MAT 312 / AMS 351
Applied Algebra

Instructor:

Sorin Popescu (office: Math 3-109, tel. 632-8255, e-mail sorin at math.sunysb.edu)
Office hours: Tu 11:30am-12:30pm, Th 2:20pm-3:30pm

Graduate Assistants:

Tanvir Prince (office: Math 2-121, email prince at math.sunysb.edu)
Office hours: Tu 6pm-8pm MLC, Wed 1pm-2pm Math 2-121

Travis Waddington (office: Math 3-122, e-mail ratatosk at math.sunysb.edu)
Office hours: Tu 1:45-3:45pm MLC, Mo 12-2:00pm 3-122

Schedule:

Lecture: TuTh 12:50pm-2:10pm, Library W0512
Recitation 1: Tu 3:50pm-4:45pm, Physics P117
Recitation 2: Mo 11:45am-12:40pm, Physics P112
Midterm Review session: Monday, Feb 21, 5:00-6:30pm in Math P-131

Midterm Review session: Tue, Mar 29, 6:30-8:00pm in Math P-131
Final exam review session: Wed, May 11, 3:00-5:00pm in Math P-131
Final exam: Tuesday, May 17, 11:00-1:30pm in Old Eng 145

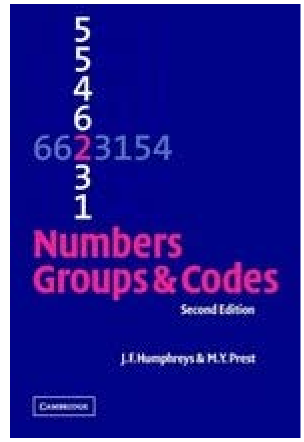
Grades are now posted on the Solar system. Have a nice summer!

Prerequisites:

Either **MAT 203** or **MAT 205** or **AMS 261** (Calculus III), and **MAT 211** or **AMS 210** (Linear algebra) are prerequisites for this class. In general basic linear algebra exposure is required and assumed, but I will try to keep prerequisites to a minimum.

Textbook(s):

Numbers, Groups and Codes, J. F. Humphreys, M. Y. Prest, (second edition), Cambridge University Press.
Available from the university bookstore or check prices at AddAll.



The class is an introduction to algebraic structures and applications. The above textbook moves from algebraic properties of integers, through other examples, to the beginnings of group theory. Applications to finite state machines, public key cryptography and to error correcting codes are also emphasised. Attention is also paid to the historical development of the mathematical ideas presented. The text should be easily accessible for both students of mathematics and computer science.

Here are a number of other good undergraduate books that you may perhaps find useful to consult during the semester (all of them available in our library):

- *A Friendly Introduction to Number Theory*, J.H. Silverman, (second edition).
- *An Introduction to the Theory of Numbers*, I. Niven and H.S. Zuckerman
- *Elementary Number Theory and Its Applications* , by Kenneth Rosen, (fourth edition)
- *Number theory with computer applications*, R. Kumanduri and C. Romero
- *Concrete Abstract Algebra : From Numbers to Groebner Bases*, Niels Lauritzen
- *Introduction to Cryptography with Coding Theory*, Wade Trappe and Lawrence C. Washington
- *Naive set theory*, P. Halmos
- *Groups and Symmetry: A Guide to Discovering Mathematics*, David W. Farmer

Course description:

We will basically cover the following chapters in the textbook but the schedule below may/will be adjusted based on students' preparation and progress.

Topic	Sections in textbook	Week	Notes
Euclidean division algorithm, GCD/LCM, Induction	Sections 1.1 and 1.2	1/24-1/30	
Prime numbers, Unique factorization, Congruences, Linear Congruences	Sections 1.3 and 1.4	1/31-2/6	
Fermat's theorem, Euler's theorem, applications	Sections 1.5 and 1.6	2/7-2/13	
Public key criptography, Cryptographic protocols	Section 1.6	2/14-2/20	
Sets, functions	Sections 2.1 and 2.2	2/21-2/27	Midterm 2/22
Relations	Section 2.3	2/28-3/6	
Permutations	Section 4.1	3/7-3/13	
Order and signature of a permutation, transpositions and cycles	Section 4.2	3/14-3/20	
Groups: definition and examples	Section 4.3	3/28-4/3	Midterm 3/31
Algebraic structures	Section 4.4	4/4-4/10	
Order of an element, generators, subgroups	Sections 5.1 and 5.2	4/11-4/17	
Lagrange's theorem; finite groups of small order	Sections 5.2 and 5.3	4/18-4/24	
Error detecting/correcting codes	Section 5.4	4/25-5/1	
Error detecting/correcting codes (continued)	Section 5.4	5/2-5/8	
Review session	Wed 05/11	3:00-5:00pm	P-131
Final Exam	Tu 05/17	11:00am-1:30pm	Old Eng 145

Note: Although students may take both **MAT 312** and **MAT 313**, there is some nontrivial overlap in the material of these two courses.

Projects, Homework & Grading:

Students are encouraged to do an individual special project or participate in a group special project. These could involve a historical report on material of the course, including perhaps a brief oral presentation or learning some topic in algebra not discussed in the course or writing a computer program for some algorithm. The choice of topic and the exact scope of the special project are to be determined after consultation with the instructor and the final form of a proposal must be presented in writing to the instructor.

Homework is an integral part of the course. Problems will be assigned periodically. You should try to solve them by yourself. You should also discuss them with your fellow students and you may work together on each problem set, but what you hand in must be your own writing and you should be able to answer questions about its content. The solutions of homework problems can be discussed (after the due date) in lectures and/or more appropriately in recitation sections. Some of the homework problems will be graded and solutions will be posted on the web. Problems marked with an asterisk (*) are for extra credit.

Late homeworks will not be accepted.

There will be two midterm examinations (on 2/22 and 3/31) and a final exam (on 05/17). All examinations are inclusive in the sense that they will cover all the material studied up to a specified date. The exact area of coverage of each examination will be posted on the web. No calculators, notes, or books, etc., will be allowed during the midterms or final exam. Exam dates and times are not flexible and there will be NO makeup exams.

Your grade will be based on the weekly homeworks (20%), midterms (25% each), and the final exam (30%). The two lowest homework grades will be dropped before calculating the average. A special project and class participation may also contribute (up to 15%) toward the final grade (either as bonus, or as substitute for some of the homework).

- Homework assignments
- Projects

Links:

The following is a (growing) list of web sites devoted to topics relevant for our class:

- An On-Line Encyclopedia of Integer Sequences.
- Fibonacci Numbers and Nature. Or Tony Phillips' "The most irrational number". Also "Who was Fibonacci?": a brief biography of Fibonacci.
- Primes: Lots of interesting facts about prime numbers.
- Mersenne Primes: interesting facts about Mersenne primes, perfect numbers, and related topics.
- Primes is P: about a recent polynomial time deterministic algorithm to test if an input number is prime or not.

- RSA: The RSA company's web page containing lots of interesting information about the RSA public key cryptosystem and cryptography in general, from both a technological and a socio-political viewpoint.
- The RSA factoring challenge.
- The Enigma machine (in German).
- Handbook of Applied Cryptography, by Alfred J. Menezes, Paul C. van Oorschot and Scott A. Vanstone. It is a handbook for both novices and experts, introducing practical aspects of both conventional and public-key cryptography.
- GCHQ Challenge (as of December 2004). Their next cryptographic challenge is scheduled to appear on their website in June 2005.
- Ron Rivest's Cryptography and Security links page.
- MIT Lecture Notes on Cryptography, by S. Goldwasser and M. Bellare.
- Java applet drawing Hasse diagrams of posets. Another interactive poset drawing applet is available here.
- An alternative discussion (to the textbook) of the signature of permutations. Also the short argument we have used in class to define signature. (Both links work from campus IP addresses only.)
- An elementary discussion of the famous Sam Loyd 15 puzzle: A Modern Treatment of the 15 Puzzle by Aaron F. Archer, in The American Mathematical Monthly, Vol. **106**, No. 9. (Nov., 1999), pp. 793-799 (link works from campus IP addresses only).
- General graph puzzles (the above 15 puzzle corresponds to the graph = cartesian product of the path on 4 vertices with itself) are discussed in: Graph puzzles, homotopy, and the alternating group, Richard M. Wilson, in Journal of Combinatorial Theory, Series B, Volume 16, Issue 1, pages 86-96.
- Rubik's cube involves a subgroup G of S_{48}, permuting the moving 48 colored squares, and generated by six specific permutations (clockwise quarter-turns of the front, back, right, left, top and bottom faces of the cube). Solving Rubik's cube amounts to the mathematical problem of finding an algorithm such that, given any element g of the group G, one can determine a sequence $g_1,\ldots,g_k$ of powers g_i of the generators such that $g=g_1\ldots g_k$. This requires the

discovery of short words in the generators whose effects on the cube are to move relatively few of the 48 squares.

- An analysis of the 4 slices analogue of Rubik's cube using (groups of) permutations: Rubik's Revenge: The Group Theoretical Solution, by Mogens Esrom Larsen, in The American Mathematical Monthly, Vol. 92, No. 6, pp. 381-390 (link works from campus IP addresses only).
- A very brief explanation of the "mysterious art" of English bell ringing.
Read more about elements of group theory in campanology in Arthur White's paper "Fabian Stedman: The First Group Theorist?", in The American Mathematical Monthly, Vol. 103, No. 9. (Nov., 1996), pp. 771-778 (link works from campus IP addresses only).
- A brief history/introduction to error-correcting codes Digital Revolution - Error Correction Codes, Joseph Malkevitch, in What's New in Mathematics Feature Column of the AMS.
- A summary describing how information is encoded on Compact Discs. CDs use a modified form of the Reed-Solomon code called the Cross Interleave Reed-Solomon Coding (CIRC). Here is a short description of how Reed-Solomon codes are used for error-correction on a audio CD (Red Book Standard).
- Maple code (and brief explanations) relevant to class material.

A number of interesting local links that you are warmly encouraged to explore:

- Problem of the Month sponsored by the Stony Brook mathematics deptartment. The first two winners each month get $25!
- Math Club

Math Learning Center

The **Math Learning Center** (MLC), located in Room S-240A of the Math Tower, is an important resource. It is staffed most days and some evenings by mathematics tutors (professors and advanced students). For more information and a schedule, consult the MLC web site.

Special needs

If you have a physical, psychiatric, medical or learning disability that may impact on your ability to carry out assigned course work, you may contact the Disabled Student Services (DSS) office (Humanities 133, 632-6748/TDD). DSS will review your concerns and determine, with you, what accommodations may be necessary and appropriate. I will take their findings into account in deciding what alterations in course work you require. All information on and documentation of a disability condition should be supplied to me in writing at the earliest possible time AND is strictly confidential. Please act early, since I will not be able to make any retroactive course changes.

Sorin Popescu
2005-01-15

MAT 312 / AMS 351
Applied Algebra

Homework:

Problems marked with an asterisk (*) are for extra credit.

- **HW 1** (due 02/02 in P-143, Math Tower) [solutions]
  - Section 1.1: 1, 2, 5, 6, 7
  - Section 1.2: 1, 2, 3, 5, 6, 7, 8, 9*
- **HW 2** (due 02/09 in P-143, Math Tower) [solutions]
  - Section 1.3: Ex 1, 3, 4, 6, 7, 8
  - Section 1.4: Ex 1, 2
- **HW 3** (due 02/16 in P-143, Math Tower) [solutions]
  - Section 1.4: Ex 3, 4, 5, 9

    Section 1.5: Ex 1 (i, ii, iii, vi, vii), 2, 3
  - Find all integral solutions of the equation:
    1. $60x+18y=97$
    2. $21x+14y=147$
  - How many ways can change be made for one dollar, using each of the following coins:
    1. dimes and quarters
    2. nickels, dimes and quarters
- **HW 4** (due 02/23 in P-143, Math Tower) [solutions]
  - Section 1.5: Ex 4, 5
  - Section 1.6: Ex 1, 2, 3, 5, 6, 7, 8*, 10
- **HW 5** (due 03/02 in P-143, Math Tower) [solutions]
  - Section 1.6: Ex 9*, 12, 13
  - Find the primes p and q if $pq=4{,}386{,}607$ and $\varphi(pq)=4{,}382{,}136$. Explain the method you have used.
  - Are there any numbers n such that $\varphi(n)=14$? Explain!
  - Find the remainder at division of 3^{1000} by 35.
  - *Suppose that a cryptanalyst discovers a message P that is

not relatively prime to the enciphering modulus n=pq used in a RSA cipher. Show that the cryptanalyst can actually factor n.

- **HW 6** (due 03/09 in P-143, Math Tower) [solutions]
  - * Compute φ(n) for the following values of n= 10!, 20! and 100!. Explain the method you have used.
  - Section 2.1: Ex 1, 3, 4, 6
  - Section 2.2: Ex 1, 2, 5, 9, 10
  - Section 2.3: Ex 1
- **HW 7** (due 03/16 in P-143, Math Tower) [solutions]
  - Section 2.3: 2 (only c, e, d, f), 4, 6 (only the Hasse diagram), 7
  - Let X= {1, 2, 3, 4, 5}. For each part, define a relation R on the set X so that R is
    1. reflexive and symmetric, but not transitive.
    2. symmetric and transitive, but not reflexive.
    3. reflexive, symmetric, transitive, and weakly antisymmetric.
  - Let M be the relation on the real numbers **R** defined as follows: for all x, y **R**, xMy if and only if x-y is an integer.
    1. Prove that M is an equivalence relation.
    2. Describe the equivalence classes of M.
  - Section 4.1: Ex 1 (only the products $\pi_1\pi_2$, $\pi_2\pi_3$ and $\pi_2\pi_1$), 2, 3
- **HW 8** (due 03/30 in P-143, Math Tower) [solutions]
  - Section 4.1: 4, 5, 6
  - Write the permutations π_1, π_2 and π_4 in the exercise 1 of section 4.1 as a product of disjoint cycles.
  - Section 4.2: 1, 2, 3, 5, 6, 7
- **HW 9** (due 04/6 in P-143, Math Tower) [solutions]
  - Section 4:2: 12
  - Section 4.3: 1
- **HW 10** (due 04/13 in P-143, Math Tower) [solutions]
  - Section 4.3: 2, 3, 5, 6, 8
  - Describe the group of symmetries of a regular hexagon. How many symmetries does it have? What do they look like? What

relationships are there among them?
    - Section 4.4: 1, 3 ((i), (iii) and (v) only).
- **HW 11** (due 04/22 in P-143, Math Tower) [solutions]
    - Section 4.4: 7, 17*
    - Section 5.1: 1, 3, 4, 5
- **HW 12** (due 04/27 in P-143, Math Tower) [solutions]
    - Section 5.1: 6, 10
    - Section 5.2: 1, 2, 3, 5
- **HW 13** (due 05/4 in P-143, Math Tower) [solutions]
    - Section 5.3: 1, 2, 4, 7, 8, 9
    - Section 5.4: 2, 4, 5

Sorin Popescu
2005-03-28

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Information about the Project

Students are encouraged to do an individual special project. This could involve a historical report on material of the course, or learning a topic in algebra not discussed in the course, or writing a computer program/developing some algorithm, etc. The choice of a topic and the exact scope of the special project are to be determined after consultation with the instructor. A short list of potential project topics is enclosed below. However if you would like to work on a different project/topic please come see me during office hours to talk about it. Projects are **individual** and are expected to be neatly written/presented. Programs/computer code without accompanying (mathematical) explanations/description are **NOT** acceptable.

For any of the programming projects, please email to sorin at math.sunysb.edu the program source code + actual project (in readable form -- indented and commented), as well as hand in the program outline and a reasonable amount of program output. You can use any programming language you like (within reasonable limits - i.e., a language for which there exist easily available compilers). Preferred ones are *Maple*, *Mathematica* (yes, they are programming languages), *C*, *OCAML* and *Java*, but you can also use *C++*, *Pascal*, *Python*, *Fortran*, *Lisp*, *Turing machine*...

You will need to make your selection and also inform me in writing via email by 03/01, the latest. The project is due before or on 04/08/2005.

1. Let n be a positive integer, and define T(n) = n/2 if n is even, and (3n+1)/2 otherwise, so for instance T(2)=1, and T(5)=8. Form the sequence obtained by iterating T: n, T(n), T(T(n)), T(T(T(n))), ... For instance starting with n=7 we get the sequence 7,11,17,26,13,20,10,5,8,4,2,1,2,1, ... A well known conjecture asserts that the sequence obtained by iterating T always reaches 1 no matter which positive number n begins the sequence.
    - Find the sequence obtained by iterating T starting with n=39
    - Show that if we start the sequence from $n=(2^{2k}-1)/3$, $k>1$, one always reaches 1.

Write a program that verifies the above conjecture for all values of n smaller than 10000.

  - Using the above numerical evidence make conjectures concerning the number of iterations needed in the above sequence till one reaches 1.

2. Discuss and find divisibility tests for an integer n by any of the following numbers 2, 3, 5, 7, 9, 11, 13, 101. Write a program that tests such divisibilities (for very large integers). Discuss historical aspects.
3. According to the "theory" of biorhythms there are three cycles in your life that start the day you are born. These are the physical, emotional and intellectual cycles of length 23, 28 and 33 days, respectively. Each cycle follows a sine curve with period equal to the length of that cycle, starting with value 0, climbing to value 1 one quarter of the way through the cycle, dropping back to value 0 one-half of the way through the cycle, etc and getting back to value 0 at the end of the cycle.
   - For which says of your life will you be at a triple peak, where all three cycles are at maximum values?
   - For which says of your life will you be at a triple nadir, where all three cycles are at minimum values?
   - When in your life will all three cycles be at neutral position?
   - Write a program that plots biorhythm charts and finds triple peaks and triple nadirs.
4. Discuss the complexity of the euclidean algorithm for computing gcd's. Show Lam\'e's result that the number of divisions needed to find the gcd of two integers via the euclidean algorithm does not exceed the number of decimal digits in the smaller of the two integers. Write a program that checks Lam\'e's bound for various pairs of large integers of your choice. Use the numerical evidence to see how far is Lam\'e's bound from the number of actual divisions. Discuss the number needed of steps in other algorithms for finding the gcd (e.g. the least-remainder algorithm).
5. A composite number n that satisfies $n \mid b^{n-1}-1$ for all integers b with $(b,n)=1$ is called a Carmichael number.
   - Show that if n is a Carmichael number then it is squarefree.

- Show that 2821=7*13*31 is a Carmichael number.
- Show that if $n=p_1p_2...p_n$ is a product of distinct primes such that $p_i-1|n-1$ for all i, then n is a Carmichael number. Use this to show that 564651361 is a Carmichael number. You may also try to write a program to find other Carmichael numbers.

6. Discuss Vigenere and Hill ciphers (encryption, decryption). Write a program that can perform encryption, decryption using such methods. Discuss vulnerability via statistics of blocks in the encrypted test. Write a program that does cryptanalysis for such cyphers based on statistics of blocks (for small sizes of blocks).
7. Write a program that finds all twin primes less than 20,000. Hardy and Littlewood conjectured that the number of twin primes not exceeding n is asymptotic to $C\, n/(\ln n)^2$ for a constant C, approximately equal to 0.66016. Determine how accurate this asymptotic formula is for values of n as large as you can compute.
8. Compare the number of primes of the form 4n+1 and the number of primes of the form 4n+3 for a range of values of n. Can you make any conjectures about the relationship between these numbers?
9. Gather evidence for the following conjectures, or find counterexamples if you can:
   - Lehmer has conjectured that n is prime if φ(n) divides n-1.
   - Charmichael has conjectured that for every positive integer n there is a positive integer m distinct from n such that φ(n)= φ(m).
10. Describe a good method to
    - Find the number of zeroes at the end of the decimal expansion of n!. Write a simple program that uses your method and test it.
    - Find the prime factorization of n!. Write a simple program that uses your method and test it.
11. A short (4 to 5 typed pages) paper on the mathematical contributions of a number theorist. Note: This is not a biography - you will need to describe mathematical results, their proofs, etc.
12. A short (4 to 5 typed pages) historical report on material discussed

in the course. You will need to describe mathematical results, outline proofs, etc

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Sorin Popescu
2005-01-15

Sorin Popescu

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Research Interests: Algebraic Geometry, Commutative Algebra, Combinatorics and Computational methods

Teaching:

Spring 2006	MAT 311 Number Theory	MAT 614 Topics in Algebraic Geometry
Previous years	Teaching Archive	

Algebra, Geometry and Physics seminar: Spring 2006

Publications & E-Prints: Unless otherwise indicated, the files below are DVI files (), PostScript files (), PDF files (), or tar gziped DVI and PostScript files (). Files marked as () or ( ) are hyperlinked PDF or Macromedia Flash files formated for screen viewing. Other formats (source, PS using Type I fonts) can be obtained via the UC Davis Front to the Mathematics ArXiv. Click on () or () for related *Macaulay2*, or *Macaulay* code.

Syzygies:

- *Gale Duality and Free Resolutions of Ideals of Points* [], [] [] [] [], *Invent math* **136** (1999) 2, 419-449
  David Eisenbud and Sorin Popescu
- *The Projective Geometry of the Gale Transform* [], [] [] [], *J. Algebra* **230** (2000), no. 1, 127-173

  David Eisenbud and Sorin Popescu
  (in the D. Buchsbaum anniversary volume of *J. Algebra*)
- *Syzygy Ideals for Determinantal Ideals and the Syzygetic Castelnuovo Lemma* [] [], [MathSci],

Springer 1999
David Eisenbud and Sorin Popescu

- *Extremal Betti Numbers and Applications to Monomial Ideals* [] [] [] [], *J. Algebra* **221** (1999), no. 2, 497-512
  Dave Bayer, Hara Charalambous and Sorin Popescu
- *Lagrangian Subbundles and Codimension 3 Subcanonical Subschemes* [], [] [] [], *Duke Math. J.* **107** (2001), no. 3, 427-467
  David Eisenbud, Sorin Popescu and Charles Walter
- *Enriques Surfaces and other Nonpfaffian Codimension 3 Subcanonical Subschemes* [] [] [] [ ], *Comm. Algebra* **28** (2000), 5629-5653
  David Eisenbud, Sorin Popescu and Charles Walter
  (in the Hartshorne anniversary volume of *Comm. Algebra*)
- *Syzygies of Unimodular Lawrence Ideals* [] [] [] [], *J. Reine Angew. Math* **534** (2001), 169-186
  Dave Bayer, Sorin Popescu and Bernd Sturmfels
- *Hyperplane Arrangement Cohomology and Monomials in the Exterior Algebra* [] [] [] [] [], Trans. AMS. **355** (2003), 4365-4383
  David Eisenbud, Sorin Popescu and Sergey Yuzvinsky
- *Exterior algebra methods for the Minimal Resolution Conjecture* [] [] [] [], *Duke Math. J.* **112** (2002), no. 2, 379-395
  David Eisenbud, Frank-Olaf Schreyer, Sorin Popescu and Charles Walter
- *Symmetric resolutions of coherent sheaves* [] [] []
  David Eisenbud, Sorin Popescu and Charles Walter
- *A note on the Intersection of Veronese Surfaces* [] [] [] [] [ ]
  David Eisenbud, Klaus Hulek and Sorin Popescu
- *Restricting linear syzygies: algebra and geometry* [] [] [] [] [ ], *Compositio Math.* **141** (2005), no.6, 1460-1478
  David Eisenbud, Mark Green, Klaus Hulek and Sorin Popescu
- *Small schemes and varieties of minimal degree* [] [] [] [] [ ], *Amer. J of Math* (2005), to appear
  David Eisenbud, Mark Green, Klaus Hulek and Sorin Popescu

Abelian varieties, modular varieties and equations:

- *Equations of (1,d)-polarized abelian surfaces* [] [] [], *Math. Ann.* **310** (1998), no. 2, 333-377
  Mark Gross and Sorin Popescu
- *The moduli space of (1,11)-polarized abelian surfaces is unirational* [] [] [], *Compositio Math.* **126** (2001), no. 1, 1-24
  Mark Gross and Sorin Popescu
- *Calabi-Yau threefolds and moduli of abelian surfaces I* [] [] [], *Compositio Math.* **127**, no. 2, (2001), 169-228
  Mark Gross and Sorin Popescu

Calabi-Yau threefolds and moduli of abelian surfaces II [ ] [ ] [ ]
Mark Gross and Sorin Popescu

- *Elliptic functions and equations of modular curves* [DVI] [PS] [PDF] [ ], *Math. Ann.* **321** (2001), no. 3, 553-568
  Lev A. Borisov, Paul Gunnells, and Sorin Popescu

Surfaces in P^4 and threefolds in P^5:

- *The Geometry of Bielliptic Surfaces in P^4* [DVI], [PS] [PDF], *Internat. J. Math.* **4** (1993), no. 6, 873-902
  A. Aure, W. Decker, K. Hulek, S. Popescu and K. Ranestad
- *On Surfaces in P^4 and Threefolds in P^5* [DVI] [PS] [PDF], [MathSci], LMSLN **208**, 69--100
  W. Decker and S. Popescu
- *Surfaces of degree 10 in P^4 via linear systems and linkage* [DVI] [PS] [PDF] [ ] [ ], *J. Algebraic Geom.* **5** (1996), no. 1, 13-76
  S. Popescu and K. Ranestad
- *Syzygies of Abelian and Bielliptic Surfaces in P^4* [DVI] [PS] [PDF], *Internat. J. Math.* **8** (1997), no. 7, 849-919
  A. Aure, W. Decker, K. Hulek, S. Popescu and K. Ranestad
- *Examples of smooth non general type surfaces in P^4* [DVI] [PS] [PDF] [ ] [ ], *Proc. London Math. Soc.* (3) **76** (1998), no. 2, 257-275
  S. Popescu
- *Surfaces of degree >= 11 in the Projective Fourspace* [DVI] [PS] [PDF]+ *Appendix* [DVI] [PS] [PDF]
  S. Popescu

PRAGMATIC 1997: A summer school in Catania, Sicily

- *Research Problems for the summer school* [DVI], [PS] [PDF], [MathSci], *Matematiche* (Catania) **53** (1998), 1-14
  David Eisenbud and Sorin Popescu

Algorithmic Algebra and Geometry: Summer Graduate Program (1998) at MSRI:

- Poster [PS] [PDF], lecture slides and streaming video , CD ROM,
  Dave Bayer and Sorin Popescu

Linear algebra notes

- *On circulant matrices* [DVI], [PS] [PDF] [PDF] [ ],
  Daryl Geller, Irwin Kra, Sorin Popescu and Santiago Simanca

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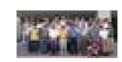
Upcoming conferences:

- DARPA FunBio Mathematics-Biology Kick-off meeting, Princeton, September 21-23, 2005
- MAGIC 05: Midwest Algebra, Geometry and their Interactions Conference, University of Notre Dame, Notre Dame, October 7-11, 2005
- AMS Special Session on Resolutions, Eugene, OR, November 12-13, 2005
- Clay Workshop on Algebraic Statistics and Computational Biology, Clay Mathematics Institute, November 12-14, 2005
- CIMPA School on Commutative Algebra, December 26, 2005 - January 6, 2006, Hanoi, Vietnam
- AMS Special Session on Syzygies in Commutative Algebra and Geometry, San Antonio, TX, January 12-15, 2006
- KAIST Workshop on Projective Algebraic Geometry, January 23-25, 2006, Korean Advanced Institute of Science and Technology, Daejeon
- AMS Special Session on the Geometry of Groebner bases, San Francisco, CA, April 29-30, 2006
- Castenuovo-Mumford regularity and related topics, Workshop at CIRM, Luminy, France, May 9-13, 2006
- Commutative Algebra and its Interaction with Algebraic Geometry, Workshop at CIRM, Luminy, France, May 22-26, 2006
- Syzygies and Hilbert Functions, Banff International Research Meeting, Canada, October 14-19, 2006

Past conferences:

- A conference on alegbraic geometry to celebrate Robin Hartshorne's 60th birthday, Berkeley, August 28-30, 1998
- Western Algebraic Geometry Seminar, MSRI, Berkeley, December 5-6, 1998
- Conference on Groebner Bases, Guanajato, Mexico, February 8-12, 1999
- The Pacific Northwest Geometry Seminar
- Computational Commutative Algebra and Combinatorics, Osaka, July 21-30, 1999. 
- Kommutative Algebra und Algebraische Geometrie, Oberwolfach, August 8-14, 1999. 
- AMS Western Section Meeting Salt Lake City, UT, September 25-26, 1999.
- Algebra and Geometry of Points in Projective Space, Napoli, February 9-12, 2000.
- AMS Spring Eastern Sectional Meeting Lowell, MA, April 1-2, 2000.
- Algèbre commutative et ses interactions avec la géométrie algébrique, Centre International de Rencontres Mathématiques, June 5-9, 2000.
- Topics in Classical Algebraic Geometry, Oberwolfach, June 18-24, 2000 
- AMS Fall Central Section Meeting Toronto, Ontario Canada, September 22-24, 2000
- AMS Fall Eastern Section Meeting, New York, Columbia U. in New York, November 4-5, 2000
- Exterior algebra methods and other new directions in Algebraic Geometry, Commutative Algebra and Combinatorics, 8-15 September 2001, Ettore Majorana Centre, Erice, Sicily, Italy. Photos from the conference.
- Classical Algebraic Geometry, Oberwolfach, May 26 - June 1, 2002 
- Current trends in Commutative Algebra, Levico, Trento, June 17-21, 2002
- Birational and Projective Geometry of Algebraic Varieties, Ferrara, September 2-8, 2002
- Commutative Algebra, Singularities and Computer Algebra, Sinaia, September 17-22, 2002. Photos from the conference.
- James H. Simons Conference on Quantum and Reversible Computation , Stony Brook, May 25-31, 2003

- Conference on Commutative Algebra, Lisbon, June 23-27 2003. Photos from the conference. Also photos from Belém.
- Commutative Algebra and Interactions with Algebraic Geometry and Combinatorics, ICTP, Trieste, June 6-11
- III Iberoamerican Congress on Geometry, Salamanca, June 7-12
- Projective Varieties: A Conference in honour of the 150th anniversary of the birth of G. Veronese, Siena, June 8-12 , 2004. Photos from the conference.
- Algebraic Geometry: conference in honour of Joseph Le Potier & Christian Peskine, Paris, June 15-18, 2004
- Classical Algebraic Geometry, Oberwolfach, June 27-July 3, 2004
- Combinatorial Commutative Algebra, Oberwolfach, July 4-10th, 2004

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