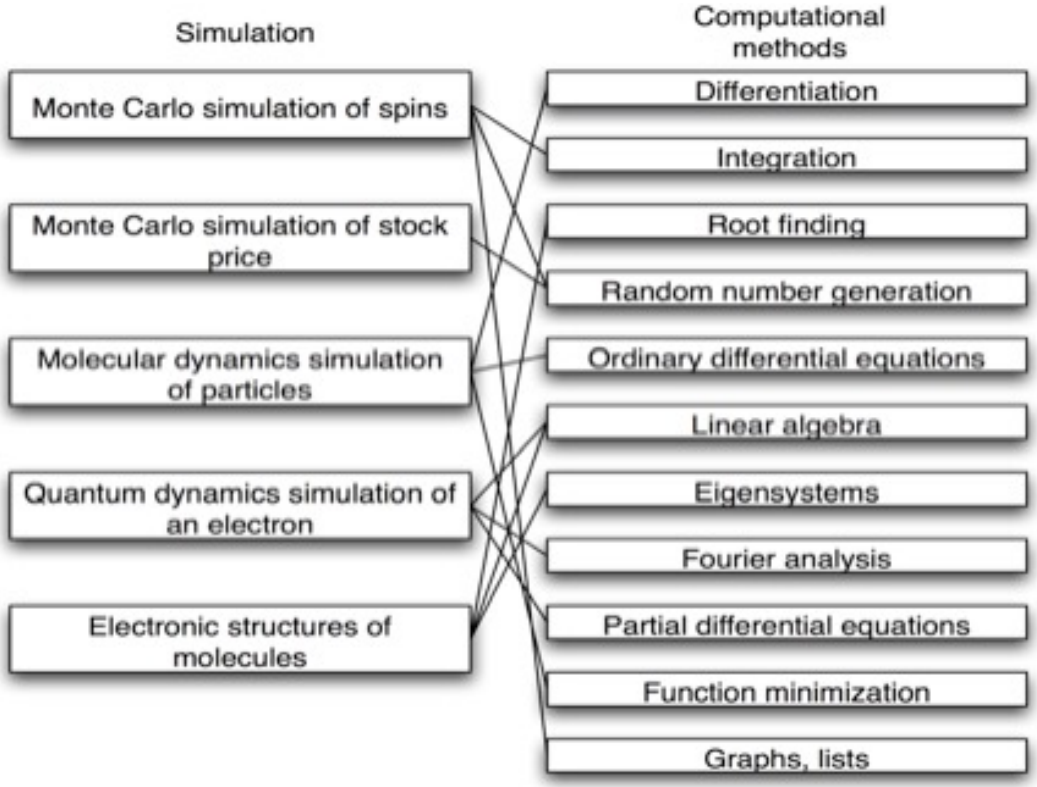
https://sites.usc.edu/cacs/teaching

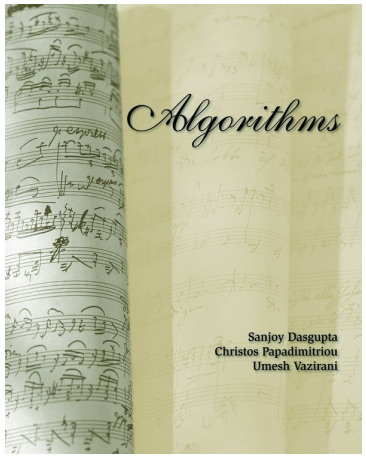
CACS HPCS Courses: Simulation!

- **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*
- **CSCI653: High Performance Computing & Simulations (25F, 28F)**
  Deterministic/stochastic simulation *algorithms*, scalable parallel/distributed computing & scientific data visualization/analytics in virtual environment



	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



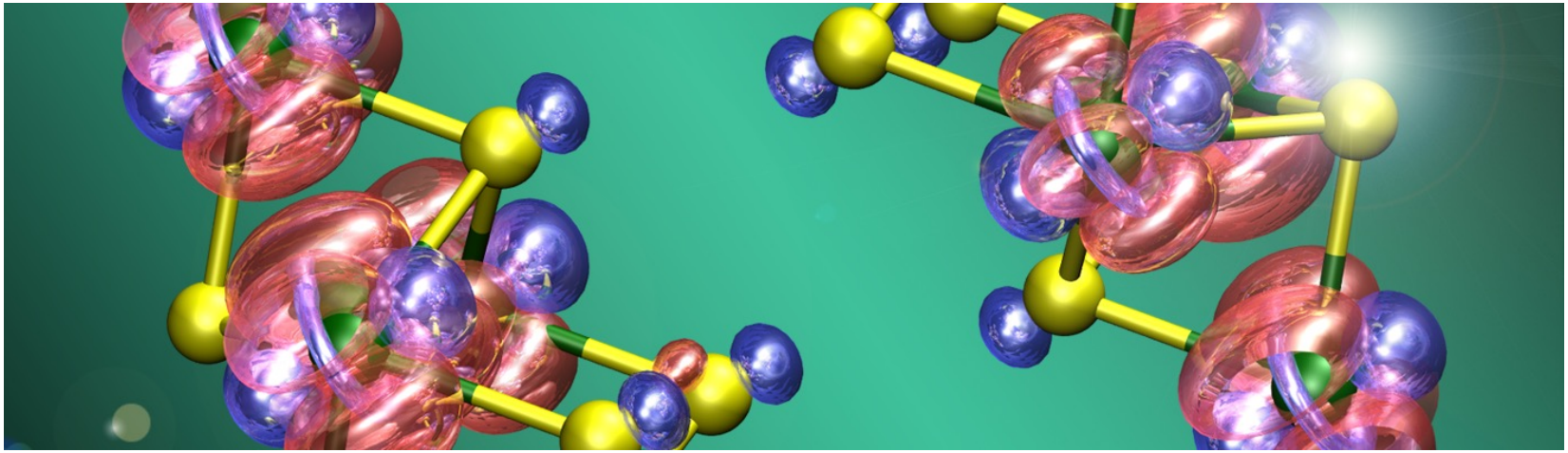
Additional HPCS Course

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

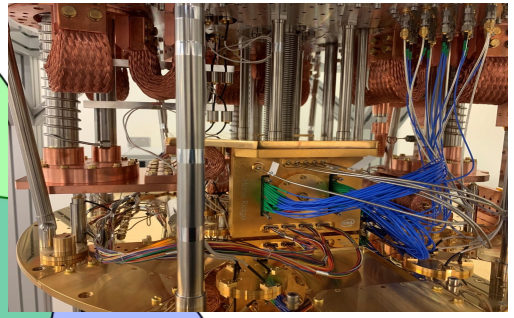
2. Basic knowledge of
   - Numerical methods (CSCI 501, PHYS 516 or equivalent)
   - Parallel computing—MPI, OpenMP, CUDA programming experience (EE 451 or equivalent)
   - 3D graphics—OpenGL programming experience (CS580 or equivalent)

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

Training Cyber Science Workforce

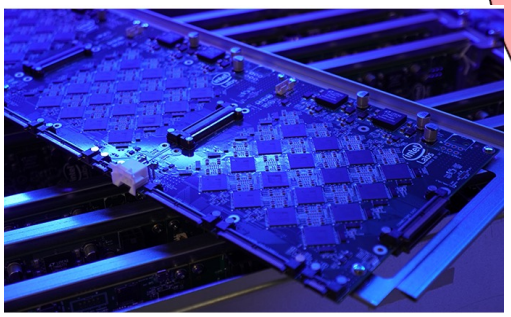
- New generation of computational scientists at the nexus of exascale computing, quantum computing & AI
- Unique dual-degree program at USC: Ph.D. in science or engineering, along with MS in computer science, quantum information science, or materials engineering with AI

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