

# SIGHPC Education Chapter

Meetings on December 16, 2014

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# Technology Logistics

- Presentation followed by question and answer
- Use the question button from Hangouts on Air to pose a question at any time
- Questions will be collected throughout the talk
- Will provide answers at end of the talk
- Note there are time delays between requests and replies because of the technology
- Entire session is recorded and available on YouTube
- Slides will be posted on the chapter website:  
<http://sighpceducation.acm.org/>

# Today's Agenda

- Overview of academic programs in computational and data sciences
  - Summary of the number and types of programs
  - Competencies embedded in a number of programs
  - Specific examples of different program types
  - Issues with program implementation and maintenance

# Information Sources

- Culling of lists provided by SIAM and others
- Internet search for programs
- Analysis of program websites
- Since the data come from the Internet, we know they are reliable
- Full listing available on HPCUniversity website  
<http://hpcuniversity.org/>

# Total Programs

U.S. vs. Foreign Programs					
		Frequency	Percent	Cumulative	
	Foreign	51	26.7	26.7	
	Domestic	140	73.3	73.3	
	Total	191	100.0	100.0	

# Undergraduate/Graduate

Undergraduate(U) or Graduate(G)?					
		Frequency	Percent	Cumulative Percent	
	Grad	157	82.2	82.2	
	Undergrad	34	17.8	100.0	
	Total	191	100.0		

# Undergrad Program Characteristics

- Majors – there are 12 programs with majors in one or more aspects of computational science
- Minors – there are 20 minor programs
  - The mean number of undergraduate credit hours is 19 (18 is most typical)
  - Minimum credit hours – 12
  - Maximum credit hours – 28

# Wide Range of Names

Domestic Undergraduate Program Names	
Applied Math	2
Bioinformatics/Comp. Biology	2
Computational Physics	3
Computational Engineering	2
Computational Science	11
Computational Thinking	1
Data Sciences*	3
Scientific Computing	1

\*Note: did not count business data science programs.  
Data science programs are undercounted.



# Program Competencies

- All programs require some mix of computer science, mathematics, and one or more domain sciences
- Mix varies by program type
- Competencies developed as part of several NSF grants and further work with the community can be a guide to program development
  - <http://hpcuniversity.org/educators/competencies/>

# Graduate Programs

- General programs in computational science or scientific computing – about 20 programs
- Next highest number in computational engineering
- Wide range of other programs focusing on specific domains

# Undergraduate Program Examples

- The Ohio State University – Minor in Computational Science
- 18 credit hours
- Core courses
  - Simulation and modeling
    - Choice of introductory course or domain specific options
  - Program and Algorithms
    - Programming for non-computer science majors
  - Numerical Methods
    - Choice of math and engineering courses
  - Capstone research or internship

# OSU Elective Courses

- Wide range across many disciplines

## Example Elective Courses - OSU Minor

CSE 3521 - Survey of Artificial Intelligence I: Basic Techniques

BMI 5730 - Introduction to Bioinformatics

CHEM 5440 - Introduction to Computational Chemistry

MATH 5651 - Mathematical Modeling of Biological Processes

PHYSICS 5740 - Quantitative Cell Biology for Engineers and Scientists

LING 5801 - Computational Linguistics

ECON 4050 - Experimental Economics

GEOG 5221 - Spatial Simulation and Modeling in GIS

PSYCH 5608 - Introduction to Mathematical Psychology

MATH 2568 - Linear Algebra

CSE 5441 - Introduction to Parallel Computing

CSE 5544 - Introduction to Scientific Visualization

CIVILEN 5168 - Introduction to the Finite Element Method

# Capital University Minor

- 21 credit requirement
- Core courses
  - Introduction to computer science
  - Calculus and modeling for biological sciences or calculus I
  - Computational science I
  - Differential equations and dynamical systems
  - Computational and numerical methods
  - Research experience

# Capital University Electives

- CSAC 394 - Comp Neuroscience and Psychology
- CSAC 392 - Computational Biology
- CSAC 391 - Computational Chemistry
- CSAC 393 - Computational Environmental Science
- CSAC 396 - Computational Physics

# University of Mary Washington

- Data sciences minor – 23 credit hours
- Required courses
  - Introduction to Statistics
  - Linear Algebra
  - Computer Science I
  - Data Mining
  - Modeling and Simulation

# Mary Washington Electives

- Computer Science II: Data Structures
- Analytics Application Development
- Foundations and Applications of Data Analytics
- Parallel Processing



# Program Organization

- Difficult to tell the administrative arrangements from the websites
- Two major groups
  - Inter-departmental agreements to teach courses and share students/credit hours
  - Lead or dedicated department that controls core courses and relevant instructional resources

# Program Issues

- Financial resources for interdisciplinary programs
- Disciplinary course pre-requisites
- Student minimization of effort to graduate
- Marketing

# Observations on Elements for Success

- Strong connections to research efforts and/or industry partnerships
- Strong group of participating faculty across multiple disciplines
- Increasing private sector push for qualified employees
- Flexibility in internal financial and appointment arrangements at institutions
- Possible endorsement by professional societies

# Questions and Discussion