ABSTRACTS OF TALKS PRESENTED TO THE INDIANA SECTION OF THE MAA

1. Introduction

The Fall 2013 meeting of the Indiana Section of the Mathematical Association of America is at the University of Southern Indiana, October 26. The abstracts appearing here are based on text electronically submitted by the presenters. Contributed talks are listed in alphabetical order by presenter.

2. Invited Talks

Presenter: Neeti Parashar, Professor of Physics, Leader of High Energy Physics Program, Purdue University Calumet

The Nobel Prize Connection: The Higgs Boson aka The God Particle

The 2013 Nobel Prize in Physics was awarded to theorists Peter Higgs and Francois Englert to recognize their work that led to the development of the theory now known as the Higgs field, which gives elementary particles mass. I am a part of the team of U.S. scientists that played a significant role in advancing the theory and in discovering the particle that proves the existence of the Higgs Field, the Higgs Boson, aka the "God" Particle.

In this presentation I will take the audience on a grand journey from the beginning of the universe through the present, describing objects moving near the speed of light and colliding to make temperatures far hotter than the center of the sun. The largest scientific machine ever built is the Large Hadron Collider at CERN, the European Organization for Nuclear Research located in Geneva, Switzerland. This accelerator probes the smallest constituents of matter known to mankind today. The search for the "God" particle has been a worldwide effort in the high-energy physics community for more than 20 years. It has been an untiring attempt to explain the origin of mass.

3. Invited Panel Discussion

Teaching an Online Class

Panelists:

- Amanda Harsy Ramsay, Indiana University - Purdue University Indianapolis
- Haseeb Kazi, Trine University
- Markus Pomper, Indiana University East
- Kathy Rodgers, University of Southern Indiana.

The panel discussion on Teaching an Online Class will feature four panelists with various levels of experience in online education, ranging from expert to novice. The discussion will begin with each panel member describing their level of experience with online education. The moderator will the begin the discussion by asking the panel an initial question. Then the audience will have the opportunity to address questions to the panel.

4. Indiana Project NExT Panel Discussion

Publishing Undergraduate Research
Panelists:

- Josh Holden, Rose-Hulman, editorial board member, Ball State Mathematics Exchange
- Ahmed Mohammed, Ball State, editor, Ball State Mathematics Exchange
- David Rader, Rose-Hulman, editor in chief, Rose-Hulman Undergraduate Mathematics Journal

Moderator: Karl Schmitt, Valparaiso University
In this panel we will discuss considerations of publishing research done with undergraduate students. Our panelists will each give an overview of their publishing experience, followed by a time for Q&A.

5. Contributed Talks

Presenter: Adam Coffman, IPFW
MSC 2010: 15A04, 15A24, 14N20
Real linear maps preserving some complex subspaces
How can you tell if a real linear map L is also complex linear? You could check that $L(z \cdot \vec{v}) = z \cdot L(\vec{v})$ for all vectors $\vec{v}$ and complex scalars z, but it can be done more efficiently by checking a weaker condition on only finitely many lines.

Presenter: Dennis Collins, University of Puerto Rico, Mayagüez (retired)
Symmetry for groups to genomes
This paper covers some topics of measuring symmetry from groups to genomes, based on the author's patent. It is necessary to count the number of pairs of equal distances between objects of the system. Extending from the "circle theorem" of the author's book, *Conflict in History, Measuring Symmetry, Thermodynamic Modeling and Other Work* (2011, Author House) are the so-called "stove-pipe hat" inequalities for entropy.

Presenter: Paul Fonstad, Franklin College
Helping elementary education majors become "The Mathematician Behind the Math"
Of all the students who pass through college, the elementary education majors have the unique opportunity to influence the minds of the next generation of mathematicians, but often find themselves frustrated and intimidated by the idea of math. In an effort to help them improve their own mathematical confidence level, I created the "Mathematician Behind the Math" project. This project engages students in making discoveries in math history, trying their hand at math research, and finally in presenting their discoveries to their peers.

Presenter: Adrian P. Gentle, University of Southern Indiana

Perplexing factorizations

The properties of the integers are so familiar and deeply ingrained that it can be difficult to even imagine that alternatives are possible. We report on an undergraduate research project that explored the number theory of perplex (or hyperbolic) integers, which take the form $a + bh$, where a and b are regular integers and the hallucinatory number h is defined by $h^2 = 1$, but h is not real (and therefore $h \neq \pm 1$). We show that perplex integers behave very differently from regular integers, and in particular, demonstrate that unique factorization fails to hold, making it possible to construct several different factorizations of perplex integers into irreducible factors.

Presenters: David Gunderman and Ashish Baiju, Wabash College undergraduate students

Faculty Advisor: Chad Westphal, Wabash College

Solving numerical PDEs with adaptive finite elements and multigrid.

This summer, David Gunderman and Ashish Baiju worked collaboratively with Dr. Chad Westphal on applying adaptive finite elements and multigrid in order to solve Numerical PDEs. David worked with a program called FreeFem++, writing code that adapitvely weights the Finite Element method's solvers so that the pollution effect caused by irregularities in the elliptic PDEs, such as discontinuous coefficients, corner singularities, and slit problems, could be eliminated. Ashish worked with pyAMG, an algebraic multigrid solver to solve the weaker form of the now more complicated matrix form PDEs using numerical linear algebra.

Presenter: Amanda Harsy Ramsay, IUPUI graduate student, and IU East adjunct instructor, Butler University adjunct instructor

How online teaching has made me a better face to face instructor

This talk will discuss how my experience teaching completely online mathematics has improved my face to face teaching. Teaching completely online is challenging and requires some extra creative thought to be successful. As I strived to become a better online instructor, I discovered I was learning methods that would also improve my in-class teaching. This talk will specifically discuss several online tools I have successfully implemented in my face to face classes. Some examples include using online discussion boards, Echo Smartpens, and Adobe Connect.

Presenter: Stacy Hoehn, Franklin College

Several approaches for incorporating WeBWorK into mathematics courses

While many people who are familiar with WeBWorK, an open-source online homework system, are aware of its uses for traditional homework assignments, fewer people know about some of the other features available within WeBWorK. During this talk, I will focus on the various ways that I have used WeBWorK in my precalculus and calculus courses, as well as some of the ways that I plan to take advantage of features currently under development in future courses. In particular, I will discuss how I have used WeBWorK for algebra mastery exams, both to help the students review the algebra skills covered on these exams and also to help streamline the administration of the exams. In addition, I will discuss some new features in WeBWorK that bring a new level of gamification and fun to the system.

Presenter: Michael Karls, Ball State University

Joint work with: Brenda M. Skoczelas, Ball State University undergraduate student

Modeling a diving board

The beam equation is a classic partial differential equation that one may encounter in an introductory course on boundary value problems or mathematical physics, which can be used to describe the vertical displacement of a vibrating beam. A diving board can be thought of as a cantilever beam, which is a bar with one end fixed and the other free to move. Using a video camera and physics demonstration software to record displacement data from a vibrating cantilever beam, we verify a modified version of the beam equation that incorporates damping and a forcing term.

Presenter: Tiffany Kolba, Valparaiso University

Joint work with: Hui Gong, Valparaiso University; Hannah Dorman, Nicolle Kinzel, and Kathryn Merkling, Valparaiso University undergraduate students.

Statistical analysis of the effect of AP Calculus on performance in college calculus courses

This talk will discuss a statistical analysis of the effect of taking Advanced Placement (AP) Calculus in high school on final letter grades in Calculus I, II, and III at Valparaiso University. The data used in the study was obtained from the Valpo Registrar and included demographic information, entrance exam scores (ACT, SAT, AP, etc.), GPA for each semester, and final letter grades in all math courses from Spring 2008 – Summer 2012. The results show that students who took AP Calculus in high school on average received higher final letter grades in Calculus I at Valpo, even after controlling for differences in ACT/SAT math scores. In Calculus II and Calculus III at Valpo, students who passed out of the previous calculus course due to AP credit on average performed better or at least approximately the same as students who took the previous calculus course at Valpo, again after controlling for other confounding factors.

Presenter: Kenneth Luther, Valparaiso University

Resequencing calculus at Valparaiso University

During Fall 2013 through Fall 2014, I am offering one track of our Calculus sequence at Valparaiso University using the course material being developed under the Resequencing Calculus project spearheaded by Dwyer and Gruenwald at the University of Evansville. VU is one of 5 institutions helping to develop and/or pilot this new course material. Although it is early in the project, I can discuss some desired outcomes, planned assessment methods, and —most importantly— the effect on the chain of pre-requisites and potential for early access to courses for students in partner STEM disciplines that occurs as a result of the reordered topics in the Calculus sequence.

Presenter: Andy Rich, Manchester University
The mathematics of "Spot It"
"Spot It" is a game with 55 cards, each having 8 symbols. Any two cards have a unique symbol in common. What is the mathematics underlying this game? (Spoiler Alert: Read no further if you want to figure it out yourself.) "Spot It" is two cards shy of being an example of a finite projective geometry. Examples of these can be constructed using finite fields. We will explain how to do so and reveal the manufacturer's reason that "Spot It" is missing two cards.

Presenter: Derek Thompson, Trine University
Writing about continuity
This semester, I began the discussion of limits in Calculus I by asking students what they knew about continuity. From there, we learned the definition of continuity and the three ways to be discontinuous: a hole, an asymptote, and a jump. I asked students to write a 500-word paper on the topic. They were to discuss three graphs of their own creation, which had to have physical meaning. Each graph was to have one of these types of discontinuities, and they had to explain the reason for the discontinuity. In this talk, I will discuss the results of the assignment — both good and bad.

Presenter: Feng Tian, Trine University
Geometry, physics, and self-adjoint extensions
We study several unbounded operators with view to extending von Neumann's theory of deficiency indices for single Hermitian operators with dense domain in Hilbert space. This problem is of a geometric flavor, and we study an index formulation for its solution. Even for single Hermitian operators, there is no classification if the index is greater than one. In that case, we seek solvable models. The emphasis is the link between geometry and spectrum of certain self-adjoint operator extensions.