Eleventh Annual VSU Mathematics Technology Conference
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ABSTRACTS for Workshops and Talks

WORKSHOPS:

Improving Retention Rates with MyMathLab by Prentice Hall

MyMathLab is a series of text-specific online courses that accompany Pearson Addison-Wesley and Pearson Prentice Hall textbooks in Mathematics and Statistics. Since 2001, one million students at over 1100 colleges and universities have had more success in Math by using MyMathLab's dependable and easy-to-use online homework, guided solutions, multimedia, tests, and eBooks. At this presentation, we will demonstrate how MyMathLab works and why it has been the most successful online assessment tool in the market.

Scott Smith
Prentice Hall

The Fano Plane leads us to the Fano Tetrahedron and beyond

The smallest Finite Projective plane has exactly 3 points on each line and it has exactly 7 points and 7 lines. It is known as the Fano Plane and has been well known for over one hundred years. If one imbeds these lines with a certain direction, it can be shown that these 7 vectors correspond to the 7 imaginary units of the eight dimensional octonions. The real unit is the eight component of a typical octonion. We will see that if components are added to or subtracted from these vectors, the new geometry has a new dimension and a new corresponding algebra. We have our own "big bang" starting with the Fano Point.

Finite Geometry	***Dimension***	***Corresponding Algebra***
The Fano Plane	2	The Octonions
The Fano Line	1	The Quaternions
The Fano Point	0	The Complex Numbers
The Fano Tetrahedron	3	The Sedenions
The 4-D Fano Tetrahedron	4	32 dimensional hyper- complex numbers

Chris Niemann
Valdosta State University

Making Sense of Primes: A Spreadsheet Simulation of the RSA Cryptosystem

Prime numbers are an important topic at all levels of mathematics; yet students typically do not go beyond the definition, thus missing great opportunities to see the significance and structure of mathematics. While it used to be difficult to illustrate such aspects in the classroom, computer technology, as a tool and a topic, has afforded new perspectives on the learning and teaching of a variety of number theoretic content. We would like to present an Excel spreadsheet implementation of the *RSA* public key cryptosystem, heavily used nowadays in secured online transactions. Starting from the basics of modular arithmetic, we would present the concepts of relative primes, modular inverses, and power mod, which are all built on the conception of a prime number, and can be explored interactively on the Excel spreadsheet. The scheme of a public key system will be staged using everyday objects such as a suitcase, a lock, a key, and some documents; it will be further examined in the case of credit card transactions on the Internet. Drawing an analogy between the suitcase-lock-key scheme and prime numbers, we are going to implement the *RSA* cryptosystem on an Excel spreadsheet. Students will then be given the opportunity to pick their prime numbers and the encryption key, work out the corresponding decryption key (naturally challenging), and then enjoy the moment when prime numbers work the wonder. The whole process is interactive, and the users will see the flow of the original data, the encrypted code, and the decrypted data while all mathematical formulas are just a click away.

Lingguo Bu and Rob Schoen
Florida State University

Mathematical Modeling of Simple Mechanical Systems

Simple mechanical devices are helpful in enabling students to visualize the concept of mathematical modeling. Basic pulley systems are easy to comprehend and to construct, and they offer a remarkable opportunity to illustrate equations of the form **ax + by = c**. The same apparatus may be used to illustrate rates of change in a pre-calculus course or in a differential calculus course. The presentation will involve a system of pulleys which can be easily modified to illustrate a number of variations in equations of the above form, and options for use in illustrating rates of change will be discussed.

Thomas Reid and Michael D. May
University of South Carolina Aiken

GNU Octave

GNU Octave is a program primarily intended for numerical computation which offers extensive tools for solving common linear algebra problems, finding the roots of nonlinear equations, integrating functions, manipulating polynomials, and integrating differential equations.

I will discuss the main reasons why Octave can be a very appealing educational and research tool. These include the program's compatibility with MATLAB and its GNU GPL license.

I will demonstrate how to install GNU Octave on a Windows machine and I will present a sample of its capabilities (such as operations with matrices, solving linear systems of equations, integrating differential equations, and displaying graphs) and their possible use in teaching and research.

Dan Lipsa, Information Technology,
Armstrong Atlantic State University

TALKS:

Fundamentally Different Software Models for Predator-Prey Problems

Some approaches to predator-prey problems deal with the animals in groups while others deal with the animals as individuals. This session will look at software models of predator-prey problems using these different approaches.

Hugh A. Sanders
Georgia College & State University

Differential Equations with Winplot

Winplot, which is available free of charge at http://math.exeter.edu/rparris/, is a general-purpose plotting utility, which can draw and animate curves and surfaces presented in a variety of formats. I will demonstrate how to illustrate many of the interesting concepts in Differential Equations with quick animations using Winplot's 2D and 3D graphing capability. With the use of its recursive sequence menu, showing how the Euler, Improved Euler, and Runge-Kutta methods work becomes a very simple task that requires no programming experience of any kind. Winplot is neither a symbolic toolbox nor a calculator but it is much easier to use than Maple and Mathematica when it comes to plotting (especially during lectures). No programming is required for its use.

Carlos Almada
Columbus State University

The Wald Confidence Interval

The Wald confidence interval for a proportion is almost universally used. Better mmethods of contructing this type of confidence interval will be presented.

James Issos
Florida A&M University

The Correlation Between Success in Pre-Calculus and Java Programming Among CS and IT Majors in the School of Computing at AASU

A systematic, algorithmic approach to problem-solving is one of the foundations of an understanding of programming, which is the centerpiece of an education in Computer Science (CS) and Information Technology (IT). This approach is based on the logical problem-solving skills taught in mathematics. Various mathematics courses are required to be taken by the students in the Armstrong Atlantic State University School of Computing as pre-requisites to their programming courses. In particular, students majoring in either CS and IT must successfully pass MATH 1113 (Pre-Calculus) prior to taking the introductory programming course, CSCI 1301, taught in Java.

As a professor and advisor in AASU's Department of Information Technology, I have noted over time that some IT students repeatedly fail CSCI 1301. This motivates the subject of my research and presentation. Is there a measurable correlation between success in MATH 1113 and success in CSCI 1301 for students majoring in IT? Furthermore, is there such a correlation between the two courses for students majoring in CS, and what is the difference between students in the two majors? My hypothesis is that students majoring in CS have a higher success rate than those majoring in IT.

I will describe my research methods and present my preliminary results. This is the first stage of an ongoing research project to track the success of our IT students in CSCI 1301 as it relates to their success in the prerequisite mathematics courses. Continued monitoring of the statistics presented will enable AASU's IT faculty to properly advise our students about the importance of the prerequisite mathematics course.

Frank H. Katz
Armstrong Atlantic State University

Computations with large numbers

As we know that any calculator has a very limited number of digits that you can type in, for instance, the calculator built into the Microsoft Windows takes at most 24 digits, therefore, we cannot calculate large numbers of more than 24 digits with that calculator. We would have a problem to display large integers without using the scientific notations that unfortunately result in a real number. How can we write an algorithm that would allow us enter any number of digits for our numbers and perform calculations without getting an overflow and display the result as it is without using the scientific notations? We will discuss a way for us to write a workable algorithm and implement it on a web page.

Weihu Hong
Clayton State University

Capturing the Moment: Answering Questions Remotely

Many times instructors are asked how to do something that is too complex to describe in words, but relatively simple and fast to show. Things like drawing three dimensional objects, demonstrating a problem solving strategy, walking a student through the process of doing an algebraic T-proof and so on. Using Mimio board and its broadcast capabilities affords the instructor the ability to tape a lecture and capture what is written on the board simultaneously. A library of information can be saved over time and either made available on a website or emailed directly to the student. The Mimio board files require Real Player to view and listen to the files.

Peggy Moch
Valdosta State University

Selected Topics from Algebra, Trigonometry, and Symbolic Logic Illustrated with Maple

Maple illustrations drawn from the study of systems of equations, of triangles, and of formal statements and their equivalence will be presented. Each is suitable for classroom use.

J. A. Ziegler
Southern Polytechnic State University

Incorporating Music and Art

Mathematical properties and rules will be put to music for reinforcement. In addition, art may be incorporated into the classroom through the use of the graphing calculator. Mathematical topics from Intermediate Algebra to Precalculus will be demonstrated.

Jacqueline Spann
Georgia Perimeter College

Developing a Cluster for Research with Nanostructures and Cancer Drugs

SUN Microsystems funded a cluster that Valdosta State University that consists of 13 Sun Microsystems v20z machines. Each of these machines has 2 AMD Opteron 250 processors. One of these is setup to be the master node, and 12 of them are setup to be slave nodes. The slaves have had extra RAM added to bring them up to 8GB each and contain a 72 GB SCSI hard drive and are located on a 1Gb private network. The slaves are all running a stripped down RedHat Linux operating system so that nearly all of their significant computational resources can be devoted to the task at hand.

Currently work in the chemistry department is focused in two general areas: calculations involving nanostructures that have some potential as electronic components. For example, work is underway with the single molecule magnet (Mn_{12}), a cluster that is predicted to be a quantum computer in the future. Also, we are working with DNA and Single walled Carbon nanotubes, two materials that when combined may be used as a nanoresistor.

Our second major endeavor involves simulations with large macrolide structures, such as bryostatin, that are used in medicinal applications. In this area we are working to better understand geometric factors that will allow these natural products to function better in a clinical setting. The role that large scale computations can play in these areas will be discussed.

Ike Barton[1], Jonathan Bryant[1], Andrey Asadchev[2], Joseph Newton[1], Wendy Palen[3], Nigel Kasali[3], Ken Jones[3], Jessica Thomas[3], Stephen Berilonson[3], Justin Smith[3],Thomas Manning[3]

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Application of the Cholesky Decomposition to the Monte Carlo Simulation

The Cholesky Decomposition is widely used in the Monte Carlo method for generating multivariate with a desired covariance matrix. The covariance matrix is symmetric and positive semi-definite in theory. However it is usually unknown in practice and has to be estimated. The estimated covariance can be positive definite, positive semi-definite or ill-conditioned due to the degree of different estimation methods. We have derived that the estimated covariance matrix is positive definite if the samples variance and samples covariance are used in estimation. Different algorithms are studied. Practitioners are more interested in the ill-conditioned case when the estimated covariance matrix is not positive definite or positive semi-definite. It the estimated covariance matrix is almost positive definite and not very differ, we suggest to add a diagonal matrix with small positive diagonal elements to form a positive definite covariance matrix. Perturbation analysis and computational errors are also studied.

Jin Wang and Chunlei Liu
Valdosta State University

Invited Address:

Multivariate Splines and their Applications

Ming-Jun Lai
University of Georgia

I will explain how to use multivariate spline functions, i.e. smooth piecewise polynomial functions over triangulation for applications such as scattered data interpolation and fitting, numerical solution of partial differential equations, and image processing.

Mainly, I will explain how to use bivariate splines for temperature data interpolation and surface reconstruction and how to use spherical spline functions to reconstruct geopotential from satellite measurements.

I will demonstrate how to use box splines for constructing tight frames for image denoising and edge detection.

Banquet Talk:

College Football Ranking and Rating Systems

John Seppala
Valdosta State University

College football (Division 1-A) is one of the few team sports in which the national champion is not determined by a playoff at the end of the regular season. Instead, select teams participate in bowl games as determined by committees and by the Bowl Championship Series (BCS) rankings, a combination of two human poll rankings and six computer ratings. The BCS rankings are subject to many shortcomings, and have caused much controversy since their inception in 1998.

A new rating system was developed to attempt to more accurately measure the performance of each team throughout the course of an entire season using the simplest model possible. The new system will be presented and explained in detail using only quadratic, linear, and constant terms. General comparisons will be made between the system, human poll rankings, and other computer ratings, and specific rankings will be compared in cases where significant differences occurred.