USTARS

underrepresented students in topology and algebra research symposium

University of Iowa
Iowa City, Iowa
April 1-3, 2011

NSF

The University of Iowa

Symposium Agenda

Friday, April 1

6:00-8:00pm Early Registration
Sheraton Hotel

Saturday, April 2

8:00-12:00pm Registration
Sheraton Hotel Lobby

8:30-9:00am Welcome and Opening remarks
40 Schaeffer Hall

9:00-9:35am Session I
Quivers and Universal Deformation Rings
Shannon Talbott, University of Iowa
105 MacLean Hall

Affine Covers of Quantized Flag Varieties
Bryan Bischof, Kansas State University
110 MacLean Hall

On The Homotopy Type of The Complement of An Arrangement of Lines
Kris Williams, University of Iowa
113 MacLean Hall

9:40-10:10am Session II
An Algebraic View of the Littlewood-Richardson Rule
Nickolas Hein, Texas A & M University
105 MacLean Hall

The Least Inert Prime in A Real Quadratic Field
Enrique Trevino, Dartmouth College
110 MacLean Hall

A Twisted Dimer Model for Knots
Heather Russell, Louisiana State University
113 MacLean Hall

10:10-10:25am Coffee Break

10:25-10:55am Session III
Brauer Group and Monoid
Holly Attenborough, Indiana University
105 MacLean Hall

Finiteness Theorems for Chains of Toric Ideals
Abraham Martin del Campo, Texas A & M University
110 MacLean Hall

Saturday, April 2

11:00-11:30am	Session IV *Rational Distance Sets on Conic Sections* Kevin Mugo,Purdue University 105 MacLean Hall *The Chromatic Polynomial of Signed Graphs* Mela Hardin, San Francisco State University 110 MacLean Hall *Concordance Genus of Knots* Kate Kearney, Indiana University 113 MacLean Hall
11:30-11:45am	Coffee Break
11:45-12:45pm	Invited Faculty Speaker *The σ-order on B_n* Dr. Emille Davie Lawrence, California State Polytechnic University 40 Schaeffer Hall
12:45-2:00pm	Lunch MacLean Hall
2:00-2:35pm	Session V *Matrix Varieties: An Analogue of Isospectral Hilbert Scheme* Mee Seong Im, University of Illinois 105 MacLean Hall *Bernoulli-Dedekind Sums* Anastasia Chavez, San Francisco State University 110 MacLean Hall *Classifying Knots* Mauricio Lopez-Hernandez, New Mexico State University 113 MacLean Hall
2:45-3:20pm	Session VI *Higher Abelianess in p-groups* Vinay Kalyankar, University of Arkansas 105 MacLean Hall *ABC Triples in Families* Edray Goins, Purdue University 110 MacLean Hall *Toroidal Dehn Fillings of Hyperbolic 3-Manifolds* Luis Valdez-Sanchez, University of Texas- El Paso 113 MacLean Hall
3:20-3:45pm	Coffee Break

Saturday, April 2

3:45-4:45pm	Distinguished Scholar *Marked Poset Polytopes* Dido Salazar-Torres, San Francisco State University 40 Schaeffer Hall
6:00-830pm	Symposium Banquet *Sheraton Hotel, Carver Room*

Sunday, April 3

9:00am- 12:00pm	Networking Breakfast and Symposium Closing *Iowa Memorial Union, South Room* **Panelists:** Dr. Ulrica Wilson, Morehouse College Dr. Teresita Ramirez-Rosas, Grand Valley State University Dr. Oscar Vega, California State University, Fresno **Moderator:** Syvillia Averett

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Abstracts

Title: Brauer Group and Monoid
Presenter: Holly Attenborough
Affiliation: Indiana University
Abstract: An algebra A over a field K is central simple if K is the center of A and A has no non trivial two sided ideals. The Brauer group of a field K is the set of K-central simple algebras under an equivalence relation with the binary operation being tensor product. In this talk, I will discuss the Brauer group and how to modify the construction to obtain the Brauer monoid.

Title: Affine Covers of Quantized Flag Varieties
Presenter: Bryan Bischof
Affiliation: Kansas State University
Abstract: If one considers semi-simple reductive Lie groups, and constructs the flag variety associated to it, it is easy to construct the affine cover by cells. This is normally referred to as Schubert decomposition. If instead one considers the quantized universal enveloping algebra associated to the Lie algebra, it is not immediately clear what the flag variety should be. In particular, it is a noncommutative variety. I will explain the meaning of noncommutative varieties, and some simple examples. I will also give the construction of affine covers for the most simple case, sl_2.

Title: Bernoulli-Dedekind Sums
Presenter: Anastasia Chavez
Affiliation: San Francisco State University
Abstract: While studying the eta-function, Richard Dedekind derived what we today call the Dedekind Sum. The Dedekind sum is defined $S(a,b) = Sum_{hmodb}((h/b))((ah/b))$, where a and b are positive integers and $((x)) = x - Floor(x) - 1/2$ when x is an integer, and otherwise $((x)) = 0$. Dedekind sums appear in many areas of mathematics, such as topology, geometric combinatorics, algorithmic complexity, algebraic geometry and modular forms, as well as exhibit many beautiful properties, the most famous being Dedekind's reciprocity law $S(a,b) + S(b,a) = -1/4 + (1/12)(b/a + a/b + 1/(ab))$ if a and b are relatively prime.

Since Dedekind, many mathematicians, such as Apostol, have introduced generalizations of Dedekind sums involving Bernoulli polynomials. In 1999, a 3-variable Dedekind-like sum called the generalized Dedekind-Rademacher sum was introduced by Hall, Wilson and Zagier, as well as the reciprocity relation it satisfies. One can naturally extend the generalized Dedekind-Rademacher sum to the n-variable case and begin to ask what reciprocity law may the n-variable case satisfy.

We introduce a n-variable generalization of the generalized Dedekind-Rademacher sum we call a Bernoulli-Dedekind sum along with a corresponding reciprocity law. Our proof of the reciprocity theorm uses a complelty novel, combinatorial approach that not only simplifies the proof of Hall, Wilson and Zagier's reciprocity theorem but also lends to the proof of an extension of Hall, Wilson and Zagier's reciprocity theorem to 4-variables.

Title: The σ-order on B_n
Presenter: Dr. Emille Davie Lawrence**
Affiliation: California State Polytechnic University
Abstract: The braid groups have been an interesting field of study in low-dimensional topology and algebra since Emil Artin introduced the notion of a braid in the 1920s. Over the years it has been discovered that the braid groups play a useful role in knot theory, robotics, theoretical physics, and a variety of other areas. In 1992 Patrick Dehornoy proved that the braid groups were left-orderable, however he used methods that were foreign to most topologists. Soon after, a 5-author paper gave a completely topological proof to braid group orderability, and furthermore, they proved that this order was equivalent to Dehornoy's. We will give a brief introduction to the braid groups, B_n, and define the σ-order on B_n. We will also show how a distinguished form for a 3-braid allows us to determine positivity in the σ-order.

Title: *ABC* Triples in Families
Presenter: Dr. Edray Goins
Affiliation: Purdue University
Abstract: Given three positive, relative prime integers A, B, and C such that the first two sum to the third i.e. $A + B = C$, it is rare to have the product of the primes p dividing them to be smaller than each of the three. In 1985, David Masser and Joseph Osterlé made this precise by defining a "quality" $q(P)$ for such a triple of integers $P = (A, B, C)$; their celebrated "ABC Conjecture" asserts that it is rare for this quality $q(P)$ to be greater than 1 – even through there are infinitely many examples where this happens. In 1987, Gerhard Frey offered an approach to understanding this conjecture by introducing elliptic curves. In this presentation, we introduce families of triples so that the Frey curve has nontrivial torsion subgroup, and explain how certain triples with large quality appear in these families. We also discuss how these families contain infinitely many examples where the quality $q(P)$ is greater than 1. This will describe work done at the Mathematical Sciences Research Institute's Undergraduate Program (MSRI-UP).

Title: The Chromatic Polynomial of Signed Graphs
Presenter: Mela Hardin
Affiliation: San Francisco State University
Abstract: It is natural to study vertex colorings in graph theory. The function that counts the number of colorings of a graph G is the chromatic polynomial. One way to compute this polynomial is through the deletion contraction method involving the recursive combination of its subgraphs. Such colorings can also be done with signed graphs.

A signed graph S is a graph consisting of an unsigned graph G along with a sign function σ that labels each edge and loop positive or negative. σ is defined for all edges except halfedges and σ; must be positive on free loops. Coloring a signed graph requires signed colors and it has a chromatic polynomial with the same enumerative and algebraic properties as for ordinary graphs. I will discuss the properties of this polynomial.

Title: An Algebraic View of the Littlewood-Richardson Rule
Presenter: Nickolas Hein
Affiliation: Texas A&M University
Abstract: The Littlewood-Richardson rule gives a combinatorial way to calculate structure coefficients in the cohomology of the Grassmannian. Eisenbud and Harris reformulated a specialization (the Pieri rule) to apply to honest Schubert varieties, giving scheme-theoretic intersections. While their methods are elegant, they seem to only be able to give a cycle-theoretic version of the full Littlewood-Richardson. I use a Groebner degeneration to study the intersection given by Eisenbud-Harris, and I give the scheme structure of some intersections explicitly. This may give a way to extend their work further.

Title: Matrix Varieties: An Analogue of Isospectral Hilbert Scheme
Presenter: Mee Seong Im
Affiliation: University of Illinois
Abstract: The Hilbert scheme of n points on a plane is one of the simplest moduli space that arise in many areas of mathematics. To name a few, it comes up in holomorphic symplectic geometry, Grojnowski-Nakajima quiver varieties, algebraic combinatorics, braid groups, Fourier expansion of partition functions that are associated to certain Siegel modular forms, Calogero-Moser space, Young tableau, Dynkin diagrams, and Heisenberg algebra. I will define the construction of the Hilbert Scheme of n points on a scheme X and its associated matrix representation when X is a complex plane. My research is then discussed, which may be related to the Isospectral Hilbert scheme. I begin by introducing a family of affine algebraic varieties over an algebraically closed field and a set of solvable group acting on this variety. There exists a moment map, which I show is flat, dominant and the pre-image of 0 is a B-equivariant complete intersection. The proof consists of simple linear algebra techniques and induction. Examples will be given at every step along the way and only some background in linear algebra will be assumed for my talk.

Title: Higher Abelianess in p-groups
Presenter: Vinay Kalyankar
Affiliation: Univeristy of Arkansas
Abstract: In this talk I will focus on finite non-abelian groups that tend to be as close to being abelian as possible; the degree of abelianness being measured as the probability that two arbitrary elements commute. We will show statistical evidence that p-groups in general are better than non p-groups.

Title: Concordance Genus of Knots
Presenter: Kate Kearney
Affiliation: Indiana University
Abstract: Two knots are considered concordant if they cobound an annulus in $S^3 \times I$. Concordance is an equivalence relation, and with the operation of connect sum knots up to concordance form a group. The concordance genus is one tool used to study this group. I will give relevant definitions and discuss several interesting examples of calculations of concordance genus.

Title: Classifying Knots
Presenter: Mauricio Lopez-Hernandez
Affiliation: New Mexico State University
Abstract: The main goal is to study knots by looking at its fundamental groups that can be generated by two generators.

Lots of results are now available with respect to those kinds of knots. In this opportunity I want to show how is the behavior when S_3 acts on G/G, where G is a subgroup of a free group generated by two generators. The strongest tool in this process is the Writinger presentation for fundamental groups of knots. I made some computer programs in order to compute the presentation of such actions.

Title: Finiteness Theorems for Chains of Toric Ideals
Presenter: Abraham Martin del Campo
Affiliation: Texas A&M University
Abstract: We study chains of toric ideals that are invariant under a symmetric group action. In our setting, the ambient rings for these ideals are polynomial rings which are increasing in (Krull) dimension. Thus, these chains will fail to stabilize in the traditional commutative algebra sense. However, we prove a general theorem which says that "up to the action of the group", these chains stabilize up to monomial localization. This gives a partial resolution to a conjecture of Aschenbrenner and Hillar.

Title: Rational Distance Sets on Conic Sections
Presenter: Kevin Mugo
Affiliation: Purdue University
Abstract: In the 18th century, the great Swiss mathematician Leonhard Euler proved that there are infinitely many rational points with pairwise rational distance on a unit circle. More recently, in the last few years, there have been efforts to construct such 'rational distance sets' on a parabola. We will review these results and detail our attempts to construct rational distance sets on a hyperbola.

Title: A Twisted Dimer Model for Knots
Presenter: Dr. Heather Russell
Affiliation: Louisiana State University
Abstract: We develop a dimer model for the Alexander polynomial of a knot. This recovers Kauffmans state sum model for the Alexander polynomial using the language of dimers. By providing some additional structure we are able to extend this model to give a state sum formula for the twisted Alexander polynomial of a knot depending on a representation of the knot group.

Title: Marked Poset Polytopes
Presenter: Dido Salazar-Torres *
Affiliation: San Francisco State University
Abstract: The order and chain polytopes arise from the inequalities implied by a partially ordered set. We generalize the order and chain polytopes so the poset can include fixed values, these are called the marked order polytope and marked chain polytope.

Title: Quivers and Universal Deformation Rings
Presenter: Shannon Talbott
Affiliation: University of Iowa
Abstract: Our goal is to use combinatorial methods to determine universal deformation rings of representations. Quivers, which are directed graphs, provide a combinatorial framework for the study of representations of algebras. Suppose k is an algebraically closed field. We look at a special class of k-algebras, called special biserial algebras, which are defined by certain quivers and relations and for which all representations are given combinatorially using so called strings and bands. We consider string modules M for Λ and show how their stable endomorphism ring $\underline{End}_\Lambda(M)$ can be determined. If $\underline{End}_\Lambda(M)$ is isomorphic to k, then M has a universal deformation ring $R(\Lambda, M)$. We show how to compute $R(\Lambda, M)$ for certain Λ and M.

Title: The Least Inert Prime in A Real Quadratic Field
Presenter: Enrique Trevino
Affiliation: Dartmouth College
Abstract: In this talk, we prove that for any positive fundamental discriminant $D > 1596$, there is always at least one prime $p \leq D^{0.45}$ such that the Kronecker symbol $(D/p) = -1$. We use a "smoothed" version of the Pólya–Vinogradov inequality, which is very useful for explicit estimates.

Title: Toroidal Dehn Fillings of Hyperbolic 3-Manifolds
Presenter: Dr. Luis Valdez-Sanchez
Affiliation: University of Texas- El Paso
Abstract: We give a brief account of the classification of hyperbolic 3-manifolds admitting toroidal Dehn fillings down to distance three.

Title: On The Homotopy Type of The Complement of An Arrangement of Lines
Presenter: Kris Williams
Affiliation: University of Iowa
Abstract: For two topological spaces, we know that the spaces being homeomorphic implies they are homotopy equivalent which implies they have isomorphic fundamental groups. In this talk we explore the complements of complex line arrangements and examine conditions that allow us to reverse some of these implications.

* Invited Faculty Speaker
** Distinguished Scholar

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