Do you recall the first time you taught a discrete mathematics course, if ever? What were your goals for the course? Your thought processes preparing? How did you prepare to teach it the first time? As educators, there is always that first time teaching a new course. To capture this scenario I have enlisted the services of two professors at the United States Military Academy at West Point, Rachelle DeCoste and Kevin L. Huggins, who will each be teaching, for the first time, a section of discrete mathematics for cadets majoring in computer science. This is the first of two columns they will be contributing – before and after.

Teaching Discrete Math for the First Time
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Six months ago, it was just an idea. Now we are just a couple of weeks away from teaching our first class in Discrete Math. Neither of us has taught the course before. Rachelle is a professor in the Math department and Kevin is a Computer Science professor at the United States Military Academy at West Point. Our goal this year is to align the course to the SIGSCE 2001 recommendations for a CS focused discrete math course, hopefully tying the inherently disparate topics together. In addition, we hope to reinforce the critical importance of discrete math to computer science. In the remainder of the article, we will describe our student population along with course material that we plan to use and an approach to assessment. We conclude by discussing the resources that will be used throughout the semester and what we see as our challenges.

Our students
We will each teach a section of Discrete Math this fall semester. There will be approximately 10 cadets enrolled in each section. These students will be first semester juniors who are mostly computer science majors since Discrete Math is a required course for them. They will have taken four semesters of “core” math courses during their first two years at West Point. These courses cover differential and integral calculus as well as one semester of statistics. Their previous math classes have all been taught with a heavy technology component (i.e., Mathematica and Excel used daily in class on their laptops) with an emphasis on problem solving. Additionally, the cadets would have taken their first CS course, CS1 the previous semester. This course covers sequence, selection and iteration, and basic data structures such static arrays and linked lists. Concurrently with the Discrete Math course they will be taking Data Structures and Digital Logic. We plan to leverage both of these courses by pointing out topics in Discrete Math that directly support their work in Data Structures and Digital Logic. We have begun coordinating with both course directors to explore other ways of linking Discrete Math to these courses.

Course material and assessment
The topics we will cover are aligned with the SIGCSE 2001 recommendations for a one-semester CS focused DM course: functions, relations and sets; basic logic; proof techniques; basics of counting; and graphs and trees. This varies slightly from the last version of the Discrete Math course taught at West Point. Last year the (math) instructor spent more time on mathematical induction at the recommendation of a Computer Science professor who had previously taught the course. He removed material on functions, relations, applications of number theory, and recursive algorithms. Our plan is to tie these topics all together by making mathematical reasoning our theme. We will spend a good amount of time on the topics of logic and proof techniques at the beginning of the semester and constantly return with our students to these basics while visiting other topics. We
aim to reinforce the ideas of true mathematical reasoning and understanding as we introduce our students to the relevant topics in number theory and graph theory. It is also our hope that we will be able to show them the relevance of the math to their futures as computer scientists, both with concrete connections to their current coursework and through our ability to convey the importance of communicating and understanding mathematics as computer scientists. We will use the book *Discrete Mathematics and Its Applications, Sixth Edition* by Kenneth Rosen, as it seems well-aligned with our course goals and the level of maturity we expect of our students.

At West Point students are expected to learn using the Thayer Method. The idea is that they read the material in the text the night before it is covered in class so that class is less of a lecture by which the instructor is teaching the material and more of an interactive discussion. The instructor can determine from the students’ comments and questions about the material what they understand and what topics need to be clarified. Then after going over the material together the students can spend time in class working on problems while the instructor circulates through the room, helping where needed. It seems that Discrete Math is an ideal class for this kind of teaching. Additionally, since our students are half-way through their West Point experience, they should have the maturity to be able to make a good effort at reading and understanding the text before class. We hope to make use of this technique, starting each class with basic concept questions addressed to the class to determine their level of understanding and any obvious misconceptions that they have. Then we can review the main ideas of each lesson, discuss some of the more difficult problems on the topic, and finally have our students work on problems themselves. While students are working on problems, they are encouraged to work at chalkboards around the room so that we can discuss their work—whether it is correct or incorrect. They are also encouraged to work together on problems to help foster a collaborative environment and, because as we all know, math is not a solitary activity.

Given the nature of the course and our theme of mathematical reasoning, we have chosen to pursue a path of continuous assessment. Learning the foundational concepts in discrete math requires practice. To ensure that students are grasping the concepts, we plan on administering weekly or bi-weekly homework sets that cover the topics that will be taught in class during the same period. This will accomplish two things. First, we will have an assessment instrument to measure the students’ progress. Additionally, since some of the topics given on the homework sets will not have been covered at the time the homework is assigned, the students will be more focused both in their readings and class participation when we cover those topics. We will also administer two midterm exams and a final. Initially we had hoped to include a course project into the course in the hopes that we could give the students an opportunity to tie the course topics together in one larger piece of work. However, we have decided that instead of trying to force too much into the course in our first experience teaching it, we will instead focus on good homework and in-class exercises. If an obvious project arises as we move through the semester, we can assign it as a larger homework as it fits in.

**Resources**

Since neither of us has taught the course before, and because we believe that we can profit greatly from those who have much experience, we have actively sought resources beyond West Point. Several ideas that we have included for our semester were developed while Rachelle attended the Discrete Math workshop at Messiah College in June. This workshop was run by Bill Marion, Peter Henderson and Susanna Epp. Kevin also attended a workshop with Peter at the Spring 2006 SIGCSE meeting and has continued his conversations about this course with Peter since then. In fact, Peter visited West Point in the spring to offer some guidance as we planned the course. We intend to continue discussing DM with him throughout the semester as we are able to more thoroughly flush out our course and as we discover which ideas of ours worked and others which did not. Additionally, as mentioned above, we have read and plan to implement some of the SIGCSE guidelines and suggestions for DM course for CS majors.

**Our challenges**

As stated above, our primary goal is to improve the level of our students’ mathematical thinking. This should in turn improve their skills as computer scientists. Discrete Math covers the foundational computer science topics that students will build on the rest of their undergraduate career and into graduate school. At West Point, Discrete Math is taught by the math department. As a result, CS students have a tendency of treating the course as a detour from their major. They fail to fully grasp the central role that discrete math plays in computer science. Accordingly, one of our goals for the semester is to help the students understand the central role that discrete math plays in computer science. In the past it has been a challenge since math professors, although conversant on the discrete math topics, were not clear on how they tied into computer science. Since Kevin, a
computer science professor, will be teaching discrete math also, we feel this should be a positive step in achieving our goal.

Another challenge will be working as a team: though we will each have one assigned section of this course to teach, we intend to take more of a team teaching approach. We hope to switch in and out of the sections so that the students see and become comfortable with both of us as instructors. Neither of us has had this type of teaching experience before and therefore this extra component to the course will need to be monitored to make sure it is enhancing the students’ learning, not becoming a distraction to them.

As has been discussed by many Discrete Math instructors, combining our chosen topics into one cohesive course, rather than five seemingly unrelated topics that do not fit together seems to be one of our biggest challenges. We are hoping that we can really keep our mathematical reasoning theme throughout the semester and that we can tie the material together well for the students.

Finally, as Peter Henderson has reminded us, we need to make sure we do not try to do too much our first semester out. We have been tempted to try to implement labs, projects and too many topics. We hope to be able to focus ourselves and our students to cover the main topics well without being overly ambitious and instead losing ourselves in peripheral activities that detract from our students’ learning. Next time we teach the class we can try to add a few more bells and whistles!

We will be back to let you know how we did. Throughout the semester we aim to keep track of how we are doing and try to assess ourselves and our students in the framework we have set aside here. We will summarize our overall thoughts on the course once we have finished the semester. In the meantime, if you have comments or suggestions, please feel free to contact either of us!