(z and the a_n are complex numbers) that satisfy two additional conditions:

1. the series converges for all z with $|z| < 1$
2. the function $f(z)$ is one-to-one

In 1916 the German mathematician Ludwig Bieberbach informally conjectured that for every such function the nth coefficient must obey $|a_n| < n$ for every n. Bieberbach himself showed this only for the second coefficient. During the next 60 years, complicated proofs were found for the third through the sixth coefficients (not in that order!) The difficulty of these proofs led some experts to suspect the conjecture was false. They were wrong.

In spring 1984, de Branges announced, at last, a general proof. With the aid of a group of Russian mathematicians, de Branges soon shortened and clarified his proof. It is now only a few pages long.

The talk will focus not on the proof, but on mathematical and historical context: What does the conjecture say? Why is it reasonable? What partial results are "obvious"? What does the result mean geometrically? Some Mathematica-generated "close-ups" of complex mappings will illustrate the discussion.

Abstracts: By Name of Presenter

Listing is alphabetical by last name. Titles of joint presentations appear under the joint presenter whose name appears first in the alphabetical listing.

EDWIN ALLISON, University of Northern Colorado

Differential Equations using VisualDSolve and a Dynamical Systems Approach.

Friday, April 17; 4:25 - 4:55 p.m.; M340

Following the changes in calculus courses in recent years and the availability of good software, the introductory equations course can look much different than the traditional "cookbook" course. I will discuss my experiences teaching a course using a dynamical systems approach and the new software VisualDSolve. Traditional topics such as first order systems can be enhanced by using a more geometric approach using easily produced graphics. New topics such as bifurcation theory becomes accessible to students.

JEFFREY O. BENNETT, University of Colorado at Boulder, and WILLIAM L. BRIGGS, University of Colorado at Denver

What About the Other Half? A Case for Quantitative Reasoning

Friday, April 17; 3:15 - 3:45 p.m.; M340

A precalculus course in quantitative reasoning for liberal arts students has been developed at the University of Colorado that is also appropriate for students at two-year colleges. Supported by a new textbook, the course provides a broad survey of contemporary applied mathematics as it arises in current issues and disciplines. In this workshop, the authors will talk about the rationale for the course, special features of the course material, and conduct sample class presentations and activities.

STEVE BILLUPS, University of Colorado at Denver

Enhancing the Optical Density Range of Digital Cameras: A Mathematical Approach

Friday, April 17; 2:00 - 2:20 p.m.; M364

Photographic film typically contains a larger optical density range than can be captured by a digital scanner. Thus, scanned images which are stored using gray scale values ranging from 0 to 255 lose detail in either the darkest or lightest areas of the image. This problem was studied and solved by the Mathematics Clinic at the University of Colorado at Denver. Students in the clinic derived a solution which involves scanning the image multiple times using different exposure settings. These images are then combined mathematically tc form a composite image which captures the entire optical density range of the film, and which displays as much detail as possible.

SHAHAR BONEH, Metropolitan State College of Denver

Least Squares Solutions to Problems of Property Splitting

Friday, April 17; 2:50 p.m. - 3:10 p.m.; M365

We introduce a new approach for the old problem of how to divide a property among two people when their total claims add up to more than the size of the property. We show how the least squares method can decide among several solutions but it also has some surprising features. Extending this problem can be an excellent student project.

HENC BOUWMEESTER, Mesa State College

How bad a set can be measured?

Friday, April 17; 2:50 - 3:10 p.m.; M333

We begin with a discussion of desirable properties in deciding how to measure a set. We then give the construction of a set which is not measurable. We also construct a function using the Cantor set which will enable us to construct a measurable set that is not a Borel set.

DAVE BROWN, Metropolitan State College of Denver

Quaternions in Action

Friday, April 17; 2:00 - 2:20 p.m.; M333

In the late 1800's, while struggling to embed both the real

us with an interesting problem. Can chaos give rise to stability? Indeed, it can. Another example of this can be found in the asteroid belt between Mars and Jupiter. Although the Kirkwood and Hubbard gaps are created by a chaotic mechanism, other asteroids exhibit chaotic orbits yet do not escape the solar system. These topics will be given due attention also.

PAUL ZORN, St. Olaf College

BANQUET TALK: Math Mag Morsels

Friday, April 17; 8:00 p.m.; Radisson Hotel Denver South

Mathematics Magazine, one of three MAA journals, has 70 years of colorful history, The magazine began in 1927, an offshoot of the Louisiana-Mississippi MAA section. Over the years the Magazine has assumed various forms, had various homes and supporting institutions - and an on-again-off-again relationship with the MAA. Through all this the Magazine has built a fascinating and entertaining mathematical archive; its author list includes many of the century's most famous (or, in one case, notorious) mathematicians. I'll trace where and what the Magazine has been over the decades, illustrating the narrative with morsels chosen from the historical smorgasbord: mathematical notes, cartoons, proofs without words, tables of contents, references to some very famous names, Problems and Quickies, columns.

PAUL ZORN, St. Olaf College

KEYNOTE ADDESS: The Bieberhach Conjecture, A Broad Historical View and a Close Look with Technology

Saturday, April 18; 8:50-9:50 a m.; M260

One of the long-standing open problems of classical analysis was solved in 1984 by Louis de Branges, of Purdue University. Like Fermat's theorem, the Bieberbach conjecture is tantalizingly easy to state. It concerns power series ('infinite polynomials") of the form

$$f(z) = z + a_2 z^2 + a_3 z^3 + \ldots$$

(1) The description of quantum mechanical phenomena requires students to embrace completely new and unusual mental constructs and thus provides them with better understanding of the constructivist view on cognition;

(2) Studying the mathematical structures of Quantum Mechanics provides a versatile modeling experience (e.g., Riemann sphere, Hilbert spaces, probability, quantum logic);

(3) Quantum Mechanics could provide a paradigm f conscious thoughts.

PAUL THALOS, University of Colorado at Denver

Bishop Domination on an M by N Chessboard

Saturday, April 18; 11:15 - 12:00 p.m., M333

In the game of chess, a Bishop attacks diagonally any numbers of squares. A set of Bishops "dominate" an m by n chessboard if for every square there is either a Bishop on it or a Bishop attacking it. What is the minimum number of Bishops that are necessary to dominate an m by n chessboard? This talk will make a conjecture (which will be partially proven) for the answer to this question.

WILLIAM F. TRENCH, Trinity University

Some Dirichlet-like Tests for Convergence of Series

Friday, April 17; 3:50 - 4:20, M365

Dirchlet's test is a test for conditional convergence of an infinite series, since it is usually applied to series that are known to be not absolutely convergent. Abel's test and the alternating series test are special cases of Dirichlet's test. We will present some other tests for conditional convergence of series.

TESSA WEINSTEIN, Metropolitan State College of Denver

Chaos in the Heavens: A Presentation About Chaos in Our Solar System

Friday, April 17; 3:30 - 3:45 p.m.; M333

The Jovian atmosphere of Jupiter is a dynamical system in which chaos ought to rein. Therefore, the Red Spot presents

and complex numbers in a common space, William Rowan Hamilton discovered that this could be done using ordered quadruples. Unfortunately the multiplication of the "quaternions" is non-commutative, so Hamilton's embedding was virtually ignored.

As late as the 1960's quaternions were still regarded as little more then "important examples" of a division ring, and a non-abelian group. However, today they are used in the fields of computer graphics, animation, simulation, imagery and probability. Mathematica's graphics and Quaternion package are used to demonstrate an application of quaternions in rotating a 2-dimensional object in 3-space. The advantages of this procedure over the usual matrix rotations are noted.

JENNIFER BUSH, University of Northern Colorado

Preliminary findings regarding what comprises student understanding of the quotient group concept in abstract algebra

Saturday, April 18; 11:15 - 12:00 p.m.; M364

This presentation will present the audience with preliminary results from the author's doctoral dissertation work. This work involved investigating what affective, cognitive, and metacognitive issues the beginning abstract algebra student faces as they attempt to learn quotient groups.

Because of the nature of the problem, a primarily qualitative approach to the data collection was taken. Data was collected in a variety of ways: classroom observations, analysis of homework/exams, pre- and post- attitude survey, videotaped interviews, and tutor session observations. The study took place in the fall of 1997.

HOWARD CANODE and ERIC KNIGHT, Metropolitan State College of Denver

Rudin Plot Investigation

Friday, April 17; 2:25 - 2:45 p.m.; M333

As part of our *Mathematica* class we investigated a surface given in the form of $z=f(x,y)$. The surface is given by the following equation with f(0,0)=0,

$$f(x,y) = -2yx^2 + x^2 + y^2 - \frac{4x^6y^2}{(x^4+y^2)^2}$$

When a graph of the above function is generated in Mathematica it appears to have a local minimum at the origin. Our investigation of the behavior of the function at the origin included both analytical and graphical techniques, which appeared to confirm this observation. The graphical analysis included the construction and manipulation of a variety of three-dimensional graphs and the use of contour plotting. The analytical method utilized carious built-in Mathematica functions to determine behavior at the origin which reinforced the graphical observations. It can be shown through a more rigorous examination utilizing the above techniques that what appears to be an intuitively obvious local minimum at the origin is, in fact, a saddle point.

HOWARD CHRISTENSEN, Community College of Denver

The Algebra Review Workshop at CCD

Friday, April 17; 2:25-2:45 p.m., M365

The algebra review workshop at CCD is a free, no-credit, intensive review of basic algebra skills open to all students in the college during week #1 of each semester. It helps returning students refresh and remember what they already knew 2, 5, even 20 years earlier, especially if they must start all over. The workshop includes two different activities: (A) Group work on sheets of review problems (with solution sheets nearby), and (B) problem solving using tutorials on the math lab computers. These workshops have been offered continuously by the math lab at CCD, following my minigrant in the Fall 1993 .

JOHN STARRETT, University of Colorado at Denver

Removing Hotspots from Aerial Photographs

Saturday, April 18; 10:00 - 10:20 a.m., M340

A hotspot is a distortion of brightness and contrast levels in an aerial photograph caused by direct overhead solar illumination. One source of lost contrast is the loss of shadows due to direct illumination, and another is due to film saturation. We demonstrate a method to automatically detect hotspots based on a mathematical measure of the loss of contrast, and show how to remove hotspots in a digitized photograph by a combination of low pass filter subtraction and contrast enhancement.

LINDA SUNDBYE, Metropolitan State College of Denver

Chaos and Fractals on the TI Graphing Calculator

Saturday, April 18; 10:25 - 10:45 a.m., M333

Fractals are generated on the TI-83 and TI-85 graphing calculators using a random iterated function system algorithm. These programs are demonstrated for the Sierpinski triangle, the Sierpinski gasket, the fractal fern, a crystal and other fractal images.

These fractal images have been shown in various mathematics classes with the TI viewscreen. The students became quite interested in the mathematics behind these pictures. This led to discussions on the algorithm, fractal dimension, self-similarity and dynamical systems, in general.

IGOR SZCYRBA, University of Northern Colorado

Quantum Mechanics and Thinking Processes

Friday, April 17; 3:15 - 3:45, M364

Recent theoretical and experimental discoveries in Quantum Mechanics and possible links between this theory and thinking processes are discussed. Various benefits of teaching Quantum Mechanics to all mathematics majors (especially to would-be math teachers) are presented. In particular:

be talked about sensibly. I will present methods for explicating logic, number, sets, spaces, and computability for students at this level, and show how these methods and subject matter can help students obtain appreciation and confidence about mathematics, and provide the context for their subsequent successful study of more traditional topics.

WENDY HAGEMAN SMITH, University of Colorado at Boulder

An Internet Application in a Constructivist Mathematics Classroom

Friday, April 17; 3:50 - 4:20 p.m., M340

Application of new learning theories in mathematics classrooms can help students acquire a robust, working mathematical knowledge base, use that knowledge when called upon to do so, and develop the desire and ability to continue the learning process after graduating. I will discuss a WWW application which I designed to augment a constructivist math survey course I teach at C.U. Its purpose is to provide students with mathematical skills and help them to utilize new information systems, learn to apply skills in problem solving, and communicate mathematical ideas.

ANNE SPALDING, University of Colorado at Denver

A Dynamic Programming Algorithm in Min-Plus Algebra for Finding the Domination Number for GxP_n

Saturday, April 18; 11:15 - 12:00 p.m., M340

Let G be any graph and let Pn be a path on n nodes. The Cartesian product, denoted G X Pn, is formed by connecting each set of corresponding vertices of the n copies of G with a Pn. The domination number of a graph is the smallest set of vertices S with the property that every vertex of the graph either in S or adjacent to a vertex in S. This talk will develop a dynamic programming algorithm in the Min-Plus Algebra which finds the domination number of G x Pn for specific graphs G and for all n.

JASON DEROSE, Mesa State College

Topics of Fair Division

Friday, April 17; 4:05 - 4:20 p.m.; M333

Can a cake be divided among n people in a "proportional" manner, that is, such that each person feels they receive at least $1/n$ of the cake? Furthermore, can a cake be divided among n people in an "envy-free" manner, that is, such that each person feels their piece to be at least as large as everyone else's? We will discuss continuous and discrete algorithms for proportional and envy-free divisions for case n=3, as well as issues of generalizing to arbitrary n.

GEORGE DONOVAN, Metropolitan State College of Denver

Atlantic Menhaden: Migration and Population Estimates

Friday, April 17; 2:50 - 3:10 p.m.; M364

Menhaden are fished commercially off the Atlantic coast. Because of their commercial importance, population estimates are made by the US Fisheries Laboratory at Beaufort, NC. There are many factors affecting this population such as: the size of the mature female population, the size of the predator population, the condition of the estuaries where the larva grow, etc. However, approximately 40% of the population estimates can be explained by the timing of their yearly northward migration.

BILL EMERSON, Metropolitan State College of Denver

Mathematical Animations for Linear Algebra and Partial Differential Equations

Saturday, April 18; 10:50-11:10, M364

(no abstract available)

DONALD FAIRBAIRN

Transformations on the Greatest Integer Function

Friday, April 17; 2:50 - 3:10 p.m.; M354

This short talk presents the Greatest Integer Function along with a discussion of transformations that adapt this function to modeling the problem of phone charges.

JULIE FERRERA, University of Southern Colorado

The Galois Troupe Presents: Resolutions of a Young Radical

Friday, April 17; 4:25 - 4:55 p.m.; M341

This dramatization of the life of Evariste Galois, written, directed and produced by Julie Ferrera, provides insight into the personal and societal factors which shaped the young genius and his ground-breaking work in algebra.

DAVE FISHER, University of Colorado at Denver

The Expected Time for a Widely Used Min-Plus Algebra Algorithm is Infinite

Saturday, April 18; 10:25 - 11:00 a.m.; M340

In min-plus algebra, minimization replaces addition, and addition replaces multiplication. For example, let

$$A=\begin{bmatrix} 2 & 0 & 2 \\ 4 & 2 & 3 \\ 3 & 0 & 3 \end{bmatrix}$$

Iterating with the matrix multiplication done in min-plus algebra, we get

$$A^2=\begin{bmatrix} 4 & 2 & 3 \\ 6 & 3 & 5 \\ 4 & 2 & 3 \end{bmatrix} \quad A^3=\begin{bmatrix} 6 & 3 & 5 \\ 7 & 5 & 6 \\ 6 & 3 & 5 \end{bmatrix} \quad A^4=\begin{bmatrix} 7 & 5 & 6 \\ 9 & 6 & 8 \\ 7 & 5 & 6 \end{bmatrix}$$

Note $A^4=3A^2$ (using "scalar addition") implying $A^n=3A^{(n-2)}$ when $n>=4$. It can be shown that this iteration will alway find a recursion.

How long does it take to find a recursion? Usually, it is found with only a few iterations. However for a random 2x2 matrix, we show that the expected time to find a recursion is infinite. This talk will first introduce Min-Plus Algebra and conclude with calculations verifying the title result.

GEORGE W. HEINE, Math & Maps

Finding God by Calculation: Attitudes Towards Mathematics in Medieval Islam

Friday, April 17, 3:15 - 3:45 p.m., M341

MICHAEL J. SEERY, U.S.A.F.A. Preparatory School

Pursuit and Regular N-gons

Saturday, April 18; 10:00 - 10:20 a.m., M333

One person is positioned at each vertex of a regular n-gon. Simultaneously, and at the same speed, each person walks toward the person who is located k vertices away in the counterclockwise direction. Find an equation that describes the shape of the path taken by each person. (This is a generalization of a fairly well-known problem. The case where n=4 and k=1 is the familiar situation.)

DALUSS SIEWERT, University of Colorado at Denver

Multi-Image Mosaic Problem

Saturday, April 18; 10:50 - 11:10 a.m., M333

When a single photographic image is converted to a digital image the scanner converts a negative into a number of smaller digital images, called tiles, which must be reassembled into a large composite image. I will talk about a method designed by the Fall 1997 Mathematics Clinic at the University of Colorado at Denver for removing the mosaic lines between the tiles. This problem is inherent in the conversion of a single photographic image to a digital composite, but is also a problem when compiling a large number of photographic negatives or positives into a large image. The method I will discuss removes the mosaic lines by finding a solution to Laplace's equation using iterative methods. The algorithm requires minimal computational time while producing an image no apparent distortion to the interior of the tiles.

BECKER SMITH, University of Colorado at Boulder

Teaching Mathematical Foundations in Lower-division and Survey Courses

Friday, April 17; 2:50 - 3:10 p.m., M340

In four years teaching undergraduates, I've discovered that most find mathematics mysterious - in the strict sense of having no underlying explanation. They ache to know what it's really about, and are relieved to discover this is a question that can

ROBERT REAM, University of Colorado

Distribution of Additive Functions (mod 1)

Friday, April 17; 4:25 - 4:55 p.m., M365

For any real-valued additive arithmetic function $f(n)$, there is a "translation constant" Υ_x depending on x, such that the *fractional part* of the numbers $\{f(n) - \Upsilon_x \mid n \le x\}$ have a distribution whose characteristic function (of k) is given by the approximate product representation

$$e^{-2\pi ik\Upsilon_x} \prod_{psx} (1-p^{-1})(1+\sum_{m=1} e^{2\pi ikf(p^m)} p^{-m(1-ikt)}) + o(1)$$

as $x \to \infty$, for some real constant τ. This product may be viewed roughly as an "expected value." We will investigate the effect of replacing the interval $n \le x$ with $x - y \le n \le x$ in the distribution of $f(n)$ (mod 1).

DAVID RECKSEEN, Metropolitan State College of Denver

Chaos and the Stock Market

Friday, April 17; 3:50 - 4:05 p.m.; M333

This project will review various published attempts to analyze stock market data for deterministic chaos. The discovery that some random-appearing systems are deterministic provides a ready-made explanation as to why statistical analysis of the stock market has always failed. The mathematical researchers' findings are not strong in favor of the presence of deterministic chaos in the markets. There is also concern that becoming able to detect low dimensional non-linearity (less than 10 variables) may be of theoretical interest only, since most markets are probably relatively high dimension. Researchers generally conclude that stock market data is not just random; but, they are unable to infer the extent and nature of determinism in the data. They agree (except for a few fanatics) that their research has not yet resulted in an increased ability to forecast the market.

During its classical Golden Age, 750-1050 C.E., Islam was among the most enlightened civilizations of the world. To an astonishing degree, the society tolerated dissent and heterodoxy, and produced a long line of scientists, philosophers, and humanists. The mathematics of this period was the ancestor of our own. Superficially, the reasons that medieval Islam valued these studies might also resemble our own. But a deeper examination shows evidence of a quite foreign perspective. We use the writings of scholars such as Al-Khowarizmi, Al-Biruni, Ibna Sina, Omar Khayyam, and the underground writings of the "Brethren of Purity", to learn something about the relation between mathematics and the larger society during the Golden Age of Islam.

JACK HODGES, University of Colorado, Boulder

At Least 5 Obvious Things I Learned in 44 Years of Teaching Mathematics with some Examples from Teaching the History of Mathematics.

Friday, April 17; 2:00 - 2:20 p.m., M341

"The title tells it like it is." Hopefully this talk will be of some interest to old timers as well as new timers.

ROBERT H. JACOBSON

Influence of Astronautics on Plane Geometry

Friday, April 17; 3:50 - 4:20 p.m., M364

The velocities of satellites can be related to all conic curves. A space vehicle velocity can be expressed by two components which are constant in magnitude throughout an orbit. These components also determine the location of all the points on a conic curve. The normalization of these components bring the orbital trajectories down to earth so curves which fit on a page can be defined by two values. The method uses polar instead of rectangular coordinates. The result provides one simple graph to define any size conic as a point. This method, which is proposed for math teachers and their students, allows continuous changes of the properties of ellipses to parabolas

to hyperbolas. One equation for all conics define a position on the curves.

ROGER W. JOHNSON, South Dakota School of Mines & Technology

Hands-on Learning Activities and Data Collection Project in Probability and Statistics

Friday, April 17; 4:25 - 4:55 p.m., M364

Fundamental concepts in probability and statistics are made more memorable and, arguably, more understandable to students using hands-on learning activities and data-collection projects. In my talk I'll present a few of my favorite such activities and projects. These include, for instance, counting M&Ms, capturing Pepperidge Farm Goldfish, tossing an inflatable globe, and collecting and examining data from a tape recorder, men's hats, and NFL quarterbacks. Some references to the literature concerning such activities and projects may be found on my homepage at URL http://silver.sdsmt.edu/~rwjohnso and at http://silver.sdsmt.edu/~rwjohnso/rckymtn_maa98.html.

THOMAS KELLY, Metropolitan State College of Denver, Recipeint of 1997 MAA Distinguished Teaching Award

Molasses, MacLaurin and Oil: A Series of Surprising Connection

Friday, April 17; 12:50 - 1:50 p.m.; M260

Colin MacLaurin is usually first encountered in the context of MacLaurin Series. He is also mentioned as the author of "Treatise of Fluxions" and the acclaimed "Account of Sir Isaac Newtons Philosophical Discoveries". While working with Metro students on the Tilted-Tank Problem for Underground Storage Tanks (UST's) I chanced to attend a talk by Judi Grabiner describing Maclaurin's work on measuring the volume of molasses in barrels.

This talk will examine the similarities between Maclaurin's molasses barrel problem and the present day problems with USTs. These similarities range from the direct, wherein both

Real Numbers.

Saturday, April 18; 11:40 - 12:00 a.m., M341

Demonstration of the correspondence and at least two "proofs" that there is a (1-1) correspondence between the natural numbers and the real numbers with an examination of why two "proofs" that there is no such correspondence are wrong.

WILLIAM RAMALEY, Fort Lewis College

History of Mathematical Induction

Friday, April 17; 3:50 - 4:20 p.m., M341

Mathematical induction grew from the sequential thinking found in cultures around the world. From those many roots grew a body of results, but Pascal was the first to use Induction in the modern sense. Finally Peano gave a new formalism in the "reform math" of 1895.

ROBERT REAM, University of Colorado

Fractional Funcitons and Operations

Friday, April 17; 3:15 - 3:45 p.m., M365

I developed two formulas for "fractional differentiation" before realizing that they have been known since the beginnings of calculus. I have discovered a way to use fractional differentiation to extend a function defined on the integers to an analytic function defined in the complex plane. I have also developed formulas that "fractionalize" analytic functions (that is, generalize an n-fold iteration of a function, $fofofo...of(x)=f_n(x)$, to a z-fold iteration of the function $f_z(x)$, where z is any real or complex number). We have for example, under different hypotheses on f) where c is a fixed point of f

$$f_x(x) = \lim_{n\to\infty} f_n(c+e^{z\log f'(c)}(f_{-n}(x)-c))$$

$$f_x(x) = \lim_{n\to\infty} f_n\left(c+((f_{-n}(x)-c)^{-(m-1)}+(m-1)a_m z)^{-1/(m-1)}\right)$$

The basic definition of convergence of continued fractions will be given, and some early examples of continued fraction expansions will be discussed. A brief biography of Stieltje will be given, and some important theorems from his 1894 paper will be discussed. Stieltjes invented the Stieltjes integral to solve a problem in the analytic theory of continued fractions. Orthogonal polynomials are closely related to this work.

JODIE NOVAK, University of Northern Colorado

Is SAS True on a Sphere? A Question Based Approach to Teachin Geometry.

Saturday, April 18; 10:50 - 11:35 a.m., M341

I will talk about my experiences using Henderson's book "Experiencing Geometry on Plane and Sphere" and how his approach motivates the need for proof. I will also address how the students react to this approach, how assessment activities and learning activities are blurred, and how this approach helps students find their mathematical voice. Finally, I will address the question in the title.

ZIM OLSON

Mathematics and the Human Condition

Friday, April 17; 2:00 - 2:20 p.m., M365

Much of current and past mathematics has been dependent on unmentioned human parameters for its guidance a direction. Quantum mechanics is one example of mathematics currently attempting to go beyond normal human experience in rationalizing the unknown and poorly understood. In this presentation I would like to direct mathematical scrutiny toward human conditions which directly or indirectly influence mathematical development. Such concepts include: the doma of experience; limits of quantifying experience; a general law of finite intelligence; expressing an absolute unknown; alternative "experiencing" and subsequent logic.

DAVID J. QUERTON,

A(1-1) Correspondence Between the Natural Numbers and the

volumes are gauged with a stick and tables to the indirect, such as the reasons for desiring accurate volume measurements in the first place.

JUDITH KEYES, University of Southern Colorado

The Beginning of Rigor in The Calculus

Friday, April 17, 2:25 - 2:45 p.m., M341

During the century following its "official" development by Newton and Leibniz in the 17th century, the Calculus was used extensively to solve problems from mathematics and physics, without much regard for the question of WHY it worked. In the late 18th Century, we begin to see growing concerns with foundational issues as mathematicians begin to ask questions such as "What is a function?". These concerns culminate with the introduction of rigor into the Calculus during the early 19th century. This talk examines the work of the central player in this movement, Augustin-Louis Cauchy, and its relation to earlier work done by Euler, Lagrange, Fourier, Bolzano and LaCroix.

BRADFORD J. KLINE, U. S. Air Force Academy

Some Simple Technology for Complex Variables-A Preliminary Look

Saturday, April 18; 10:00 - 10:45 a.m., M341

One of the more difficult aspects of learning complex variables for the first time is coming to grips with the geometry of complex-valued functions. Too often, textbooks do not augment the classical analysis with any discussion of what's really going on. I will present a number of Mathematica notebooks that I have recently developed and am currently using in a complex variables course which highlight some of the beautiful geometric aspects of complex analysis.

W.W. KOKKO, Arapahoe Community College

On Corley's Problem

Friday, April 17; 2:25 - 2:45 p.m., M364

An introduction to, and a few points of progress made by

W.W. Kokko on the random distribution of points within a bounded region. Specifically, Corley's Problem has to do with the probability of minimal distance between any pair of n random points within a unit square.

ALLEN LAWRENCE, Metropolitan State College of Denver

The Belousov-Zhabotinsky Reaction

Friday, April 17; 4:25 - 4:55 p.m.; M333

The project of choice is chaos in chemical reactions. The Belousov-Zhabotinsky reaction is one of the best studied oscillating reactions. This mechanism was chosen because the reactants and products are relatively safe to work with. The reaction periodically and aperiodically oscillates between five colors; however, at no concentration will you see all five. The chemical reactants are given as follows:

Solution A: NaBrO3

Solution B: CH2(COOH)2 O.O3M, KBr 0.059M

Solution C: Ce(SO4)2 0.01M, H2SO4 2.7M

The parameter studied was the volume ratios of the concentrations A, B, and C. An electrode which measured chemical potential (voltage) vs. time (in min) recorded the oscillations. The bifurcation's and sensitive dependence to initial conditions, i.e. the chaotic regime of the reaction, were noted and will be discussed in detail. Further, a comparison of details and a discussion of other experiments related to this reaction will be reviewed.

STEVEN C. LETH, University of Northern Colorado

What I Learned about the Prime Number Theorem from My Students

Friday, April 17; 2:35 - 2:45, M340

While working on a Mathematica project which I designed to introduce the Prime Number Theorem and reinforce limit concepts, students in my Analysis Course discovered a slight

modification in the statement of the result which dramatically decreases the error in a finite approximation. In this talk I will take you through the lab and show you how the slight variation arises in a natural way, and we will look at advantages of the new statement over the classical form of the theorem. No knowledge of the classical result is needed.

LU ANN MALIK, Community College of Aurora, and PETE WILDMAN, Casper College

NASA-AMATYC PC

Saturday, April 18; 10:00 - 10:45 a.m., M364

NASA-AMATYC PC is a collaborative project between NASA and 20 community college instructors. The instructors spent a week with scientists and engineers at Kennedy Space Center in Florida and developed over 30 real life problems into classroom activities. Problems are written to be adopted to all levels of 2-year college instruction from pre-algebra to calculus III. Come and see what this is all about and bring back some space science for your classroom.

MEAGAN MCNULTY, Metropolitan State College of Denver

The Heart and Chaos

Friday, April 17; 3:15 - 3:30 p.m.; M333

The heart is one of the most important parts of the body, and therefore is the focus of many studies. The idea of the healthy heart beating rhythmically is now being over turned by new studies showing that the heart beats chaotically through the day. Aside from being healthy, hearts beat chaotically during a heart attack. Current research is trying to predict when the heart will change from a normal beat into fibrillation. The hope is that one day doctors will be able to predict heart attacks. Finally, by learning to understand chaotic heart beating, controlling heart fibrillation may be possible.

BURNETT MEYER, University of Colorado at Boulder

The Work of T.J. Stieltjes on Continued Fractions

Friday, April 17; 2:50 - 3:10 p.m.; M341