

**Mathematics & Computer Science  
at  
Goucher College**

**Handbook**

**Spring 2011**

Welcome to the Department of Mathematics and Computer Science at Goucher College! Whether you are a declared or prospective major, you probably have many questions concerning mathematics and computer science. You may be wondering about which courses to take, what career options await you, or what special programs the department offers. We hope that this handbook will help answer many of your questions and introduce the department to you. If you would like even more information, please do not hesitate to contact any member of the department.

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## MATHEMATICS AND COMPUTER SCIENCE AT GOUCHER COLLEGE

One of the pleasures of working in mathematics and computer science is that each of the disciplines is rich both in theory and in practical application. The Department of Mathematics and Computer Science strives to impart to its students an appreciation for this duality.

Goucher College students come to the department with various needs and backgrounds. For students who seek only an introductory familiarity with mathematics or computer science, perhaps to satisfy a general education requirement, the department offers a variety of elementary courses. Some of these courses are quite practical, while others have a more theoretical flavor, but they all endeavor to expose students to a broader view of mathematics or computer science.

Many students from other departments take mathematics and computer science courses in order to satisfy requirements in their majors. In such courses, instructors discuss suitable applications which enable students to see the connections among disciplines.

Then, of course, there are students who wish to focus primarily on mathematics or computer science while at Goucher College. For them, the department offers three majors:

- Mathematics (for students interested in graduate work in mathematics, as well as for those who intend to seek employment in areas such as actuarial science, finance, statistics, or operations research);
- Mathematics with Certification in Secondary Education (for those who wish to qualify for secondary school teaching certification by the Maryland State Department of Education);
- Computer Science (for students who wish to either pursue graduate work in computer science or careers in fields such as software engineering, web design and system analysis).

In addition, the department offers the opportunity to minor in either mathematics or computer science to those students who have a strong interest in these subjects but who have chosen to major in another discipline.

Finally, Goucher College and The Johns Hopkins University jointly offer a Three/Two Engineering Program which enables a student to earn both a B.A. from Goucher and a B.S. in Engineering from Hopkins at the end of five years.

The department strives to instill professionalism in its majors by encouraging them to choose suitable internships, join professional societies, attend professional meetings, and participate in appropriate research and academic competitions.

The department's intent is to play an active and supportive role in the intellectual development of Goucher students so that upon graduation they are, relative to their own chosen goals and objectives, competent and sophisticated in mathematics and computer science.

## MAJORS IN MATHEMATICS AND COMPUTER SCIENCE

The department offers three options in the major:

- I. The Mathematics Major
- II. The Concentration in Mathematics with Secondary Education Certification in Mathematics
- III. The Computer Science Major

### I. THE MATHEMATICS MAJOR

#### REQUIRED COURSES

|                  |     |  |
|------------------|-----|--|
| Mathematics      | 170 | Calculus I or 171 Calculus I - Environmental |
|                  | 180 | Calculus II                                  |
|                  | 221 | Linear Algebra                               |
|                  | 222 | Calculus III                                 |
|                  | 311 | Introduction to Higher Mathematics           |
|                  | 313 | Fundamentals of Real Analysis                |
|                  | 321 | Elements of Abstract Algebra                 |
| Computer Science | 116 | Introduction to Computer Science             |

Fifteen (15) additional credits in mathematics at either the 200 or 300 level, at least three (3) of which must be at the 300 level, are required.

Courses fulfilling the writing proficiency requirement in the major:

- Computer Science 245
- English 206
- Mathematics 260
- The senior thesis in mathematics

Courses recommended for students with interests in Applied Mathematics:

|             |     |  |
|-------------|-----|--|
| Mathematics | 216 | Introduction to Applied Mathematics      |
|             | 231 | Differential Equations with Applications |
|             | 240 | Probability                              |
|             | 241 | Statistics                               |
|             | 347 | Topics in Applied Mathematics            |

**NOTE:** A typical major of this type will complete:

- MA 170 and 180 in the Freshman Year
- MA 221 and 222 in the Sophomore Year
- MA 311 and either 313 or 321 in the Junior Year

## II. THE CONCENTRATION IN MATHEMATICS WITH SECONDARY EDUCATION CERTIFICATION IN MATHEMATICS

Students who choose this option qualify for secondary school teaching certification by the Maryland State Department of Education upon graduation.

### REQUIRED COURSES

|             |     |  |
|-------------|-----|--|
| Mathematics | 170 | Calculus I or 171 Calculus I - Environmental |
|             | 180 | Calculus II                                  |
|             | 221 | Linear Algebra                               |
|             | 222 | Calculus III                                 |
|             | 233 | Basic Concepts of Geometry                   |
|             | 240 | Probability                                  |
|             | 260 | History of Mathematics                       |
|             | 311 | Introduction to Higher Mathematics           |
|             | 313 | Fundamentals of Real Analysis                |
|             | 321 | Elements of Abstract Algebra                 |

Three (3) additional credits in mathematics at either the 200 or 300 level are required.

|           |     |   |
|-----------|-----|---|
| Education | 103 | Adolescent Development  |
|           | 207 | Psychological and Developmental Foundations of Education<br>(with field work) |
|           | 210 | Development and Education in the United States                                |
|           | 253 | Methods of Secondary School Teaching  |
|           | 254 | Reading and Assessment in the Secondary School                                |
|           | 353 | Observation and Student Teaching in the Secondary School                      |

|                   |     |  |
|-------------------|-----|--|
| Special Education | 100 | Historical, Philosophical, and Legal Foundations |
|-------------------|-----|--|

|                  |     |                                  |
|------------------|-----|----------------------------------|
| Computer Science | 116 | Introduction to Computer Science |
|------------------|-----|----------------------------------|

The writing proficiency requirement in the major is automatically satisfied by MA 260. No further course needs to be taken to satisfy this requirement.

**NOTE:** A typical major of this type will complete:

- MA 170 and 180 in the Freshman Year
- MA 221 and 222 in the Sophomore Year
- MA 311 and either 313 or 321 in the Junior Year

### III. THE COMPUTER SCIENCE MAJOR

#### REQUIRED COURSES

|                  |     |                                     |
|------------------|-----|-------------------------------------|
| Computer Science | 116 | Introduction to Computer Science    |
|                  | 119 | Foundations of Computer Science     |
|                  | 220 | Computer Architecture               |
|                  | 224 | Principles of Programming Languages |
|                  | 230 | Analysis of Algorithms              |
|                  | 250 | Theory of Computation               |

|             |     |  |
|-------------|-----|--|
| Mathematics | 170 | Calculus I or 171 Calculus I - Environmental |
|-------------|-----|--|

Four (4) of the following with at least three (3) at the 300 level:

|                  |     |  |
|------------------|-----|--|
| Computer Science | 240 | Digital Logic Design   |
|                  | 245 | Software Engineering   |
|                  | 311 | Operating Systems  |
|                  | 317 | Database and Transaction Systems                                       |
|                  | 320 | Computer Graphics  |
|                  | 325 | Topics in Computer Science ( <i>may be repeated if topic changes</i> ) |
|                  | 340 | Principles of Artificial Intelligence                                  |

Courses fulfilling the writing proficiency requirement in the major:

- Computer Science 245
- English 206
- Mathematics 260
- The senior thesis in computer science

**NOTE:** A typical computer science major will complete:

CS 116 and 119 in the Freshman Year  
 MA 170 by the end of the Sophomore Year  
 CS 220, 224, 230 and 250 by the end of Junior Year

Students who do not adhere to this schedule may have to take summer courses.

**MINORS IN MATHEMATICS AND COMPUTER SCIENCE**

**THE MATHEMATICS MINOR**

**REQUIRED COURSES:**

|             |     |  |
|-------------|-----|--|
| Mathematics | 170 | Calculus I or 171 Calculus I - Environmental |
|             | 180 | Calculus II                                  |
|             | 221 | Linear Algebra                               |
|             | 222 | Calculus III                                 |
|             | 311 | Introduction to Higher Mathematics           |

Nine (9) additional credits in mathematics at either the 200 or 300 level, at least three (3) of which must be at the 300 level, are required.

**THE COMPUTER SCIENCE MINOR**

**REQUIRED COURSES**

|                  |     |                                  |
|------------------|-----|----------------------------------|
| Computer Science | 116 | Introduction to Computer Science |
|                  | 119 | Foundations of Computer Science  |

Any two (2) courses from

|                  |     |                                     |
|------------------|-----|-------------------------------------|
| Computer Science | 220 | Computer Architecture               |
|                  | 224 | Principles of Programming Languages |
|                  | 230 | Analysis of Algorithms              |
|                  | 250 | Theory of Computation               |

Nine (9) additional credits at the 200 or 300 level, at least three (3) of which must be at the 300 level are required.

### THE THREE/TWO ENGINEERING PROGRAM

The Three/Two Engineering Program at Goucher College and The Johns Hopkins University enables a student, after three (3) years at Goucher followed by two (2) years at Johns Hopkins, to earn a B.A. from Goucher College and a B.S. in Engineering from The Johns Hopkins University. Programs have been developed in:

- Computer Science and Computer or Electrical Engineering
- Mathematics and Mechanical Engineering
- Mathematics and Civil Engineering

All students in the 3/2 Engineering Program should complete the following courses at Goucher:

|                  |   |
|------------------|---|
| Mathematics      | 170 Calculus I or 171 Calculus I – Environmental<br>180 Calculus II<br>221 Linear Algebra<br>222 Calculus III<br>231 Differential Equations |
| Computer Science | 116 Introduction to Computer Science  |
| Physics          | 125H General Physics I<br>126H General Physics II   |
| Chemistry        | 111/112 Chemistry I<br>151/152 Chemistry II   |

Students who are interested in Civil Engineering should take Economics 101 (Microeconomics). Students who are interested in Mechanical Engineering should take either Economics 101 or 102 (Macroeconomics).

**NOTE:** A typical student will complete:

- One (1) year of calculus in the Freshman Year
- One (1) year of physics OR chemistry in the Freshman Year
- MA 221 and 222 in the Sophomore Year
- One (1) year physics OR chemistry in the Sophomore Year

The following courses should be taken at Hopkins during the student's third year at Goucher:

|                                    |   |
|------------------------------------|---|
| Civil and Mechanical Engineers:    | 560.201 Statics (Fall)<br>560.202 Dynamics (Spring)                     |
| Electrical and Computer Engineers: | 520.213 Circuits (Fall)<br>520.142 Digital System Fundamentals (Spring) |

Students interested in pursuing the Three/Two Program are encouraged to speak with Dr. Jill Zimmerman for details on the various programs. This program is highly demanding and its completion in five years may be possible only if a student is exempt from some introductory courses (e.g., the student places directly into the second semester of a foreign language or the second semester of calculus).

**SCHEDULE OF COURSES IN MATHEMATICS AND COMPUTER SCIENCE**

----- COURSES OFFERED EVERY YEAR -----

|   | Fall Semester  | Spring Semester  |
|---|--|--|
| <b>Math</b>   | MA 100 Topics in Contemporary Mathematics                          | MA 100 Topics in Contemporary Mathematics                          |
|   | MA 110 Problem Solving and Mathematics: Algebra                    | MA 113 Problem Solving and Mathematics: Geometry                   |
|   | MA 141 Statistical Data Analysis with Environmental Issues in View | MA 141 Statistical Data Analysis with Environmental Issues in View |
|   | MA 160 Precalculus   | MA 160 Precalculus   |
|   | MA 170 Calculus I  | MA 170 Calculus I  |
|   | MA 171 Calculus I - Environmental                                  | MA 180 Calculus II [MA 170 or MA 171]                              |
|   | MA 180 Calculus II [MA 170 or MA 171]                              | MA 221 Linear Algebra [MA 180 or MA 190]                           |
|   | MA 216 Introduction to Applied Mathematics [MA 180]                |  |
|   | MA 222 Calculus III [MA 180]                                       |  |
| MA 311 Introduction to Higher Mathematics [MA 221 and MA 222] |  |  |
| <b>CS</b>   | CS 116 Introduction to Computer Science                            | CS 105 Explorations of Computer Programming                        |
|   | CS 325 Topics in Computer Science [CS119 and Junior standing]      | CS 119 Foundations of Computer Science [CS 116]                    |
|   |  | CS 325 Topics in Computer Science [CS119 and Junior standing]      |

Courses shown in *[brackets]* are prerequisites.

----- COURSES OFFERED IN 2010-2011 AND ALTERNATE YEARS -----

|             | Fall Semester   | Spring Semester  |
|-------------|---|--|
| <b>Math</b> | MA 240 Probability [MA 180]   | MA 241 Statistics [MA 240]   |
|             | MA 315 Topics in Pure Mathematics [MA 311 and permission of the instructor] | MA 260 History of Mathematics [MA 221 and MA 222]<br>MA 313 Fundamentals of Real Analysis [MA 311] |
| <b>CS</b>   | CS 230 Analysis of Algorithms [CS 119]                                      | CS 250 Theory of Computation [CS 119]  |
|             | CS 245 Software Engineering [CS 119]  | CS 317 Database and Transaction Systems [CS 119] (starting S2013)                                  |
|             |   | CS 320 Computer Graphics [CS 119 and Junior standing]  |

----- COURSES OFFERED IN 2011-2012 AND ALTERNATE YEARS -----

|             | Fall Semester  | Spring Semester   |
|-------------|--|---|
| <b>Math</b> | MA 347 Topics in Applied Mathematics [MA 221, 222, and permission of the instructor] | MA 231 Differential Equations with Applications [co-requisites MA 221 and MA 222] |
|             |  | MA 233 Basic Concepts of Geometry [MA 221 or MA 222]                              |
|             |  | MA 321 Elements of Abstract Algebra [MA 311]                                      |
| <b>CS</b>   | CS 220 Computer Architecture Programming [CS 119]                                    | CS 224 Principles of Programming Languages [CS 119]                               |
|             | CS 340 Principles of Artificial Intelligence [CS119 and Junior Standing]             | CS 240 Digital Logic [CS 220]   |
|             |  | CS 311 Operating Systems [CS 119]   |

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## RECENTLY TAUGHT COURSES IN OUR “TOPICS” COURSES

### MA 216 Introduction to Applied Mathematics

- Mathematical Modeling with Applications in the Natural Sciences (Spring 2009, Fall 2010)
- Mathematical Modeling of the Environment (Spring 2008)
- Graph Theory (Fall 2006, Spring 2002)
- Discrete Dynamical Systems (Fall 2003, Fall 2005)

### MA 315 Topics in Pure Mathematics

- Cryptology (Fall 2002, Spring 2005, Spring 2010).
- Number Theory (Fall 2008)

Possible topics for the future include: point set topology, number theory, coding theory.

### MA 347 Topics in Applied Mathematics

- Numerical Methods and Analysis with Applications (Fall 2007, Fall 2009)
- Calculus of Variations: An Introduction to Optimal Control (Fall 2005)
- Partial Differential Equations (Fall 2003, Fall 1999)
- Chaotic Dynamical Systems (Fall 2001)
- Mathematical Modeling (includes stochastic processes and theoretical and numerical methods of ordinary and partial differential equations) (Spring 2000)
- Fractal Geometry and Chaos Theory (Fall 1999)

Possible topics for the future include: elementary differential geometry, financial mathematics

### CS 325 Topics in Computer Science

- Mobile Device Programming (Fall 2010)
- Robotics (Fall 2007)
- Data Mining (Spring 2007)
- Computing Security (Fall 2006, Spring 2010)
- Interaction Design (Fall 2005)
- Computer Game Programming (Spring 2005, Fall 2008)
- Compiler Design (Spring 2006, Spring 2004)
- Operating Systems (Spring 1998, Fall 2003, Spring 2009)
- Database and Transaction Processing Systems (Spring 2002, Fall 2004, Spring 2009)
- Computer Networking (Spring 2000, Spring 2008, Spring 2011)

## INTERNSHIP PROGRAM

Internships are a very important facet of the curriculum at Goucher College. As such, the mathematics and computer science faculty members consider well-structured internships to be essential to a student's education. The variety of internships that have been completed under the supervision of this department is evidence of the flexible and creative applicability of degrees in both mathematics and computer science. Students find internship opportunities through the Career Development Office, through faculty and staff members, or on their own.

The following are descriptions of some recent internships in mathematics and computer science:

- Two students participated in the University of Maryland's Research Internship in Science and Engineering. One of them designed a web-based tool for collecting data on pedestrian activity, while the other worked with an interdisciplinary group in meteorology.
- A student participated in a summer actuarial internship with the Social Security Administration, where she worked in the Medicare and Medicaid Cost Estimates Group. The internship continued into the academic year with the expectation that the student will be hired into this department upon graduation from Goucher College.
- A computer science major designed an online employment application for a small business using a MySQL database, HTML and PHP.
- A computer science major working for Comprehensive Physics and Regulatory Services developed a new corporate Web site, designed and implemented a new office network, and provided support for corporate servers.
- A computer science major re-designed a 300-page website for the Maryland Psychiatric Society. He converted 70 articles from Microsoft Publisher format into HTML by using Microsoft Frontpage, and uploaded them onto the site. He also added a site-searching mechanism, and then registered the site with various search engines.
- A mathematics and computer science double major worked at the Johns Hopkins University Applied Physics Lab in the Combat Systems Evaluation Lab, programming a GUI window as part of an interface with a large tactical display system being developed for the Navy and Joint Forces.
- A computer science student interned at Lockheed Martin Information Technology, helping to set-up and then maintain a network infrastructure that supports a \$400 million government contract with the Centers for Medicare and Medicaid Services.
- A computer science major completed an Internship with Plutonian Shore Productions, a small web hosting and design company, as a database specialist. Telecommuting from home, his job was to design and implement an SQL database, and to integrate this database into a web page.
- A 3-2 engineering major worked on improving current text-to-speech and speech recognition techniques using a rules based approach as opposed to strict combinations of statistical and corpus analysis. His duties included developing a model of the Human Vocal Production system and devising data structures for the learning and active phases of the model.

- A mathematics and computer science double major took part in the Director's Summer Program at the National Security Agency. She worked with other mathematics and computer science undergraduate students to solve applied mathematics problems.
- A mathematics major and a mathematics and computer science double major worked with a Goucher College physicist to write software to test thermal calculations of high temperature superconductors.
- A mathematics major completed an internship under the National Science Foundation's Research Experience for Undergraduates program at Johns Hopkins concerning the use of Monte Carlo simulation techniques in the study of neuroscience.
- A computer science major worked on the SPARTA (Simulation of Physics on A Real Time Architecture) project at the Pennsylvania State University. The goal of the project was to develop specialized hardware that would greatly accelerate physical modeling.
- A computer science student worked at the American Festival of Microtonal Music, setting up and configuring a computer. She installed several specialized applications, removed viruses from old systems, and provided help desk support.
- A computer science major worked on the Chemistry Animation Project at the California Institute of Technology on software which assists in creating and animating three-dimensional objects.
- Another computer science major found an internship at Stanford Research Institute in California and was involved in a project which creates an on-line environment for collaboration among K-12 educators.
- A number of computer science majors have worked as interns at United Parcel Service in various departments. Some examples of their assignments include:
  - working with a software testing team, performing applications and system performance testing
  - developing user interfaces for software used to dispatch UPS drivers
  - working as a support analyst and specifications writer
- A mathematics and computer science double major worked as a summer intern at the University of Utah, doing research in text classification, an area of artificial intelligence.
- A computer science minor worked as an intern for IBM in Burlington, Vermont, measuring and recording the performance results of new computer hard disk drive components.

A detailed description of the Off-Campus Experience is published by the Career Development Office at Goucher each year and fully describes the guidelines and timetable for internships. Students interested in arranging an internship in mathematics or computer science should contact their individual academic advisors.

## INDEPENDENT RESEARCH

Undergraduates studying mathematics and computer science have the opportunity to investigate individual academic interests in a variety of ways, especially through independent study and senior thesis research.

Independent study and senior thesis research allow advanced students to pursue research topics of their own selection, with the guidance of a faculty sponsor. The department especially encourages students who are considering graduate studies or honors in the major to explore this possibility. Interested students should consult their advisor or any faculty member about research opportunities.

Recent mathematics research topics include theoretical considerations in differential equations, fractal geometry, dynamical systems, and biomathematics. Recent computer science topics include artificial intelligence and digital circuit design. One double major combined mathematics and computer science in a study of statistical pattern recognition.

Advanced courses in the major may lead to additional opportunities such as presentations at local meetings of professional societies. For example, students in MA 347 (Topics in Applied Mathematics) presented papers on game theory at a meeting of the Mathematical Association of America.

Professor Koch involves students in her biomathematics research program through independent summer research and independent studies. Current work involves modeling gastric emptying in children, and future work will include an expanded model of human digestion. A recent student presented his work at a national meeting in 2007 and won a national award. Funding for the summer research has been made possible through Goucher's summer research program in the Sciences and a Center for Undergraduate Research in Mathematics Mini-Grant sponsored by the National Science Foundation and Brigham Young University. Interested students should contact Professor Koch.

A group of students is participating in a project which involves turning an old soda vending machine into a "networked appliance." This means that the soda machine will be controlled entirely by a computer running Linux. The Computer will be programmed to handle basic operations of processing money, handling selection, and activating the dispenser. To accomplish this task, students will design a hardware interface so that the computer can control the soda machine. Once this has been achieved, new functionality will be added, including local debit accounts for cash-less vending and a web server hosting the machine's web page. The web page would then be used as an interface for several additional functions, such as inventory information, sales statistics, soda reservations, and debit account information. Other possible additions include a web-cam, which could place images of the customers on the web. Students who are interested in becoming part of this project should contact Professor Kelliher.

## INDEPENDENT STUDY

Students who wish to pursue an area not covered in the ordinary curriculum have the option of arranging an independent study with a faculty member in the department. In recent years, some topics studied have been Partial Differential Equations (Fall 1999), Point Set Topology (Fall 2000, Spring 2001), Measure Theory (Fall 2001, Spring 2002), Theory of Differential Equations (Fall 2001), Nonlinear Dynamics (Fall 2004, Spring 2005), Complex Variables (Fall 2007, Spring 2008) and Biomathematical Modeling of Human Digestion (Spring 2009, Spring 2010). . All of these have

been conducted at a beginning graduate level. Nonetheless, independent study at a more traditional undergraduate level is also possible.

## HONORS IN MATHEMATICS AND COMPUTER SCIENCE

Majors in the Department of Mathematics and Computer Science are encouraged to strive for honors in the major upon graduation. Departmental honors will be awarded to students who exhibit mastery of the subject in both course work and additional academic endeavors.

### Requirements for honors in mathematics and in computer science:

- 1) A minimum grade point average of 3.6 in 200 and 300 level courses in the major. All courses (other than CS 290 ) specifically required for the major must be taken for a grade. No more than two approved courses away from Goucher will be counted in the average.
- 2) Some evidence of maturity and creativity in mathematics and/or computer science, such as outstanding work on a senior thesis, independent work, paper or final examination in a 300 level course.
- 3) Approval of the department.

## SPECIAL PRIZES AND AWARDS IN MATHEMATICS AND COMPUTER SCIENCE

### THE MARIAN M. TORREY PRIZE

The Marian M. Torrey Prize is awarded to senior majors in mathematics who are selected by the department for their excellent records, firm grasp of subject matter, creative imagination, incisive thinking, and ability to present ideas clearly.

### THE MARY KATHERINE BOONE EKin PRIZE

The Mary Katherine Boone Ekin Prize is awarded to a senior majoring in computer science who is considered to have an excellent grasp of both theoretical and applied aspects of the subject. The criteria for the award include high achievement in course work and the ability to interpret the concepts of computer science in creative and imaginative ways.

### THE PEARL DAVIS LEAVITT PRIZE

The Pearl Davis Leavitt Prize is awarded to a mathematics major other than a graduating senior who has exhibited meritorious achievement in mathematics courses beyond the freshman level and who is judged to have outstanding potential for further high achievement in the discipline.

### THE MATHEMATICS WRITING PRIZE

The Mathematics Writing Prize is awarded annually to a student who has demonstrated excellence in the exposition of classical mathematics. The winner is determined by a contest which is open to majors and nonmajors.

## PLACEMENT AND EXEMPTION PROCEDURES

The department strives to place students in mathematics and computer science courses which are appropriate to their backgrounds. For this reason several placement and exemption procedures are available. The placement process is usually completed the summer before a student first enrolls at Goucher College.

### ADVANCED PLACEMENT

Students who have scored a grade of four (4) or five (5) on the appropriate AP examination in high school will be exempted from the corresponding courses with credit.

| AP Examination      | Goucher Credit | Course Exemption  | Course Placement  |
|---------------------|----------------|-------------------|---|
| Computer Science A  | 3              | CS 116            | CS 119  |
| Computer Science AB | 6              | CS 116 and CS 119 | 200-level Computer Science  |
| Calculus AB         | 4              | MA 170            | MA 180<br>Fulfills college mathematics requirement  |
| Calculus BC         | 8              | MA 170 and MA 180 | MA 221 or MA 222, or any course for which MA180 is a prerequisite<br>Fulfills college mathematics requirement |
| Statistics          | 3              | None              | Fulfills college mathematics requirement  |

### PLACEMENT EXAMINATION I: ALGEBRA

All incoming students who are not exempt from the collegewide mathematics requirement are required to take an on-line placement exam to determine their proper placement in an initial mathematics course. The exam may be found at the following URL: <http://meyerhoff.goucher.edu/webplacement/InstructionsMath.aspx?testType=Math>. Directions for taking the exam are distributed to incoming students prior to their first registration at Goucher College.

### PLACEMENT EXAMINATION II: CALCULUS

Students who have studied calculus in high school but have not received AP credit may still be able to exempt Calculus I (MA 170) and place directly into Calculus II (MA 180). Particularly well-prepared students may even be able to place into Calculus III (MA 222). The department's own placement exam is used to evaluate such requests and is encouraged for all students who have studied calculus. This placement examination is available online (see URL above) and also by mail during the summer before freshman year and in the Associate Dean's office thereafter.

### **POLICY ON NON-GOUCHER COURSES**

A student majoring in mathematics or computer science who has either withdrawn from or does not receive a C- or better in required courses in the major will not ordinarily be permitted to fulfill the requirement with a course outside of the department.

Any student requesting an adjustment to the policy must submit a petition through the department chair.

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**MATHEMATICS & COMPUTER SCIENCE FACULTY**

| <b>Name</b>                                     | <b>Office</b> | <b>Telephone Extension</b> | <b>E-mail address</b>          |
|---|---------------|----------------------------|--------------------------------|
| Cutrone, Joseph<br>Visiting Assistant Professor | HOF 142       | 6317                       | joseph.cutrone@goucher.edu     |
| Kelliher, Thomas<br>Associate Professor         | HOF 140       | 6189                       | thomas.kelliher@goucher.edu    |
| Koch, Gretchen<br>Assistant Professor           | HOF 132       | 6541                       | gretchen.koch@goucher.edu      |
| Lewand, Robert<br>Professor                     | HOF 130       | 6239                       | robert.lewand@goucher.edu      |
| McKibben, Mark<br>Associate Professor           | HOF 122       | 6281                       | mark.mckibben@goucher.edu      |
| Tutinas, Bernadette<br>Associate Professor      | HOF 124       | 6241                       | bernadette.tutinas@goucher.edu |
| Webster, Micah<br>Assistant Professor           | HOF 119       | 6336                       | micah.webster@goucher.edu      |
| Zimmerman, Jill<br>Professor                    | HOF 120       | 6227                       | jill.zimmerman@goucher.edu     |

**ADVISORS**

Professor Tutinas

-Mathematics majors and minors

Professor Zimmerman

-Computer Science majors and minors

## THE FULL-TIME FACULTY

### THOMAS P. KELLIHER

|        |   |                               |
|--------|---|-------------------------------|
| B.E.S. | (Electrical Engineering and Computer Science) | The Johns Hopkins University  |
| Ph.D.  | (Computer Science)                            | Pennsylvania State University |

For as long as I can remember, I've enjoyed taking things apart, studying how they worked, and putting them back together again. (Fortunately, I'm pretty good at the latter!) I enjoy Computer Science because it gives me the opportunity to take problems apart and solve them by applying the techniques of our discipline in novel ways. I use the same techniques in my teaching—breaking problems into pieces so that students may see how everything fits together. Along the way, I've helped to design and build two mainframes and three special-purpose supercomputers. Recent research interests include affordable tera-op computing and applications, new techniques for increasing the instruction throughput in multimedia and general purpose processors, and the World Wide Web as a communication medium.

### GRETCHEN A. KOCH

|       |                       |                                  |
|-------|-----------------------|----------------------------------|
| B.S.  | (Mathematics)         | St. Lawrence University          |
| M.S.  | (Applied Mathematics) | Rensselaer Polytechnic Institute |
| Ph.D. | (Mathematics)         | Rensselaer Polytechnic Institute |

I have enjoyed mathematics for as long as I can remember. My parents made math a part of our everyday lives. Everyone can relate to having a parent count to three if you are doing something wrong. For most, not stopping whatever you were doing before Mom or Dad got to three meant you were in trouble. In our house, if Mom got to  $2\frac{3}{4}$ , you were in trouble. If she made it to  $2\frac{7}{8}$ , forget about it. All of these things taught me that math has applications in the real world; as an applied mathematician, I use math to model real phenomena. As a teacher, I try to relate the topics in lecture to things that happen in our world.

My research can be categorized as biomathematics. I created two computer models of cell division in *E. coli* depicting the system that decides where the middle of the cell lies. This system, the MinCDE system, is a fascinating interplay of oscillating polymers. One of the aspects of my research that I enjoy the most is that it is interdisciplinary, since I have the opportunity to work with biochemists and see my work come to life in the laboratory.

### ROBERT EDWARD LEWAND

|       |                    |                              |
|-------|--------------------|------------------------------|
| B.S.  | (Mathematics)      | The University of Dayton     |
| M.S.  | (Computer Science) | The Johns Hopkins University |
| Ph.D. | (Mathematics)      | The University of Virginia   |

Though still very much interested in abstract algebra, my attention has shifted in recent years to the subjects of artificial intelligence and cryptology. I have written on both subjects and have been involved in writing expert systems in the field of psychiatry, ophthalmology, information retrieval, and computer system configuration. Interested in interdisciplinary applications of mathematics, I have organized sessions on cryptology, music and sports at meetings of the Mathematical Association of America.

MARK A. McKIBBEN

|       |               |                 |
|-------|---------------|-----------------|
| B.S.  | (Mathematics) | Ohio University |
| Ph.D. | (Mathematics) | Ohio University |

From leaping off the garage roof as a child, umbrella in hand, in order to investigate the effects of this “parachute” on my descent, through my teenage involvement with NASA on a space shuttle biology project, to a discussion of a stochastic model describing the dynamic buckling of an elastic beam, my quest to discover the “answer” to the questions “Why?” and “How?” has been a significant driving force. Such experiences, coupled with the love of explaining concepts in a way that instills the desire to learn, have had the most significant influence on my teaching. My research interests lie in differential and integral equations, as well as stochastic analysis. I have not only enjoyed doing research in these fields, but also delivering lectures at both national and international mathematics conferences.

BERNADETTE R. TUTINAS

|       |                                    |                     |
|-------|------------------------------------|---------------------|
| B.A.  | (Mathematics and Computer Science) | New York University |
| M.S.  | (Mathematics)                      | Rutgers University  |
| Ph.D. | (Mathematics)                      | Rutgers University  |

As an undergraduate, I was a double major in mathematics and computer science. Although I enjoyed both subjects, I opted for graduate work in mathematics. Now, as a teacher, I find myself mixing the two disciplines once again. Since mathematics and computer science are so intimately related, I feel that my teaching in each subject benefits from my familiarity with the other. My main areas of interest in both subjects tend toward the more abstract. Indeed that has always been the case. My doctoral dissertation was in finite group theory, a branch of abstract algebra. In computer science I am drawn to the subjects of data structures and analysis of algorithms. Lately, however, I find myself more and more intrigued by applied mathematics, especially problems addressed through discrete techniques. Nonetheless, my main goal as a teacher remains to show students how to see individual problems as part of a greater, more abstract whole.

MICAH WEBSTER

|       |               |   |
|-------|---------------|---|
| B.S.  | (Mathematics) | University of North Carolina at Chapel Hill |
| Ph.D. | (Mathematics) | University of California, Irvine            |

At 17, I became fascinated with mathematics. From studying the accident in our high school parking lot to looking at the effectiveness of aspirin, calculus left me wanting more. As an undergraduate student, I was exposed to not only the many applications of mathematics, but also its ability to instill critical thinking and problem solving skills in its students. As a math teacher, I focus on intuition, critical thinking, problem solving and of course applications!

My research area is nonlinear diffusions. I enjoy considering both theoretical and numerical questions. Coding models on a computer is a great way to gain intuition for theoretical results and to see your model in action. For example as a graduate student, I studied a model that describes how a chemical will travel through a polymer. The numerical results I produced on the computer gave me the insight I needed to go on and prove theoretical results. The main application of this work is in pharmaceuticals. My current research interest is image processing.

JILL ZIMMERMAN

B.S. (Computer Science)  
Ph.D. (Computer Science)

Purdue University  
University of Minnesota

Although both my undergraduate and graduate degrees are in computer science, I have always considered myself as much of a mathematician as a computer scientist. My doctoral dissertation was in recursion theory which is considered to be a field in both theoretical computer science and mathematical logic. I believe this personal lack of a dividing line between the two disciplines to be an asset and try to bring this larger view into the classroom. My current research is in programming languages.

## COMPUTING FACILITIES

Mathematics and computer science students have access to a variety of computers, located in academic buildings and residence halls, both for course work and recreational purposes. All computers are linked through a campus-wide network, which also provides access to the Internet.

The main teaching laboratory, located in Hoffberger 149, is equipped with 20 Dell Optiplex 745 workstations, with Intel Core 2 Duo E6400 CPUs and 2 GB of RAM, running Windows XP Professional. The room features a large-screen projection system for instructional purposes, as well as a scanner and printing facilities. The computers in this lab provide a variety of software, including Internet Explorer, Maple, Matlab, PowerPoint, Microsoft Excel, Microsoft Word, programming languages such as Java, C++ and Haskell, and a number of course-related software packages. This laboratory is used for introductory programming courses, the calculus sequence, and many other courses in the department.

Located elsewhere on campus are a number of other computer laboratories offering the applications that are available in Hoffberger 149. Some of these facilities are open 24 hours a day.

Hoffberger 123, nicknamed "The X-lab" by students, contains six Dell Precision 390 workstations, with Intel Core 2 Duo 6700 CPUs and 4 GB of RAM, running Windows XP Professional, Linux, and X-server software. These workstations are used in several upper-level computer science courses. Software available includes the programming languages C++, Java, Scheme and several more specialized products.

The department has one server which provides computing infrastructure for several computer science courses. Our Dell PowerEdge 1850 server (two dual-core 2.8 GHz Intel Xeon processors, 8 GB RAM, two 73 GB 15,000 RPM Ultra 320 SCSI disk drives configured for RAID 1, and a Gigabit connection to the Campus backbone) running Redhat Enterprise 4 Linux AS provides a modern and complete open source development environment. This server can be accessed remotely via either an SSH shell client or through Cygwin/X Window GUI software running on a PC client. This server supports courses in computer architecture, computer networks, operating systems, artificial intelligence and World Wide Web publishing. Any student with Internet access may use this system.

Many classrooms and lecture halls in the academic buildings are equipped with multimedia workstations featuring a computer, VCR and projection system. Several rooms also have three-dimensional visualizers.

Finally, all rooms in the residence halls are wired to provide access to the campus network and thereby the Internet. Wireless internet access is also available in many locations on campus. Students are invited to bring their own computers to campus. A member of the Computing Services Team provides technical support for students using their own computers.

## THE MATHEMATICS AND COMPUTER SCIENCE CLUB

Membership in the Mathematics and Computer Science Club is open to all departmental majors as well as other interested students. The club provides an opportunity for students to share their common interests in an informal way.

The most traditional of the club's activities is the annual Torrey Dinner, which is held each April to honor graduating mathematics and computer science majors. The officers and advisor organize the dinner. One highlight of the evening is a talk, usually about her/his work or research, given by an alumna/us. Another source of excitement is the announcement of the winners of the Torrey, Ekin, Leavitt and Writing Prizes.

The fall semester traditionally starts with a departmental pizza party, at which majors share their summer internship, research, and international experiences with fellow students and faculty.

Further club activities include field trips to Baltimore and Washington museums, films and guest lecturers about mathematics or computer science, fund-raising events, a year-end picnic and more.

The first club meeting of each academic year is announced in mathematics and computer science classes, as well as by e-mail. More information may be obtained by contacting the club president or Professor Gretchen Koch, the club advisor.

## PI MU EPSILON

In 2005, Goucher College was awarded a chapter of Pi Mu Epsilon, the national Honorary Society for Mathematics. The mission of the society is to encourage scholarship and scholarly activities among undergraduate mathematics students. Students, who by virtue of their academic promise and achievement are invited to join the society, meet on a monthly basis to support each other in their professional development. Activities include guest speakers, problem-solving sessions, book or film discussions and practice sessions for upcoming mathematical presentations. The chapter holds induction ceremonies at the Torrey dinner in the spring.

## ACADEMIC COMPETITIONS

During the academic year, there are a number of opportunities for mathematics and computer science students to participate in academic competitions, both as individuals and in teams.

Each fall semester the Association for Computing Machinery sponsors a mid-Atlantic region programming competition whose winners go on to participate in national finals. Each participating college or university fields teams (possibly including graduate students) which strive to solve the most programming problems in the shortest time. Although the competition is quite challenging, Goucher teams have placed as high as fourth place in the region.

Goucher mathematics students also have the opportunity to compete as a team. The annual Mathematical Competition in Modeling takes place early in the second semester. Each three-person team chooses one of two open-ended applied mathematics problems and then researches and writes a solution paper over the course of a single weekend! Goucher teams have received awards a number of times, competing against several hundred teams from other colleges and universities.

As a result of the problem of the month sponsored by our chapter of Pi Mu Epsilon, we can send one student per year to participate in the U.S. National Collegiate Mathematics Competition. We have performed well in this competition.

In addition, our mathematics students have participated as individuals numerous times in the annual Putnam Competition and the Virginia Tech Mathematics Contest.

## STUDENT WORK OPPORTUNITIES

Several kinds of on-campus employment are especially suitable for mathematics or computer science students. These include:

- **Paper grading:** Almost all of the freshman and sophomore mathematics classes have homework assignments which can be graded by more advanced students. Apply to the department chair during the first few days of either semester.
- **Monitoring in a computer laboratory:** Monitors check malfunctioning equipment, answer questions about hardware and software and otherwise assist students in computer labs. Apply to Reid Guanti in Information Technology.
- **Computing services support staff:** Student workers are hired to deploy new computers and re-image existing ones. They gain experience in networking and administration protocols. Apply to Reid Guanti in Information Technology.
- **Tutoring Goucher students:** Students who wish to be tutored in mathematics or computer science ask the Academic Center for Excellence for a list of qualified tutors and supplemental instruction. To apply to be a tutor, contact the Academic Center for Excellence, Froelicher Hall.

All of the above kinds of work pay at the hourly rate prevailing throughout the College for student work. Due to the specialized nature of some of the jobs, it is not required that student employees qualify for work-study.

Another employment opportunity is that of tutoring students from outside the college. There are often high school students in the area who need tutoring in secondary mathematics. Information about such positions is announced in appropriate classes or by email as it becomes available.

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## CAREERS IN MATHEMATICS AND COMPUTER SCIENCE

### Information and Guidance:

- Much information and advice is readily available in the Career Development Office. This source of information is useful at every stage of career planning both for employment and graduate school.
- Notices of special opportunities are posted on the bulletin boards near departmental offices or circulated by email.
- Applications for jobs, graduate and professional schools should be obtained early in the senior year.
- For additional guidance and specific information consult your major advisor or any member of the department.

Mathematics and Computer Science graduates have gone into a wide variety of fields after leaving Goucher College. Listed below are some of the activities of recent graduates:

### Graduate study in:

- Mathematics at California Institute of Technology, Kings College (London, England), the University of Maryland at College Park, the Georgia Institute of Technology, The Johns Hopkins University, Rutgers University, Emory University, University of California at Irvine and The University of Massachusetts.
- Computer Science at Vanderbilt University, the University of Wisconsin, Washington University at St. Louis, The Johns Hopkins University, New York University, The University of Virginia, George Washington University, and USC.
- Cognitive studies at Rice University.
- Operations Research at Stanford University, the Georgia Institute of Technology and the London School of Economics
- Business at the University of Delaware, the University of Syracuse and the Wharton School at the University of Pennsylvania.
- Medical studies at The Johns Hopkins University and Ohio State University.
- Law studies at University of Maryland at College Park, Boston University and The University of Richmond
- Cultural Anthropology at New York University; Theater at University of Delaware; Linguistics at Cornell University; Music at The University of Michigan; Poetry and Education at The Johns Hopkins University and The University of Cincinnati.

Mathematics-related jobs in a variety of places including:

National Security Agency  
AmeriCorps  
Johns Hopkins Applied Physics Laboratory  
CIGNA Property and Casualty  
Prudential Insurance  
Westinghouse Electric Corporation  
EDS  
Social Security Administration  
International Monetary Fund  
Department of Defense  
Lucent  
Aberdeen Proving Grounds

Computer-related jobs in a variety of places including:

Lockheed Martin  
Siebel Systems (Silicon Valley)  
IBM  
United Parcel Service  
Logicware, Inc.  
Apple Computer, Inc.  
RWD Technologies  
Pure Atria  
General Electric Corporation  
Westinghouse Electric Corporation  
T. Rowe Price  
Chesapeake Computer Consultants, Inc.  
NASA  
Monumental Life Insurance Company  
BGE  
National Security Agency  
Department of Defense  
National Institutes of Health  
Space Telescope Scientific Institute  
Logicon Inc.  
USF&G

Teaching at the middle school, high school and college level.