High-Performance Computing Education and Workforce Development: Needs, Hurdles, and Solution Approaches

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Shortage of HPC Professionals

- Noted shortage of high-performance computing (HPC) professionals
  - Big data, medical informatics, scientific computation, AI, algorithm implementation, ...

- Necessary skills
  - Proficiency is basic programming
  - Algorithm development
  - Computer architecture
  - Domain specific expertise
    - Often paired with traditional “CS” graduate

- How to generate a pipeline of HPC professionals?
Fitting HPC into a B.S. Degree

- HPC brings together many different fields
  - Breadth of knowledge verses depth
  - Depth in specific application domain
- HPC courses typically taken in senior year
  - Technical electives
- ABET requirements
  - Fitting HPC into an ABET accredited program
  - Ensure students obtain necessary components
- Fitting into the 128-136 credit hour B.S. Degree
  - Cost and time considerations
Student’s Perspective

• What is HPC?
  • Often identifies interest in junior or senior year
• What courses should I take for HPC?
  • Do I have all of the pre-requisites?
  • I did not know I needed to take that introductory course.
• Is there a community of students interested in this area?
  • Study groups
  • Independent learning/user groups or clubs
• I need a road-map!
Univ. of Tulsa Approach

- Targets breadth of knowledge
  - Provide the foundation for further HPC study
  - Provide basis for employment in HPC field
- High-Performance Computing Minor
  - Tandy School of Computer Science
- Goals
  - Availability
  - Wide-range of majors
  - Road map for students from day 1
Univ. of Tulsa Approach: Availability

• Availability
  • Make available to as wide a range of majors as possible
    • Diverse range of domain expertise
  • Minimize additional course requirements
    • 15-credit hours
    • Reuse required courses
  • Inter-disciplinary approach exposes students to multiple application domains
• Majors with a road map – 16 majors so far
  • Applied Mathematics, Biochemistry, Biology, Chemical Engineering, Chemistry, Computer Science, Computer Simulation & Gaming, Electrical Engineering, Electrical & Computer Engineering, Engineering Physics, GeoPhysics, Geosciences, Information Technology, Mechanical Engineering, Petroleum Engineering, and Physics
Minor Structure

- Foundational Mathematics, 3-credit hours
  - Provide basic mathematical background for scientific computing
  - Linear Algebra or Numerical Methods
- Foundational Programming, 3-credit hours
  - Basic programming and algorithm design
    - Includes introduction to algorithm runtime analysis
    - Core knowledge to learn MPI or OpenMP
  - Several courses targets the 16 majors
- HPC Core, 3-credit hours
  - Parallel programming and basic HPC architecture
    - MPI and OpenMP
- Electives, 6-credit hours
  - Domain specific electives
  - Includes further study into aspects of HPC architecture
HPC Competition

- Raspberry PI cluster
  - 8 Raspberry PIs and other specified hardware
  - Software stack left up to each team
  - Experience building and using a cluster
- Community building opportunities
  - Identify HPC resources within Oklahoma
  - Network with students and faculty interested in HPC
- Hosted by The University of Tulsa – April 22, 2017
- Hands-on learning approach
  - Special 1-credit course developed to support
    - 3 credits of this course count as 1 Elective courses in HPC Minor
Open Discussion: HPC Education

• What topics are core for HPC?
• How to facilitate inter-disciplinary learning and projects?
• What are the different pathways that can be leveraged at the undergraduate level?
• How to fit HPC material into a 4-year graduate plan?
• How to fit HPC material into an ABET accredited undergraduate program?
Thank You

Questions?

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