Bringing Applied and Interdisciplinary Research into Computer Science Teaching and Mentoring

2013 Scholar Teacher Award Symposium

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Integration of Teaching and Research

- Teaching and research are two important components in high education
- Integrating research into teaching can improve teaching effectiveness
- Integrate research in teaching through
  - Research course projects
  - Introducing students into interdisciplinary research
Teaching and Research Interests

- **Teaching interests**
  - Database
  - Data Mining
  - Data Structures

- **Research interests**
  - Database
  - Data mining
  - Bioinformatics
Teaching Philosophy

- Teach students how to learn, not just what to learn
- Emphasize creative thinking and problem solving
- Meet the diverse needs of students and care about students
- Keep the knowledge up to date
- Be a role model and mentor to students
Integrate Research into Teaching in Data Mining

- Started as Special Topic course (CSCI 6905) and developed graduate course in Data Mining (CSCI 6840)
- Strategies in teaching-research integration
  - Integrating current research into curriculum
  - Student learning through research project
  - Connecting theory and applications
Integrate Research in Teaching through Course Research Project

- Term research project
  - Proposal, progress report, presentation, final report
- Strategies
  - Motivate students’ interest in research
  - Provide flexibility for topics
  - Help students choose the project with the right scale
  - Set up milestones
  - Provide resource, guidance, and feedback regularly
  - Provide continuing mentorship to students to expand the project beyond the course
Selected Student Course Research Projects

- Real-time spam-detecting on Twitter
- A data mining application for Facebook
- Classification of vehicle data for NCDOT
- Bayesian classification in combinatorial game theory
- Clustering on miRNAs
- Evolution and divergence of modern human population migration
Additional Strategies and Activities

- Promote creative thinking and in-depth discussions
- Incorporate research into reading and homework assignments
- Encourage student self-learning
- Invited talks
- Peer feedback among students
Mentoring Students on Applied and Interdisciplinary Research

- Supervise students on how to conduct research
  - Topic selection and creative research ideas
  - Literature review
  - Method
  - Implementation
  - Evaluation
  - Presentation and documentation
- Work closely with students
- Publish research results with students
  - Published 7 articles with 6 student coauthors in the last four years
Student Research Project
- *mirCancer: Text mining to extract relationships between miRNAs and cancer*

- M.S. thesis (by Boya Xie) – 2012 ECU Thesis Award 2\textsuperscript{nd} place
- Developed text mining method to automatically extract relationships between miRNAs and cancer from research literature at *pubmed* (with manual verification of the results)
- Developed web-based database for search on discovered relationships between miRNA and cancer
- Continue working with the student after she graduated
- *mirCancer* database available at: [http://mircancer.ecu.edu/](http://mircancer.ecu.edu/)
- Boya Xie - recipient of 2010 Google Anita Borg Scholarship
- Results published in *Bioinformatics* journal in 2013 ([link](http://bioinformatics.journal))
- Requests received from researchers around the world
### Search miRCancer Database

Search by miRNA name: **hsa-mir-218**

**And**

Cancer name: **gastric cancer**

**Search**

Example: mir-145, hsa-mir-21, let-7

Example: breast cancer, lung

#### Search result for miRNA = 'hsa-mir-218' And cancer = 'gastric cancer' Total: 3 relations found.

<table>
<thead>
<tr>
<th>miRNA</th>
<th>Family/Cluster</th>
<th>Cancer</th>
<th>Profile</th>
<th>PubMed Article</th>
</tr>
</thead>
<tbody>
<tr>
<td>hsa-mir-218</td>
<td></td>
<td>gastric cancer</td>
<td>down</td>
<td>Reduced microRNA-218 up-regulation is associated with high nuclear factor kappa B activation in gastric cancer.</td>
</tr>
<tr>
<td>hsa-mir-218</td>
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<td>hsa-mir-218</td>
<td></td>
<td>gastric cancer</td>
<td>down</td>
<td>Plasma microRNAs, miR-223, miR-21 and miR-218, as novel potential biomarkers for gastric cancer detection.</td>
</tr>
</tbody>
</table>
Student Research Project
- AlienG: A computational tool for identifying horizontal gene transfer candidates

- M.S. project (by Jing Tian)
- Motivated by collaboration between Computer Science and Biology (with Dr. Stiller and Dr. Huang)
- Developed computational approach and tool to identify horizontal gene transfer candidates based on sequence similarity search, genome taxonomy, and user specified criteria.
- AlienG being used by Dr. Huang’s research team in Biology
- Results published in a peer-reviewed conference proceedings and cited by some significant publications
- Jing Tian – coauthor of another publication in BMC Genomics
Other Mentorship Activities

- Mentor for undergraduate research supported by
  - ECU Undergraduate Research Award
  - ECU Research Development Award
- Supervisor for graduate student instructors
- Advisor for student leaders (ACM Student Chapter)
- Organizer/volunteer/mentor for STEM related outreach activities for middle and high school students (STEM Girls)
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