Computational Science Certificates for the Current Workforce: Lessons Learned

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The Need for Computational Modeling

• Need for modeling echoed by national studies
  – HPC critical to the development of new products and services
  – Future competitiveness of US industry tied to effective integration of modeling and simulation
    • Improve products and create new products
    • Reduce the overall costs of product design and production
    • Reduce the time to get products to market
    • Innovate
Adoption of Technology Limited

• Only the largest firms have fully adopted this approach to doing business

• Adoption by smaller firms limited because of:
  – Cost of access to hardware
  – Cost of software licenses
  – Lack of expertise
Reducing the Barriers to Entry

• Ohio Supercomputer program focused on reducing the barriers by:
  – Providing secure access to computing hardware and software
  – Providing expert support
  – Providing training programs to increase workforce expertise

• Here we will focus on our experience with a new workforce certificate program
  – Program aimed at previous college graduates who need to learn modeling and simulation skills
Workforce Certificate Program

• Based on a combination of requirements for current undergraduate computational science programs in Ohio

• Provide a foundation in three subareas
  – Principles of modeling
  – Numerical and statistical methods
  – Programming concepts
  – Based on competencies from undergraduate programs (see http://rrscs.org)
## Basic Certificate Courses

<table>
<thead>
<tr>
<th>Course</th>
<th>Description</th>
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<tbody>
<tr>
<td>Introduction to Modeling and Simulation</td>
<td>General modeling principles; mathematical representations of relationships; using MATLAB for modeling exercises; visualizing model results; verification and validation; modeling group project</td>
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<tr>
<td>Computational Methods</td>
<td>Dealing with data; review of basic statistics and hypothesis testing; numerical methods for linear systems; empirical models and curve fitting; stochastic models; nonlinear methods for solving nonlinear equations; final statistical project</td>
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<tr>
<td>Programming</td>
<td>Application of programming and algorithms to science and engineering examples; Develop intermediate skills in C programming and program design</td>
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Advanced Certificates

• Advanced certificates focus on modeling of particular industrial processes

• Initially focused on polymer industry applications
  – Injection molding
  – Predicting polymer physical and chemical properties
  – Extrusion

• Courses to be offered in near future
Basic Certificate Implementation

- Courses offered through the workforce development offices of two community colleges
- Requirement for fully remote delivery to allow for participation across several communities
- Revised original materials to suit the environment and timeframe
  - Compressed time scale to suit the audience
  - Both synchronous and asynchronous materials for the students
  - Distribution of software for installation on student computers
Course Marketing

• Courses marketed by community college workforce development staff
  – Packaged into three course sequence
  – Brochure advertising the program
  – Regional radio broadcast about the program
Outcomes

• 31 people originally registered

• 16 dropped once they saw the full course content
  – Probably did not understand what the courses were about when they registered

• Significant dropout from other participants
  – Work related pressures
  – Personal life pressures
  – Under-prepared for content
  – Only six completed
Lessons Learned

• Long absence from academic life and unfamiliarity with terminology poses a significant start-up hurdle

• Work and life pressures for this population need to be considered in formulating course workload
  – Improved our expectations in the second course with better results

• Group projects worked poorly with this population

• Need for a slower startup phase and increased personal interaction
Conclusions

• Those that completed the courses found them to be a valuable addition to their skills

• There is demand for programs that focus on computational science skills for the existing workforce

• Meeting their needs will require different approaches to instruction and support
Acknowledgements

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