The UMaine Computer Science Department Celebrates
Black History Month
By Hosting Noted African-American Mathematician
Dr. Jonathan Farley
2009-2010 Visiting Libra Diversity Professor

Dr. Farley will lecture extensively on a wide variety of topics. Below are descriptions, times and locations of the various lectures. A detailed biography is at the end of this document.

THURSDAY FEBRUARY 4, 2010 3:30 PM 120 NEVILLE HALL

What You Need To Know To Get Your Ph.D.
Prof. Jonathan Farley
University of Linz

ABSTRACT
Many small businesses fail within 5 years, and so do many graduate students. Learn how to be in the winning half.

FRIDAY FEBRUARY 5, 2010 3:00-5:00 PM 120 NEVILLE HALL

The Wide Partition Conjecture Is Wide Open
Prof. Jonathan Farley
University of Linz

ABSTRACT
Consider a partition $P = (P_1,P_2,...)$ of a positive integer $n$, viewed as a Young diagram: row $i$ has $P_i$ boxes. Your task is to fill in each box with a number---for row $i$ you are only allowed to use the numbers 1, 2, 3, ..., up to $P_i$---so that no number appears twice in the same row or column. For some shapes $P$ you can do this, for some you cannot. The Wide Partition Conjecture asserts for what shapes this can, and for what shapes this cannot, be done. In this talk we survey what is known and present some ideas for how to tackle the conjecture. This talk will be very low on new results and is ideal for undergraduates (as well as everyone else).
ABSTRACT
How destructive was Martin Luther King's unethical philosophy?

Refreshments will be served after the talk.

TUESDAY FEBRUARY 9, 2010 3:30-5:30 PM 120 NEVILLE HALL

Toward a Mathematical Theory of Counterterrorism
Prof. Jonathan Farley
University of Linz

ABSTRACT
Since 2001, tremendous amounts of information have been gathered regarding terrorist cells and individuals potentially planning future attacks. There is a pressing need to develop new mathematical and computational techniques to assist in the analysis of this information, both to quantify future threats and to quantify the effectiveness of counterterrorism operations and strategies. Concepts and techniques from mathematics – specifically, from lattice theory and reflexive theory – have already been applied to problems related to counterterrorism. The following is a partial list of such problems.

Strategies for disrupting terrorist cells
Border penetration and security
Terrorist cell formation and growth
Data analysis of terrorist activity
Terrorism deterrence strategies
Emergency response and planning

One problem is the following: How can we tell if a terrorist cell has been broken? In other words, how can we tell that enough members have been captured so that there is a high likelihood they will be unable to carry out a new attack, and military resources can be redirected away from them and towards more immediate threats?

We can use lattice theory to quantify the degree to which a terrorist network is still able to function. This tool may help law enforcement know when a battle against a terrorist network has been won, thus saving the public's money without unduly risking the public's safety.

If one accepts the formalism of the model, then, with a few additional and reasonable assumptions, one can ask, "What is the structure of the 'perfect' terrorist cell? Which terrorist cells are most robust? Which cells are least likely to be disrupted if a certain number of their members have been captured?"

Additional information on this topic can be found at:
Refreshments will be served after the talk.

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WEDNESDAY FEBRUARY 10, 2010 3:00-5:00 PM 120 NEVILLE HALL

The Fixed Point Property for Products of Ordered Sets
Prof. Jonathan Farley
University of Linz

ABSTRACT
If two ordered sets have the fixed point property, does their product? This introduction to an exciting open problem is suitable for undergraduate math and computer science majors.

Refreshments will be served after the talk.

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THURSDAY FEBRUARY 11, 2010 3:30 PM 120 NEVILLE HALL

Valentine’s Day Special

How to Fall in Love with Mathematics
Prof. Jonathan Farley
University of Linz

ABSTRACT
How math can help you meet that special someone! For general audiences. No mathematical background is assumed. This talk will provide a gentle introduction to stable matchings and Hall’s Marriage Theorem.

Refreshments will be served after the talk.

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FRIDAY FEBRUARY 12, 2010 3:00-5:00 PM 120 NEVILLE HALL

Matchings in the Permutation Lattice
Prof. Jonathan Farley
University of Linz

ABSTRACT
Let $S_n$ be the symmetric group on $n$ letters, with the weak Bruhat order, which means the following: Write each $s$ in $S_n$ in the one-line notation $s = s_1...s_n$. We call $(s_i,s_j)$ an inversion if $i < j$ but $s_i > s_j$. The relation $s \leq t$ holds if and only if every inversion of $s$ is an...
inversion of $t$. It turns out this makes $S_n$ into a lattice – in fact, a very special kind of lattice – one which is “bounded” in the sense of McKenzie.

We say a number $i$ is a descent of $s$ if $s_i > s_{i+1}$; ascents are defined similarly. For fixed $n$, let $J_k$ be the set of all permutations with exactly $k$ descents, and let $M_k$ be the set of all permutations with exactly $k$ ascents. Also define $J_{\leq k}$ and $M_{\leq k}$ as the set of permutations with at most $k$ descents or ascents, respectively. The covering relation in $S_n$ with the weak order is given by: $s$ is a lower cover of $t$ if you can obtain $t$ from $s$ by taking exactly one ascent and reversing the corresponding two letters, turning the pair into a descent.

There is an inductive procedure for building up the $J_1$ versus $M_1$ incidence matrix, which you can see described in the book, “Formal Concept Analysis.” We ask the question what is the recursive construction for the $J_2$ versus $M_2$ incidence matrix, or the $J_{\leq 2}$ versus $M_{\leq 2}$ incidence matrix?

We also consider the question whether for $n \geq 3$ and $k \geq 3$, one can find an explicit bijection $F$ from $J_{\leq k}$ to $M_{\leq k}$ such that for all $s$ in $J_k$, $s \leq F(s)$? An even better question is whether for $2 \leq k < (n/2)-1$ you find a bijection $G$ from $J_k$ to $M_k$ such that for all $s$ in $J_k$, $s \leq G(s)$? The argument for $k = 1$ and general $n$ is due to Edelman and Reiner. Even coming up with an $F$ or $G$ for $k = 2$ would be very interesting. This is a great source of open problems for undergraduate research. A reference is Nathalie Caspard’s, “The Lattice Of Permutations Is Bounded”, *International Journal of Algebra and Computation*, Vol. 10, No. 4 (2000), pp. 481-489. [http://emis.math.ecnu.edu.cn/journals/EJC/Volume_12/PDF/v12i1n4.pdf](http://emis.math.ecnu.edu.cn/journals/EJC/Volume_12/PDF/v12i1n4.pdf)

Refreshments will be served after the talk.

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**MONDAY FEBRUARY 15, 2010 3:00 PM 120 NEVILLE HALL**

**Of Numbers and Flowers: The Truth about Truth**

Prof. Jonathan Farley

University of Linz

**ABSTRACT**


**MYTH #1:** Mathematics is only about numbers.

In fact, mathematics is the quest for Truth, and the enterprise of mathematics has much more in common with art and poetry than the ordinary layperson might think.

**MYTH #2:** Mathematicians are very often insane.

Actually, that is not a myth.

**MYTH #3:** In mathematics, everything is either right or wrong.

Indeed, in 1931, a young Austrian mathematician uncovered a secret about Reality that would revolutionize mathematics...and unravel his mind.
Everyone is welcome; no mathematical background is assumed. For more background on this talk see *Bridges*, the science newsletter of the Austrian embassy to the United States [http://www.ostina.org/content/view/1155/510/](http://www.ostina.org/content/view/1155/510/)

Refreshments will be served after the talk.

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**TUESDAY FEBRUARY 16, 2010 5:00 PM 120 NEVILLE HALL**

**How to Write for The New York Times**

Prof. Jonathan Farley  
University of Linz

**ABSTRACT**  
This talk is a how-to for people interested in writing op/eds for major newspapers.

Refreshments will be served after the talk.

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**WEDNESDAY FEBRUARY 17, 2010 5:00 PM 101 NEVILLE HALL**

**Hollywood Math and Science**

Prof. Jonathan Farley  
University of Linz

**ABSTRACT**  
A talk about math and science in the movies, focusing on the speaker's work with the hit television shows "Numb3rs" and "Medium" as well as "Flatland: The Movie" starring Kristen Bell and Martin Sheen.

This seminar is co-hosted by the Student Chapter of the Association for Computing Machinery which will supply pizza and refreshments for the seminar.

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**THURSDAY FEBRUARY 18, 2010 9:30-10:45 AM 210 NEVILLE HALL**

**How to Get Straight A's in College.**

Prof. Jonathan Farley  
University of Linz

**ABSTRACT**  
The speaker earned 29 A's and 3 A-'s at Harvard. If you attend this talk, you will learn how to do the same.

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**TUESDAY FEBRUARY 23, 2010 3:00-5:00 PM 120 NEVILLE HALL**

**Introduction to Distributive Lattices**

Prof. Jonathan Farley

Dr. Farley Visiting Libra Diversity Professor Seminars  
February 2010  
Page 5 of 10
ABSTRACT
A talk to prepare people for the colloquium level talks on February 25, 26 and 27.

Refreshments will be served after the talk.

WEDNESDAY FEBRUARY 24, 2010 7:00 PM 100 NEVILLE HALL

I Fought the Klan, and the Klan Won:
Terror in Twenty-First Century Tennessee
Prof. Jonathan Farley
University of Linz

ABSTRACT
How the speaker was forced to flee his home, leaving many of his belongings behind, by supporters of the founder of the Ku Klux Klan.

Refreshments will be served after the talk.

THURSDAY FEBRUARY 25, 2010 3:30-5:30 PM 120 NEVILLE HALL

Linear Extensions of Ranked Posets Enumerated by Descents:
A Problem of Stanley from the 1981 Banff Conference on Ordered Sets

Prof. Jonathan Farley
University of Linz

ABSTRACT
Let $P$ be a finite partially ordered set, labeled by the numbers $1...n$ so that, whenever an element $p$ is below an element $q$ in $P$, the label of $p$, $L(p)$, is less than the label of $q$, $L(q)$. We say that a permutation, perm, of $n$ is a linear extension of $P$ if whenever $x$ and $y$ are in $P$ and $x \leq y$, then $L(x)$ comes before $L(y)$ in perm. Now take any linear extension of $P$ and count the number of descents, i.e., the number of places where a bigger number comes immediately before a smaller number. Let $H_k$ be the set of linear extensions with $k$ descents and let $h_k$ be the number of such extensions.

Consider, for example, the zig-zag-shaped poset with four elements $1,2,3,4$ whose partial ordering is given by $1 < 3 > 2 < 4$. In this case, there are 5 linear extensions: $1234$, $2134$, $1243$, $2143$, and $2413$. The number of descents in the linear extensions is given by $0, 1, 1, 2,$ and $1$, respectively. Thus we get $h_0=1$, $h_1=3$, and $h_2=1$. The $h$-vector (the sequence of $h_i$) is $(1,3,1)$, which is symmetric.
Around 1971 Stanley proved that the h-vector of a ranked poset is symmetric. At the 1981 Banff Conference on Ordered Sets, Stanley asked for a bijective proof of this fact. In particular, if a naturally-labeled poset of size n is ranked (all maximal chains have the same number of elements r+1), Stanley wanted to find a bijection between the set of linear extensions with k descents and the set of linear extensions with n-1-r-k descents. We establish such a bijection, thus solving Stanley's problem.

Refreshments will be served after the talk.

FRIDAY FEBRUARY 26, 2010 3:00-5:00 PM 120 NEVILLE HALL

Cover Functions of Distributive Lattices: A Conjecture of Stanley from 1975
Prof. Jonathan Farley
University of Linz

ABSTRACT
For the purposes of this talk, a distributive lattice will be the set of order ideals (downsets) of some partially ordered set under inclusion. A distributive lattice is “finitary” if all intervals are finite (where an interval is the set of all elements in the lattice between two given ones). A finitary distributive lattice with a least element has a “cover function” if there is a function f(n) from the set of natural numbers to itself such that every element in the lattice with n lower covers (immediate predecessors) has f(n) upper covers (immediate successors). In 1975, Richard Stanley of MIT conjectured that every non-decreasing cover function must be of the form f(n) = k or f(n) = n + k, where k is a constant. We settle this conjecture, and classify all cover functions.

Refreshments will be served after the talk.

SATURDAY FEBRUARY 27, 2010 10:00AM-Noon 120 NEVILLE HALL

Functions on Distributive Lattices with the Congruence Substitution Property: Some Problems of Gratzer from 1964.
Prof. Jonathan Farley
University of Linz

ABSTRACT
Let L be a bounded distributive lattice and let k ≥ 1. A function f: L^k → L has the congruence substitution property if, for every congruence C of L, and all (a_1, b_1), ..., (a_k, b_k) in C, we have f(a_1, ..., a_k) ≡ C f(b_1, ..., b_k). The set of all such functions forms a bounded distributive lattice, denoted S_k(L) (also called the lattice of Boolean functions). Let S(L) be the lattice of all Boolean functions of finite arity on the variables x_1, x_2, ... .

In 1964, Gratzer asked:

Question 1. Let L and M be bounded distributive lattices such that S_1(L) ≅ S_1(M). Is
Sk(L) necessarily isomorphic to Sk(M)?

Question 2. Characterize those lattices isomorphic to Sk(L) or S(L) for some bounded distributive lattice L.

Using Priestley duality, we answer both questions. (The corresponding questions in the unbounded case – also asked by Gratzer – are open.)

You have to come to the talk to see what the answer is.

Refreshments will be served after the talk.

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**BIOGRAPHY**

Dr. Jonathan David Farley is currently a Teaching and Research Fellow of the Institute for Algebra at Johannes Kepler University Linz in Linz, Austria. He has been a Visiting Professor of Mathematics at the California Institute of Technology (Caltech), a professor in the Department of Mathematics and Computer Science at The University of the West Indies (Jamaica), a Science Fellow at Stanford University’s Center for International Security and Cooperation, a Visiting Scholar in the Department of Mathematics at Harvard University, and a Martin Luther King Visiting Associate Professor of Applied Mathematics at the Massachusetts Institute of Technology (MIT).

Seed Magazine named Dr. Farley one of 15 people who have shaped the global conversation about science in 2005. In 2001, the leading African-American magazine Ebony named Dr. Farley a Leader of the Future. He has also been profiled in the major African-American publication Jet (twice), in the African-American magazine Upscale, and, in 2006, on the cover of The Crisis, the magazine of the NAACP (National Association for the Advancement of Colored People), America’s largest and oldest civil rights organization.

Dr. Farley was a 2007 Proteus Monograph Series Fellow and he was the 2004 recipient of the Harvard Foundation’s Distinguished Scientist of the Year Award, a medal presented on behalf of the president of Harvard University in recognition of outstanding achievements and contributions in the field of mathematics.

“Jonathan Farley is one of the world’s most impressive young mathematicians,” Dr. Allen Counter, director of the Harvard Foundation at Harvard University, told Jet Magazine. “He is a model of excellence for young people of all backgrounds, but especially African Americans who may see their intellectual potential in him. Harvard is proud to honor his achievements and acknowledge his fine example.”

The City of Cambridge, Massachusetts (home to both Harvard University and MIT) officially declared March 19, 2004 to be Dr. Jonathan David Farley Day.

In 2001-2002, Dr. Farley was a Fulbright Distinguished Scholar to the United Kingdom; he was one of only four Americans to win this award that year. He obtained his doctorate in mathematics from Oxford University in 1995, after winning Oxford’s highest...
mathematics awards, the Senior Mathematical Prize and Johnson University Prize, in 1994. Jonathan Farley graduated summa cum laude from Harvard University in 1991 with the second-highest grade point average in his graduating class. (He earned 29 As and 3 A-s.)

Like Professor Markowsky, Dr. Farley's fields of interest are lattice theory and the theory of ordered sets. His mathematical accomplishments in the last years include the solution to a problem posed by MIT professor Richard Stanley that had remained unsolved since 1981, a problem in transversal theory (posed by Richard Rado) that had remained unsolved for 33 years, and a problem from the 1984 Banff Conference on Graphs and Order that had remained unsolved for 22 years. Some of Dr. Farley's previous mathematical accomplishments include the resolution of a conjecture posed by Richard Stanley in 1975, and the solution to some problems of George Gratzer in lattice theory that remained unsolved for 34 years.

Dr. Farley's work applying mathematics to counterterrorism, another interest shared with Professor Markowsky, has been profiled in The Chronicle of Higher Education, in Science News Online, in The Economist Magazine, in USA Today, on Fox News Television, and on Air America Radio. Dr. Farley is the author of Toward a Mathematical Theory of Counterterrorism: Building the Perfect Terrorist Cell, published by the U.S. Army War College for his Proteus Monograph Series Fellowship, and he is a co-editor of the 2009 Springer Verlag book, Mathematical Methods in Counterterrorism. He has co-organized five Conferences on Mathematical Methods in Counterterrorism. Dr. Farley is Chief Scientist of Phoenix Mathematics, Inc., a company that develops mathematical solutions to homeland security-related problems.

Dr. Farley has been an invited guest on BBC World News Television to discuss the war on terror. (The interview was filmed live from Ground Zero on the first anniversary of September 11.) He has also been an invited guest on U.S. National Public Radio’s popular Tavis Smiley Show to discuss blacks and the Green Party. His essay, My Fellow Americans: Looking Black on Red Tuesday, appeared in Beyond September 11, which also featured essays by best-selling authors Naomi Klein and Noam Chomsky.

Dr. Farley is co-founder of Hollywood Math and Science Film Consulting (www.hollywoodmath.com). This company has received coverage in the Boston Globe, the Washington Post, the Washington Times, the Chicago Tribune, the Daily Telegraph (the British newspaper with the highest circulation), the Times Higher Education Supplement in Great Britain, BBC Radio’s Midweek program, Reader’s Digest in Canada, Australian Broadcasting Corporation Radio, Comcast’s Nitebeat (which reaches 6.2 million homes) and numerous websites, including the main page of Yahoo.com and Slashdot. Dr. Farley has been a consultant for the hit television crime dramas Numb3rs and Medium.

Dr. Farley has written for Time Magazine, The New York Times, The Guardian (one of Britain’s major newspapers), the premiere black women’s magazine Essence, and the hip hop magazine The Source. Jonathan Farley is an African-American whose parents hail from the West Indies. He has lived or taught in India, Europe, the Caribbean, and the American South. (He fled Tennessee after his life was threatened by supporters of the Ku Klux Klan.)

He conceived of and co-organized a symposium on women and mathematics, featuring actress and math advocate Danica McKellar, at Stanford University’s Institute for
Research on Women and Gender (now the Clayman Institute), called, Proof and Prejudice.

Dr. Farley and his colleagues are also confidentially in negotiations with a Native American nation to help with its education (especially, math education) program.