MS137: Training Students in Skills for CS&E

Educational Strategies for Training Students in
Vital Skills for Work in CS&E

Organizer: Matthias K. Gobbert

SIAM Conference on CSE 2011

02/28-03/04, 2011 – Friday 09:30-11:30

- *Jeff Humpherys*, Brigham Young University
- *Peter R. Turner*, Clarkson University
- *Eric J. Kostelich,* Arizona State University
- *Matthias K. Gobbert* and Nagaraj K. Neerchal, UMBC

Profiles

❑ **UMBC = University of Maryland, Baltimore County:**
- founded in 1966 as third research university in USM;
- 13,000 students (10,000 undergrad., 3,000 graduate);
- 480 research faculty in 33 departments;
- science and technology focus, particularly biology/medical research, plus Visual Arts, Public Policy, Psychology, Theatre;
- #1 "up-and-coming" for second year in US News & World Report

❑ **Department of Mathematics and Statistics:**
- 380 undergraduate majors, 50 B.A./B.S. per year;
- M.S./Ph.D. in Applied Mathematics and in Statistics;
- Applied Mathematics oldest graduate program at UMBC (first Ph.D. in 1975)!

Outline

Initiatives in the Department of Mathematics and Statistics at the University of Maryland, Baltimore County (UMBC):

- Center for Interdisciplinary Research and Consulting (CIRC) – *shown from perspective of graduate students!*

- UMBC High Performance Computing Facility (HPCF).

- REU Site: Interdisciplinary Program in High Performance Computing – Summers 2010 and 2011.

Center for Interdisciplinary Research and Consulting

Scientific Computing and Statistical Data Analysis

Department of Mathematics and Statistics
University of Maryland, Baltimore County
www.umbc.edu/circ
circ@umbc.edu

CIRC Directors:

**Dr. Nagaraj K. Neerchal and Dr. Matthias K. Gobbert**

Mission and Goals

- ❑ Established in 2003, CIRC is dedicated to support interdisciplinary research for the UMBC campus community and for outside industry researchers.

- ❑ CIRC provides a full range of consulting services on mathematics and statistics from free initial consulting to long term support for research programs.

- ❑ Mathematics and statistics students gain hands on interdisciplinary experience vital for industry and academia jobs.

Become a Member

- Students can become involved with CIRC through research assistantships, by taking Math/Stat 750, or other ways

- CIRC RA's participate in the daily consulting activities such as meeting with new clients, working on projects, and presenting project results to the client

- CIRC RA's also assist with developing and presenting software workshops and gain experience with business development

- Math/Stat 750 students work on specialized consulting projects as outlined in their course description and assist with other CIRC activities as needed

- All CIRC students meet weekly to review their projects and provide updates to the other CIRC students and center directors
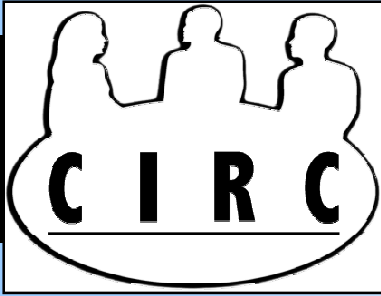
Software Workshops

- In collaboration with the Division of Information Technology (DoIT), CIRC provides hands-on workshops on various mathematical and statistical software packages including:
  - MATLAB, COMSOL, Mathematica, Microsoft Access, SAS, S-Plus, and SPSS.

- We offer both introductory workshops for first-time users as well as advanced workshops on more specialized features of the software packages.

- The workshops are taught interactively in an instructional computer lab at UMBC accompanied by tutorial handouts.

- CIRC RA's and Math/Stat 750 students continue to develop new software workshops including:
  - Maple, WINBUGS, R, Excel for Data Analysis

Sample Consulting Projects (1)

❑ **Statistical analysis of Baltimore storm water monitoring data**

Client: Dr. Upal Ghosh, Katie DiBlasi, Department of Civil and Environmental Engineering, UMBC

Consultants: Dr. Nagaraj K. Neerchal and Yan Zhuang

❑ **Modeling the Spread of Epidemic Cholera**

Client: Dr. David Hartley and Dr. Holly Gaff, Department of Epidemiology and Preventive Medicine, University of Maryland School of Medicine

Consultants: Alen Agheksanterian and Dr. Matthias K. Gobbert

❑ **Analysis of Failure Time Data in Cancer Patients**

Client: Mukund S. Didolkar, MD, Sinai Hospital of Baltimore

Consultants: Justin Newcomer, Willy Weng and Dr. Nagaraj K. Neerchal

Sample Consulting Projects (2)

❏ **Retention Rate and Academic Performance of UMBC Students**

Client: Learning Resources Center (LRC), UMBC

Consultants: Dr. Neerchal and Ines Urrestarazu

❏ **Validation of Drug Testing Software**

Client: John Shatley, Constellation Energy

Consultants: Alen Agheksanterian, Willy Weng, Dr. Gobbert, and Dr. Neerchal

❏ **Extrapolation of Maryland Child Support Table**

Client: Stuart Rehr, local resident

Consultants: Alen Agheksanterian and Dr. Gobbert

Testimonials from CIRC Clients

❑ "... [CIRC] has done an exemplary job on a project currently being conducted at Sinai Hospital involving Cyberknife Radiosurgery (CK) and pancreatic cancer. Their insight and help in doing this statistical work was invaluable. This is one of our first collaborative efforts involving Surgical Oncology and UMBC. It is my hope that this mutually fruitful relationship will materialize into a larger national protocol, which will certainly bring UMBC's name into the forefront of national group protocols ..."

  - Dr. Mukund S. Didolkar, MD, Director, Surgical Oncology,
    Sinai Hospital of Baltimore.

❑ "I had several opportunities to interact and get services from statisticians who were part of CIRC. I was very pleased with the professionalism and high quality scientific support. I recommend the services of the center to scientists, researchers, and businesses."

  - Dr. Uri Tasch, Professor of Mechanical Engineering, UMBC.

www.umbc.edu/circ

Other Activities

- CIRC was among the inaugural recipients of the Kauffman Foundation Innovation Grants just awarded through the Alex. Brown Center for Entrepreneurship at UMBC
  - www.umbc.edu/entrepreneurship/innovation_grants.html
  - Guan Wang and Yushu Yang were supported on this grant in Summer 2008 and helped develop a marketing plan for off-campus projects

- CIRC provides a weekly social hour (Friday 10:30 AM) for faculty and graduate students. CIRC provides coffee, tea, and a morning snack. This social hour provides a place for students and faculty to get to know each other better in a non-classroom environment.

Benefits for the Students (1)

❑ **Research and Job Opportunities**

Following his project in Math 750, *Using a Fourier Method to Solve a Convection-Diffusion Equation,* Zhibin Sun was hired as Research Assistant by Dr. Andrew Tangborn at the NASA Goddard Space Flight Center.

❑ **Products**

Microsoft Access database applications, computer programs, tutorials and training guides for software packages, free hands-on software workshops.

❑ **Student Involvement**

Justin Newcomer (Stat RA), Aaptha Murthy (Math RA), Alen Agheksanterian (Math RA), Martin Klein, Willy Weng, Aarti Gupta, Elizabeth Stanwyck (Stat RA), Shiming Yang (Math RA), Gaurav Sharma, Jia Liu, Mathangi Gopalakrishnan, Yan Zhuang, Guan Wang (Math RA), Yushu Yang, Xiaoshu Feng, Aaron Churchill (Math RA), Kyle Stern (Math RA), David Trott, Navy Sushon, Airong Yu, Andrew Raim (HPCF RA), and more …

Benefits for the Students (2)

- **CIRC Consultant of the Year Award:** Willy Weng 2007-2008, Yukun Wu 2008-2009, Airong Yu and Navy Sushon 2009-2010.

- **Conference Presentations (Examples)**

  Justin Newcomer and Will Gretes
  - Probability and Statistics Day, UMBC, April 28, 2007
    * *1st Prize Student Poster Competition*

  Justin Newcomer, Nagaraj K. Neerchal, and Barry Nussbaum
  - *EPA National Conference on Managing Environmental Quality Systems*. Austin TX, April 27, 2006

  Shiming Yang and Matthias K. Gobbert
  - *Department of Mathematics, U.S. Naval Academy*, 2008
 - *software tutorial on COMSOL with honorarium*

❑ **Research Publications (Examples)**

Ana Maria Soane, Matthias K. Gobbert, and Thomas I. Seidman, Numerical exploration of a system of reaction-diffusion equations with internal and transient layers, *Nonlinear Analysis: Real World Applications*, 6(5), 914-934, 2005.

P. A. Gurbel, K. P. Bliden, J. DiChiara, **J. Newcomer, W. Weng, N. K. Neerchal,** T. Gesheff, S. K. Chaganti, A. Etherington, U. S. Tantry, Evaluation of dose-related effects of aspirin on platelet function: results from the Aspirin-Induced Platelet Effect (ASPECT) study, *Circulation*, 115(25), 3156-3164, 2007.

Matthias K. Gobbert and Shiming Yang, Numerical demonstration of finite element convergence for Lagrange elements in COMSOL Multiphysics, In: Vineet Dravid, editor, *Proceedings of the COMSOL Conference 2008*.

Plus several more recently and technical reports for most projects!
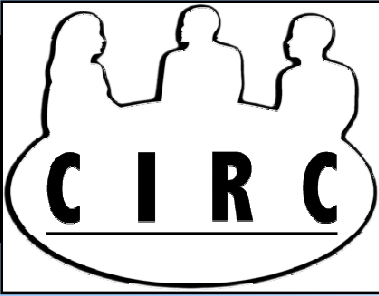
Testimonials from CIRC Students

- "During my Research Assistantship with CIRC during Spring 2006, I worked on various projects including one with Dr. David Salkever from the Public Policy Department at UMBC which involved modification of a C/C++ program. At the end of the semester, I landed an internship at multi-national company thanks to the experience and knowledge I gained during my time at CIRC."

    - Aaptha Murthy, CIRC Mathematics RA, Spring 2006.

- "... After joining CIRC, not only did I get involved in many interesting projects that helped build my resume, I also received credits for my work and am able to graduate a semester earlier than planned. ..."

    - Willy Weng, Stat 750 Student, Fall 2006.

www.umbc.edu/circ

Ingredients for Success

- **Chair's support:** financial, space (CIRC office), modest equipment (renovation, furniture, computer, travel)

- **Dean's support:** political, direction of college (interdisciplinary research)

- **Technical support:** accounting, legal, webpage hosting, e-mail address

- **Faculty volunteers:** (i) directors, (ii) mentors, (iii) clients, (iv) supporters

- **Persistence:** need to establish credibility through track record

- **Connections on campus:** credibility and trust of directors needed!

Benefits for the Department

- **Make scientific expertise of department available to campus and community:** see examples of consulting projects!

- **Synergy among programs:** Applied Mathematics and Statistics, graduate and undergraduate

- **Resource for support:** webpage, software workshops, help for conferences, workload report, income to department

- **Outreach:** (i) social hour used for promoting department to prospective students, visitors, administration (opinion leaders, e.g., new Provost!), (ii) special social hour for faculty candidates and during program reviews, (iii) free hands-on software workshops, (iv) Math/Stat 750 Consulting

- **Energy level in department! Unique feature of department!**

- **Student-centered philosophy:** REU Site, courses, programs, etc.!

High Performance Computing Facility

- Initiated by MRI proposal in Jan. 2007 that outlined the need for **(i) hardware, (ii) sys. admin, (iii) user support, and (iv) usage policies**

- MRI proposal successful in 2008 with 23 faculty in 10 departments across campus; plus SCREMS proposal for department (4 faculty)

- **2008 ("hpc"):** 33 compute, 1 develop, and 1 user/management node; two dual-core AMD Opteron processors and 13 GB memory per node; dual-data rate (DDR) InfiniBand; 14 TB central storage

- **2009 ("tara"):** 82 compute, 2 develop, 1 user, and 1 management node; two quad-core Intel Nehalem processors and 24 GB memory per node; quad-data rate (QDR) InfiniBand; 160 TB central storage

- **User support:** 2008-2010 full-time RA; post-doc hired in 2010

- **Coordinated community building:** Math 627 Parallel Computing, colloquium talks in departments across campus, tech. rep. server, meetings with administrators, follow-up grant proposals, etc.

REU Site: Interdisciplinary Program in High Performance Computing

- ❏ **NSF-funded** for 8 students for 8 weeks in Summers 2010 and 2011, additional students via UMBC Meyerhoff / NSA funded program

- ❏ **HPCF leveraged** by fully transferrable course Math 447 on scientific, parallel, and statistical computing course in Phase I (Weeks 1 to 3)

- ❏ **CIRC leveraged** by consulting with interdisciplinary clients (AT&T Labs, EPA, NIH, other departments) in Phase II (Weeks 3 to 8)

- ❏ All aspects of program in teams of participants, supported by graduate TAs/RAs (UMBC funded)

- ❏ **Participants diverse:** gender, race, universities vs. liberal arts colleges

- ❏ **Holistic approach:** GRE course, field trips, professional development workshops, lectures on LaTeX, CV, paper publication process, etc.

- ❏ **Deliverables:** (i) result to client, (ii) presentation at university-wide poster session, (iii) publications (HPCF tech. rep., SIURO, home institution, etc.)

Summary

CIRC (www.umbc.edu/circ) uses consulting framework as educational vehicle to introduce students to interdisciplinary work (workforce development), then leverages the framework:

❑ **Direct benefits:** synergy of our graduate programs, exposure of students to interdisciplinary research, publications and presentations, resource for work (webpage, support for conferences, social hour), community interaction, job opportunities for students, excitement!

❑ **Downstream benefits:**
   (i) High Performance Computing Facility (www.umbc.edu/hpcf),
   (ii) REU Site: Interdisciplinary Program in HPC (www.umbc.edu/hpcreu)

❑ **Consulting is one approach to training in CS&E**