Dr. Eric Stahlberg  
Computational Science Program  
Wittenberg University  

October 18, 2007  

Dr. Stahlberg  

As mentioned in an earlier grant application (enclosed below), the math department has provided me with the opportunity to teach a topics course on Computational Algebraic Geometry. I applied to Wittenberg’s Computational Science Grant for course development funds and it was kindly pointed out to me that I didn’t properly consider the value of producing such a course.

In response to this, I am resubmitting this grant for $6000 in course development funds with the following rational.

This course is not in my area of expertise and will require significant redirection time to prepare. It is typically assumed that new faculty will teach a topics course directly in line with their research (in fact this is why new faculty are explicitly prohibited from applying for course development funds from Wittenberg University.) However, I want to help support the Computational Science Program, and that will involve teaching somewhat outside of my research area.

I intend to spend approximately 14 hours per week over the next 7 weeks and 40 hours per week over winter break preparing this course (total of 178). This time will be spent:

- **Preparing Class Examples.** I have already begun this process and rough Mathematica notebooks are enclosed below as well as electronically with this document. I am by no means currently a Mathematica expert.
- **Preparing Lecture Outlines.**
- **Learning MaCaulay2.** MaCaulay2 is a free computational commutative algebra program. While not absolutely necessary to teaching the course, I want to be able to show the students a variety of computational packages. It would also make an excellent project.
- **Translating Maple examples.** One of the supplemental texts that I’m using for examples does all the work in Maple. Rather than purchase a copy of Maple, I will attempt to translate these examples into Mathemtica.
- **Preparing Projects.** Dr. Susan Jane Colley at Oberlin has taught a similar class, and has kindly offered to share some of the projects that her students have done. Obviously, we don’t have Oberlin students here at Witt, and this will require work to adapt to our quality of students. In addition, I have several ideas for my own projects that need to be developed.

In addition, during the school year, I predict spending an average of 3.5 hours outside of class for every hour in class giving 157.5 hours. This time would be spent grading, preparing exams, finalizing lectures, office hours, and actually teaching. I understand this may be considered “double dipping” since I am being paid for the teaching via Wittenberg. I believe it’s justified considering the additional time necessary over, say, a calculus class.

In totality, this comes to 335.5 hours, or approximately $17.88/ hr. This is 2.5 times minimum wage during this time period – a reasonable additional stipend for the amount of work and expertise that would be necessary to prepare and teach this course.
One method of creating a distinctive program at a university is to appropriately compensate faculty for developing courses that further the program. A quick web search around the state has found several examples of this beyond our own Computational Science program.

- The five colleges (Oberlin, Kenyon, Denison, Ohio Wesleyan, and Wooster) share a Mellon Foundation grant. As part of this grant, course development grants of $6,500 are awarded for courses to “incorporate information literacy in substantive ways”. In addition, “Larger grants are appropriate for new course development.”
- John Carroll gives $4500 grants that incorporate distance learning.
- The University of Dayton gives $7500 grants for courses using “new teaching methods”.

The increase in funds brings my proposal to the average of the above grants ($6166.67). Also, as pointed out by you, the NSF funds computational science modules at $5000 each. As stated in my previous proposal, it is my intention to prepare a short module that could be used for our own Computational Models and Methods class (at the discretion of the teacher at the time).

It is absolutely my intention to produce a high quality course that excites students not only about algebraic geometry, but also about computation. In order to attract students to the course, I’ve advertised extensively to both our declared majors and the current Math 205 class (the only prerequisite for my course). I also spoke during the first meeting of the Math Club. After talking with several students I will be holding an alternative lecture on Tuesday for students with a lab conflict with Monday’s class. Preliminary feedback seems to indicate an enrollment of 10-15.

Recruiting for this course should be easy considering the multiple applications of algebraic geometry. Bernd Sturmfels, a leading researcher in the area notes, “A classic problem in mathematics is solving systems of polynomial equations in several unknowns. Today, polynomial models are ubiquitous and widely used across the sciences. They arise in robotics, coding theory, optimization, mathematical biology, computer vision, game theory, statistics and numerous other areas.”

If you need any additional information, please don’t hesitate to contact me.

Thank you for your time,

Adam Parker

Enclosed: Previous grant proposal, Course description, Syllabus, Three Mathematica notebooks.
Dr. Eric Stahlberg  
Computational Science Program  
Wittenberg University  

October 4, 2007  

Dr. Stahlberg  

The mathematics department has provided me with the opportunity to offer a topics course on a subject of my choosing. I’ve decided to develop and teach a course in computational algebraic geometry. The purpose of this letter is to request a $2000 stipend from the federal grant for enhancement of computational science at Wittenberg University for the development of said course.

I have chosen this topic for two main reasons.

First, algebraic geometry is notoriously abstract and the complexity of the classical algorithms increases so rapidly that illuminative examples are impossible to do by hand. This kept the field out of reach to undergraduates and many researchers. However, new algorithms and advances in computation have changed this. Using this computational view, we can introduce this fascinating and useful field to an undergraduate audience. It has also led to the discovery of many applications.

Second, teaching this course will enable me to contribute to the computational science program at Wittenberg, especially considering that I am not a computational scientist. My hope is that students may use this as a course to become excited about computation. I’ve kept the prerequisite at Math 205 to hopefully encourage enrollment. I hope to also develop a module for the computational models and methods course.

Math 380 – Computational Algebraic Geometry will be a 4 credit course meeting MWF, 12:40-1:40 and the text is Ideals, Varieties, and Algorithms: An Introduction to Computational Algebraic Geometry and Commutative Algebra. This excellent text was selected with a computational science book grant last year of which I am very thankful.

The course will begin with several weeks of lectures on the basics of algebraic geometry. Important algorithms involving Groebner bases and Elimination Theory are introduced almost immediately and are used to illustrate the classical theorems. However, these algorithms are independently useful and have applications to many different fields. As such, we will start having class in the computer lab (hopefully after covering the first 4 chapters of the text) where students will work on a project applying Groebner bases. Part of this request would be to develop projects on coding theory, statistics, and Sudoku, though I would welcome other ideas from students. The students will be using Mathematica.

Enclosed is a copy of the course description and a preliminary syllabus. If you have any questions, please don’t hesitate to contact me.

Thank you for your time,

Adam Parker
Math 380 – Computational Algebraic Geometry (4 credits)

Prerequisite - Math 205

Algebraic geometry is the study of systems of polynomial equations in one or more variables. The solution to such a system is a geometric object called a variety and much of algebraic geometry is concerned with how algebraic properties of the system are related to geometric properties of the variety. Results in this field tend to be quite abstract and complexity increases rapidly, making examples hard to compute.

This changed in the mid 1960’s with the discovery of a generalized division algorithm called Buchberger’s algorithm. With this new computational tool, it became possible to manipulate systems of polynomials efficiently. As a result, algebraic geometry has become accessible to a wider audience of both students and researchers.

This course will concentrate on the algorithmic and computational aspects of algebraic geometry. Topics covered will include, but not be limited to Hilbert Basis Theorem, the Nullstellensatz, resultants, and Buchberger’s algorithm. The final course grade will be based on homework, tests, class participation, and a computer project.
Math 380 – Computational Algebraic Geometry

Syllabus – Spring 2008

Room 320, MWF 12:40-1:40

Professor Info: Adam Parker  Office: 329D Science

Phone: 327-7864  E-mail: aparker@wittenberg.edu

Office Hours: (Tentatively) TBA  I will be very happy to meet at other times as well, just e-mail me to make an appointment!


Goals: We will essentially cover the first 4 chapters of the text. This will include the definition of a variety, the Hilbert Basis Theorem, the Nullstellensatz, and most importantly the introduction of Groebner bases. Groebner bases are a computational technique that allows us to illustrate many of the theoretical results in algebraic geometry. In addition, there are many applications of Groebner bases to fields as varied as computer science, biology, statistics, and economics and we will examine some of these applications in the computer lab during the second half of the course.

Assignments: Homework will be assigned and graded throughout the semester. Homework will be very important in understanding the material. There will be two exams, one computer program, and a final. While proofs will be presented in class, the majority of assessment will be over computational aspects of algebraic geometry. Attendance and class participation is essential.

Grades:  

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If your final raises your grade, you have the option of the following grade scale. I will automatically choose the scheme that gives you the higher grade.

| Homework | 20% |
| Final   | 35% |
| Exams I, II, III | 15% (each) |

**Web Site:** [http://userpages.wittenberg.edu/aparker/380.html](http://userpages.wittenberg.edu/aparker/380.html)  I will be posting homework, class announcements, and useful web sites here throughout the semester.

**Wittenberg Honor Code:** (by W. Higgins)

I support and fully endorse the Wittenberg Honor Code. Academic dishonesty of any kind on tests, quizzes, homework or other graded projects will not be tolerated. All of the work that you submit on quizzes, tests and homework must be your own work done without any outside source (books, notes, etc.) unless it is explicitly permitted.

You will be allowed to use your graphing calculator on all quizzes and tests. You are also allowed to store notes in the memory of your calculator and refer to them during quizzes and tests. However, I would strongly caution that over reliance on such notes usually does not lead to a successful learning experience in this course.

You will be required to sign an Honor Code pledge on each quiz and test. On tests, the following full statement will be printed for your signature:

> I affirm that my work upholds the highest standards of honesty and academic integrity at Wittenberg and that I have neither given nor received unauthorized assistance.

On homework that you turn in, you must write and sign the pledge above or this shorter form which is understood to be completely equivalent to the longer form:

> I affirm that this is my work and that I have followed the Honor Code.

Any assignment that does not have the appropriate pledge and/or student signature on it will not be considered to have been turned in and will not be graded.

Suspected instances of academic dishonesty will be reported to the Honor Council. There may be other University sanctions. See your *Student Handbook* for further information and policies regarding the Honor Code and academic dishonesty.

**A Plea:** If you ever feel that you are getting lost in class, please come see me right away. I will do my best to help. I have to be in office hours whether anyone is there or not. I’d rather have someone to talk to.