MD/DC/VA Spring 2002 Meeting Contributed Paper Abstracts

U = Undergraduate Student Competition Paper

Aileen Cuddy and *George Mackiw Loyola College of Maryland *Extending the Error Correcting Capabilities of the ISBN Code* The International Standard Book Number (ISBN) scheme adds a mod 11 check digit to book identification numbers to allow for detection of common errors. The authors use the elementary theory of finite fields to construct variations of this scheme which in addition permit actual correction of detected errors.

Dipa Choudhury Loyola College in Maryland *Matrix Factorization* Matrix factorization plays an important role in linear algebra. In our introductory linear algebra course we encounter LU decomposition, diagonalization, QR factorization etc. Later courses we discuss Schur's factorization, singular value decomposition etc. In this talk we'll discuss the above factorizations and their analogous results when we replace unitary matrices with orthogonal matrices and vice versa; symmetric matrices with hermitian matrices and vice versa.

G. Edgar Parker James Madison University *Some Issues in Teaching Mathematics to Prospective Elementary and Middle School Teachers* Over the past four years, the Department of Mathematics and Statistics at James Madison University has done extensive self-examination regarding its mathematics offerings that support the education of prospective elementary school and middle school teachers. As a teacher who regularly takes his turn in the foundation courses for this support curriculum, I have both been involved in the department's deliberations and had occasion to rethink how I should offer my courses. My talk is informed by these deliberations and discusses resulting curricular issues, attempts to implement change, philosophy, course outlines, and compromises.

U Mary R. Lee James Madison University *Asymptotic Analysis of an Inward Point Load Acting on a Half Space: a nonlinearly elastic near-load model* The problem of a compressive point load acting on an elastic half-space was solved by Boussinesq in 1885 within the framework of linear elasticity. While the most interesting and crucial material behavior takes place under and nearby the point load, it is precisely here where Boussinesq's solution breaks down, predicting physically unreasonable behavior and violating the basic premise of the linear theory in which it was derived. This work studies this important problem in the context of incompressible nonlinear elasticity. An asymptotic analysis of the exact, nonlinear, governing, partial differential equations of equilibrium and boundary conditions is carried out and we are able to determine and apply a series of simple tests to decide whether an elastic material may sustain a finite deflection under a point load.

Ezra Brown Virginia Tech *Square Roots from 1;24,51,10 to Dan Shanks* This talk is about (CHOOSE ONE)---

(a) The oldest mathematical algorithm

(b) Approximations of square roots throughout history

(c) Calculating square roots by hand

(d) The Shanks-Tonelli algorithm for computing square roots modulo a prime

(e) Twenty minutes long

Answer: (f) And what's 1;24,51,10? Come and find out!

William P. Wardlaw U. S. Naval Academy *Factoring Polynomials with Matrices* Two elementary methods of using matrices to factor polynomials over finite fields are given. The first factors a cyclotomic polynomial over a finite field by finding matrix representations of roots of the polynomial in a splitting field of the polynomial. The second starts with a companion matrix of the polynomial and examines the action of powers of the matrix on randomly chosen vectors. When successive powers of the matrix acting on a single vector produce a dependent set of vectors of size smaller than degree of the polynomial, a factor of the polynomial is obtained.

Karen Z. Benbury Bowie State University *Problems from the History of Probability* Problems from the history of probability are presented. Many of these are suitable assignments in probability courses. Some of these led to basic ideas of probability theory.

U J. Brandon Coates Hampden-Sydney College *Cwatsets and Two-Dimensional Cell Complexes* A cwatset is a set of binary words that is closed under addition with the aid of a permutation. This talk will describe a method for creating two-dimensional cell complexes using cwatsets such that equivalent cwatsets form homeomorphic complexes. We will also describe a method for calculating the Euler characteristic of these complexes strictly from the cwatsets. **Note: This talk is the result of my research completed over the past year as part of a Senior Honors Project at Hampden-Sydney College.

Carol G. Crawford and Mark D. Meyerson U. S. Naval Academy *Interactive Web Based Labs for the U.S. Naval Academy - Real World Applications Designed with Java for the 3-semester Calculus Sequence* The authors present a package of interactive, web based calculus labs designed for the 3-semester calculus sequence at The United States Naval Academy. These labs were designed using Java applets and the web. Nine "labs" were produced, each one containing a Java language applet that simulated some real world (military or industrial) application of calculus. The applets are interactive, allowing the user to experiment with adjusting parameters to see how that affects the results. See more at: http://www.usna.edu/MathDept/cdp/

James Case Consultant *Concerning the Redesign of Baseball's Postseason Playoff Format* As matters stand, a major league baseball team could conceivable win 162 regular season games, yet be eliminated from world series contention after only three post season games. In an attempt to correct this and other defects of the playoff system, a class of alternative (round robin) formats will be analyzed probabilistically. A technical handout will be provided.

Mihaela Malita St. Mary's College of Maryland *Logical Puzzles in Prolog* Logical programming languages provide a good framework for solving logical puzzles. I will present how to use Prolog to solve some classical puzzles and also how to design new puzzles.

U Kevin Beanland St. Mary's College of Maryland *Regular Polytopes in Four Dimensions* This talk will give a proof, using vertex figures, that there exist only six regular polytopes in four dimensions. It will also show how, by using quaternions to parameterize rotations of 3-D regular solids, one can obtain coordinates for many of the 4-D regular polytopes. On display will be five of the 3-D projections of the 4-D regular polytopes.

Conrad Lotze Towson University *Online Math Tutoring* The results of my dissertation research into the use of digital notepads, web-cams, and headsets to conduct math and stats tutoring online. While mixed, results were generally positive. The technical and psychological barriers faced by the participants will be discussed.

Gheorghe Stefan St. Mary's College of Maryland *Revisiting the History of Mathematics in a Computer Science perspective. A Case Study* Computing values of trigonometric and exponential functions, starting from calculus, can be time consuming and less precise than using methods discovered long before the calculus was invented. I present pre-calculus methods developed in Middle Age monasteries, which show how a sine or a logarithm can be computed in a much shorter time with better precision and a smaller representation.

U Kelly I. Dickson James Madison University *The Modified Picard Method for Singular Problems* While Runge-Kutta order four has been a predominant solution technique for differential equations, a shooting algorithm using the Picard method can yield better efficiency and accuracy near singularities. A more efficient Picard approach (Parker/Sochacki, 1996) converts the right hand side of an ODE into polynomial form and allows the Taylor polynomial to be formed at each step of the way as the solution marches toward the area of interest. This method applies to many non-linear, singular BVPs such as those that model concentrated loads, cavitation, and other solid mechanics problems.

U Mihaela Guberovic Virginia Military Institute *Ceva's Theorem and Its Applications* Ceva's Theorem will be presented with a proof. At least one standard incidence theorem from geometry will be proved using Ceva's Theorem. Other examples for which Ceva's Theorem can be used will also be presented.

Ilhan M. Izmirli Strayer University *Two Dimensional Arrays of Pitch Classes* In this paper I will talk about some basic mathematical properties, the generation of, and the transformation of two dimensional arrays of pitch classes. I will also introduce some related concepts such as array classes, order transformations, association set, association graph, and association matrix.

George Rublein William and Mary *Quantitative Literacy at William and Mary* Courses to satisfy the ``Math Requirement" at William and Mary are offered by a number of departments. We will describe the simple, non-standard, philosophy that is applied to measure the appropriateness of such offerings. Roughly: Model, Compute, Compare with Practitioners.

Mieczyslaw K. Dabkowski George Washington University *Burnside obstraction to the Montesinos-Nakanishi 3-move conjecture* Yasutaka Nakanishi asked in 1981 whether a 3-move is an unknotting operation. We find an invariant of 3-moves, which we called the Burnside group of a link, to prove that the Montesinos-Nakanishi 3-move conjecture does not hold for the closure of the square of the center of the braid on 5 strings.

U Danilo N. Machado*, Charles R. Johnson, Patrick X. Rault William and Mary *Multiplicative Generation of Integral Matrices via Elementary Bidiagonal Matrices* It is shown that the n-by-n matrices of determinant 1 are generated by certain subsets of the elementary bidiagonal matrices of cardinality 2(n-1) and that each subset is minimal. Using this fact, it is shown how to generate the unimodular matrices and all integral matrices. The totally nonnegative matrices of determinant 1 that are generated by elementary bidiagonal totally nonnegative matrices are also discussed.

U Lois Simon Morgan State University *Math Model of Airflow Propagation through Non-Uniform Materials* Abstract: In measurements of parameters of porous materials (for example, fiber materials), there are often used airflow methods. Theory of this method is considered in many papers. But all these papers use the assumption that airflow propagates through uniform materials. This means that all properties of sample of material are the same at any points of the sample. In our paper we will consider airflow propagation through non-uniform material and find a mathematical model of this propagation.