Cover Art:

Enigma of Sentience; an Allegory of the Arts and Sciences

A painting by Ernest P. Garcia

Created for the 10th Anniversary of Albuquerque TVI's Arts and Sciences Department.

An allegory in painting is the use of objects and figures as symbols for ideas. There is a rich tradition of allegory in art. Its power to communicate depended on a shared understanding of common symbols. Today, in a civilization of divergent beliefs, one that emphasizes the matter of fact, the here and now, the artist may struggle to find symbols that have the power to communicate the essence of an idea.

These mannequin-like figures are based on the enigmatic Cycladic statues of the ancient Aegean (ca. 3000-1500 BC). Their faces lack any surviving features except for the prominent wedge-shaped nose. Here they are voiceless actors used to enact through blind gesture the two fundamental roles of the arts and sciences.

The azure figure, blind, studies a fluorite crystal, thus portraying the function of the sciences (astronomy, chemistry, biology, sociology, economics, etc.) to measure, describe and understand the universe, and its workings. She also holds a polished hematite sphere in which is reflected the artist at work --- a reminder of the essential artificiality of the imaginary world proposed by the painting.

The golden figure, deaf, is absorbed in the sound of the sea echoing through the conch. The sound is an illusion, a simulacra of the sea --- a symbol. Here the role of the arts (music, literature, philosophy, history, etc.) is portrayed. The arts seek to interpret and ascribe meaning to the world, humanity, its works, and even to existence itself.
The setting, stage-like, is a dream world where the monumental works of humankind serve as a backdrop. The landscape is a desert wilderness, walls crumble over time, a vacant-eyed skull --- a reminder of individual mortality --- serves a rodent as a nest (an apparent affront by nature against the conceit of individual pride); an owl perched atop a broken idol, coldly eyes the viewer and reminds of Athena's wisdom, science, and warrior skills; the dove, ancient symbol of peace and prosperity holds forth conscience, and hope; below a serpent variously symbolic of water and the generative powers of life, or of temptation and deceit, winds across the feet of the statues and binds together the arts and sciences.

Welcome from the ACA Conference Chair

Welcome to New Mexico oh denizens of Earth (and members of ACA)! New Mexico, "The Land of Enchantment," is a land of ready access to both the astral plane of the mind and the physical plane of our cosmos. Here the cosmic, the astral and the everyday mingle freely and naturally. This natural weirdness is what attracted me here in the first place and of which I hope you will get some taste in your visit to us. You will not have to look far. I wish you bigger game, however. We hope you find here on your visit a whiff of awe.

The stage is certainly well set.

Computer algebra, as a wonder created by humankind, is one of the highest expressions of our civilization. That's cosmic. High technology thrives on the vast semi-arid steppe of the Southwest and bridges it. That's cosmic. We will physically cross a sublime and magical land to a high tech marvel, the VLA. The VLA or Very Large Array is a gigantic eye on the universe and looks across time itself. Again, all cosmic. Then there is mathematics itself, a magnificent cooperative continuing work of art unfolding before our very eyes. Very cosmic.

There is friendship. Globe straddling, geopolitical friendships helping to reverse the sillier excesses of the nationalisms of our species. There are big opportunities for new friendships as well. New Mexico is loaded with interesting people and some of the most interesting have concentrated in NMMATYC, the co-host of this conference. Try to seek out the NMMATYC people and form new geopolitical friendships. You will not regret it and that is cosmic too.

While in the land of enchantment, I would like you people from around the globe to reflect upon the cosmical aspects of everyday reality. We have tried to aid this reflection with a suggestive program and the 2001 Mathematical Odyssey theme. New Mexico's shimmering vistas and cerulean skies lull our corporeal selves into receptivity. Now we strike for the mind. I think if you let it, the whole conference can act as a matrix expressly designed to deliver big deep ideas right to the gut, and thence to the brain, but now with a visceral aura that is very convincing.

So you see there is no shortage of material for a transcendental experience.

With some luck, especially for those of you jetlagged to hallucinations, you will find in your examinations new connections and inspirations and can return home energized and ready to go further in your labors. With some luck, you will glimpse the awe and beauty we locals see in New Mexico, you will feel how we feel the cosmic vibrations in everyday things. And just maybe, your mathematics will improve.

Thank you,

Bill Pletsch
ACA 2001 General Chair

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ACA: Applications of Computer Algebra: An international organization whose focus is on solving important problems in science, engineering, and mathematics using computer algebra.

Welcome from the NMMATYC Conference Chair

Welcome to Albuquerque TVI,
This year's conference is even more special than usual; we're fortunate to be co-hosting and sharing meeting space with ACA. Joint sessions cover a wide range of topics with up to seven sessions running concurrently.

During this long weekend you have a unique opportunity to exchange ideas and teaching techniques and to network with accomplished professionals from all over the state and around the world.

Let this conference experience follow you home with new insights and information to enhance your teaching careers.

Janet Heath
NMMATYC Conference Chair

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2000 – 2002 NMMATYC Executive Board

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NMMATYC: The New Mexico Mathematical Association of Two Year Colleges: a state affiliate of the American Mathematics Association of Two Year Colleges (AMATYC), dedicated to achieving state of the art instruction of mathematics at the freshman and sophomore college level.

Please note: It was necessary to abbreviate some of the abstracts due to page limitations in the printed program. Full abstracts for ACA'01 and other information about the conference are available on the World Wide Web at http://math.unm.edu/ACA/2001/2001.html

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Acknowledgements

The executive conference committee wishes to express our thanks to the following people and organizations, who gave time, money, or equipment to support this conference.

Albuquerque Technical Vocational Institute
Cotopaxi
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Prentice-Hall
Texas Instruments
The TVI Bookstore

Michael Glennon (TVI president)
Jon Bentley, Jenna Johnson, and Susan Murphy (TVI A&S deans)
Paul Beck
Ernest Garcia
Shiva Hardee and Lillian Cordova
Mary Robinson
Celeste Nossiter (Prentice Hall)
Gina Rodriguez and the A&S computer lab staff
The staff of TVI's Instructional Media Services

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The 2001 NMMATYC/ACA Executive Conference Committee

Janet Heath
Linda Martin
Tamra Mason
Bill Pletsch
Jim Rewalt
Mark Rudd
Stanly Steinberg
Richard Warren
Michael Wester

Schedule Overview

Day	Starting Time	Registration/ Information	Special Event	MS-217	MS-216	MS-209	MS-201	MS-203	MS-204	MS-205	MS-208
Wed., May 30	5:00 – 9:00	At the Radisson									
Thurs., May 31	8:00	In the Cafeteria			Computer Algebra in Analysis and Solving of Equations in Mathematical Physics and Control Theory						
	9:00										
	9:30										
	10:00										
	10:30			Non-Standard Applications of Computer Algebra							
	11:00										
	11:30					Application of Computer Algebra to Image and Signal Processing					
	12:00										
	2:00										
	2:30				Symbolic and Numerical Scientific Computation						
	3:00										
	3:30										
	4:00										
	4:30										
	7:00		Party								
Fri., June 1	8:30	In the Cafeteria									
	9:00			Education Meets Computer Algebra	Symbolic and Numerical Scientific Computation	Gröbner Bases and Applications					
	9:30										
	10:00		Deux Ex Machina								
	10:30										
	11:00										
	11:30										
	12:00		VLA								
	2:00		NM Articulation Task Force								
Sat., June 2	7:30	In the Cafeteria									
	8:00		Mixer								
	8:30		Opening Remarks								
	9:00			Education Meets Computer Algebra	The Scientific Committee's Invitational Special Session	Gröbner Bases and Applications	NMMATYC sessions				
	9:30										
	10:00										
	10:30										
	11:00										
	11:30										
	12:00		Lunch, *Math for Humans*								
	2:00					Applications of Involutive and Gröbner Bases; the Differential and the Polynomial Case					
	2:30										
	3:00										
	3:30										
	4:00				NMMATYC						
	4:30										
	5:00		ACA business meeting								
	7:00		Banquet, *Keynote Address*								
Sun., June 3	8:00		NMMATYC business meeting	Education Meets Computer Algebra							
	8:30	In the Cafeteria				Applications of Involutive and Gröbner Bases; the Differential and the Polynomial Case	NMMATYC sessions				
	9:00										
	9:30										
	10:00		Panel: Technology in the classroom								
	10:30										
	11:00		Brunch								
	1:00		Santa Fe								

Thursday, May 31, morning sessions

	MS-217	MS-216	MS-209
9:00 – 9:30am		***A Use of Computer Algebra in the Inverse Problem of the Birkhoff-Gustavson Normalization*** Yoshio Uwano	
9:30 – 10:00am		***Constructing Highest-Weight Modules of Quantized Enveloping Algebras*** Willem de Graaf	
10:00 – 10:30am			
10:30 – 11:00am	***"Parametric Geometry" Package for Maple: Sketching, Automatic Theorem Proving and Cooperation with "The Geometer's Sketchpad" Made Easy*** Eugenio Roanes-Lozano	***Constraint Hamiltonian Dynamics and Involutive Bases*** Vladimir Gerdt	
11:00 – 11:30am	***Apollonius Meets Computer Algebra*** Robert H. Lewis	***The Involutive Form of a "Higher Index" DAE*** Teijo Arponen	
11:30 – noon	***Some Principles of Rational Drug Design*** Eric Burks and Michael Wester	***Generalized Power Expansions in Cosmology*** Alejandro S. Jakubi	***Balancing Multiwavelets using Gröbner Bases and Relinearization Techniques*** Jerome Lebrun
Noon – 2:00pm	**Lunch**		

Thursday, May 31, afternoon sessions

	MS-217	MS-216	MS-209
2:00 – 2:30pm	***"Ready, Fire, Aim": Social Systems and Rational Choice*** Michael A. Faia	***Non-commutative Generating Series, in Control Theory and Special Functions*** Gerard Jacob	***Automatic Derivation and Implementation of Fast Convolution Algorithms*** Anthony Breitzman & Jeremy Johnson
2:30 – 3:00pm	***A Computer Algebra Package for Constraint Satisfaction Problems*** Carl DeVore	***Faithful and Reliable Plotting of Curves by Symbolic-Numerical Methods*** Franz Winkler	***SPIRAL: A System for Implementation and Platform-Adaptation of Signal Processing Algorithms*** Jeremy Johnson & Markus Pueschel
3:00 – 3:30pm	***A Topology-Independent Accelerated Time Simulation of Passengers' Flux in Airport Terminals*** Eugenio Roanes-Lozano, Eugenio Roanes-Macias & Luis M. Laita	***Solving SNPE as a New Basic Symbolic-Numerical Operation for Modeling PDEs*** Valentine D. Borisevich & Valeriy G. Potemkin	***SUGAR – A Computer System for SUpersolvable Groups and Algorithmic Representation Theory*** Meinard Müller & Michael Clausen
3:30 – 4:00pm			
4:00 – 4:30pm	***Computing the Adjoint Matrix of Multivariate Polynomial Matrices Given by Straight-line Programs*** B. Castano, J Heintz & J. Llovet	***The SNPE2 Solver Developed for the MATLAB Environment*** Valentine D. Borisevich & Valeriy G. Potemkin	***Algebraic Properties of Approximate Quantum Fourier Transforms*** Martin Roetteler
4:30 – 5:00pm	***Investigating Young Group Double Cosets with Computer Algebra*** Bill Pletsch	***EROC: A Maple Library for Exact Real Object Computation*** G. Bodnar & J. Schicho	***Numerically Invariant Solutions of Geometric Flows*** Mireille Boutin
7:00 – 11:00	**Comida de Chihuahua, Vino Blanca y Cerveza** At Stan Steinberg's house, 715 Jefferson NE		

Friday, June 1, morning sessions

	MS-214	MS-216	MS-217	MS-110	W-16
9:00 – 9:30am	***Examples of How We Use Symbolic, Hand-Held Calculators in Teaching Engineering Mathematics*** Michel Beaudin & Kathleen Pineau	***Connecting External Engines through OMEI: Open Mathematical Engine Interface*** Weidong Liao, Dongdai Lin & Paul S. Wang	***Modular Algorithms for Computing Gröbner Bases*** Elizabeth Arnold		
9:30 – 10:00am	***New Insight in Mathematics by Live CAS Documents*** Ivan Cnop	***Computing Riemann Surfaces for Factoring Bivariate Approximate Polynomials*** Rob Corless	***Application of SAGBI-Bases to Dynamics*** Karin Gatermann		
10:00 – 10:30am				***Fermat, a Polynomial and Matrix Computer Algebra System*** Robert H. Lewis	***Deux Ex Machina*** Paul Beck and Richard Warren
10:30 – 11:00am	***The Joy of Mathematica: Instant Mathematica for Calculus, Differential Equations, and Linear Algebra*** Alan Shuchat & Fred Shultz	***Development and Analysis of 3D Non-Split Optimally Stable Lax-Wendroff Type Difference Scheme for Conservation Laws*** M. Kucharik, R. Liska, S. Steinberg & B. Wendroff	***Noncommutative Gröbner Bases: An Overview*** Ed Green		
11:00 – 11:30am	***CAS:Tool of First Recourse in Classical Applied Mathematics*** Robert J. Lopez	***Symbolic Computation and Wavelets*** Peter Paule	***Alternative Ways of Solving Polynomial Systems*** Ilias Kotsireas	***An Overview about News in MuPAD 2.0*** Frank Postel	
11:30 – noon	***Computer Algebra in a Course on Lie Symmetries of ODEs*** Alejandro Jakubi	***Symbolic and Numeric Computation of the Barnes Function*** Victor Adamchik	***Gröbner Bases with Respect to Several Orderings and Multivariable Hilbert Polynomials*** Alexander Levin		
2:00 – 5:00pm	***New Mexico Articulation Task Force*** Kitty Berger and Sue Hall				
12:00 – 5:00pm	**Trip to the Very Large Array**				

Saturday, June 2, morning sessions

8:00 – 8:30am	**ACA/NMMATYC Mixer in the Cafeteria**						
8:30 – 9:00am	**Opening Remarks in the Cafeteria**						
	MS-203	MS-204	MS-205	MS-208	MS-214	MS-216	MS-217
9:00 – 9:30am	***Part-Whole Concept: The Hidden Assumption in Adult Math Materials*** Dorothea Steinke	***Vocational Math Issues in the Arts and Sciences Curriculum*** Richard Araiza, James Rewalt, Dennis Vargo, and Richard Warren	***Learning Styles and a Laboratory Environment*** Lynn Onken	***Just What Should We Be Teaching Teachers?*** Jay Malmstrom	***What Math Should We Teach When We Teach Math With CAS?*** Bernhard Kutzler	***The Center Variety of Polynomial Differential Systems*** Abdul Salam Jarrah	***Valuations to Compute Gröbner Bases*** Ed Mosteig
9:30 – 10:00am					***Transforming Traditional Exam Questions into CAS-Save Exam Questions*** Vlasta Kokol-Voljc	***Computation of Erdos-Woods Numbers*** Nik Lygeros	***On Gröbner Bases in Polynomial Rings over Von Neumann Regular Rings*** Yosuke Sato
10:00 – 10:30am	***Pre-calculus at UNM – Past, Present, and Future*** Kristin Umland and Anna Madrid	***Maximally Even Sets*** Jack Douthett	***Ingredients for Increasing Student Success: Communication, Curriculum*** Marilyn Mays	***Teaching Presentations from EPCC students*** Joanne Peeples, Diana Kretzer, Lorena Lopez, Rocio Myres, Rogelio Myres, Edward Perez, Stephanie Phillips, and Angela Saddler			
10:30 – 11:00am					***How to Make Tests for Students Using CAS Tools (such as TI-89)*** Bengt Ahlander	***Symbolic-Numerical Methods for Solving Singularly Perturbed Problems*** Raya Khanin	***Toric Initial Ideals without Embedded Primes*** Rekha R. Thomas
11:00 – 11:30am	***Sex, Drugs, and Rock 'n Roll*** Jay Lehmann	***What is Quasiperiodicity?*** Peter Steinbach	***Developing Reasoning in Algebra Students*** Anne Dudley and David Dudley		***The Use of CAS in the Thuringian School System: Present and Future*** Karsten Schmidt	***Resultants of Composed Polynomials*** Manfred Minimair	***FOLA: A Computer Algebra System for Doing Research, Teaching and Studying Formal Languages, Grammars and Automata*** Quoc-Nam Tran
11:30 – noon					***The Symbolic Math Guide in Calculus*** Doug Child	***Quantified Constraints Under Perturbation*** Stefan Ratschan	***Computational Algebraic Geometry and Switching Surfaces in Optimal Control*** Uli Walther
Noon – 2:00pm	**Lunch in the Cafeteria with Richard Griego: *Math for Humans***						

Saturday, June 2, afternoon schedule

noon – 2:00pm	**Lunch in the Cafeteria with Richard Griego speaking, "Math for Humans"**						
	MS-201	MS-203	MS-205	MS-208	MS-214	MS-216	MS-217
2:00 – 2:30pm	***Cultural Diversity: The Stories We Tell*** Max Cisneros, Michele Diel, Rita Gonzalez	***Functions - I Love You!*** James L. Smith	***Cooperative Learning: Who Has The Time?*** Terrylynn Vigil	***Relearning the Operations – In Another Language*** Carolyn Stupin	***Electronic Submission of Student Work Using WORD and MAPLE*** Gary A. Harris	***Functional Decomposition*** Rosario Rubio San Miguel	***Algebraic Analysis: New Perspectives for Applications*** Jean Francois Pommaret ***Differential Bases and***
2:30 – 3:00pm					***Assessing the Effects of the TI-89 Hand-Held CAS in a First Year Calculus Sequence*** Mary Ann Connors	***Parametric Treatment of Generalized Constraint Systems*** Thomas Sturm	
3:00 – 3:30pm	***Student Panel: What is it like to be a community college math student?*** TVI Student Panel	***Dangerous Dan Runs the Bases: Number Magic, Polynomials, and Divisibility*** Jay Malmstrom	***Cognition, Visualization, and Technology: In-Depth Learning of Mathematics*** Tchoshanov & Fuentes	***Teachers of Teachers Committee*** Michele Diel	***Computer Algebra Systems and Mathematics Education: Resolving the Disharmony –or - Why You Can't Have Your Cake and Eat it.*** Martyn Quigley	***Computing the Frobenius Canonical Form*** Arne Storjohann	***Dynamical Aspects of Involutive Bases Computations*** Ralf Hemmecke
3:30 – 4:00pm							
4:00 – 4:30pm	***Tuesday Afternoon at the State Penitentiary; Monday and Thursday evening at St. John's*** Reuben Hersh	***For what functions is $f^{-1}(x)=\frac{1}{f(x)}$?*** Sharon MacKendrick	***Student On-Line Collaboration in Mathematics*** Peg Pankowski	***Alternative Calculus*** Joanne Peeples and Rogelio Myres	***Computer Algebra: A Tool of Today for the Mathematics of Yesterday*** Franz Lichtenberger	***"101" Ways to Meet the Needs of Developmental Math Students*** Donna Gaudet and Nancy Fortenberry	***Differential Elimination Algorithms and Deformations of Symmetric Differential Systems*** Greg Reid
4:30 – 5:00pm				***Help in Using Symbolic, Hand-Held Calculators in Teaching Engineering Mathematics*** Gilles Picard & Kathleen Pineau	***SmartTools: Developing Tools for Teaching Mathematics*** Frank Postel		
5:00 – 6:00pm	***ACA Business Meeting***						
7:00 – 11:00pm		**Banquet at El Pinto (10500 4th NW) with Keynote Address from Deborah Hughes-Hallett**					

Sunday, June 3, morning schedule

<table>
<tr><th></th><th>MS-201</th><th>MS-202</th><th>MS-110</th><th>MS-204</th><th>MS-205</th><th>MS-209</th><th>KC 25-28</th></tr>
<tr><td>8:00 – 8:30am</td><td rowspan="2">NMMATYC business meeting</td><td rowspan="2"></td><td rowspan="2"></td><td>Derive 5 – A Tool for Teaching and Learning
Bernhard Kutzler and Vlasta Kokol-Volic</td><td>From Computing to Proving: Experiments with THEOREMA in Mathematics Education
Franz Lichtenberger</td><td rowspan="2"></td><td rowspan="2"></td></tr>
<tr><td>8:30 – 9:00am</td><td>Fast Computation of Polynomial Janet Bases
Vladimir P. Gerdt, Yu A. Blinkov & D. A. Yanovich</td><td>Introducing Mathematical Models with a CAS in an Introductory Course of Differential Equations
Angel Balderas Puga</td></tr>
<tr><td>9:00 – 9:30am</td><td rowspan="2">Do We Understand the Math We Teach?
Fred Ream</td><td>A Project Based Arithmetic Course: Learning Skills While Problem-Solving
Juan Saavedra</td><td rowspan="3">Symmetry and Tilings
Louis Romero and Paul Mitschler</td><td>Stanley Decompositions and Involutive Bases
Joachim Apel</td><td>Computer Algebra with Beginning Community College Students
Peg Pankowski</td><td rowspan="2">The Scientific Notebook Interface to Computer Algebra
Steven Swanson and Keith Kendrick</td><td rowspan="2"></td></tr>
<tr><td>9:30 – 10:00am</td><td>Boolean Algebra with Mathematica and TI-83, 89
Igor Gachkov</td><td>Transformation of Functions: A Graphing Calculator Game
Julie DePree</td><td></td></tr>
<tr><td>10:00 – 10:30am</td><td rowspan="2"></td><td rowspan="2"></td><td></td><td></td><td></td><td rowspan="2">Panel Discussion: Appropriate Use of Technology in the Mathematics Classroom
Rob Corless, Jack Douthett, Deborah Hughes-Hallett, Bernhard Kutzler, & Linda Martin
Moderator: Richard Fox.</td></tr>
<tr><td>10:30 – 11:00am</td><td></td><td></td><td></td></tr>
<tr><td>11:00 – 1:00pm</td><td colspan="7">Brunch in the cafeteria</td></tr>
<tr><td>1:00 – 10:00pm</td><td colspan="7">Trip to Santa Fe</td></tr>
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Invited Addresses

Keynote Address: *Understanding Students: Mathematics from Another Angle,* Deborah Hughes-Hallett

Saturday Banquet, 7:00pm, at El Pinto Restaurant

Effective teachers know both their subject and their audience. As students arrive with goals and backgrounds that differ markedly from our own, how should we adjust? Should we adjust at all? How do we arrange to keep the good, and discard the unnecessary? Indeed, how do we tell which is which, since we do not all agree? In this talk I will talk about how I think students have changed, and how we might respond.

Deborah Hughes Hallett is Professor of Mathematics at the University of Arizona. With Andrew M. Gleason at Harvard, she organized the Calculus Consortium based at Harvard, which brought together faculty from a wide variety of schools to work on undergraduate curricular issues. She is actively involved in discussions about the teaching of undergraduate mathematics at the national and international level and is an author of several college level mathematics texts. She is a member of the National Academy of Science's Committee on Advanced Study in American High Schools and of the MAA Committee on Mutual Concerns. In 1998 she was co-chair of the International Conference on the Teaching of Mathematics in Samos, Greece, attended by faculty from 44 countries. She established programs for master's students at the Kennedy School of Government, pre-calculus, and quantitative reasoning courses (with Andy Gleason), and courses for economics majors. She was awarded the Louise Hay Prize and elected a fellow of the American Association for the Advancement of Science for contributions to mathematics education. She won the three teaching prizes given at Harvard.

Math for Humans, Richard Griego

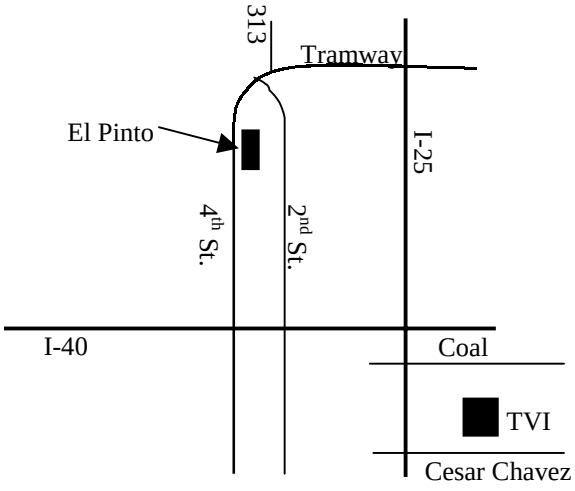
Saturday Lunch, noon, in the cafeteria

While math may be important to the scientific and technical elite, how important, really, is math to the "man in the street"? I would like to talk about how mathematics should and can be relevant to ordinary humans and what should be taught.

Dr. Griego is a retired Presidential Professor of Mathematics at the University of New Mexico. Before retiring, he was dean of the graduate school, chair of the Mathematics department, director of the Chicano Studies program, and founder of the College Enrichment Program, recruiting and supporting minority students. His field is probability theory. He published over 30 papers and monographs, and is recognized as one of the founders of the theory of random evolutions.

Driving directions to the banquet at El Pinto Restaurant, 10500 4th Street NW

- Drive North 10 miles on I-25 to the Tramway exit (exit 234).
- Turn left (west) on Tramway.
- Follow Tramway until it curves south, where it turns into 4th street (about 2 miles).
- El Pinto is on the left.



Thursday morning

9:00 – 9:30 **A Use of Computer Algebra in the Inverse Problem of the Birkhoff-Gustavson Normalization**

Yoshio Uwano, Kyoto University, Japan

The Birkhoff-Gustavson (BG) normalization has been utilized very effectively in various studies in Hamiltonian systems. The inverse problem of the BG normalization has been posed by the speaker: What kind of polynomial Hamiltonians can be brought into a given polynomial Hamiltonian in the Birkhoff-Gustavson normal form? Since elementary algebraic operations, differentiation, and integration of polynomials have to be repeated many times both in the inverse and the direct problems, computer algebra is worth applying to these problems; the program named 'ANFER' working on REDUCE has been proposed. The aim of the talk is to present:

1. *the algorithm of ANFER solving the inverse problem,*
2. *how ANFER works effectively in the inverse problem associated with two-dimensional perturbed harmonic oscillators with homogeneous cubic-polynomial potentials (PHOCPs),*
3. *further results in the inverse problem with the PHOCPs obtained from the viewpoint of separability,*

not only from the viewpoint of computer algebra, but also from that of mathematical analysis.

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9:30 – 10:00 **Constructing Highest-Weight Modules of Quantized Enveloping Algebras**

Willem de Graaf, University of Utrecht, The Netherlands

In this talk I will sketch an algorithm for computing with PBW-type bases in quantized enveloping algebras. This leads to an algorithm for constructing highest-weight modules, and corresponding R-matrices.

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10:30 – 11:00 **"Parametric Geometry" Package for Maple: Sketching, Automatic Theorem Proving and Cooperation with "The Geometer's Sketchpad" Made Easy**

Eugenio Roanes-Lozano, Universidad Complutense de Madrid, Spain

Maple 6 already incorporates an excellent Euclidean Geometry package (named "Geometry"). Unfortunately (and surprisingly), this package can't handle parameter equations (only numerical data). This lack is a serious restriction. Therefore, a "Parametric Geometry" Maple ad-hoc package has been developed by the author. It is almost a re-creation of the standard ``Geometry'' package, allowing parameters.

10:30 – 11:00 **Constraint Hamiltonian Dynamics and Involutive Bases**

Vladimir Gerdt, JINR, Dubna, Russia

In this talk we apply the algorithmic techniques of commutative computer algebra based on the use of involutive polynomial bases to finite-dimensional constrained Hamiltonian systems of polynomial type. We show that involutive bases allows one to compute the complete set of constraints and separate them into the first and second classes in accordance to the Dirac classification.

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11:00 – 11:30 **Apollonius Meets Computer Algebra**

Robert H. Lewis, Fordham University, New York, and Stephen Bridgett, Queen's University, Belfast

The circles of Apollonius problem is a classic geometry problem dating from Greek antiquity. Although there are various generalizations and special cases, the main problem was to find the circle(s) tangent to three given circles in the plane. Here we are concerned with higher dimensional generalizations. First, to find equations for a sphere tangent to four given spheres in three-space. Secondly, to similarly find equations for a hypersphere tangent to n+1 given hyperspheres in n-dimensional space. Thirdly, to replace some of these spheres with ellipsoids. We will discuss computer algebra solutions based on Groebner bases and on Dixon resultants.

11:00 – 11:30 **The Involutive Form of a "Higher Index" DAE**

Teijo Arponen, Helsinki University of Technology, Espoo, Finland

We present an algorithm to study the structure of polynomial DAEs. Although there are already several such algorithms, we argue that they lack certain properties we consider important. Our motivation is to get an algebraic analog to the geometrical approach to DAEs developed by Prof. J. Tuomela. We discuss about the needed properties of the algorithm and shortly compare it to other approaches in literature. Usually DAEs are studied by people who work either on numerics or on symbolic computation, but not both. We try to mix these: for a given DAE, by using symbolic computation we achieve a formulation which is suitable for doing numerical computations, in the sense that the biggest problems (drift-off and instability) in DAE numerics are avoided.

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11:30 – 12:00 **Some Principles of Rational Drug Design**

Eric Burks and Michael Wester, University of New Mexico

Drug design has traditionally been a process of biological and chemical experimentation, trying to come up with a drug that interferes with the normal progress of a disease or condition. This is an expensive proposition, both in time and in money, so a more "rational" approach has long been desired. In the last few years, structure based rational drug design has come into its own with its most notable success a pill announced in late 2000 that has so far proved in clinical trials to be 90% effective in putting people into remission for chronic myeloid leukemia. In this talk, we will present some of the basic principles of structure based rational drug design.

11:30 – 12:00 **Generalized Power Expansions in Cosmology**

Alejandro S. Jakubi, University of Buenos Aires, Argentina

An advance report is given on a recently introduced algorithm to obtain generalized power asymptotic expansions of cosmological solutions of the Einstein equations. An implementation in Maple with improved tools for sorting exponents is described. Also it is shown how to apply the algorithm when the evolution is determined by a system of nonlinear differential equations.

11:30 – 12:00 **Balancing Multiwavelets using Groebner Bases and Relinearization Techniques**
Jerome Lebrun, Swiss Federal Institute of Technology - Lausanne

Wavelets and filter banks have become useful in digital signal processing in part because of their ability to represent piecewise smooth signals with relative efficiency. For such signals, the discrete wavelet transform (DWT) developed as a main tool for signal compression (JPEG 2000), fast algorithms, and signal estimation and modeling (noise suppression and image segmentation, etc). The DWT is usually implemented as an iterated digital filter bank tree, so the design of a wavelet transform amounts to the design of a filter bank.

While the spectral factorization approach is the most convenient method to construct the classic Daubechies wavelets (and the corresponding digital filters), it is not applicable anymore to most of the other wavelet design problems where additional constraints are imposed. A typical case comes with the construction of multiwavelets (corresponding to filter banks with relaxed requirements on their time-invariance). Multiwavelets are a natural generalization of wavelets where one allows the associated multiresolution analysis to be generated by more than one scaling function so as to overcome the limitation preventing the construction of orthogonal wavelets with compact support and symmetries. Conditions of balancing are then introduced in the design so as to ensure that the multiwavelets behave like bona-fide wavelets up to a given order of approximation. These conditions and stronger conditions of interpolation leading to multiCoiflets will be extensively detailed.

Thursday afternoon

2:00 – 2:30 **"Ready, Fire, Aim": Social Systems and Rational Choice**
Michael A. Faia, The College of William & Mary, Williamsburg, Virginia

We explore a migration process with two unknowns, facilitating geometric illustrations. Chaos events involve potential migratory streams that remain empty, along with abrupt shifts of corner solutions. Post-optimality experiments give further evidence of such events. In a model involving school enrollments, we show that apparently minor policy constraints, construed as emergent social norms, may create large shifts of optimal LP solutions. We speculate about the prospects of extending Zipf's hypotheses to mentalistic phenomena. Finally, we develop an LP model of social mobility containing utilities to be maximized. This analysis---although more experimentation is needed---leads to the finding that a mobility pattern with realistic utilities may eliminate nearly all "stayers."

2:00 – 2:30 **Non-commutative Generating Series, in Control Theory and Special Functions**
Gerard Jacob, University Lille I, France

The noncommutative power series appear as a combinatorial tool that is useful in control theory - where they play the rule of the transfer functions, in a non linear setting - as well as in the domain of the special functions. In these two fields, we introduce them by encoding iterated integrals on some differential forms, as defined by K. T. Chen. We use them jointly with free Lie algebras, Poincarre-Birkhoff-Witt theorem, and Hopf algebras. Recently, we obtained new results by use of the noncommutative rational series. We get so a good combinatorial preparation for writing down some specific packages in Computer Algebra Systems.

2:00 – 2:30 **Automatic Derivation and Implementation of Fast Convolution Algorithms**

Anthony Breitzman and Jeremy Johnson, Drexel University

We discuss a Maple package created for exploring the techniques of Winograd, Nussbaumer, and others for computing "fast" convolution algorithms. By codifying known convolution techniques into a common framework of bilinear algorithms built from parameterized matrices and algebraic operators, we are able to use Maple's symbolic and algebraic computation facilities to derive and manipulate these algorithms. The resulting environment allows one to systematically apply the algebraic theory developed over the years to produce correct and efficient programs. Numerous algorithmic choices can be tried, allowing the user to rapidly test various optimizations to find the best combination of algorithms for a particular size convolution on a particular computer. Furthermore, automatic code generation and algebraic verification provides the ability to construct non-trivial examples with confidence that the resulting code is correct.

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2:30 – 3:00 **A Computer Algebra package for Constraint Satisfaction Problems**

Carl Devore, University of Delaware

We present a Maple package for solving a class of Constraint Satisfaction Problems (CSPs). The Computer Algebra System allows for the easy specification of symbolic constraints of arbitrary complexity. Conjunctions and disjunctions of constraints can be nested to arbitrary depths. Constraints can be specified as procedures which may return additional constraints. Such procedures are akin to the constraint handling rules discussed by Fruhwirth. Constraints and entire problem specifications can be programmatically generated. Solutions and partial solutions can be displayed graphically as they are being generated. The package can display its internal workings at any level of detail that the user wants. Two consequences of these features are that (1) the package can be used to analyze a small-scale version of a problem and to develop an efficient solution technique before the real-scale version in encoded in another language, and (2) the package can be used to teach logic, programming, and computer algebra. Several examples are shown of puzzle problems that are fun and understandable at an elementary level.

2:30 – 3:00 **Faithful and Reliable Plotting of Curves by Symbolic-Numerical Methods**

Franz Winkler, RISC-Linz, J. Kepler University, Linz, Austria

We describe a parallel hybrid symbolic-numerical solution to the problem of reliably plotting a plane algebraic curve. The original sequential program is implemented in the software library CASA on the basis of the computer algebra system Maple. The new parallel version is based on Distributed Maple, a distributed programming extension written in Java. We describe the mathematical foundations of the algorithm, give sequential algorithmic improvements and discuss our parallelization approach.

2:30 – 3:00 **SPIRAL: A System for Implementation and Platform-Adaptation of Signal Processing Algorithms**

Jeremy Johnson, Drexel University, and Markus Pueschel, Carnegie Mellon University

The SPIRAL system allows the user to obtain high-performance platform-adapted implementations of fast signal transforms from a high-level mathematical formulation. At the simplest level, the user can specify the desired transforms by giving their names and sizes and ask for an implementation on a given platform. A more interactive session would allow the user to guide the implementation process selecting from a database of algorithm

rules, implementation strategies, and search methods. A more sophisticated user can define new transforms and symbolic rules for deriving fast algorithms for the transform. This talk presents an implementation of the SPIRAL system using the GAP computer algebra system.

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3:00 – 3:30 **A Topology-Independent Accelerated Time Simulation of Passengers' Flux in Airport Terminals**

Eugenio Roanes-Lozano and Eugenio Roanes-Macias, Universidad Complutense de Madrid, and Luis M. Laita, Universidad Politecnica de Madrid

The authors were commissioned to develop this work by the airport authority of one of the main Spanish airports. It should be able to simulate in advance the different possible designs of the new terminal, now in project, with a "accelerated time simulation". This package, currently under development, will consider departures, arrivals and luggage managing. The program can show:

- *Detailed numerical data about any queue in the terminal at any minute*
- *Representations in curves, animations... of the evolution of any queue*
- *Maximum, media... of waiting time at any queue and of length of any queue*

Therefore it enables both to test different designs of the topology of the terminal and to manage problems like check-in desk assigning. The program, to be developed in a very tight schedule is being implemented in Maple.

3:00 – 3:30 **Solving SNPE as a New Basic Symbolic-Numerical Operation for Modeling PDEs**

Valentine D. Borisevich and Valeriy G. Potemkin, Moscow State Engineering Physics Institute

As is known in the case of solving Partial Differential Equations (PDEs) the initial system is reduced to the nonlinear system of finite difference equations that are the System of Nonlinear Algebraic Equations (SNAE). Solving of the latter is in turn reduced to System of Linear Algebraic Equations (SLAE) of a large size, which is considered conventionally as a basic operation for modeling PDEs. As the result of our recent research we offer to apply a direct technique of solving SNAE using instead of SLAE a System of Nonlinear Polynomial Equations (SNPE) as the model. In fact, it means the replacement of the linear basic operation to the nonlinear one. To solve SNPE by means of our new basic operation we offer (i) to analyze them as an object of the theory of ideals; (ii) to reduce the SNPE to a Groebner basis; (iii) to transform SNPE in the Groebner basis to the System of Spectral Problems (SSP) for rectangular matrix pencils. So the new basic operation includes two different types of computations: the first is a symbolic one (reducing SNPE to a Groebner basis) and the second is a numeric one (solving of SSP). At the moment the algorithm is accomplished as a solver in the MATLAB environment.

3:00 – 3:30 **SUGAR – A Computer System for SUpersolvable Groups and Algorithmic Representation Theory**

Meinard Müller and Michael Clausen, University of Bonn, Germany

Let G be an finite group of order n. By Wedderburn's Theorem, the complex group algebra $\mathbb{C}G$ *is isomorphic to an algebra of block diagonal matrices:**** Every such isomorphism D, a so-called discrete Fourier transform of* $\mathbb{C}G$*, consists of a full set of pairwise inequivalent irreducible representations* D_k *of* $\mathfrak{R}G$*. Concerning these generalized DFTs there are two fundamental computational problems.*

1. *How can a DFT of G be generated efficiently?*
2. *Is there a suitable DFT of G which can be performed efficiently?*

In the case of supersolvable groups given by consistent power-commutator presentations, Baum and Clausen have presented algorithms for both computational problems which are essentially optimal. We will present SUGAR – SUpersolvable Groups and Algorithmic Representation theory – which realizes both algorithms, the fast generation of DFTs as well as the fast evaluations of DFTs (FFTs) for the class of finite supersolvable groups.

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4:00 – 4:30 **Computing the Adjoint Matrix of Multivariate Polynomial Matrices given by Straight-line Programs**

B. Castano and J. Heintz, University of Cantabria, Spain, and J. Llovet, University of Buenos Aires, Argentina

We describe a new implementation of an algorithm for computing the adjoint matrix of a multivariate polynomial matrix. The innovation of our approach consists on using an arithmetic circuit implemented in the computer as a directed acyclic graph (DAG) for representing the polynomials, the matrices and the algorithms as well. The mentioned DAG represents a straight-line program (SLP) when executing an evaluation algorithm, otherwise known as pebble game across the arithmetic circuit.

We have managed to compute the adjoint matrix of a n x n square polynomial matrix A by deriving the determinant of A given in DAG representation with respect to all its entries. This entirely novel approach, which required backward-derivation we made possible by relying on Baur-Strassen's algorithm in the Jacques Morgenstern's version.

4:00 – 4:30 **The SNPE2 Solver Developed for the MATLAB Environment**

Valentine D. Borisevich and Valeriy G. Potemkin, Moscow State Engineering Physics Institute

For the last 10 years the toolbox for solving Systems of Nonlinear Polynomial Equations (SNPE) including more than 30 modules has been under development. By now on the basis of this toolbox there is accomplished the solver named as SNPE2 for finding solutions of SNPE with two variables and one parameter. The SNPE2 Solver is designed as a GUI application in the MATLAB environment. The Solver is based on a new generation of mixed symbolic-numerical algorithms. It provides finding all real and complex solutions by means of only pure algebraic operations; calculating for a number of equations that may not coincide with a number of variables; evaluating residuals and time of execution; making calculations with the accuracy within the range of 10^-8 up to 10^-14.

4:00 – 4:30 **Algebraic Properties of Approximate Quantum Fourier Transforms**

Martin Roetteler, Universitaet Karlsruhe, Germany

It is well known that fast algorithms for the computation of Discrete Fourier Transforms can be explained and cast in representation-theoretical terms. The pillar of this approach is to take advantage of their property to decompose a representation into a direct sum of irreducible representations. The special case of regular representations of cyclic groups leads to the most familiar case, in the following denoted by DFT.

The field of definition of DFT is a cyclotomic field L containing a primitive N-th root of unity where N denotes the length of the DFT. Approximate Quantum Fourier Transforms (AQFT) are a class of unitary transformations which are defined over subfields of L and which are shown to yield good approximations to the DFT with respect to the spectral norm.

AQFTs have been introduced by D. Coppersmith for use in quantum computing. They provide a significant speedup compared to the computation of a DFT on a quantum computer. As a new result we show that AQFTs are basefield transforms: they decompose the regular representation of the cyclic group into irreducibles over subfields of L, i.e., over non-splitting fields.

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4:30 – 5:00 **Investigating Young Group Double Cosets with Computer Algebra**
Bill Pletsch, Albuquerque Technical Vocational Institute

Let us consider a deuteron colliding with another deuteron ignoring charge and spin. In the case where after the collision two deuterons are returned there are only two possible reactions. Either nothing happened or a particle was exchanged. Generalizing this simple problem from scattering theory results in an excursion into Polya's theory of counting and the theory of double cosets.

Until the advent of computer algebra, the theory of double cosets has been restricted to a few elegant but computationally impossible theorems. Impossible in the sense that in principle the calculation can be done but it will take ten thousand years.

Today, using Computer Algebra much can be calculated quickly. Using Macsyma and Maple in the special case of Young group generated double cosets, we will see just how valuable Computer Algebra can be. Some surprising and stimulating patterns emerge after a just few computer algebra experiments.

4:30 – 5:00 **EROC: A Maple Library for Exact Real Object Computation**
G. Bodnar and J. Schicho, RISC-Linz, J. Kepler University, Linz, Austria

The EROC package implements computable real numbers and related objects in Maple. It is meant to be a tool that can be used in symbolic-numeric computation. The main topics we discuss are: representation and arithmetic of exact real numbers, vectors and matrices; polynomial arithmetic and root computation. Some operations raise ill-posed problems; we used regularization methods to solve them.

4:30 – 5:00 **Numerically Invariant Solutions of Geometric Flows**
Mireille Boutin, University of Minnesota

Given a G-invariant differential equation (e.g. a geometric flow), we are interested in obtaining numerical solution schemes which are also invariant under G. For example, we would like to obtain affine invariant numerical schemes for the affine invariant flow C_t = Css for a curve C in the plane. We do this using an algorithmic method based on moving frames. The method involves solving a set of equations defining a cross-section of the orbits of the group action.

Friday morning

9:00 – 9:30 **Examples of How We Use Symbolic, Hand-Held Calculators in Teaching Engineering Mathematics**
Michel Beaudin and Kathleen Pineau, Ecole de Technologie Superieure, Montreal, Canada

Since the 1999 fall semester, the TI-92 Plus or TI-89 has been a compulsory purchase for new students entering our engineering school. The introduction of this hand-held technology

had forced us to re-assess our goals in teaching mathematics and to explore new approaches in teaching traditional subjects. In this talk, we will present innovative uses of the TI-92 Plus/89 that relate to our calculus and differential equations courses. We will give examples of presentations taken from our lectures as well as examples of the problems that we now use to assess our students understanding of mathematics and their problem solving skills.

9:00 – 9:30 **Connecting External Engines through OMEI: Open Mathematical Engine Interface**

Weidong Liao, Dongdai Lin, and Paul S. Wang, Kent State University

Open Mathematical Engine Interface (OMEI) is an application programming interface specification for providing computational services through external engine for compute servers. The background and use scenarios of OMEI, the OMEI specification and its implementation in Java environment are discussed. First we introduce the background and motivation behind OMEI. Then several use scenarios of OMEI specification will be described; we can see that OMEI cannot only be used with compute servers, but also the regular front-ends. The OMEI specification and OMEI implementation in Java environment will be also discussed. Finally we provide some conclusions and our plans about OMEI.

9:00 – 9:30 **Modular Algorithms for Computing Gröbner Bases**

Elizabeth Arnold, Texas A&M University

Intermediate coefficients swell is a well known difficulty associated with Buchberger's algorithms for computing Groebner bases. Modular algorithms limit this growth. I will present two algorithms, one which uses the Chinese remainder theorem, and another which uses Hensel lifting techniques. These algorithms extend the modular algorithms for computing the greatest common divisor of polynomials in one variable. In particular, the concept of "lucky primes" for modular Groebner basis computations and a method for checking the result for correctness will be discussed and illustrated with examples.

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9:30 – 10:00 **New Insight in Mathematics by Live CAS Documents**

Ivan Cnop, Vrije Universiteit, Brussels, Belgium

Traditional education in mathematics in mostly a matter of hindsight, and many mathematics texts offer little opportunity for students and learners to gain insight. Here we show how experiments in CAS can lead to new ways of handling problems, new conjectures, new visualizations, new proofs, new correspondences between theories and sometimes even new definitions. Experimentation will also have an effect on the teaching of mathematics and its applications, together with the introduction of Computer Algebra Systems and symbolic programming. Many examples in this presentation involve randomness and simulations by CAS. The live documents are being offered in classroom lecturing using data projection, and also on CDROM and local servers as a template for project work by the students. Next fall semester class work will be fully interactive in a special classroom equipped with laptop computers. The approach also offers opportunities for distance learning and some of the material is already being used in such programs.

9:30 – 10:00 **Computing Riemann Surfaces for Factoring Bivariate Approximate Polynomials**
Rob Corless, University of Western Ontario, Canada

A new technique for factoring bivariate approximate polynomials rests on the numerical construction of a substantial portion of the Riemann surface for the function defined by one factor. We discuss the reliability and complexity of this technique. Joint work with Mark Giesbrecht, Ilias Kotsireas, Mark van Hoeij and Stephen Watt.

9:30 – 10:00 **Application of SAGBI-bases to Dynamics**
Karin Gatermann, ZIB, Berlin, Germany

SAGBI-bases are a tool for systematic computation with algebras. They are a special basis such that membership etc. may be decided algorithmically. Typical examples of algebras are invariant rings which appear naturally in the context of dynamical systems such as Birkhoff normal form, Liapunov-Schmidt reduction and reduction onto center manifold with symmetry. Everytime it is important to find a basis of invariant polynomials of a certain degree and/or to find a set of relevant coefficients which have to be computed. We will show that SAGBI bases are a most suitable tool for these tasks.

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10:00 – 10:50 **Fermat, a Polynomial and Matrix Computer Algebra System**
Robert H. Lewis, Fordham University, Bronx, New York

Fermat is an interactive system for mathematical experimentation. It is a computer algebra system/super calculator in which the basic items being computed can be rational numbers, real numbers, complex numbers, elements of finite fields, multivariable polynomials, rational functions, or polynomials modulo other polynomials.

10:00 – 11:50 **Deux Ex Machina**
Paul Beck and Richard Warren, Machine Tool Technology, Albuquerque TVI

We will design/draw a part (CAD), create a machining program (CAM), machine it (CNC), and inspect it (CMM). Watch computers and math make real stuff!!!!!

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10:30 – 11:00 **The Joy of Mathematica: Instant Mathematica for Calculus, Differential Equations, and Linear Algebra**
Alan Shuchat and Fred Shultz, Wellesley College

In this talk, we will present examples of using the Joy of Mathematica software and curricular materials in the college classroom. Joy is software for Windows and Macintosh, written by the authors, that makes it easier to use and learn Mathematica by substituting menus and dialog boxes for typing commands. Students with only basic computer skills can begin using Mathematica after about a half hour "Guided Tour" of Joy. The talk will emphasize topics in single and multivariable calculus, differential equations, and linear algebra where Mathematica can be especially useful. Possible examples include: comparing different methods of numerical integration, visualizing convergence of sequences and series, designing a waterslide, visualizing equilibria for Markov chains, and analyzing the motion of a comet. The Joy software requires Mathematica 3.0 and is optimized for version 4.0. The Joy book includes illustrative examples, homework exercises, labs, and student projects. The software and book are published by Harcourt/Academic Press.

10:30 – 11:00 **Development and Analysis of 3D Non-Split Optimally Stable Lax-Wendroff Type Difference Scheme for Conservation Laws**

M. Kucharik and R. Liska, Czech Technical University, S. Steinberg, University of New Mexico, and B. Wendroff, Los Alamos National Laboratory

Direct generalization of a 2D non-split optimally stable Lax-Wendroff (LW) type finite difference scheme to 3D is unconditionally unstable. A variation of this scheme is sub-optimally stable. On the other hand the 3D split extension of the 1D optimally stable LW scheme is also optimally stable. We start with this optimally stable 3D split scheme, assume linearity of fluxes and derive a new 3D non-split scheme. As the transformation is linear and stability analysis is done using scalar advection, the new scheme remains optimally stable. The new scheme is second order both for scalar advection and a general non-linear conservation law. Derivation and analysis of the new scheme has involved processing of large complicated formulas on a 3D stencil (basic and staggered) and has heavily relied on computer algebra facilities. Computer algebra tools have been used for scheme transformation, stability analysis, truncation error analysis and modified equation construction.

10:30 – 11:00 **Noncommutative Gröbner Bases: An Overview**

Ed Green, Virginia Tech, Blacksburg, Virginia

In this talk, I will present a brief overview of both the theory and some applications of noncommutative Gröbner bases.

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11:00 – 11:30 **CAS: Tool of First Recourse in Classical Applied Mathematics**

Robert J. Lopez, Rose-Hulman Institute of Technology

Post-calculus classical applied and engineering math includes material found in courses on ordinary and partial differential equations, vector calculus, matrix algebra, complex variables, and numerical analysis. Modern computer algebra systems implement nearly all the calculations found in these disciplines, and should be used as the tool of first recourse for teaching, learning, and doing applied math. The nine units in Advanced Engineering Mathematics, Addison-Wesley's new text by Robert Lopez, develop a complete applied math curriculum based on a CAS. The text is written in traditional mathematical notation and language - no computer code appears in the text. However, it is paralleled by 273 Maple worksheets that contain the exposition and calculations described in the text. The text retains the order and structure made possible by reliance on software tools for executing calculations. The proposed talk will use examples to illustrate the new pedagogy made possible by this active use of a CAS in teaching and learning applicable mathematics. Hence, we will demonstrate introductions to the Laplace transform and the wave equation on a string, computation of convolutions, construction of Bezier curves, derivation of the gradient in polar coordinates, and the Joukowski map of complex variables.

11:00 – 11:30 **Symbolic Computation and Wavelets**

Peter Paule, RISC-Linz, J. Kepler University, Linz, Austria

The talk reports on recent work joint with F. Chyzak, O. Scherzer, A. Schoisswohl and B. Zimmermann. It discusses the construction of wavelets in connection with the use of methods from computer algebra, in particular, Groebner bases and symbolic summation.

11:00 – 11:30 **Alternative Ways of Solving Polynomial Systems**

Ilias Kotsireas, University of Western Ontario, Canada

We present some ways to solve polynomial systems using differential elimination algorithms (e.g. RIF) and the notion of normal set which arises in the interpretation of polynomial system solving as a matrix eigenproblem. These ideas apply to zero-dimensional systems, as well as to systems with parameters. These ideas are illustrated with two zero-dimensional polynomial systems that arise in the study of central configurations in the N-body problem of Celestial Mechanics and an inverse kinematics example from Robotics. The computations have been performed in Maple 6. This is joint work with Greg Reid. The normal set notion we use is borrowed from an article by Rob Corless.

11:00 – 11:50 **An Overview about News in MuPAD 2.0**

Frank Postel, University of Paderborn, Germany

This talk gives an overview about news in the new MuPAD release with many demonstrations. The MuPAD interfaces and the library have been strongly improved and extended. Concerning the library, examples are:

- *An Assume und Property mechanism has been integrated. The user now can make assumptions about free variables.*
- *The Solver has been improved. The solver now also concerns assumptions about free variables.*

- The plot library for plotting graphs has been redesigned.

- The numeric library of MuPAD 2.0 contains various new functions: a fast linear solver for sparse systems was implemented, the non-linear solvers were rewritten and enhanced, fast spline interpolation and functional calculus for matrices were introduced.

And much more...

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11:30 – 12:00 **Computer Algebra in a Course on Lie Symmetries of ODEs**

Alejandro Jakubi, University of Buenos Aires, Argentina

In recent years renewed interest has been given to methods based on Lie symmetries of differential equations. One of the main reasons has been the widespread availability of computer algebra systems and the development of specialized packages for this kind of calculations. Hence a course on this subject is, in principle, ideally suited to introduce computer algebra tools. The experiences with the use of these tools in a course for undergraduate and graduate students in Physics are described. Both general purpose CAS like Maple and stand alone system like LIE were tried. Specialized packages considered include ODEtools and DESOLV, both running over Maple. Some additional routines were developed to interface and extend these packages. No previous knowledge on Lie groups or differential geometry is required for this course. Its scope has been limited up to now to Lie point symmetries of ODEs.

11:30 – 12:00 **Symbolic and Numeric Computation of the Barnes Function**

Victor Adamchik, Carnegie Mellon University

The Barnes G function, defined by a functional equation as a generalization of the Euler gamma function, is used in many applications of pure and applied mathematics, and theoretical physics. The theory of the Barnes function has been related to certain spectral functions in mathematical physics, to the study of functional determinants of Laplacians of

the n-sphere, to the Hecke L-functions, and to the Selberg zeta function. There is a wide class of definite integrals and infinite sums appeared in statistical physics (the Potts model) and lattice theory which can be computed by means of the G function. This talk presents new integral representations, asymptotic series and some special values of the Barnes function. An explicit representation by means of the Hurwitz zeta function and its relation to the determinants of Laplacians are also discussed. Finally, we propose an efficient numeric procedure for evaluating the G function.

11:30 – 12:00 **Gröbner Bases with respect to Several Orderings and Multivariable Hilbert Polynomials**
Alexander Levin, The Catholic University of America, Washington, DC

Let R = k[X] be a ring of generalized polynomials in a set of indeterminates X over a field k, and let a partition of X into p disjoint subsets be fixed. Furthermore, let E be a finitely generated free R-module. We consider p orderings of the set of terms of E that naturally correspond to the partition of X and develop a Gröbner basis technique that involves these orderings. As an application we give a method of computation of Hilbert polynomials in several variables.

Saturday morning

9:00 – 9:30 **What Math Should We Teach When We Teach Math With Computer Algebra Systems?**
Bernhard Kutzler, Austrian Center for Didactics of Computer Algebra, Austria

We suggest to look at mathematics as comprising two main qualities, namely "mental training" and "problem solving training", and show how this model greatly helps to design appropriate mathematics curricula and how to plan the use of technology in teaching, learning, and assessing.

9:00 – 9:30 **The Center Variety of Polynomial Differential Systems**
Abdul Salam Jarrah, New Mexico State University

Consider the two-dimensional differential system of the form $\frac{dx}{dt} = P(x, y)$, $\frac{dy}{dt} = Q(x, y)$ *where P and Q are polynomials with complex coefficients and x and y are complex functions. Suppose (0,0) is a singular point of the system. Identifying those systems with a center at the origin is the so-called center problem. This problem is still open for higher dimensional systems. To solve the center problem for a given system, one needs to compute the so-called Lyapunov quantities, which are polynomials in the coefficients of P and Q. In this talk, we present an algorithm, using methods from computational algebra, to find all those systems with a center at the origin, such that the linear parts of P and Q form a nonsingular matrix over the complex numbers. If we restrict ourselves to real systems, our algorithm finds all the systems with a center at the origin and an axis of symmetry through the origin.*

9:00 – 9:50 **Just What Should We Be Teaching Teachers?**
Jay Malmstrom, Oklahoma City Community College
Presider: Joanne Peeples

A discussion of the recent work by Liping Ma and others and its implications for our work in preparing future teachers.

9:00 – 9:50 **Learning Styles and a Laboratory Environment**
Lynn D. Onken, San Juan College

Presider: Jim Rewalt

Learning styles and alternative delivery in the computer laboratory setting, along with helpful hints and activities, for the developmental mathematics instructor.

9:00 – 9:50 **Part-Whole Concept: The Hidden Assumption in Adult Math Materials**
Dorothea Steinke, NumberWorks
Presider: Sharon McKendrick

Four current adult math texts will be reviewed for the "hidden assumptions" that adults understand the part-whole concept. Research suggests a significant percentage of adults lack the concept. Alternative ways of making students aware of part-whole relationships in math will be offered.

9:00 – 9:50 **Vocational Math Issues in the Arts and Sciences Curriculum**
Richard Araiza, Jim Rewalt, Dennis Vargo, and Richard Warren, TVI
Presider: Judy Brown

Under funding from a Perkins Grant, a team of math instructors at TVI has been working a number of issues pertaining to mathematics education in vocational degree and certificate programs. The team will discuss their past, current and future efforts in this project. Instructors from schools that have significant vocational student enrollments in their courses may be interested in this presentation.

9:00 – 9:30 **Using Valuations to Compute Gröbner Bases**
Ed Mosteig, Tulane University, New Orleans

Classical computations of Gröbner bases rely upon initially setting a term order that will be used in the division algorithm. Alternatively, Sweedler suggested in a paper (1986) another method of computing Gröbner bases by using valuations in place of term orders. This talk will address the use of valuations and some of the computational issues involved.

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9:30 – 10:00 **Transforming Traditional Exam Questions into CAS-Save Exam Questions**
Vlasta Kokol-Voljc, University of Maribor, Slovenia

We look at traditional exam questions, analyze them as a feedback instrument in CAS environment and suggest some conceivable changes to improve their value for assess the mathematical knowledge.

9:30 – 10:00 **Computation of Erdos-Woods Numbers**
Nik Lygeros, Universite Lyon, France

Erdos-Woods Numbers are defined as the length of an interval of consecutive integers whose every element is not coprime with its extremities. Woods was the first to find such numbers, Dowe proved there exists an infinity and Cagielski, Heroult and Richard that their set is recursive. Our aim is to study the arithmetical proprieties of those numbers.

9:30 – 11:00 **On Gröbner Bases in Polynomial Rings over Von Neumann Regular Rings**
Yosuke Sato, Ritsumeikan University, Japan

A commutative ring R with the following property is called a Von Neumann regular ring: $\forall a \in R, \exists b \in R \;\; a^2 b = a.$ *Our purpose in introducing Gröbner bases over such rings was to*

provide a technique for Boolean constraint solving. Our work has been developed and a free software is created. Recently we found that we can construct special types of comprehensive Gröbner bases as examples of Gröbner bases in polynomial rings over Von Neumann regular rings.

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10:00 – 10:50 **Ingredients for Increasing Students Success: Communication, Curriculum**
Marilyn Mays, North Lake College
Presider: Max Cisneros

In fall 2000, North Lake College doubled the student success rate in their introductory mathematics classes. This reform effort was guided by the Crossroads standards, a "Mathematics Manifesto," and the presenter's work with Japanese teachers and observation of their "lesson study" process.

10:00 – 10:50 **Pre-calculus at UNM: Past, Present, and Future**
Kristin Umland and Anna Madrid, University of New Mexico
Presider: Richard Araiza

We will talk about current and historical trends in success and preparation rates in all pre-calculus courses, and the impact of the Lottery Scholarship and prerequisite checks. We will also discuss proposed changes to the Core Curriculum and new Intermediate and College Algebra problems courses.

10:00 – 10:50 **Maximally Even Sets**
Jack Douthett
Presider: Peter Steinbach

Initial work on the Theory of Maximally Even Sets began about a decade ago to describe musical phenomena (such as the distribution of white and black keys on the keyboard). The basic concepts of this theory will be presented as well as some of its more recent applications in mathematics and physics.

10:00 – 11:50 **Teaching Presentations from EPCC students**
Joanne Peeples, Diana Kretzer, Lorena Lopez, Rocio Myres, Rogelio Myres, Edward Perez, Stephanie Phillips, and Angela Saddler
Presider: Xiaoming Wang

PETE students from El Paso Community College would like to present the MiniTeach that each of them have presented to a grade school class. The ideas presented could expanded for a pre-service teacher class or a developmental math class.

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10:30 – 11:00 **How to Make Tests for Students Using CAS Tools (such as TI-89)**
Bengt Ahlander, Östrabogymnasiet, Sweden

In my school, Ostrabogymnasiet an upper secondary school in Sweden, I work with a math class where everybody uses TI89. The age of the students are 17 year. My thoughts about how to examine students using this powerful tool and still testing the understanding of mathematics I will try to explain here. I will give some examples from my classroom experience in my short presentation.

10:30 – 11:00 **Symbolic-Numerical Methods for Solving Singular Perturbation Problems**
Raya Khanin, DAMTP, University of Cambridge, Cambridge, England

The term singular perturbation problem applies to any problem whose solution has a near-singular behaviour relative to a perturbation parameter in the system. This usually represents the appearance of several time scales (or, for example, length scales) meaning that various components of the system change at different rates. The long term solution is of particular interest to engineers and scientists as it describes the long-term behaviour of the system.

A symbolic technique for applying the results of asymptotic analysis is based on the method of matched asymptotic expansions and in particular on the polyhedron algorithm for finding the appropriate scaling and local approximating systems near the singularity. I will show how application of the hybrid method can improve or facilitate the procedure of solving the singularly perturbed problems.

10:30 – 11:00 **Toric Initial Ideals without Embedded Primes**
Rekha R. Thomas, University of Washington, Seattle

In this talk, we give characterizations and examples of toric initial ideals without embedded primes. Such ideals give rise to families of integer programs in which every program can be solved by the classical Gomory group relaxations. Joint work with Serkan Hosten.

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11:00 – 11:30 **The Use of CAS in the Thuringian School System: Present and Future**
Karsten Schmidt, University of Applied Science, Schmalkalden, Germany

Based on a recent survey carried out in all 450 secondary schools in the state of Thuringia, Germany, the following questions will be investigated: Which level of computer equipment is available for classroom use? Which kinds (simple / scientific / graphical / symbolic) of pocket calculators are used in which grades? Does the school possess a license for a CAS?

In a second part of the survey, the person filling in the questionnaire is asked to give some of his/her personal attitudes, which will also be analyzed in the presentation: Which kinds (simple / scientific / graphical / symbolic) of pocket calculators should be used in which grades? Which knowledge does he/she have of symbolic calculators and CAS? What are the advantages and disadvantages associated with the use of symbolic calculators and CAS in the classroom?

11:00 – 11:30 **Resultants of Composed Polynomials**
Manfred Minimair, North Carolina State University

The subject of the talk is computing resultants of composed polynomials, efficiently, by utilizing their composition structure. By the resultant of several polynomials in several variables (one fewer variables than polynomials) we mean an irreducible polynomial in the coefficients of the polynomials that vanishes if they have a common zero. By a composed polynomial we mean the polynomial obtained from a given polynomial by replacing each variable by a polynomial.

The main finding of this research is that resultants of composed polynomials can be nicely factorized, namely, they can be factorized into products of

powers of the resultants of the component polynomials and of some of their parts. These factorizations can be utilized to compute resultants of composed polynomials with dramatically improved efficiency.

11:00 – 11:30 **FOLA: A Computer Algebra System for Doing Research, Teaching and Studying Formal Languages, Grammars and Automata**

Quoc-Nam Tran, Lamar University, Beaumont, Texas

In this speech, I will talk about the use of Gröbner bases and other symbolic techniques in doing research and teaching theoretical computer science and vice versa.

The goal of this project is to use symbolic techniques from computer algebra for developing an easy-to-use, portable and efficient software which can be used for both visualizing abstract theoretical models and for assisting the manipulation of the models of computers and computation. FOLA provides an environment that supports experimental research on both formal languages, grammars, automata and related matters.

11:00 – 11:50 **Developing Reasoning in Algebra Students**

Anne Dudley, Glendale Community College, and David Dudley, Phoenix College
Presider: Rita Gonzales

How do we know when our students are reasoning? How do we help our students spend more time reasoning and less time mimicking a process? These and many other questions will be raised and discussed. One approach that leads to reasoning in students will be shared.

11:00 – 11:50 **Sex, Drugs, and Rock 'n Roll**

Jay Lehmann, College of San Mateo
Presider: Richard Warren

Grab intermediate algebra students' attention with a curve fitting approach where students can model current, compelling, authentic applications. Enhance their understanding of concepts with explorations and conceptual exercises. Come hear the "Number Guy" song and "Top Ten Reasons Why I Should Take a Break for Lecturing." Not for the timid.

11:00 – 11:50 **What is Quasiperiodicity?**

Peter Steinbach, Albuquerque Technical Vocational Institute
Presider: Jack Douthett

The remarkable and counter-intuitive properties of quasiperiodic tilings have been described in scores of articles and books. Though tiling is essentially a geometric pursuit, their descriptions are usually algebraic, because these unusual designs do not easily reveal their secrets to the untrained eye. This presentation introduces a new QP tiling that captures and conveys the nature of the phenomenon visually. It teaches us the new properties as new feelings in the mind's eye, and it leads us to deep questions, both technical and aesthetic, about the nature and perception of pattern.

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11:30 – 12:00 **The Symbolic Math Guide in Calculus**
Doug Child, Texas Instruments

Texas Instruments recently released the Symbolic Math Guide (SMG), a concept application for TI-89 and TI-92 Plus calculators. It consists of a set of core technologies that may form the basis of several future applications. This presentation will consider function notation, logarithmic and exponential equations, difference quotients, and derivatives. Can SMG help students learn to think about these problems in a way that not only helps them learn to write careful textbook like solutions for them, but which also helps them develop skills that extend to other areas of calculus and other mathematics? Finally, what does an instructor need to do to integrate the use of SMG into a calculus classroom?

11:30 – 12:00 **Computational Algebraic Geometry and Switching Surfaces in Optimal Control**
Uli Walther, Purdue University, Indiana

Some problems in control can be reduced to finding suitable real solutions of algebraic equations. In particular, such a problem arises in the context of switching surfaces in optimal control. In this note, we apply Gröbner basis techniques and some facts from the theory of real systems to find effective solutions to the classical problem of time-optimal control.

11:30 – 12:00 **Quantified Constraints Under Perturbation**
Stefan Ratschan, RISC, Linz, Austria

Quantified constraints (i.e., first-order formulae over the real numbers) are often exposed to perturbations: Constants that come from measurements usually are only known up to certain precision, and numerical solvers only compute with approximations of real numbers. In the talk we study the behavior of quantified constraints under perturbation by showing that one can formulate the problem of solving quantified constraints as a nested parametric optimization problem followed by one sign computation. Using the fact that minima and maxima are stable under perturbation, but the sign of a real number is stable only for non-zero inputs, we derive practically useful conditions for the stability of quantified constraints under perturbation.

Saturday afternoon

2:00 – 2:30 **Electronic Submission of Student Work Using WORD and MAPLE**
Gary A. Harris, Texas Tech University

We present the results of our experimentation in the use of Microsoft Word with MAPLE as a vehicle for students to submit mathematical work in electronic format. An obvious application of our results lies in the area of distance delivery of advanced mathematics courses.

2:00 – 2:30 **Functional Decomposition**
Rosario Rubio San Miguel, Antonio de Nebrija, Madrid, Spain

During the last years several results has been obtained on univariate decomposition rational function area. However, multivariate decomposition problem has not been studied so much. The problem to compute a decomposition of a univariate rational function is equivalent to compute a proper intermediate subfield in the univariate rational function field K(t).

In this talk we introduce an algorithm that requires the computation of Gröbner bases with respect to tag variable orderings and factorization in algebraic extensions, this last part is equivalent to factor a multivariate polynomial with coefficients in the ground field. This method can also be generalized to finite extensions, not necessarily unirational over K.

2:00 – 3:00 **Differential Bases and Algebraic Analysis: New Perspectives for Applications**
Jean Francois Pommaret, Ecole Nationale des Ponts et Chaussees, France

The purpose of this plenary lecture is to emphasize the use of Groebner, differential and involutive bases in "algebraic analysis". We shall focus on its application to control theory in order to study linear as well as nonlinear multidimensional control systems by means of new methods from module theory and homological algebra. Our exposition will be rather elementary as we shall insist on the main ideas and open problems while illustrating the corresponding concepts through explicit examples.

2:00 – 2:50 **Relearning the Operations – In Another Language**
Carolyn Stupin, Santa Fe Community College and New Mexico Highlands
Presider: Dennis Vargo

In order to better understand what children go through when they first learn to count, add, subtract, multiply, and divide, you need to try it for the first time – in another base. In this workshop, we will work with place value boards and base pieces to get a better sense of how place value plays into counting and computation.

2:00 – 2:50 **Cooperative Learning: Who Has The Time?**
Terrylynn Vigil, University of New Mexico
Presider: Peggy Brock

Using cooperative learning as a tool in teaching post-secondary mathematics is nothing new. the question is why are not more instructors using this method. In this presentation, examples of how cooperative learning can be interjected into the traditional lecture format with only a few modifications. Also, some preliminary findings of the outcome of this teaching method in a pre-calculus course at UNM.

2:00 – 2:50 **Cultural Diversity: The Stories We Tell**
Max Cisneros Jr., Albuquerque TVI, Michele Diel, UNM-Valencia Campus, and Rita B. Gonzalez, Dona Ana Community College
Presider: Maria Pacheco

Three members of AMATYC's EOMC will facilitate this session. Clips from a diversity training video will be shown. Participants will be given the opportunity to react to the issues raised by stories told in the video. Constructivist structures, i.e. dyads, small group or large group discussion, will be utilized to process reactions.

2:00 – 2:50 **Functions - I Love You!**
James L. Smith, McCurdy School
Presider: Ellen Schneider

Functions are approached using colorful sets and relations; then beautified using the TI-83 and other applications. Bring own colored pens and graphing calculator.

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2:30 – 3:00 **Assessing the Effects of the TI-89 Hand-Held Computer Algebra System in a First Year Calculus Sequence**

Mary Ann Connors, U. S. Military Academy, West Point

This report presents the process, impact, and results of the integration of the TI-89 hand-held Computer Algebra System (CAS) into the first year calculus sequence at the United States Military Academy at West Point (USMA) during the 1999-2000 academic year. The study investigated the impact of the TI-89 hand-held Computer Algebra System (CAS) on student achievement and attitudes.

2:30 – 3:00 **Parametric Treatment of Generalized Constraint Systems**

Thomas Sturm, Unversity of Passau, Germany

We discuss two generalizations of constraint systems. The first one is parametric constraints over the real numbers, where we allow equations, negated equations, and both weak and strong order inequalities as constraints. These constraints may occur in arbitrary boolean combinations. The second one is systems of congruences over the integers where the moduli are possibly parametric. In both cases we check for feasibility and provide sample solutions in the positive case. Our tool is extended quantifier elimination of the reals and over p-adic fields, respectively. We illustrate the application range of our methods by giving computation examples with the current development versions of REDLOG/REDUCE.

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3:00 – 3:30 **Computer Algebra Systems and Mathematics Education: Resolving the Disharmony -or- Why You Can't Have Your Cake and Eat it**

Martyn Quigley, University Brunei Darussalam, Brunei

In this paper I shall use the solution a problem in mathematics to demonstrate as clearly as possible those steps in the solution which can be done by a computer algebra system (CAS) and those steps which cannot. Clearly, if some steps in a solution cannot be done with a CAS, they must be done by the human. Generalising, this results in a distinction between "machine possible" steps and "machine impossible" steps.

This distinction leads us to consider two issues. Firstly, just because the machine possible steps can be done with a CAS, should they? The way forward in this respect is not so easy and will require some hard decisions to be made. Arguments will be put forward to support the contention that either we use a CAS or we don't, there is no half-way house, and that this decision is ultimately a philosophical one. Secondly, we need to consider where the "interesting" mathematics lies, in the machine possible steps or the machine impossible steps? An answer to this controversial question is given which it is hoped will guide us in developing 21st century curricula in mathematics.

3:00 – 3:30 **Computing the Frobenius Canonical Form**

Arne Storjohann, University of Western Ontario, Canada

Computing the Frobenius canonical form of a matrix over a field is a classical problem with many applications. The form is entirely rational and thus well suited to be computed symbolically; this is in contrast to the closely related Jordan form which may have entries --- eigenvalues of the input matrix --- in

an algebraic extension of the ground field. In the first part of the talk I will define the form and recall some of it's properties and uses.

The complexity of computing the form has been well studied, with first efficient algorithm given about fifteen years ago by Ozello. Many algorithms have been proposed since then; in the second part of the talk I will give an overview.

3:00 – 3:30 **Dynamical Aspects of Involutive Bases Computations**
Ralf Hemmecke, RISC, University of Linz, Austria

In this talk we give a short introduction to involutive divisions and involutive bases computations. Different approaches are discussed and compared and a new class of involutive divisions is presented. We show results of our computer experiments with the different approaches.

3:00 – 3:50 **Teachers of Teachers Committee Meeting**
Presider: Michele Diel

Two year colleges play a pivotal role in the preparation of mathematics teachers. Come discuss recent legislation, the new AMATYC grant, and colleagues' teacher preparation activities.

3:00 – 3:50 **Dangerous Dan Runs the Bases: Number Magic, Polynomials, and Divisibility**
Jay Malmstrom, Oklahoma City Community College
Presider: Kristin Umland

An investigation into the properties of numbers and how those properties result in divisibility checks.

3:00 – 3:50 **Cognition, Visualization, and Technology: In-Depth Learning of Mathematics**
Mourat A. Tchoshanov and Celina Fuentes, University of Texas at El Paso
Presider: Lynn Onken

In this session we will explore and discuss pedagogical possibilities of helping students move from a level of their actual knowledge through a zone of proximal development (ZPD) to an in-depth understanding of mathematical concepts. We will use problem solving and proof activities for middle and high school mathematics with emphasis on computer animated visualization. Examples from teaching of math method course on multiple representation for pre-service middle school teachers will also be presented.

3:00 – 3:50 **Student Panel: What is it like to be a community college math student?**
Panel Members: Bob Cross, Marie Forman, Mike Gibson, Steven Laskey, Lucia Sanchez-McGranahan, Susan Stoddard
Presider: Linda Martin

Five TVI math students discuss community college mathematics instruction from the student perspective – what works, and what doesn't in the classroom.

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4:00 – 4:30 **Alternative Calculus**

Joanne Peeples and Rogelio Myres, El Paso Community College
Presider: Fred Ream

When you redefine calculus so that the derivative of an exponential is a constant, and then try to prove the "usual" theorems, the result is a better understanding of the classical calculus. This talk is the result of such a student project.

4:00 – 4:30 **For What Functions is $f^{-1}(x) = \frac{1}{f(x)}$?**

Sharon MacKendrick
Presider: Anna Madrid

Several years ago, an algebra student posed the following question: "I finally got it through my thick skull that $f^{-1}(x) \neq \frac{1}{f(x)}$. My question is: Are there any functions for which it is true that $f^{-1}(x) = \frac{1}{f(x)}$?" I eventually discovered the answer to his question, and feel that the solution may be of interest to others.

4:00 – 4:30 **Computer Algebra: A Tool of Today for the Mathematics of Yesterday**

Franz Lichtenberger, Research Institute for Symbolic Computation, Hagenberg, Austria

There is no doubt that teaching mathematics, especially for students in the classical engineering disciplines, can substantially be enhanced by the uses of computer algebra systems. From my experience in teaching math to software engineering students I have learned that this kind of traditional, calculus-based mathematics and the tools of today are inappropriate. More than that: I believe that extensive use of these tools deteriorates their ability to use a more formal, abstract, axiomatic kind of mathematics, which is essential for software engineers.

4:00 – 5:00 **Differential Elimination Algorithms and Deformations of Symmetric Differential Systems**

Greg Reid, UWO, London, Ontario, Canada

Novel approaches, specialized C-implementations, probabilistic and classical symbolic differential elimination algorithms are discussed. Determination of approximate symmetry groups and algebraic-geometric properties of differential systems are also discussed.

4:00 – 4:50 **Student Online Collaboration in Mathematics**

Peg Pankowski, Community College of Allegheny County, Pennsylvania
Presider: Julie DePree

Community College Intermediate Algebra students were assigned to teams and collaborated via the internet to complete a series of progressively more complex projects. The presentation will detail the results of this collaboration.

4:00 – 4:50 **Tuesday Afternoon at the State Penitentiary; Monday and Thursday evening at St. John's**

Reuben Hersh, University of New Mexico
Presider: Mark Rudd

I will tell anyone interested "what it's like" at St. John's mathematically, and what it's like tutoring at the pen; I can also see what lessons, morals, or general principles, if any, I can make of all this.

4:00 – 4:50 **"101" Ways to Meet the Needs of Developmental Math Students**
Donna Gaudet and Nancy Fortenberry, Academic Systems

Academic Systems has partnered with campuses nationwide to increase achievemnt in developmental mathematics courses, from basic math to college algebra. Campuses can also supplement teaching and support learning 'anytime/anywhere' via a library of tutorials on the Internet.

This session focuses on new teaching modalities to meet the needs of under-prepared students. Instructors who teach entry-level mathematics courses are encouraged to attend.

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4:30 – 5:00 **Help in Using Symbolic, Hand-Held Calculators in Teaching Engineering Mathematics**
Gilles Picard, Kathleen Pineau, Ecole de Technologie Superieure, Montreal

Since the 1999 fall semester, the TI-92 Plus or TI-89 has been a compulsory purchase for new students entering our engineering school (almost 1000 enrollments a year). The purpose of this presentation is to share our impressions of this campus-wide experiment and to communicate the solutions that we considered and adopted in order to help students and faculty members with the use of these calculators

4:30 – 5:00 **SmartTools: Developing Tools for Teaching Mathematics**
Frank Postel, MuPAD Research Group, Univ of Paderborn, Germany

We present software components for developing tools for teaching mathematics at elementary schools, high schools, and universities. A "SmartTool" built with these components is devoted to a particular mathematical problem. It is flexible and easy to use, it provides mathematical "intelligence" by accessing a mathematical expert system (viz. the kernel of the computer algebra system MuPAD), and it can be adapted to special educational needs.

Sunday morning

8:00 – 8:30 **From Computing to Proving: Experiments with THEOREMA in Mathematics Education**
Franz Lichtenberger, Research Institute for Symbolic Computation, Austria

THEOREMA is a language and system which aims at combining general predicate logic proof methods and special proof methods for special areas of mathematics in one coherent system. We use THEOREMA in lab exercises for the mathematics course for first year students of software engineering. We will give several examples where students have to give formal definitions of notions in areas relevant to programming like sequences, trees, graphs etc. and then have to prove properties of and relations between objects of those types. We will analyse the benefits of that approach, but also report of difficulties students have with using the system in its current state and with doing this kind of mathematics per se.

8:00 – 8:30 **Derive 5 – A Tool for Teaching and Learning Math**
Bernhard Kutzler, Austrian Center for Didactics of CA, Austria, and Vlasta Kokol-Voljc, University of Maribor, Slovenia

Derive is for algebra, equations, trigonometry, vectors, matrices, and calculus, what the scientific calculator is for numbers. We give an introduction to using and teaching with Derive, showing its symbolic, numeric, and graphic capabilities.

8:00 – 8:50 **NMMATYC Business Meeting**

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8:30 – 9:00 **Introducing Mathematical Models with a CAS in an Introductory Course of Differential Equations**

Angel Balderas Puga, University of Queretaro, Mexico

We describe the intensive use of math software, primarily Derive, in the context of an introductory university course in differential equations. Different aspects are detailed: changes in the curriculum, including not only course content, but also the order of introduction to various topics and methodologies. Also covered is the enrichment of discussion about classic problems; discussion of new problems; using CAS potentialities to demonstrate properties without the necessities of investing excessive time in technical details, avoiding long and boring calculations; design and redesign of materials that attempt to guarantee success of information technology integration; combined use of several software packages, and finally, feedback from students and assessment. In addition, examples are presented to demonstrate the support materials utility for high school Calculus.

8:30 – 9:00 **Fast computation of polynomial Janet bases**

Vladimir P. Gerdt, Yu. A. Blinkov, and D. A. Yanovich, JINR Dubna, Russia

In this talk we present basic algorithmic ideas and their implementation in Reduce, C and C++ for computation of Janet bases for polynomial ideals. We also give the timings of our codes in comparison with the latest version (2-0-0) of computer algebra system Singular having one of the most efficient implementations of the Buchberger algorithm for computation of Groebner bases.

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9:00 – 9:30 **A Project Based Arithmetic Course: Learning Skills While Problem-Solving**

Juan Saavedra, Albuquerque Technical Vocational Institute

Presider: Xiaoming Wang

9:00 – 9:30 **Computer Algebra with Beginning Community College Students**

Peg Pankowski, Community College of Allegheny County, Pennsylvania

This paper/presentation details my experiences using a computer algebra system with community college students. This system begins each lesson with a problem scenario designed to introduce and/or reinforce specific algebraic concepts but the scenario is only one part of a multipart screen. Other parts of the screen require students to define expressions, complete tables, construct graphs, and solve equations in order to answer the questions posed. In this fashion, the system guides student exploration of every problem graphically, numerically, symbolically and verbally. The system provides assistance in the form of hints to the student based on his/her responses. Student motivation is high with this system. Most students tackle the problems enthusiastically, as though they were solving a puzzle.

9:00 – 9:30 **Stanley Decompositions and Involutive Bases**

Joachim Apel, MSRI Berkeley, California

In 1982 Richard P. Stanley conjectured that a graded module M over a graded k-algebra R can be decomposed in a particular way in a direct sum of finitely many free modules over suitable subalgebras of R. We will show how general involutive bases may be applied in order to prove some particular cases of Stanley's conjecture and to provide algorithms for the computation of Stanley decompositions.

9:00 – 9:50 **Do We Understand the Math We Teach?**

Fred Ream, Albuquerque Technical Vocational Institute

Presider: Ellen Schneider

Neither Reform nor Traditionally oriented courses can be said to present concepts in a logical order. Technology can be viewed as another haphazardly considered topic thrown into the hash we call course content. Since current structure is so poorly organized, we must ask the question: Do we understand the math we teach?

9:00 – 9:50 **The Scientific Notebook Interface to Computer Algebra**

Steven Swanson and Keith Kendrick, MacKichan Software

Scientific Notebook is a scientific word processor with computational facilities. I will show how Scientific Notebook's ease of use and computational power makes it perfectly suited for undergraduate mathematics.

9:00 – 10:50 **Symmetry and Tilings**

Louis Romero and Paul Mitschler

Presider: Tamra Mason

This presentation centers around an educational software program developed by one of the presenters. This program is an extension of the "pattern blocks" commonly used in elementary and middle schools. The software program allows the user to make much more intricate patterns than can be made with pattern blocks. We will show how using this program one can teach elementary, middle school and high school students some very sophisticated ideas of modern mathematics such as recursion, symmetry, and convexity.

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9:30 – 10:00 **Transformation of Functions: A Graphing Calculator Game**

Julie DePree, University of New Mexico, Valencia Campus

Presider: Ilene Maness

This graphing calculator game will get your students actively involved in learning. It will give them the opportunity to explore transformations of functions while having fun. The rules of the game can be changed to emphasize various concepts. The game can be easily adapted for different levels (Math 100-Math 150).

9:30 – 10:00 **Boolean Algebra with Mathematica and TI-83, 89**

Igor Gachkov, Karlstad University, Sweden

The package "Boolean algebra" is a program package, which was created especially for TI-83 and is used for teaching in course of Discrete Mathematics based on a traditional textbook Ralph P. Grimaldi, "Discrete and combinatorial Mathematics: An Applied Introduction". Actually this package is a natural development and a further edition of the

package "Boolean.m" in MATHEMATICA, which has been used by the author during a long time for teaching in this course. Calculators allow to change the teaching process by replacing of MATHEMATICA with TI-83 due to their safety, low price and because they are easy to use and are possible to develop and provide. Of course MATHEMATICA has more powerful calculating possibilities, but calculators are very flexible, and can therefore be used during lectures in big rooms without technical facilities.

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10:00 – 10:50 **Panel on Appropriate Technology in the Math Classroom**

Panel Members: Rob Corless, Jack Douthett, Deborah Hughes-Hallett, Bernhard Kutzler, and Linda Martin
Moderator: Richard Fox
Presider: Bill Pletsch

Panel members will present a summary of their views on appropriate use of technology in the classroom, followed by discussion and questions from the audience. Care to debate?

(MS = Max Salazar, KC = Ken Chappy, W = West Building)