ADDENDUM
STUDENT SPEAKERS
MAA TRI-SECTION MEETING

Sumit Chawla, Knox College, Galesburg, Illinois

The Comproof: An Automatic Theorem Prover

The *Comproof* was a program designed to serve as a pedagogical tool for writing proofs. It is a program that will do automatically most of the routine work involved in proving theorems. It scans the statement to be proved, looking for keywords like **'if, then, for all, is, exist,'** as a mathematician would do. Upon finding one, it classifies the statement based on the type found, and then processes it accordingly. In particular the keyword 'exist' forces the use of the 'theorem bank,' which is a bank that stores the theorems associated with various mathematical terms. Some simple proofs have been written by the program already, and with the complete implementation of the 'theorem bank,' which we are working on currently, the number of proofs that the program could write completely will increase.

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Jie Chen, Illinois Wesleyan University, Bloomington, Illinois.

Application of B-Waverlet on Detecting Pitches of Sound

Like the Fourier Transform, Wavelet Transform decomposes signals into simple units and the original signals can be reconstructed from them. Fourier Transform decomposes signals into sine and cosine functions of different frequencies, while Wavelet Transform decomposes signals into wavelets.

Since Fourier Transform is a global integration transform and there is no time factor in it, it cannot analyze nonstationary signals whose statistical properties change with time. In order to analyze nonstationary signals, we need decompose signals into units which are localized in both time and frequency domain. Basic theory of Fourier Transform tells us that there is tradeoff between time and frequency compactness. This problem is solved by decomposing the signal several times at difference levels. This is the essence of multiresolution analysis method developed by Stephane G. Mallat. Mallat summarized some fundamental theorems of multiresolution analysis, which state the existence of scaling functions and wavelets, and proposed a procedure to decompose and reconstruct signals when given a certain wavelet. Ingrid Daubechies at Bell Laboratories found out how to construct a suitable wavelet. A team in Texas A & M University indicated that a special wavelet constructed by B-spline function had certain properties that are useful in signal analysis.

According to the results of the above sources, we have the mathematical formulas and a procedure for signal analysis using a second-order B-wavelet. I write a program package in Mathematica to implement the decomposition and reconstruction algorithms. A data acquisition system developed in another project is used to acquire both the artificial sound signals and real voice signals. Results and comparisons of the wavelet transform and autocorrelation on detecting fixed and varying pitches will be presented.

Satyan Devadoss, Bryan Dwyer, North Central College, Naperville, Illinois.

Big and Bigger

Is there any number bigger than infinity? We will set out to investigate this and other questions that deal with the "size" of a set as we explore the world of transfinite numbers. We introduce the concepts of cardinality, ordinality, and countability, and we prove that the natural and rational numbers are countable while the irrationals are not! We conclude the topic with discussion of transfinite algebra: properties of addition and multiplication, and a hint of division.

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Brent A. Ferguson, Kenyon College, Gambier, Ohio.

Heterogeneous System for Analytical Problem-Solving

Work has been done by Barwise and Etchemendy in recent years to study the valid use of diagrams in logical and mathematical proofs. Working with Dr. Barwise at Indiana University's 1992 REU, I created a system called Familyproof which uses both diagrams and more standard logical formulas, and in which one can prove statements about familial relationships. These type of questions often appear on exams in the form of problems of "analytical reasoning" in the GRE and LSAT. My presentation will include a brief look at Familyproof's logical structure and will conclude with a sample proof which utilizes this innovative system.

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Jennifer Jancik, Illinois Wesleyan University, Bloomington, Illinois

The Multisurface Method of Pattern Separation

The recognition and separation of pattern sets is becoming increasingly important in everyday problems. An algorithm is developed, which can be used to separate sets whose convex hulls intersect. The algorithm can be solved in polynomial time and obtains a nonconvex piecewise-linear function.

Julie Kerr, Washington State University, Pullman, Washington

Orders and Hypergraph Representations of Cwatsets.

A subset C of Z_2^d is a cwatset if, for each element b of C, there exists a permutation σ is S_d such that $(C+b)^\sigma = C$. Here σ acts on an element of Z_2^d by permuting its components. The weight of the i-th column if C is the number of elements of C having a 1 in the i-th component. A (d,m)-cwatset is a cwatset in Z_2^d having m columns of weight k and $(d - m)$ columns of weight $(n - k)$, where n is the order of the cwatset and $0 < k < n$.

It is known that the order of a cwatset divides $2^d d!$ In this paper, we find additional constraints on the order of cwatsets.

i) A cwatset of odd order has order at most $\binom{d}{(d-1)/2}$ if d is odd or $\binom{d}{(d-2)/2}$ if d is even.

ii) Let m be an integer, $0 < m < d$, such that m is even if d is odd and m is either odd or even if d is even. If $m > (d - m -1)(d - m - 2)$ and if $(d - m)$ does not divide d then there is no $(d,2)$-cwatset of order $md/2$.

iii) Any (d,m)-cwatset has order which is at most $\binom{d}{m}$ and is divisible by $d/\gcd(d,m)$. We also show that a (d,m)-cwatset can be represented in terms of hypergraph with highly symmetrical properties.

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Heather Mickelson, Northern Illinois University, DeKalb, Illinois.

Graphing Inequalities of Women in Mathematics Education

Throughout the past few decades there has been a growing concern over the role of women in mathematics. Although there has been considerable progress, there still exists the need to increase national support for the mathematical education for girls and women. Parents and teachers especially need to be made aware of the causes and effects of the current educational environment. Only then can society's attitude be changed, and the problem of female inequality solved. Fortunately, during the past decade, numerous outreach programs and research have originated focusing on encouraging young women in mathematics and on reshaping teachers' attitudes toward their female students. It is a combination of all of these factors that will eventually lead to a truly equal education for all.

Eriks Smidchens, Kalamazoo College, Kalamazoo, MI

Bursting Oscillations Along the Axon of a Neuron

The body transfers electrical signals from one part to another by means of neurons. The conveyed signals are electrical potentials arising from the potential drop across the membrane of the neuron. When observed at a fixed location the electrical potential promulgates and action potential, a single nerve impulse that defines an active phase posited between two quiet phases. This bursting will be repetitive if the stimuli is large enough. The phenomena of bursting oscillations has been of great interest to mathematicians. Hudgkin and Huxley published the first relatively complete mathematical model and won the Novel Prize in 1963 for this work. Currently, research is being conducted on a simpler model, The Fizhugh-Nagumo-Rinzel equations to demonstrate the properties of bursting oscillations.

One area being investigated is the quasiperiodicity of the bursting oscillations (i.e. the ratio of the frequencies that comprise the oscillations is irrational) produced by the Fitzhugh-Nagumo-Rinzel equations. Analyses of the system were preformed using Fourier transformations, Hopf bifurcation diagrams, and perturbation theory. Although the discrete Fourier analysis can not prove the bursting oscillations are quasiperiodic, they do, however lend support to the claim since the individual, discrete frequencies disprove chaos. Additionally, bifurcation diagrams are used to find the influence of a parameter on the system. The Hopf point on the bifurcation diagram identifies the critical point where the steady state of the system and the periodic branch connect giving rise to the bursting observed.

By attempting to understand this simpler model, new insight can be shed on more complicated systems of equations in order to promote and guide further research.

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Kristin Toft, University of Dayton, Dayton, Ohio

Teaching Computers to Listen

Hidden Markov Models have applications in computer speech recognition. This talk focuses on implementing such HMMs and modifying the output to improve the recognition rate.

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Erik Varness , Valparaiso University, Valparaiso, Indiana

Algorithmic Aspects of Bipartite Graphs

We consider Gaussian elimination in non-symmetric matrices and a method of representing Gaussian elimination in terms of graph theory. Treating each non-zero entry in the matrix as an edge in the graph, we present several theorems dealing with an edge-elimination process on bipartite graphs. We will then see how these theorems lead to an algorithm for computing the minimal fill-in of a given graph.

Tony Vazzana, University of Notre Dame, Notre Dame, Indiana

Affine Root Systems and Their Associated Affine Weyl Groups

Given a Euclidean space with inner product one can define a root system which is a finite subset of vectors satisfying four special properties. Root systems are highly symmetric and give rise to a subgroup of GL(E) generated by reflections on hyperplanes perpendicular to the elements of the root system. This group is called the Weyl group. A root system must span the Euclidean space containing it and thus contains a basis of the space. We can construct a special type of basis called a base such that we get a simpler representation of the Weyl group. We get the same group by considering reflections on hyperplanes of the base elements only as our set of generators.

We can extend the Weyl group to include certain affine reflections (i.e. an affine transformation followed by a reflection.) The resulting group is called the affine Weyl group. By adding an extra dimension to the original Euclidean space we can define a corresponding affine root system. We can again obtain a base with the desired properties which is in fact finite even though our affine root system is now infinite. This gives rise to a finite set of generators for the affine Weyl group which is also now infinite. The relationship between a root system and the associated Weyl group has a number of other interesting properties which can also be extended to the affine case. Time permitting, we will consider the notion of the length of the Weyl group element and its analog in the affine case.

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Paul Warner, Hope College, Holland, Michigan

On Graphs Associated with Fractal Constructions

In 1988 Maudlin and Williams generalized the idea self-similarity in iterated function systems to that of graph self-similarity by associating a directed graph G and similarity ratios labelled by the edges of G with certain geometric constructions. If the graph is contracting (all edge ratios are less than 1), then the graph dimension is equal to the Hausdorff dimension. We show that the graph is cycle contracting (every cycle in the graph has ratio less than 1), then the graph is equivalent to a contracting graph, and hence the graph dimension is equal to the Hausdorff dimension of the associated fractal.

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James R. Wuerfel, Northern Michigan University, Marquette, Michigan

Fractal Views from Newton's Method

Newton's Method is a common algorithm used to find real roots of function. When seeded with a complex number however, the algorithm will also find complex roots of an equation. Under certain circumstances the method fails, falling into a cyclic pattern, or finding roots other than the one closest to the seed value. When graphed, fractal patterns emerge. We will explore these areas of nonconvergence that lead to beautiful images, using computer graphics. Also an animation of the function $Z^3 - C^3$ as C varies will be presented.

Errata to Printed Program

For the session entitled *The Trisectors' Guide to Circling the Square* Althoen's name is misspelled and M. F. Wyneken should have been listed as a contributor.

NOTES

Friday Schedule Revisions and Additions

2:30 - 3:40	**Parallel Session 1**		Rooms in Madeleva Hall
Session A	**Session B**	**Session C** (General) **Madeleva 233**	**Session D (Student Papers) Madeleva 224**
NO CHANGE	NO CHANGE	NO CHANGE	2:30 - 2:40 *Teaching Computers to Listen,* **Kristin Toft,** University of Dayton. 2:45 - 2:55 *The Comproof: An Automatic Theorem Prover,* **Sumit Chawla,** Knox College. 3:00 - 3:10 *Heterogeneous System for Analytical Problem-Solving,* **Brent A. Ferguson,** Kenyon College. 80 Solut 3:15 - 3:25 *Graphing Inequalities of Women in Mathematics Education,* **Heather Mickelson,** Northern Illinois University.

3:40 - 4:10 **Break** *Refreshments and Exhibits*	Le Mans
Refreshments Compliments of Harper Collins	

4:10 - 5:05	**Parallel Session 2**		Rooms in Madeleva Hall
Session A	**Session B**	**Session C** (General) **Madeleva 233**	**Session D (Student Papers) Madeleva 224**
NO CHANGE	NO CHANGE	NO CHANGE	4:10 - 4:20 *The Original "Proof" of the Four Color Conjecture,* **Robert Gemrich,** Alma College. 4:25 - 4:35 *Analysis of Natural Convection in a Rotating Loop,* **Mark A. Stremler,** Rose-Hulman Institute of Technology. 4:40 - 4:50 *Beyond the Third Dimension,* **Damen Peterson,** Alma College. 4:55 - 5:05 *The Multisurface Method of Pattern Separation,* **Jennifer Jancik,** Illinois Wesleyan University.

Saturday Schedule Revisions and Additions

10:15 - 1:10	**Parallel Session 3**		Rooms in Madeleva Hall
Session A	**Session B**	**Session C (Student Papers)** **Madeleva 233**	**Session E (Student Papers)** **Madeleva 224**
N O C H A N G E	N O C H A N G E	10:15 - 10:25 *Efficient expression of permutations using 3-cycles, 4-cycles or k-cycles,* **B. Culver, N. Fende, M. Jain,** Northern Michigan University.	10:15 - 10:25 *Fractal Views from Newton's Method,* **James R. Wuerfel,** Northern Michigan University.
		10:30 - 10:40 *Application of B-Waverlet on Detecting Pitches of Sound,* **Jie Chen,** Illinois Wesleyan University.	10:30 - 10:40 *On Graphs Associated with Fractal Constructions,* **Paul Warner,** Hope College.
		10:45 - 10:55 *The norm of a Hadamard multiplier,* **Dana K. Jackman,** College of Wooster.	10:45 - 10:55 **OPEN**
		11:00 - 11:10 **OPEN**	11:00 - 11:10 *Orders and Hypergraph Representations of Cwatsets,* **Julie Kerr,** Washington State University.
		11:15 - 11:25 *Bursting Oscillations Along the Axon of a Neuron,* **Eriks Smidchens,** Kalamazoo College.	11:15 - 11:25 *Big and Bigger,* **Satyan Devadoss & Bryan Dwyer,** North Central College.
		11:30 - 11:40 *A computer system conversion project,* **Mary Pat Sullivan,** Saint Mary's College.	11:30 - 11:40 *Algorithmic Aspects of Bipartite Graphs,* **Erik Varness,** Valparaiso University.
		11:45 - 11:55 *Nuclear tank calibration,* **Joy Wysocki,** Saint Mary's College.	11:45 - 11:55 *Affine Root Systems and Their Associated Affine Weyl Groups,* **Tony Vazzana,** University of Notre Dame. to Friday at 3:00
		Session D (General) Madeleva 233 NO CHANGE	