Archived Seminars
2008/09

September 26, 2008: Todd Wilson (Department of Computer Science, CSUF)

Title: ***Smooth Infinitesimal Analysis***

Abstract: Non-standard analysis (NSA) is an attempt to found, on a rigorous basis, the notion of infinitesimal that was so influential in the development and early history of the calculus before it was supplanted in the 19th century by the limit concept. In generalizing the real line to richer structures, it is inevitable that certain properties are lost. I will be speaking about an alternative to NSA a different approach to infinitesimals that boasts several of the more intuitive properties of infinitesimals that NSA does not have, and reduces much of elementary calculus to ordinary algebra. The price is that the development requires an adjustment in the underlying logic that is used, namely, a move from classical to intuitionistic logic. I will be including several examples from elementary calculus to illustrate the approach.

October 2, 2008: Piero Nicolini (University of Trieste, Italy)

Title: ***Introductory Notes to Non-Commutative Geometry (Part 1)***

Abstract: Not Available

October 9, 2008: Piero Nicolini (University of Trieste, Italy)

Title: ***Introductory Notes to Non-Commutative Geometry (Part 2)***

Abstract: Not Available

October 9, 2008: Iliana Perez (CSUF)

Title: ***Urbanization and International Trade - A Possible Relationship***

Abstract: In this talk we present a model incorporating the effects the level of urbanization in a given country may have on the proportion of people who eliminate the cultural cost of international trade by learning. We postulate that due to economies of scale, the higher the level of urbanization in a country, the larger the proportion of the population with low cultural learning costs. By investigating a certain class of cost distributions, we find that depending on the relative sizes of the physical and cultural costs of trade we may see either the larger or the smaller of two countries exhibiting the larger share of learners. This result departs from that of Kónya (2006) whose model we extend. Our model also provides a possible explanation of over-urbanization as a result of the social planner trying to increase the number of learners in a country.

October 16, 2008: Doreen De Leon (CSUF)

Title: ***A Simple Solution to Euler-Cauchy Problems with Polynomial Right-Hand Sides***

Abstract: The nonhomogeneous Euler-Cauchy equation, one of the first higher order differential equations with variable coefficients introduced in an undergraduate differential equations course, presents some surprising results when the right-hand side function is the product of a constant and a power of t. It turns out that a particular solution to such an equation is either a monomial of the same degree as the right-hand side function or the product of such a monomial and a power of $\ln(t)$. As a result, we can determine a particular solution when the right-hand side function is a polynomial of any degree without using variation of parameters or transforming the equation to a constant-coefficient equation and then applying the method of undetermined coefficients.

October 23, 2008: Adnan Sabuwala (CSUF)

Title: ***The Mystery of the Euler-Cauchy Surprise Unraveled***

Abstract: The Euler-Cauchy differential equation is one of the first and simplest forms of a non-constant coefficient ODE that is encountered in an undergraduate differential equations class. For a non-homogeneous Euler-Cauchy equation, the particular solution takes one of several possible forms which are usually determined by using the method of undetermined coefficients or variation of parameters. Last week, I got a chance to hear about the "Euler-Cauchy surprise" from Dr. Doreen De Leon where she presented a few examples of the surprising discovery that she made for the case of a polynomial function in t as the non-homogeneity for second-order Euler-Cauchy equations. In this talk, I unravel the mystery behind this surprising form of the particular solution for the most general case, an nth order Euler-Cauchy equation with a polynomial right hand side, by presenting a complete proof of the form of the particular solution. In addition, I will also present a formula that can be used to compute the unknown coefficient in the form of the particular solution.

October 30, 2008: Oscar Vega (CSUF)

Title: ***More Questions than Answers***

Abstract: One of the interesting classes of graphs are planar graphs, formed by those that can be drawn on the surface of a plane with no 'self- intersections'.

Finite planes are (finite) abstractions of our regular Euclidean/blackboard plane. Many times these other planes do not behave as well as the classic one.

Thus the question is: What are the graphs that can be embedded in a (finite) projective plane? Well, nobody knows!!

In this talk I will introduce this topic and I will present a couple of new results. Nothing too fancy, I still have more questions than answers.

November 6, 2008: Adnan Saabuwala (CSUF)

Title: ***Finite Difference Methods for Partial Differential Equations: Part 1***

Abstract: Partial differential equations (PDE's) appear in a variety of physical problems. In an introductory numerical partial differential equations class, one studies the various kinds of equations that govern physical phenomena along with the techniques of solving them. Many

a times separation of variables is used to arrive at closed-form solutions to such boundary value problems. However, it is often not possible to solve them analytically and one needs to resort to numerical methods in solving such equations. In this talk, my goal is going to be to introduce you to one of the numerical techniques, namely, finiite difference methods. This talk will be a very basic introduction to the idea behind finite differences along with terminologies associated with them. Prior knowledge of linear algebra will be helpful but for most part of the talk, I will try to keep it at a level accessible to a typical undergraduate mathematics major.

November 13, 2008: Tamas Forgacs (CSUF)

Title: ***Extrema of Functionals, the Euler-Lagrange Equation and an Application in Economics***

Abstract: Perhaps the one of the most central problems in economics is that of utility maximization. Often, life time utility is represented by a functional, thus solving the maximization problem requires finding extrema of functionals. We will give an introduction to the theory of finding extrema of functionals (called variational problems), and de- rive the Euler-Lagrange equation, which is the "first order condition" for such problems. We will then discuss an application of the theory to a current paper I am working on, concerning addictive behavior and its treatment. The talk will be slightly technical, but should be accessible to all upper level undergraduate and graduate students. As always, all are welcome to attend.

November 20, 2008: Comlan de Souza (CSUF)

Title: ***Introduction to Logarithmically Convex Functions and Applications***

Abstract: A positive function f defined on a convex set I is logarithmically convex or simply log convex if the function

$$g := \log f$$

is convex, i.e.,

$$\log f\{\alpha x + (1-\alpha)y\} \leq \alpha \log f(x) + (1-\alpha)\log f(y)$$

for $x, y \in I$, and $0 \leq \alpha \leq 1$.

The collection of log convex functions features pretty interesting functions that are widely used in applied mathematics and in statistics. After mentioning some properties of log convex functions, I will show that if f is a positive function defined on $\mathbb{R}_+$ then

$$\frac{[f(y)]^a}{f(ay)} \leq \frac{[f(x)]^a}{f(ax)} \leq [f(0)]^{a-1}$$

where $0 \leq x \leq y$ and $a \geq 1$.

I will then derive some well known inequalities involving the Euler gamma function and the Riemann zeta function.

December 4, 2008: Paul Savala (CSUF)

Title: ***On Cayley Graphs of the Form*** $C_n[1, a]$

Abstract: We discuss semitransitive graphs of the $C_n[1, a]$ family. Depending on the restrictions on a, these graphs may have Cayley representations. We explore when this occurs, and what we can say about the representation and the underlying groups. This talk is based on research done in Northern Arizona State University under Dr. Steve Wilson during the 2008 Summer REU program.

February 5, 2009: Doreen De Leon (CSUF)

Title: ***An Introduction to Scientific Research: Modeling with Maple***

Abstract: This talk discusses my experience with a Research Experience for Undergraduates (REU) one-semester course. The main purpose of this course was to introduce students to scientific research using mathematical modeling, while teaching them some of the latest computer software tools. The idea was to lead the students through the steps of selecting a topic of interest, collecting the background information and data, and using tools such as Maple, LaTeX, and PowerPoint to analyze the data and present results. In order to illustrate the development of a mathematical model from first principles, material was presented showing the development of population models. Addition- ally, topics related to working with data sets and curve fitting was explored.

February 12, 2009: Carmen Caprau (CSUF)

Title: ***The Universal sl(2) Link Homology (Part 1)***

Abstract: I will introduce and describe the features of the 'universal' sl(2) link homology that categorifies the Jones polynomial of the link. This theory depends on two parameters, and is constructed via webs and foams (piecewise oriented cobordisms) modulo local relations. If we let both parameters to be zero, we obtain an isomorphic version of the Khovanov homology.

February 19, 2009: Carmen Caprau (CSUF)

Title: ***The Universal sl(2) Link Homology (Part 2)***

Abstract: See abstract for Part 1 - February 12, 2009.

February 26, 2009: Comlan de Souza (CSUF)

Title: ***Introduction to Diffraction Pattern Invariant One Dimensional Crystals***

Abstract: Let $\mathcal{F}$ be the Fourier transformation defined on the function space of tempered distributions over $\mathbb{C}$. Since $\mathcal{F}$ is linear then the equation

$$\mathcal{F}f = \lambda f, \quad \lambda \in \mathbb{C} \tag{1}$$

(where f is a nontrivial tempered distribution), is equivalent to

$$\mathcal{F}^n f = \lambda^n f, \quad n \in \mathbb{N}.$$

It is well known that the order of Fourier transformation is 4, thus the characteristic equation is

$$\lambda^4 - 1 = 0$$

i.e., the eigenvalues of the Fourier transformation are

$$\lambda = 1, -1, i, -i.$$

The collection of distributions that satisfy (1) is nonempty since when

$$\begin{aligned} f(x) &= e^{-\pi x^2}, \\ (\mathcal{F}f)(s) &:= \int_{-\infty}^{\infty} f(x) e^{-2\pi i s x}\, dx \\ &= e^{-\pi s^2} \\ (\mathcal{F}f)(s) &= f(s). \end{aligned}$$

The aim of this talk is to characterize the subcollection of p-periodic distributions that satisfy (1).

March 5, 2009: Merab Gogberashvili (Andronikashvili Institute of Physics & Javakhishvili State University, Tbilisi, Georgia)

Title: *Octonionic Geometry*

Abstract: The seminar will be devoted to the applications of hyper-complex numbers in physics. The model where physical signals are described by split octonions will be presented. Eight real parameters of octonions are interpreted as space-time coordinates, energy and momentum. In this approach both the velocity of light and Plancks constants have a similar geometrical meaning and arise from the condition of positive definiteness of norms. Generalized Lorentz factor contains 'quantum' term that disappears in classical limit. It will be shown how the Maxwell and Dirac equations can be written as the simple octonionic continuity conditions.

March 12, 2009: Andrea Arias De Gill (Physics Department, CSUF)

Title: *A Simple WKB Approach to Unruh Radiation*

Abstract: Recently, it has been shown that the radiation arising from quantum fields placed in a gravitational background with a horizon (e.g. Hawking radiation) can be derived using a quasi-classical calculation. This method consists of calculating the tunneling rate of the quantum field across the horizon, and it is based on the standard WKB approximation method from quantum mechanics. However, this approach has some distinct features due to the different character of time in general relativity versus quantum mechanics. Thus, the quasi- classical method for gravitational backgrounds contains subtleties not found in the

usual quantum mechanical tunneling problem. We will present a detailed discussion of this method, focusing on the Riddler spacetime (the spacetime seen by an accelerating observer, moving with a constant acceleration through vacuum) and the associated Unruh radiation since this is the prototype of the phenomena of radiation from a spacetime with a horizon.

March 19, 2009: Oscar Vega (CSUF)

Title: ***Classifying Translation Planes by Studying Their Groups of Symmetries***

Abstract: The study of affine (or projective) planes is very combinatorial in its beginnings. However, the more one digs into the structure of these planes the more evident it is that algebraic tools need to be used. In particular, the study of certain symmetry groups of a plane that fix a line pointwise seems to be weapon of choice.

Translation planes are a class of planes with a natural vector space structure, which makes them ideal to be studied by looking at their symmetry groups, which are always groups of semi-linear maps.

In this talk we will go over the basic tools that allow this 'a la Klein' study of translation planes. We will also see an example of this study: we will look at the solution of an old problem, called "Il Problema Abeliano Rosso" (joint work with E. Diaz, U. of Connecticut).

Just some linear algebra and group theory is enough to follow this talk. Hence, this is a student-friendly talk.

April 2, 2009: Tamas Forgacs (CSUF)

Title: ***An Inclusion Theorem for Multiplier Sequences***

Abstract: It has been shown that if a sequence of real numbers is a Hermite-multiplier sequence, or a generalized Laguerre multiplier sequence, then it is also a standard multiplier sequence. In this talk we show that the generalized Laguerre multiplier sequences are a proper subset of the Hermite multiplier sequences. The proof is docile, but somewhat technical, although it uses mostly ideas from undergraduate real analysis. We will not assume complete familiarity with multiplier sequences, but the introduction will be brief and fast. We will try to lighten the mood with some examples. All students are welcome to attend!

April 16, 2009: Travis Kelm (CSUF)

Title: ***The Whitehead Question and Asphericity Tests***

Abstract: The Whitehead Asphericity question asks whether every connected subcomplex of an aspherical two-complex must also be aspherical. To date there are no known examples with a negative answer to the question. This talk will discuss what all these words mean and investigate how one can determine when a two-complex is aspherical.

To get the most out of this talk, you should probably be familiar with the term homotopy group. For a quick refresher you could go to *http://en.wikipedia.org/wiki/Homotopy_group*

April 23, 2009: Lance Burger (CSUF)

Title: ***There Might Be Giants? - Teaching Inquiry Based Mathematics***

Abstract: Could giants like in 'Jack and the Beanstalk' or the 1950's sci-fi film 'Attack of the 50 foot woman' really exist? Are there limits to the sizes of organisms? Constructivism is the idea that as learners, we must construct our own knowledge and own it, so to speak. These questions about giants will be explored mathematically from a context of how to design inquiry-based mathematics lessons from a constructivist perspective. This presentation describes an 8th grade lesson where, using the Necessity Principle, lesson concepts and discussions are coordinated to create opportunities for students to develop personally meaningful mathematical understandings in proportional reasoning.

May 7, 2009: Adnan Sabuwala (CSUF)

Title: ***Max-Plus Algebra: An Introduction***

Abstract: Max-plus algebra is a research area that is very effective in modeling sequences of events, where events are viewed as sudden changes in a process to be studied. Some examples of events are a message arrives, a train leaves the station, a door opens, and a set of jobs arrive on a set of machines in a typical manufacturing system setting. Usually one is interested in modeling, analysis and timing of such events, subject to synchronization constraints such as a message must have been sent before it can arrive or a certain train should not depart before another train has arrived (to allow changeover of passengers, for instance) or a machine cannot be made available to a new job until the previous job has been completed.

In this talk, I will present a very basic introduction to the field of max-plus algebra with a lot of definitions and several properties that the *max* and *plus* operators satisfy in this algebra. We will also introduce vectors and matrices in this algebra and then study a very simple first model of heaps that can be studied using max-plus algebra.

This talk will be at a level accessible to the typical undergraduate student.