Mathematician Monday

Dr. Ulrica Wilson

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Atlanta, Georgia

Ph.D from Emory University

Dissertation: Cyclicity of Division Algebras Over an Arithmetically Nice Field

Interests:
- noncommutative ring theory: specifically, finite-dimensional division algebras and the Brauer group
- combinatorial matrix theory: specifically, eventual properties of matrices

My teaching philosophy:
"The best way to learn is to do; the worst way to teach is to talk." −Paul Halmos

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Ulrica Wilson Named Morehouse College's 2016-2017 Vulcan Teaching Excellence Award Winner

Associate Director for ICERM - The Institute for Computational and Experimental Research in Mathematics

One of nine Committee Members for the National Science Foundation's **Mathematical Sciences Institute Diversity Initiative**

is a collaboration among the mathematical sciences institutes to increase the participation of underrepresented groups in the mathematical sciences, including women, underrepresented racial and ethnic minorities, and persons with disabilities.

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Ring Theory introduction:

DEFINITION

A **ring** is a set R together with two operations $(+)$ and $(\cdot)$ satisfying the following properties (ring axioms):

(1) R is an abelian group under addition. That is, R is closed under addition, there is an additive identity (called 0), every element $a \in R$ has an additive inverse $-a \in R$ and addition is associative and commutative.

(2) R is closed under multiplication, and multiplication is associative:

$$\begin{aligned} &\forall a, b \in R && a \cdot b \in R \\ &\forall a, b, c \in R && a \cdot (b \cdot c) = (a \cdot b) \cdot c. \end{aligned}$$

(3) Multiplication distributes over addition:

$$\forall a, b, c \in R \quad a \cdot (b + c) = a \cdot b + a \cdot c \quad \text{and} \quad (b + c) \cdot a = b \cdot a + c \cdot a.$$

A ring is usually denoted by $(R, +, \cdot)$ and often it is written only as R when the operations are understood. □

https://brilliant.org/wiki/ring-theory/

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Eventual Properties of Matrices by **Ulrica Wilson and Leslie Hogben**

http://repository.uwyo.edu/ela/vol23/iss1/67/

excerpt:

3. Eventually reducible matrices. We begin this section with an example of an irreducible, eventually reducible matrix M that we decompose into a sum of a reducible matrix M_1 having $\operatorname{rank} {M_1}^2 = \operatorname{rank} M_1$ and a nilpotent matrix M_0 with $M_0M_1 = M_1M_0 = 0$. Theorem 3.5 below shows that every eventually reducible matrix has this type of decomposition.

EXAMPLE 3.1. The matrix

$$M = \begin{bmatrix} 1 & 1 & -2 & 1 & 0 & -1 \\ 3 & 0 & -3 & 0 & 1 & -1 \\ -4 & -1 & 5 & -1 & -1 & 2 \\ 1 & 1 & 1 & 1 & 1 & -2 \\ 1 & 1 & 1 & 3 & 0 & -3 \\ 1 & 1 & 1 & -4 & -1 & 5 \end{bmatrix}$$

is eventually reducible, because M^2 and M^3 are reducible with ordered partition $\Pi = (\{1,2,3\},\{4,5,6\})$. Clearly, M is irreducible. Furthermore, if we define

$$M_1 = \begin{bmatrix} 1 & 1 & -2 & 1 & 0 & -1 \\ 3 & 0 & -3 & 0 & 1 & -1 \\ -4 & -1 & 5 & -1 & -1 & 2 \\ 0 & 0 & 0 & 1 & 1 & -2 \\ 0 & 0 & 0 & 3 & 0 & -3 \\ 0 & 0 & 0 & -4 & -1 & 5 \end{bmatrix} \quad \text{and} \quad M_0 = \begin{bmatrix} 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & 1 & 1 & 0 & 0 & 0 \\ 1 & 1 & 1 & 0 & 0 & 0 \\ 1 & 1 & 1 & 0 & 0 & 0 \end{bmatrix},$$

we see that $M = M_1 + M_0$, M_1 is reducible, $\operatorname{rank} {M_1}^2 = \operatorname{rank} M_1$, $M_1M_0 = M_0M_1 = 0$, ${M_0}^2 = 0$, and for all $k \geq 2$, $M^k = {M_1}^k$.

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The Enhancing Diversity Through Graduate Education (EDGE) Program

EDGE is designed to strengthen its participants abilities to successfully complete their graduate studies in the mathematical sciences, thereby contributing to the development of a diverse mathematical community. This year the program was attended by a diverse group of 14 women -- all of whom are engaged in doctorial studies at various institutions this fall.

The program is administered by co-directors Dr. Ulrica Wilson of Morehouse College and Dr. Ami Radunskaya of Pomona College.

During the EDGE reunion weekend, EDGE alumni gathered to share knowledge, inspire and socialize with this year's students.

Through programing by faculty facilitators, peer mentorship and networking opportunities this program seeks to give these young scientists the edge they need to complete their programs.

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Learning mathematics:

(Moorhouse College and Ulrica Wilson's advice to students)

"Studying to learn is different from studying for grades. Popular study techniques often fail to produce adequate long-term learning."

Most students spend a majority of their study time on four activities:

1. highlight the text
2. read through the examples
3. try the exercises
4. copy solutions from the answer book

https://www.morehouse.edu/facstaff/uwilson/morehouse/home.html

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Learning mathematics:

These activities involve no real commitment. Passive activities such as highlighting, reading, and copying have little long-term benefits, and trying the exercises before copying solutions is only minimally active. This kind of study leads to the common complaint, "I 'understood' everything, but I didn't do well on the test."

- **People learn mathematics best by doing mathematics and then reflecting on what they have done.**

The words "doing" and "reflecting" imply activity on the part of the learner, rather than passivity.

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Learning mathematics:

DOING MATHEMATICS

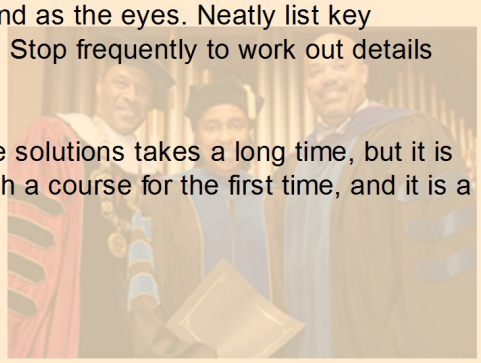
"Doing" mathematics means reading and working problems actively.

•Writing up a few exercises neatly is just as important as doing a lot of exercises.

•When you don't understand something, work to frame a specific question. Then seek help.

•Active reading is done as much with the hand as the eyes. Neatly list key definitions, ideas, and results for each topic. Stop frequently to work out details and to rework text examples.

Active reading and careful writing of exercise solutions takes a long time, but it is what teachers do when they prepare to teach a course for the first time, and it is a crucial learning activity.



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Learning mathematics:

REFLECTING ON WHAT HAS BEEN DONE

- **After learning a body of material, prepare a careful summary, as though you were going to teach the material to others.**

We never really know that we understand something until we have successfully written it down or explained it to others. Often we think we understand an idea, but we find our written or spoken explanation inadequate. The search for a better way to say something can lead to a better understanding.