Índice

1. Itinerario global (global itinerary)

TMC es el teatro del edificio Morales Carrión.
VMC es el vestíbulo del edificio Morales Carrión.
MC denota salones en el edificio Morales Carrión.

Viernes 1 de marzo de 2013						
Hora	**TMC**	**VMC**	**MC 110**	**MC 110-A**	**MC 111**	**MC 111-A**
5:00-6:00		Registro				
5:00-7:00		Mesas				
			Sesiones concurrentes			
6:00-6:25			R. Kvasov	W. Velázquez	H. Rosario	R. Trespalacios
6:30-6:55			P. Negrón	A. Cruz & R. Martínez	G. Zamba	A. Vélez
7:15-8:15	B. Vogeli					
8:15-9:30	Actividad de confraternización - Lobby Muñiz Souffron					

Sábado 2 de marzo de 2013						
Hora	**TMC**	**VMC**	**MC 110**	**MC 110-A**	**MC 111**	**MC 111-A**
7:00-8:00		Registro/Desayuno				
8:00-9:00	Bienvenida					
9:00-10:00	M. Renardy					
10:00-12:00		Mesas	Sesiones concurrentes			
10:00-10:25			G. Fontánez	E. Orozco	D. Torres	L. Medina
10:30-10:55			I. Koutis	E. Morales	M. Pérez	F. Castro
11:00-11:25			J. Parapar	D. Bollman	L. Pericchi	I. Rubio
11:30-11:55			J. Martire	A. Lecompte	V. Palomino	R. Ortiz
12:00-1:30	Almuerzo MC105- MC106A					
1:30-2:55		Mesas	Sesiones concurrentes			
1:30-1:55			H. Ortiz	K. Wang	M. Delgado	J. Rivera
2:00-2:25			P. Negrón	H. Anwa	P. Ordóñez	K. Rios-Soto
2:30-2:55			P. Albin	S. Nguyen	R. Aparicio	K. Kirkpatrick
3:00-4:00		Afiches				
4:00-5:00	Ceremonia de premiaciones					
4:40-5:00			Sesión Admin.			

2. Itinerario detallado (detailed schedule)

Viernes 1 de marzo de 2013		
Hora	**Lugar**	**Actividad**
5:00-6:00pm	VMC	Registro
5:00-7:00pm	VMC	Mesas de auspiciadores
6:00-6:25pm		Conferencias
	MC110	*Finite element modeling of micropolar elastic plates* Roman Kvasov y Lev Steinberg
	MC110-A	*Solución de problemas matemáticos aplicados a la administración de empresas integrando el uso de la calculadora gráfica* Wanda Velázquez
	MC111	*From math circles to math classrooms* Hector Rosario
	MC111-A	*Modelo con retraso y correlación cruzada para predecir la intensidad de la lluvia a corto plazo* Roberto C. Trespalacios y Nazario Ramírez Beltrán
6:30-6:55pm		Conferencias
	MC110	*What is the value of* $\lim_{x\to 0^\circ} \frac{\sin x}{x}$ *?* Pablo V. Negrón
	MC110-A	*La construcción de las funciones trigonométricas y sus inversas* Angel L. Cruz Delgado y Rafael Martínez Planell
	MC111	*Why consider biostatistics for graduate studies? Graduate school requirements in biostatistics* Gideon Zamba
	MC111-A	*On the well-posedness of first order variable exponent Cauchy problems with Robin boundary conditions on arbitrary domains* Alejandro Vélez-Santiago
7:15-8:15pm	TMC	*The rise, the fall and the resurrection of special education* for the mathematically talented Bruce R. Vogeli
8:15-9:30pm	Actividad de confraternización - Lobby Muñiz Souffron	

Sábado 2 de marzo de 2013		
7:00-8:00am	VMC	Registro & Desayuno
8:00-9:00am	TMC	Bienvenida
9:00-10:00am	TMC	*Issues in stability of viscoelastic flows* Michael Renardy
10:00-12:00m	VMC	Mesas de auspiciadores
10:00-10:25am		Conferencias
	MC110	*Global sensitivity analysis of optimization problems for ion transport Models* Guillermo Fontanez y Mariano Marcano
	MC110-A	*On inverses and square roots in optimal extension fields* Dorothy Bollman y Edusmildo Orozco

Hora	**Lugar**	**Actividad**
	MC111	*Forecasting cancer incidence in Puerto Rico using bayesian dynamical models for panel data* David A. Torres Núñez y Luis Pericchi
	MC111-A	*Asymptotic behavior of the exponential sum of perturbations of symmetric polynomials* Luis Medina y Francis Castro
10:30-10:55am		Conferencias
	MC110	*A fast solver for a class of linear systems* Ioannis Koutis
	MC110-A	*An FPGA implementation of finite field multiplication* Einstein Morales y Dorothy Bollman
	MC111	*Changing statistical significance as the amount of information changes: the adaptive significance level* María Eglée Pérez Hernández y Luis Pericchi
	MC111-A	*On the calculation of* $m_o(n) = \min \max_{1 \leq i \leq n} x_i$ *for the equation* $\sum_{i=1}^{n} \frac{1}{x_i} = 1$ *in distinct odd or even numbers* Francis Castro, Rafael Arce Nazario y Raul Figueroa
11:00-11:25am		Conferencias
	MC110	*Mathematical model and parallel merge sort algorithms* Javier E. Parapar Ray
	MC110-A	*On a family of primitive graphs* Bollman, Dorothy y Omar Colón-Reyes
	MC111	*Changing testing statistical hypothesis: from fixed statistical significance to practical significance* Luis Pericchi
	MC111-A	*Exact p-divisibility of exponential sums using the covering method* Ivelisse Rubio Canabal y Francis Castro
11:30-11:55am		Conferencias
	MC110	*Pipelined algorithm to calculate Gibb's free energy for mutational robustness* Joseph Martire Rodríguez y Rafael Arce
	MC110-A	*Las clases de residuos en los enteros gaussianos* Alvaro Lecompte Montes
	MC111	*Análisis Bayesiano de un modelo lineal mixto para medir el impacto del cambio climático en el rendimiento del frijol para el año 2030 a nivel mundial* Velcy Palomino Lescano, Dámaris Santana Morant y Timothy Porch
	MC111-A	*Factores en la teoría de factorizaciones generalizadas* Reyes Ortiz-Albino
12:00-1:30pm	Almuerzo MC105- MC106A	
2:30-3:55pm	VMC	Mesas de Auspiciadores
1:30-1:55		Conferencias

Hora	**Lugar**	**Actividad**
	MC110	*Comparing empirical Bayes and majority logic decoding methods for detecting differential expression in public RNASeq data from Drosophila melanogaster* Roberto Arce Corretjer y Humberto Ortiz-Zuazaga
	MC110-A	*About the bound of the C^* exponential length* Kun Wang
	MC111	*APN functions against differential attacks* Moises Delgado Olortegui
	MC111-A	*A model for antibiotic-resistant infections with application of optimal control theory* Joaquin Rivera y Wang Shujing
2:00-2:25pm	MC110	*Computer simulations of wavefronts in drosophila embryos* Pablo V. Negrón
	MC110-A	*Eigenvalues and expansion of bipartite graphs and their applications* Heeralal Janwa y Tom Høholdt
	MC111	*Multivariate methods for classifying time series data* Patricia Ordóñez, Tom Armstrong y Tim Oates
	MC111-A	*Competition model between the invasive Sahara Mustard and native plants in the Sonoran Desert* Kyle Dahlin, Erika Koenig, Amanda Laubmeier, Austin Wehn y Karen Ríos
2:30-2:55pm	MC110	*Compactness of relatively isospectral sets of surfaces* Pierre Albin, Clara Aldana y Fréderic Rochon
	MC110-A	*Convergence rates for numerical solutions of Markovian switching stochastic differential equations* Son Nguyen y George Yin
	MC111	*Using ontologies to improve document classification with transductive support vector machines* Roxana Karen Aparicio Carrasco y Edgar Acuña Fernandez
	MC111-A	*Bose-Einstein condensation, the nonlinear Schrodinger equation, and a central limit theorem* Kay Kirkpatrick
3:00-4:00pm	VMC	*Afiches*
4:00-5:00pm	TMC	*Ceremonia de premiaciones*

3. Resúmenes de conferencias plenarias (invited talks)

The rise, the fall and the resurrection of special education for the mathematically talented

Bruce R. Vogeli, Teachers College, Columbia University

Although special educational programs that include mathematics have occurred infrequently since classical times, serious concern for the mathematically talented has been confined to the past 100 years. Programs for the talented appeared first in Hungary, then in the Soviet Union, and finally in the United States and elsewhere. During the past two decades, concern for average performance evident in No Child Left Behind legislation in the US–as well as TIMMS, PISA and Post-16 studies abroad–have directed attention away from gifted education. I will address the revival of interest in mathematics education for the talented, both its causes and potential future trends.
Keywords: talented students, mathematics education

Issues in stability of viscoelastic flows

Michael Renardy, Department of Mathematics, Virginia Tech

It is not known whether stability of viscoelastic flows can be inferred from the spectrum of the linearization. This talk will review recent results on rigorous stability criteria which are based on combining spectral information with short wave asymptotics. The methods used in the proof build on techniques developed for the Euler equations.
Keywords: viscoelastic flows, stability

4. Resúmenes de conferencias concurrentes (concurrent talks)

On the well-posedness of first order variable exponent Cauchy problems with Robin boundary conditions on arbitrary domains

Alejandro Vélez-Santiago, Department of Mathematics, University of Puerto Rico, Humacao campus

We define the notion of relative capacity of variable exponent type, referred here as the relative $p(\cdot)$-capacity, and use this approach to obtain a necessary and sufficient condition for the well-posedness of the corresponding parabolic boundary value problems involving the $p(\cdot)$-Laplace operator and Robin boundary conditions on arbitrary domains.
Keywords: Relative $p(\cdot)$-capacity, $W^{1,p(\cdot)}$-Extension domains, d-Ahlfors measures, $\mathrm{Cap}_{p(\cdot),\Omega}$-admissible measures, First order variable exponent Cauchy problem, Robin boundary conditions

Las clases de residuos en los enteros gaussianos

Alvaro Lecompte Montes, Matemáticas y Ciencias Aplicadas, Universidad Interamericana, Recinto de San Germán

Los enteros gaussianos o enteros complejos comparten algunas de las características de los enteros: tienen algoritmo de división, algoritmo de Euclides, primos y factorización única en primos. Los primos en particular resultan útiles para caracterizar las triplas pitagóricas, las cuales fueron nuestra primera razón para examinar estos números. Un estudio más detallado llevó a la pregunta de cuan diferentes son las clases de residuos gaussianos de las clases de residuos en los enteros. Además, también nos preguntamos si podemos extender los análogos de la función Phi de Euler y del Pequeño Teorema de Fermat a estos números. La respuesta positiva a estas preguntas así como métodos efectivos de cálculo que son adaptaciones de los conocidos para los números enteros nos lleva proponer su utilización para claves criptográficas similares a RSA y a comparar estos métodos de encriptación con los basados en los enteros.
Keywords: Números, Álgebra, Criptografía

La construcción de las funciones trigonométricas y sus inversas

Angel L. Cruz Delgado, Departamento de Ciencias Matemáticas, Universidad de Puerto Rico-Mayagüez
Rafael Martínez Planell, Departamento de Ciencias Matemáticas, Universidad de Puerto Rico-Mayagüez

Usamos la teoría APOS para estudiar la construcción de los conceptos de las funciones seno, coseno y sus inversas desde la perspectiva del círculo unitario. Proponemos una serie de construcciones que un estudiante debe poder hacer para alcanzar un dominio a nivel de proceso u objeto de estas funciones. Esta conjetura se pone a prueba usando entrevistas semidirigidas con un grupo de 11 estudiantes subgraduados. Análisis de las entrevistas sugiere que un pequeño grupo de estas construcciones básicas ayuda a explicar las dificultades observadas por los estudiantes y requiere énfasis especial durante la enseñanza.

Forecasting cancer incidence in Puerto Rico using bayesian dynamical models for panel data

David A. Torres Núñez, Instituto de Estadisticas y Sistemas Computadorizados de la Información, Universidad de Puerto Rico Rio Piedras
Luis Pericchi, Departamento de Matemáticas, Universidad de Puerto Rico Rio Piedras

Projections of cancer incidence and mortality provide a valuable indication of the current and future situation of cancer in Puerto Rico. These are invaluable inputs for planning and decision making, and assist in the efficient allocation of resources to meet the future needs for the prevention, detection, and treatment of cancer. We estimate the present incidence and predict the future (2014) of incidence for the top cancer tumor types in Puerto Rico (PR), by gender, age group and primary cancer site, to design public policy. Incidence data from Puerto Rico Central Cancer Registry were obtained for the years 1985 to 2009. The dynamic autoregressive models used in modern epidemiology are function of age-period-cohort (APC). Robust priors were fitted using Bayesian methods. We use model selection using the Deviance Information Criteria (DIC) to compare APC models with Age-period (AP), Age-cohort

(AC) and Period-cohort (PC) models. The model produces point estimations as well as probability intervals for 2001 and 2014 by gender and five (5) years age bands. We analyzed the fifteen (15) most important tumors types, including colon, lung and bronchus, breast in situ and malignant, and prostate among others. We introduce a novel robust and stable prior, the autoregressive variance, the scaled beta prior of the second kind (Beta2 prior). We found that this leads to a stable convergence of the model at the Markov Chain Monte Carlo (MCMC) implementation.
Keywords: Bayesian Models, Panel Data, Cancer Incidence, Epidemiology

On a family of primitive graphs

Dorothy Bollman, Department of Mathematical Sciences, UPR-Mayagüez
Omar Colón-Reyes, Department of Mathematical Sciences, UPR-Mayagüez

A primitive graph is a directed graph G for which there exists a positive integer k such that for any two vertices u and v there exists a walk of length k from u to v. The smallest such k is called the exponent of G. Currently there is no known formula for the exponent of a general primitive graph. In this work we consider primitive graphs consisting of sequences of cycles where any two adjacent cycles have exactly one vertex in common. We give an upper bound for any such graph. We conjecture that this bound is also a lower bound and we discuss various approaches toward proving this conjecture.
Keywords: Discrete Dynamical Systems, Primitive Graphs, Transients

On inverses and square roots in optimal extension fields

Dorothy Bollman, Department of Mathematical Sciences, University of Puerto Rico at Mayagüez
Edusmildo Orozco, Department of Computer Sciences, University of Puerto Rico at Río Piedras

The choice of an optimal extension field (OEF) is especially attractive for use in elliptic curve cryptography due to the simplicity of the arithmetic operations, especially multiplication, which can be expressed in terms of the so called Mastrovito matrix. The aim of this work is to exploit the potential of the hankel structure of the Mastrovito matrix to develop more efficient algorithms, compared to methods that do not exploit such structure, for finding inverses and square roots in OEFs.
Keywords: Optimal extension fields, Mastrovito matrix, finite field inverse, finite field square root

An FPGA implementation of finite field multiplication

Einstein Morales, Department of Mathematical Sciences, University of Puerto Rico at Mayagüez
Dorothy Bollman, Department of Mathematical Sciences, University of Puerto Rico at Mayagüez

We develop a fast algorithm for multiplication in the optimal extension field $GF(239^{17})$ that optimizes parallelization, as well as modular arithmetic in the ground field $GF(239)$. We describe an implementation of this algorithm on field programmable gate arrays (FPGAs). Experimental results show that our algorithm outperforms implementations of two other well known algorithms, MSE and LSE, in both time and area.
Keywords: Optimal Extension Field, Finite Field Multiplication, FPGA

On the calculation of $m_o(n) = \min \max_{1\leq i\leq n} x_i$ for the equation $\sum_{i=1}^{n} \frac{1}{x_i} = 1$ in distinct odd or even numbers

Francis Castro, Departamento de Matemáticas, Universidad de Puerto Rico, Río Piedras
Rafael Arce Nazario, Departamento de Ciencias de Cómputos, Universidad de Puerto Rico, Río Piedras
Raul Figueroa, Departamento de Matemáticas, Universidad de Puerto Rico, Río Piedras

In this note we combine theoretical results and computer search to obtain

- $m_o(n) = \min \max_{1\leq i\leq n} x_i$, where the minimum is taken over all sets $\{x_i\}$ satisfying the equation $\sum_{i=1}^{n} \frac{1}{x_i} = 1$ in distinct odd numbers when $13 \leq n \leq 41$.
- $m_e(n) = \min \max_{1\leq i\leq n} x_i$, where the minimum is taken over all sets $\{x_i\}$ satisfying the equation $\sum_{i=1}^{n} \frac{1}{x_i} = 1$ in distinct even numbers when $3 \leq n \leq 29$.

Also, we compute $\liminf \frac{x_n}{x_{n-k}}$ for fixed k.
Keywords: Egyptian Fractions, Units Fractions

Why consider biostatistics for graduate studies? Graduate school requirements in biostatistics

Gideon Zamba, Department of Biostatistics, The University of Iowa

This talk provides an exposure to the fields of Statistics and Biostatistics, and the window of opportunities they present to young mathematicians. The presentation further elaborates on Biostatistics and advises about the mathematical and computational pre-requisites for Masters' and PhD degrees in Biostatistics. This talk is not technical but provides examples where theoretical thinking is required.
Keywords: Biostatistics, Graduate Studies

Global sensitivity analysis of optimization problems for ion transport models

Guillermo Fontanez, Departamento de Matematicas, UPR Rio Piedras
Mariano Marcano, Departamento de Ciencias de Computos, UPR Rio Piedras

We evaluate the performance of global sensitivity analysis methods in the context of two optimization problems. First, we intend to maximize an efficiency function for sodium transport across a whole cell under reasonable physiological constraints. We make use of the Monte Carlo Filtering and Regionalized Sensitivity Analysis technique to identify desirable realizations of the model and select parameters that are most influential in order to reduce the parameter space by fixing the values of the least influential parameters. The second model is that of a potassium chloride cotransporter. We intend to estimate transport rate parameters to fit the model to experimental data. The Morris method is used

to organize parameters by importance, where the sensitivity measures are computed as the expected values of the changes in the model output by small variations in each parameter. Also, a statistically robust alternative form of computing the sensitivity measures is provided. By fixing the least influential parameters we reduce the dimension of the parameter space and the size of the optimization problem.
Keywords: Optimization, Global Sensitivity Analysis, Ion Transport Models

From math circles to math classrooms

Hector Rosario, Department of Mathematical Sciences, Universidad de Puerto Rico, Mayagüez Campus

This article addresses the importance for teachers to incorporate logic and mathematical puzzles into their lessons: a key element in math circles. The excitement and motivation these problems create help to develop deductive reasoning skills and sense making. Besides, they can serve as catalysts to understanding the concept of proof.
Keywords: math circles, education, concept of proof, puzzles

Eigenvalues and expansion of bipartite graphs and their applications

Heeralal Janwa, Department of Mathematics, University of Puerto Rico-Rio Piedras
Tom Høholdt, Department of Mathematics, Technical University of Denmark

We will present a survey of our joint work with Tom Hoeholdt. We will present a lower bounds on the largest and second largest eigenvalue of the adjacency matrix of bipartite graphs and give necessary and sufficient conditions for equality. We also will give several examples of classes that are optimal with respect to the bounds. In particular we determine the expansion parameters of the BIBD graphs and show that they yield optimal expander graphs and also bipartite Ramanujan graphs. Another result is that BIBD-graphs are characterized by their eigenvalues. Finally we present an improved version of the expander mixing lemma, and derive an improved bound on the expansion coefficient of (c,d)-regular bipartite graphs and compare that with our earlier bound, and a classical bound. We show that the bipartite graphs derived from several classical combinatorial configurations yield optimal or excellent expander graphs. We will demonstrate that this result, in turn, combined with our expansion bound, leads to a theoretical explanation of the good performance of some classes of LDPC codes that have been constructed so far, and of some additional ones that we now propose.

Comparing empirical Bayes and majority logic decoding methods for detecting differential expression in public RNASeq data from Drosophila melanogaster

Roberto Arce Corretjer, Department of Computer Science, University of Puerto Rico, Rio Piedras Campus
Humberto Ortiz-Zuazaga, Department of Computer Science, University of Puerto Rico, Rio Piedras Campus

The genome of an individual organism is constant, but different genes express at different times. Finding differences in gene expression is the first step to understand the biological process of growth or the progression of diseases. Biological systems are notoriously noisy and gene expression data can have millions of different measurements. In this case, we want to find the differences between the differentially

expressed genes of fruit flies at certain periods of their lives using the information of the abundance of RNA sequences (RNASeq data) obtained from the ReCount database. Because RNASeq data continues to grow at exponential rates, we need to devise more efficient methods to analyze it. To approach this problem, we used two methods in the statistical programming language R. The traditional method consists of using an Empirical Bayesian method, with which we found 12,148 differentially expressed genes in four developmental stages of *Drosophila melanogaster*. As a more efficient method, we propose a discrete method called Majority Logic Decoding, adapted from the analysis of micro arrays, in which we were able to find 12,914 differentially expressed genes. We will present a summary of the differences in the genes selected by each method.
Keywords: bioinformatics, RNASeq, development, discrete methods

A fast solver for a class of linear systems

Ioannis Koutis, Department of Computer Science, University of Puerto Rico - Rio Piedras

The solution of linear systems is a problem of fundamental theoretical importance but also one with a myriad of applications in numerical mathematics, engineering and science. Linear systems that are generated by real-world applications frequently fall into special classes. Recent research led to a fast algorithm for solving symmetric diagonally dominant(SDD) linear systems. We give an overview of this solver and survey the underlying notions and tools from algebra, probability and graph algorithms. We also discuss some of the many and diverse applications of SDD solvers.
Acknowledgements: joint work with Gary Miller and Richard Peng
Keywords: graph algorithms, linear systems

Exact p-divisibility of exponential sums using the covering method

Ivelisse Rubio Canabal, Departamento de Ciencias de Cómputos, Universidad de Puerto Rico, Río Piedras
Francis Castro, Departamento de Matemáticas, Universidad de Puerto Rico, Río Piedras

The p-divisibility of exponential sums of polynomials over finite fields has been used in applications to coding theory and cryptography and their methods also can be applied to compute bounds for value sets of polynomials. If one can compute the exact p-divisibility of an exponential sum associated to a system of polynomial equations over a finite field, one guarantees that the system is solvable.

In general, the methods to compute p-divisibility of exponential sums are non-elementary. In this talk we present an elementary combinatorial method (the covering method) that can be used to compute exact p-divisibility of exponential sums over a prime field. This method unifies and sometimes improves previously known results of Ax-Katz, Moreno-Moreno, Adolphson-Sperber, and Cao-Sun.
Keywords: p-divisibility, exponential sums, finite fields, covering method

Mathematical model and parallel merge sort algorithms

Javier E. Parapar Ray, Ciencias y tecnología, Universidad Metropolitana

Parallel computing is an area currently revisited due to the easy access to fast and inexpensive computing systems and the emerging new commercial computing platforms such as Amazon EC2. This

platform gives the increased opportunity to use parallel algorithms. Sorting parallel algorithms as Quick Sort, Merge Sort, and Inception sort are frequently used in many parallel applications. Parallel Merger Sort has been studied in parallel computation but it has been used in a common way distribution using a half partition strategy (n/2). This research developed a new technique to distribute the job in a considerable reduced number of processors. A mathematical model for the run-time was developed including computation cost. This model was used to create a method to get the right balance between run-time vs numbers of processors. This model allows to determine the number of processors needed to perform the job efficiently and at a low cost.
Acknowledgements: Dr. Luis de la Torre
Keywords: Parallel Merge Sort, Algorithm, Computer Science

A Model for antibiotic-resistant infections with application of optimal control theory

Joaquin Rivera, Departamento de Matemáticas, Universidad de Puerto Rico en Humacao
Wang Shujing, Department of Mathematics, Colgate University

Healthcare associated infections caused by medical-facility-borne antibiotic-resistant bacteria have become a costly problem that compromises medical care in hospitals worldwide. We analyzed a compartmental model that focuses on the evolution of two bacterial strains (drug-resistant and non-drug resistant) residing within the patient population and healthcare workers in a hospital. Reformulating the model as an optimal control problem, the model predicts that the non-resistant bacteria will decrease and eventually reach a very low level after the control is applied. Moreover, in contrast to the differential equation model, the drug-resistant bacteria will persist, possibly because of mutation, but it will take about five times longer to reach the maximum levels.
Keywords: Mathematical Biology, Optimal Control

Pipelined algorithm to calculate Gibb's free energy for mutational robustness

Joseph Martire Rodríguez, Departamento de Ciencias de Cómputos, Universidad de Puerto Rico, Recinto de Rio Piedras
Rafael Arce, Departamento de Ciencias de Cómputos, Universidad de Puerto Rico, Recinto de Rio Piedras

Robustness is a fundamental property of biological systems which expresses a system's ability to maintain function in the face of mutational or environmental challenges. From the genomic evolution standpoint, the robustness of a DNA strand is measured by computing the Gibb's Free Energy of folding on evolving populations of strand permutations. On a typical mutational robustness algorithm, a large number of arithmetic operations $O(n^2)$ must be performed for each population and many populations must be generated, thus requiring considerable execution times on sequential algorithm implementations. The increasing quantity and availability of genomic data makes faster implementations of these algorithms a necessity. Computations on population members are data independent, which make these algorithms good candidates for improvement by using the parallelism available in field programmable gate arrays (FPGAs). In this presentation, we will discuss the pipelined implementation of Gibb's Free Energy within a mutation. The algorithm was built in Verilog HDL and validated by behavioral simulation. Although the algorithmic complexity is still $O(n^2)$, its run-time is accelerated due to the pipelined method. After the synthesis report, the algorithm's maximum frequency was 164 MHz and

used less than 1.6 % of the FPGA Xilinx Virtex 5 LX330 resources. Thus the estimated speedup versus the software solution is 200x.
Acknowledgements: Rafael Arce, Agnes Ramos, Steven Massey, Edusmildo Orozco, Jose Alejandro
Keywords: Verilog HDL, FPGA, Pipeline, Hardware, Mutational Robustness

Competition model between the invasive Sahara Mustard and native plants in the Sonoran Desert

Kyle Dahlin, Department of Mathematics,University of Hawaii
Erika Koenig, Department of Mathematics and Statistics, University of Maryland Baltimore County
Amanda Laubmeier, Department of Mathematics, University of Arizona
Austin Wehn, Department of Mathematics, Arizona State University
Karen Ríos-Soto, Department of Mathematical Sciences, University of Puerto Rico Mayaguez

Sahara Mustard (Brassica tournefortii) is an invasive weed that has become widespread throughout the southwestern United States. Its early germination, high fecundity, and dispersal effectiveness augment its ability to outcompete and possibly displace local flora. In this work, we model the dynamics of Sahara Mustard as it competes with winter annuals native to the Sonoran Desert, such as the widespread forb Lepidium lasiocarpum. A discrete-time competition model of plant-plant interactions is constructed to study factors that may affect competition between invasive and native species in favor of the native species. Through a system of non-linear difference equations we quantify each species'seed banks and flowering adult populations over several generations. We take into consideration the dependence of fecundity, survivability, and germination on total annual rainfall. We also examine the effect of seasonal variability on existence of native species in competition with Sahara Mustard. We found that rainfall variability was advantageous to the native population, though the native forbs that compete with Sahara Mustard will likely be reduced in population or driven to extinction in absence of any control strategy.
Keywords: Sahara Mustard, mathematical ecology, difference equations, competition model

Bose-Einstein condensation, the nonlinear Schrodinger equation, and a central limit theorem

Kay Kirkpatrick, Department of Mathematics, University of Illinois at Urbana-Champaign

Near absolute zero, a gas of quantum particles can condense into an unusual state of matter, called Bose-Einstein condensation (BEC), that behaves like a giant quantum particle. The rigorous connection has recently been made between the physics of the microscopic many-body dynamics and the mathematics of the macroscopic model, the cubic nonlinear Schrodinger equation (NLS). I'll discuss recent progress with Gerard Ben Arous and Benjamin Schlein on a central limit theorem for the quantum many-body dynamics, a step towards large deviations for Bose-Einstein condensation.
Acknowledgements: NSF grants DMS-1106770 and OISE-0730136
Keywords: Statistical mechanics, nonlinear PDE

About the bound of the C* exponential length

Kun Wang, Department of Mathematics, University of Puerto Rico, Rio Piedras

In this talk, we give an example to show that, there is $u \in \mathrm{C}(X) \otimes \mathrm{M}_n$ with $\det(u) = 1$ and $u \sim_h 1$ such that the C* exponential length of u (denoted by $cel(u)$) can not be controlled by π. This example answers a question of N.C. Phillips. Moreover, in simple inductive limit C*-algebras, similar examples exist.
Keywords: C* exponential length

Asymptotic behavior of the exponential sum of perturbations of symmetric polynomials

Luis Medina, Departamento de Matemáticas, Universidad de Puerto Rico, Río Piedras
Francis Castro, Departamento de Matemáticas, Universidad de Puerto Rico, Río Piedras

In this talk we consider perturbations of symmetric boolean functions

$$\sigma_{n,k_1} + \cdots + \sigma_{n,k_s}$$

in n-variable and degree k_s. We compute the asymptotic behavior of boolean functions of the type

$$\sigma_{n,k_1} + \cdots + \sigma_{n,k_s} + F(X_1, \ldots, X_j)$$

for j fixed. In particular, we characterize all the boolean functions of the type

$$\sigma_{n,k_1} + \cdots + \sigma_{n,k_s} + F(X_1, \ldots, X_j)$$

that are asymptotic balanced. We also present an algorithm that computes the asymptotic behavior of a family of Boolean functions from one member of the family. Finally, as a byproduct of our results, we provide a relation between the parity of families of sums of binomial coefficients.
Keywords: Boolean symmetric functions, asymptotic behavior

Changing testing statistical hypothesis: from fixed statistical significance to practical significance

Luis Pericchi, Departamento de Matemáticas, Universidad de Puerto Rico Rio Piedras

This presentation is an account of work motivated by the growing dissatisfaction of the scientific community with traditional significance testing, and inspired by Morris DeGroot and Jack Good independent powerful insights: how can we amalgamate frequentist assessments (sensible from an objective viewpoint) with Bayes/Decision sound theory? How can we move from Statistical Significance to Practical Significance?
DeGroot, for simple versus simple hypothesis, proved that if instead of the traditional practice of fixing a Type I error and minimizing a Type II error, a weighted sum of errors is minimized, then the Likelihood Ratio is the criterion and the ratio of weights becomes the (fixed) cutting point. We extend, this reasoning in various directions, for general hypothesis. The main result is: the optimal test

is the Bayes Factor and the cutting point is given by the relative weights. Furthermore, the criterion of minimizing weighted errors, obeys automatically the Likelihood Principle, Lindley Paradox disappears and practical and statistical significance are reconciled. Frequentist practice plays a crucial role: the weights of Type I and Type II errors, are assessed by designing a sample size with set Type I and Type II errors in the conceptual design experiment. What most practical statisticians do all the time: designing experiments, we may dig out what are their assessments from their designs.
Acknowledgements: INBRE-NIH and Comprehensive Cancer Center University of Puerto Rico
Keywords: Alternative Testing Hypothesis, Practical significance; Statistical significance

Changing statistical significance as the amount of information changes: the adaptive significance level

María Eglée Pérez Hernández, Department of Mathematics, University of Puerto Rico, Río Piedras campus
Luis Pericchi, Department of Mathematics, University of Puerto Rico, Río Piedras campus

In Statistics, the amount of information varies wildly from problem to problem. Still, the most traditional statistics is anchored in fixed significance levels, and constant tables of evidence to judge p-values. We put forward an "adaptive α"significance level which adapts with the amount of sample information. Looked in a "dual"manner, we put forward a calibration of p-values which is consistent with a Bayesian/probabilistic interpretation of the evidence, leading to statistical consistency as the information accumulates. Finally, this adaptive alpha can be used to test hypothesis through probability intervals, with a potential radical simplification of Bayesian Testing in simple settings.
Acknowledgements: INBRE-NIH and Comprehensive Cancer Center University of Puerto Rico
Keywords: Adaptive confidence level, Bayes-non Bayes compromise, p-value calibration

APN functions against differential attacks

Moises Delgado Olortegui, Departamento de Administración de Empresas, Universidad de Puerto Rico, Río Piedras

Linear and differential attacks are algorithms designed to break the security of encryption systems. High non-linear functions called Almost Perfect Non-linear (APN) defined over finite fields are used as components of some cryptographic algorithms (block ciphers). These functions provide high resistance against differential attacks when are used as S-Boxes. In this talk we explain how APN functions work for information security, show some known families of this functions and also state one of the most important open problems in this subject.
Acknowledgements: Roberto Reyes
Keywords: differential attack, block cipher, S-Box, cryptosystem

What is the value of $\lim_{x\to 0^\circ} \frac{\sin x}{x}$?

Pablo V. Negrón, Department of Mathematics, University of Puerto Rico at Humacao

If you answer quickly to this question, you might say the value of this limit is one, which is incorrect! However, if you pay attention to details, you might have noticed the sign for degrees in the limit, and probably have correctly answered $\frac{\pi}{180}$ for the value of the limit. The result that $\lim_{x\to 0} \frac{\sin x}{x} = 1$, which requires that x be measured in radians, is essential to get that the derivative of $\sin x$ is $\cos x$ (again x in radians). If one does not pay attention to this fact, it is very easy to make mistakes in derivations that could lead to erroneous answers or conclusions. In this talk I will describe two such instances. In the first case, in an article published in the journal *Mathematics Teacher* of December 2005 and having to do with an application of the Lagrange multiplier rule. The other example of computing or applying this limit incorrectly, is on a solution to a related rates problem generated by the test generator on the Pearson website for Purcell et al. calculus book.
Keywords: limits, differentiation, angle measures

Computer simulations of wavefronts in drosophila embryos

Pablo V. Negrón, Department of Mathematics, University of Puerto Rico at Humacao

In this talk I will outline a collaboration with Andrea Liu (UPENN) which involves the modeling of wavefronts that propagate in Drosophila embryos during mitosis. One of the proposed models by Dr. Liu's group to explain this phenomena is based on mechanical signaling. In this model the embryo membrane is modeled using the equations of elasticity for thin membranes, including the effects of external (dipole type) forces and a damping term. After a brief introduction to the equations for thin membranes and mechanical signaling, I will describe a finite element scheme for the approximate solution of the resulting diffusion type system of partial differential equations. I will present some preliminary results (including a movie) of a computer simulation for the propagation of wavefronts in an ellipsoidal shell.
Acknowledgements: This research was sponsored by the NSF-PREM project of the University of Puerto Rico at Humacao (Grant No. DMR–0934195).
Keywords: wavefronts, drosophila, membranes, mechanical signaling

Multivariate methods for classifying time series data

Patricia Ordóñez, Department of Computer Science, University of Puerto Rico, Rio Piedras Campus
Tom Armstrong, Department of Computer Science, Wheaton College
Tim Oates, Department of Computer Science, University of Maryland, Baltimore County

We examine two novel multivariate time series representations to classify physiological data of different lengths, Multivariate Bag-of-Patterns and Stacked Bags-of-Patterns. We also borrow techniques from the natural language processing and text mining (e.g., term frequency and inverse document frequency) to improve classification accuracy. We compare how these multivariate representations classify the data compared to extensions of two univariate representations, known as Piecewise Dynamic Time

Warping and Bag-of-Patterns, into the multivariate domain. We present experimental results on classifying adult patients who have experienced acute episodes of hypotension (AHE) and neonatal patients who have experienced a patent ductus arteriosus (PDA). We also evaluated how these methods fared in classifying robotic sensor data to determine location and direction of the robot and motion capture data to differenciate types of motions to determine whether the methods are generalizable to other domains.
Keywords: Multivariate Time Series Classification

Compactness of relatively isospectral sets of surfaces

Pierre Albin, Department of Mathematics, University of Illinois at Urbana-Champaign
Clara Aldana, Department of Mathematics, Albert Einstein Institute (Max Planck)
Fréderic Rochon, Department of Mathematics, Université du Québec à Montréal

A famous question from the 60s is 'can one hear the shape of a drum?'. That is, can someone with perfect pitch distinguish any two drums purely by listening to them? Mathematically this asks if we can recover the geometry of a surface from the spectrum of its Laplacian. Although the answer is 'no', there are some very interesting positive results. In the 80's it was shown that the set of surfaces with the same spectrum form a compact set. I will discuss joint work with Clara Aldana and Frédéric Rochon regarding the corresponding statement for non-compact surfaces.
Keywords: Spectral geometry, geometric analysis

Factores en la teoría de factorizaciones generalizadas

Reyes Ortiz-Albino, Departamento de Ciencias Matematicas, Universidad de Puerto Rico en Mayaguez

Durante la última decada la teoría de generalización de factorizaciones ó τ-factorizaciones ha sido estudiada por varios algebristas tales como Anderson, Zafrullah, Juet, Frazier y Ortiz. Está teoría además de generalizar los resultados particulares en factorizaciones nos provee una herramienta para hallar propiedades en subconjuntos en donde no necesariamente existe una operación definida. Este proyecto presenta una idea de está teoría, pero en particular nos enfocamos en los τ-factores en común que dos elementos distintos de cero y de unidades pueden tener. Presentamos ejemplos donde el máximo τ-factor en común no existe y resultados realizados durante 2011 y 2012.
Keywords: Factorizaciones, Máximo común factor

Modelo con retraso y correlación cruzada para predecir la intensidad de la lluvia a corto plazo

Roberto C. Trespalacios, Departamento de Matemáticas, Universidad de Puerto Rico (Mayagüez)
Nazario Ramírez Beltrán, Departamento de Ingeniería Industrial, Universidad de Puerto Rico (Mayagüez)

La definición de pronóstico inmediato ha evolucionado a través de los años. Browning (1982), dijo que es una combinación de descripción del tiempo presente más extrapolación de sus tendencias hasta 2 horas hacia delante. A pesar de los grandes avances de las dos últimas décadas en la predicción numérica operacional del tiempo (Wilson et al, 1998), el pronóstico inmediato, bajo técnicas estadísticas, ha mantenido un importante rol en la vigilancia meteorológica; esto se debe, a la poca agilidad que

presentan los modelos numéricos en las primeras horas para la predicción de los fenómenos atmosféricos. En éste trabajo, exploramos la utilidad de la función de transferencia (Ramírez et al, 2008) como un principio para dar solución al problema de la predicción de la intensidad de la lluvia a corto plazo (< 2 horas). De otro lado, utilizamos la correlación cruzada y técnicas de procesamiento de imágenes como método para encontrar los vectores de desplazamiento de una nube.
Acknowledgements: Al Dr. Nazario Ramírez Beltrán, quien fue mi director de Tesis.
Keywords: Nowcasting, función de transferencia, correlación cruzada

Finite element modeling of micropolar elastic plates

Roman Kvasov, Computing and Information Science and Engineering PhD Program, University of Puerto Rico at Mayaguez
Lev Steinberg, Department of Mathematics, University of Puerto Rico at Mayaguez

In this work we present the Finite Element modeling of micropolar elastic plates. We consider the micropolar plate field equations as an elliptic system of nine differential equations in terms of the kinematic variables based on our recently published enhanced mathematical model for Cosserat plate bending. The system includes an optimal value of the splitting parameter which is the minimizer of the micropolar plate stress energy. We present the efficient algorithm for the estimation of the optimal value of this parameter and discuss the approximations of stress and couple stress components. The numerical algorithm also includes the method for finding the optimal solution of the micropolar plate field equations corresponding to the optimal value of the splitting parameter. The comparison of the numerical values of the vertical deflection for the square plate made of dense polyurethane foam with the analytical solution of the three-dimensional micropolar elasticity confirms the high order of approximation of the three-dimensional (exact) solution. We present the numerical results for plates of different shapes, including shapes with rectangular holes, under different loads.
Acknowledgements: We would like to thank Dr. Paul Castillo, Dr. Robert Acar and Dr. Frederick Just of the University of Puerto Rico at Mayaguez for their collaboration and helpful discussions.
Keywords: micropolar elasticity, micropolar plates, finite element method

Using ontologies to improve document classification with transductive support vector machines

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Edgar Acuña Fernandez, Department of Mathematical Sciences, University of Puerto Rico - Mayaguez Campus

Many modern applications of automatic document classification require learning accurately with little training data. The semi-supervised classification technique has been proposed to reduce the manual labeling process. This technique use labeled and unlabeled data for training and it has shown to be effective in many cases. However, the use of unlabeled data for training is not always beneficial and it is difficult to know a priori when it will be work for a particular document collection.

On the other hand, the emergence of web technologies has originated the collaborative development of ontologies. Ontologies are formal, explicit, detailed structures of concepts. In this paper, we propose

the use of ontologies in order to improve the accuracy and efficiency of the semi-supervised document classification.

We used support vector machines, which is one of the most effective algorithms that have been studied for text. Our algorithm enhances the performance of transductive support vector machines through the use of ontologies. We report experimental results applying our algorithm to three different real-world text classification datasets. Our experimental results show an increment of accuracy of 4 % on average and up to 20 % for some datasets, in comparison with the traditional semi-supervised model.
Keywords: transductive support vector machines, semi-supervised document classification, ontologies

Convergence rates for numerical solutions of Markovian switching stochastic differential equations

Son Nguyen, Department of Mathematics, University of Puerto Rico, Rio Piedras
George Yin, Department of Mathematics, Wayne State University

We develop numerical approximation algorithms for solutions of stochastic differential equations with Markovian switching. The existing numerical algorithms all use a discrete-time Markov chain for the approximation of the continuous-time Markov chain. In contrast, we generate the continuous-time Markov chain directly, and then use its skeleton process in the approximation algorithm. Focusing on weak approximation, we take a re-embedding approach, and define the approximation and the solution to the switching stochastic differential equation on the same space. In our approximation, we use a sequence of independent and identically distributed (i.i.d.) random variables in lieu of the common practice of using Brownian increments. By virtue of the strong invariance principle, we ascertain rates of convergence in the pathwise sense for the weak approximation scheme.
Keywords: Stochastic differential equation, Numerical method, Pathwise weak approximation, Strong invariance principle

Análisis Bayesiano de un modelo lineal mixto para medir el impacto del cambio climático en el rendimiento del frijol para el año 2030 a nivel mundial

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Dámaris Santana Morant, Departamento de Ciencias Matemáticas, Universidad de Puerto Rico - Mayaguez
Timothy Porch, Departamento de Ciencias Matemáticas, Universidad de Puerto Rico - Mayaguez

Estudiamos el efecto del cambio climático en el rendimiento del frijol (Phaseolus vulgaris L.). Este análisis fue desarrollado incorporando las proyecciones del clima futuro por país para los períodos de cultivo del frijol representados en los calendarios de Sacks (2010). Modelamos el clima futuro por país usando el método planteado por Tebaldi y Sansó (2008), y estimamos la distribución predictiva conjunta de temperatura y precipitación. Luego, estudiamos el efecto de temperatura y precipitación en el rendimiento del frijol mediante un análisis Bayesiano de un modelo lineal mixto. Los resultados predicen incrementos en la temperatura que tendrán efectos negativos en el rendimiento del frijol en la mayoría de los países para el año 2030.
Acknowledgements: A la Dra. Dámaris Santana que fue mi asesora de tesis

Keywords: Análisis Bayesiano, Impacto del cambio climático, Modelo lineal mixto, Rendimiento del frijol

Solución de problemas matemáticos aplicados a la administración de empresas integrando el uso de la calculadora gráfica

Wanda Velázquez, Instituto de Estadísticas y Sistemas Computadorizados de Información, Universidad de Puerto Rico, Recinto de Río Piedras

En el estudio se investigaron los procesos de pensamiento de los estudiantes cuando resuelven problemas matemáticos aplicados a la administración de empresas y tienen disponible la calculadora gráfica. El diseño se fundamenta en un estudio de caso múltiple en el cual participaron estudiantes que tomaron el curso Métodos Cuantitativos para Administración de Empresas I (MECU 3031) en la Facultad de Administración de Empresas de la Universidad de Puerto Rico, Recinto de Río Piedras, durante el primer semestre 2011-2012. Se realizaron entrevistas estructuradas con cada uno de los estudiantes en momentos diferentes. Se transcribieron las verbalizaciones de los estudiantes y se usaron categorías para analizar los datos. Se analizaron los documentos escritos por los estudiantes participantes durante las sesiones de entrevistas y las anotaciones de la investigadora mediante las observaciones. De los hallazgos se sostiene que la calculadora gráfica es una herramienta útil para la solución de problemas matemáticos aplicados a la administración de empresas. En algunas ocasiones donde los estudiantes tuvieron dificultad en los procesos de solucionar el problema, el uso de la calculadora gráfica les ayudó a detectar el error y proseguir hasta resolver efectivamente el mismo.
Keywords: technology, graphing calculator, mathematic, problem solving, business administration, precalculus

5. Resúmenes de afiches (posters)

Conteo de τ_n-factores

Angel Figueroa Rosado, Department of Mathematics, University of Puerto Rico-Mayaguez Campus
Reyes M. Ortiz-Albino, Department of Mathematics, University of Puerto Rico-Mayaguez Campus

La función $T(x)$ es una de muchas funciones aritméticas a las cuales se le han dado un mayor énfasis para el estudio de los divisores de un entero positivo. Este proyecto intenta extender esta definición a los productos modulares o τ_n-productos. En este reporte preliminar se presenta la caracterización completa de dicha extensión cuando $n = 0, 1, 2, 3, 4$.
Acknowledgements: Reyes M. Ortiz-Albino
Keywords: Number Theory, Tau Function, Tau Factorizations

A first approach to study soluble reactive phosphorus (SRP) dynamics in Laguna Cartagena using software Stella (V8) and ordinary differential equations

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Laguna Cartagena (LC) is a tropical freshwater wetland located in southwestern Puerto Rico impacted by unnaturally high nutrient loading, particularly phosphorus, since the latter half of the 20th century. Eutrophication leads to excessive plant productivity that contributes to wildlife habitat degradation and enhanced greenhouse gas (methane) emissions. A first step in this analysis was the documentation of phosphorus dynamics within the lagoon using real field and laboratory data. The primary variables for this analysis are Soluble Reactive Phosphorus (SRP) concentrations taken from samples of water entering and exiting LC at its inlet and outlet points, and at three locations in the western, eastern and center sectors of the lagoon. Samples for all 5 sites were collected in triplicate on 18 occasions from August 2010 to September 2011. STELLA (v8) was used to model SRP dynamics based on the net amount of SRP (ug/L)in the system using a stock block, and two main unidirectional flows to describe the SRP concentrations that enter and exit the system. Real data were included in two converters that provide information on the main flows. Ordinary differential equations are developed and modeling results are compared with real data from within Laguna Cartagena.
Keywords: Eutrophication, Internal eutrophication; P source dynamics; P sink dynamics; SRP (Soluble Reactive Phosphorus); TP (Total Phosphorus), STELLA Software, Ordinary Differential Equations

Biological reaction network modeling and simulation with stochastic differential equations

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Ana Ferreira, Department of Electrical Engineering and Computer Science, University of California-Berkeley
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The field of synthetic biology is progressing as biologist and theorists collaborate to engineer new systems that either mimic phenomenon found in nature or demonstrate other useful behaviours. Biochemical reactions are inherently stochastic and this necessitates the use of Monte Carlo simulations before any effort to proceed with experimental implementations. However, there is often a large disconnect between these Monte Carlo simulations and the deterministic models on which the designs and analysis are usually based. In this project, we will examine the spectrum of modeling and simulation techniques between ordinary differential equations (ODEs) and Monte Carlo simulations, in particular focusing on stochastic differential equations (SDEs) using the Langevin approximation. The application goal will be quenched oscillator networks, a new class of patterning system in gene expression.
Acknowledgements: National Science Foundation; Murat Arcak PhD; Juan Arratia PhD
Keywords: Biological Reactions, Network Modeling, Stochastic Differential Equations

Flexible and protective bio-inspired armor systems

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Stephan Rudikh, Mechanical Engineering Department, Massachusetts Institute of Technology
Mary Boyce, Mechanical Engineering Department, Massachusetts Institute of Technology

The understanding of mechanics of composites plays an important role in the design of protective structures. In this work we specifically focus on biologically inspired scale-armors presented at fishes. The aim of this research is to identify optimal geometrical arrangements that can gain flexibility and protection. These systems are characterized by volume fractions, geometrical parameters, and mechanical properties, among others. To this end, we develop finite elements (FE) based in code and analyze different configurations. In parallel, an analytical model is developed. These approaches shed light on the governing parameters and their role in overall material performance. Next, these findings are compared with the experimental results of 3D printed prototypes. This research will enable a good understanding of the complex structure and help in the future of protective materials at macroscopic level, for example help in the development of more tough and flexible human body armors. The results of these experimental, numerical and analytical methods will be presented.
Keywords: flexibility, protection, geometrical arrays, layered materials

On parallel methods for classifying time series data

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Patricia Ordóñez, Department of Computer Science, University of Puerto Rico, Rio Piedras Campus

Data mining algorithms are crucial in the analysis of many real data-intensive problems. Due to its high accuracy and low memory storage requirements, the Symbolic Aggregate Approximation (SAX) algorithm is being used widely by researchers to analyze time series and streaming data. Fields such as biomedical informatics uses SAX to process physiological data. Previous work done by P. Ordóñez et. al. has shown that it is possible to classify a patient's data by creating two representations of multivariate time series that compare physiological data of varying lengths by using a combination of SAX, the Bag-of-Patterns algorithm (BoP) and a k nearest-neighbors distance algorithm. To our knowledge, parallel implementations for these algorithms have not been proposed yet. In this work, we study SAX and BoP for univariate data and discuss possible opportunities of parallelization in different architectures with the aim of extending our formulations to multivariate time series data in healthcare.
Keywords: SAX, BoP, data mining, biomedical informatics, parallel algorithms

Función de Euler para τ_n-factorizaciones

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Reyes M. Ortiz-Albino, Departamento de Matemáticas, Universidad de Puerto Rico - Recinto de Mayagüez

En teoría de números, la Función de Euler, $\phi(x)$, es una función que determina la cantidad de factores menores y relativamente primos al entero positivo x. En este proyecto, definimos la misma

idea, pero en la teoría de τ_n-factorizaciones o factorizaciones modulares. Se ha caracterizado la Función de Euler para las τ_n-factorizaciones, en los casos $n = 0, 1, 2, 3$ y 4, y se presentan algunas fórmulas. Esto es un trabajo en progreso, que intenta definir la fórmula que describa la Función de Euler en la teoría de τ_n-factorizaciones para $n \geq 5$.
Acknowledgements: Reyes M. Ortiz-Albino
Keywords: Teoría de Números, Función de Euler, Factorizaciones

Web implementation of the spinning cube of potential doom for netflow data analysis

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The monitoring and analysis of computer networks to detect abnormal network behavior is a complex task for network administrators, which can not be accomplished without the aid of visualization analytics. In this work, we present a web based implementation of the three dimensional cube known as the Spinning Cube of Potential Doom using WebGL and the Three.js library. With this implementation our goal is to provide an easy to use and access cube interface, without the need to install and configure additional graphic software in a single machine. This application allows the system administrators to visualize distinct network events such as network and port scanning. In our current implementation we use data from NetFlows stored in a remote server, and provide the system administrator with a control panel that allows the selection of past data, and filtering by networks classes. The computing needed for the filtering and parsing of the data is done in the server side, the web browser is only used for the visualization.
Acknowledgements: Dr. Humberto Ortiz Zuazaga
Keywords: network security, visual analytics, data manipulation

Design of a programming framework for education in computer programming

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Many students come into the field of computer science with many misconceptions of what computer science is about. For example many students enroll in computer science thinking it is all about web development or developing video games. Sometimes it is hard for new students to stay in computer science, because in the introductory courses, they are immediately faced with something different to what they expect.

The goal of this project is to give the students meaningful and engaging results for every basic concept that they learn in the introduction to programming course. We are developing laboratory experiences where we provide almost complete libraries and source code that the students are intended to solve and complete with some new programming concept that they have recently learned in the

course. We want the students to learn that computer science is a highly applicable field, and ensure that they will get actively engaged in the introduction to programming course.

In this work we present three projects towards our goal, one of them is an avatar creator program where the student is expected to apply the concept of selection structures for each part of the body of the avatar. The second project is a domino game where students are expected to develop a function with the algorithm of a playing strategy to compete with the strategies of other students and then compare what playing strategy is the best. And the third project is an image editor where the student is expected to apply the concept of nested loops in order to implement simple image manipulation algorithms.

Keywords: students, programming, education

Non planar mirror arrays for the collection of sun light

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Pablo V. Negrón, Department of Mathematics, University of Puerto Rico at Humacao
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An array of mirrors that directs or reflects sun light onto a collector tower is called a *heliostat*. Heliostats have successfully been employed in several countries (Spain and US) as a means of generating clean renewable energy. The usual arrays of heliostat mirrors, have them set in a kind of semi-circular planar arrangement, each mirror facing to the collecting tower. Recently it has been found that if the mirrors are arranged in a pattern reminiscent to the way leaves arrange in many plants (and related to the golden ratio), then the efficiency of the heliostat is greatly increased. In this project we study whether such arrangements or others increase efficiency as well, but in non planar arrangements of mirrors. We consider the special case in which the incident light rays, the collector tower, and the normal directions to the mirrors, all lie in the same plane. After finding an expression for the total collected light by the tower in terms of the geometrical parameters of the mirror array (distances from the tower, heights, inclinations), we use a nonlinear optimization computer package to determine the values of these parameters that maximize the total collected light.

Acknowledgements: This research was sponsored in part (Velázquez and Negrón-Marrero) by the NSF–PREM project of the University of Puerto Rico at Humacao (Grant No. DMR–0934195).
Keywords: heliostat, renewable energy, golden ratio, optimization

Mathematical analysis of runtime complexity of sorting algorithms on a Spartan 6 SP605 FPGA

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Luis De la Torre, School of Science and Technology, Universidad Metropolitana

As of today, sorting is still one of the most studied and practiced topic in computer programming. In addition, advances in technology have made sorting easier, faster, and more precise. However, the problem has always been choosing the fastest and most efficient device and sorting algorithm. Past investigations have revealed that sorting with microprocessors is better, faster, and more precise- even though not much- over sorting with Field Programmable Gate Arrays (FPGAs), due to Hertz (Hz) capacity. On the other hand, the FPGA has an advantage: it does one work at a time, and it does it fast. This work compares the performance of five sorting algorithms (Quicksort, Heap Sort, Merge

Sort, Bitonic Sort and Radix Sort) using the Spartan 6 FPGA versus a common desktop computer. Each code was implemented in VHDL and C languages. The runtime of the sorting algorithms on both devices is comparable, while the Hz capacity is not (the ratio of FPGA:Processor is 2:21). It is expected that a FPGA with higher Hz capacity should outperform the processor.
Acknowledgements: SACNAS
Keywords: Sorting Algorithms, FPGA, Runtime Complexity

Mapping the genetic regulation of gene expression in a rat model of metabolic syndrome

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The metabolic syndrome (MetS) is characterized by obesity, dyslipidemia, hypertension, and insulin resistance and is a major risk factor for cardiovascular disease. Using rat models of MetS (LH and LN strains), we aim to map both physiological and transcriptional regulation underlying the syndrome. To identify genetic loci influencing phenotypes underlying MetS, we performed a genome wide scan by using R/QTL in an F2 intercross between LH and LN. This study reports the mapping of gene expression, or expression (e)QTL, using the R/eQTL package. We performed RNA-seq in livers from 36 individuals from the intercross to identify the eQTLs. Linkage analyses identified eQTL with significant logarithm of odds (lod) scores. Permutation tests were performed, which determined genome-wide lod threshold at 5 % significance was 3.89 and at 1 % significance was 4.82. We analyzed the R-square correlation between SNP genotype and gene expression phenotype for each gene. We identified 75 eQTL at 1 % significance and 126 eQTL at 5 % located on 16 of 20 rat chromosomes. Often several SNPs in a single QTL interval are significant for the same gene. We are investigating an eQTL on rat chromosome 17 that regulates the expression of multiple genes. It is possible that these genes share a common transcription factor which is affected by genetic variation on chromosome 17. eQTLs are genetic loci likely to be that influence precursor pathways and cofactors of the metabolic syndrome. Identifying these in the rat could lead to translational studies to determine their role in the human MetS.
Acknowledgements:
Keywords: metabolism, genetic variation

Efficient haplotype assembly: HapCut vs a new algorithm

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Adrian Vladu, Department of Mathematics, Massachusetts Institute of Technology
Jonathan Kelner, Department of Mathematics, Massachusetts Institute of Technology

The determination of DNA sequences in individuals can help track gene expression patterns and consequently varying susceptibility to a disease. A method to obtain DNA information is using sequencing technologies to read DNA fragments and reconstruct combinations of alleles, known as haplotypes. DNA reads contain errors and gaps. The reconstruction of the DNA sequence is modeled into an optimization problem called the Haplotype Assembly Problem, which is known to be NP-hard. The HapCut algorithm uses an approach based on computing maximum cuts in certain graphs derived from the sequenced fragments. Because HapCut works by initially generating a random haplotype and performing local moves to improve the haplotype, its running time is significantly long. Choosing a random entry from a gapless data set as haplotype provides a 2-approximation and reduces the running time of the

algorithm. Because a gapless data set does not appear in practice, we developed an algorithm to reconstruct a gapped string. This new algorithm provides a good results in practice, and is visibly faster than the HapCut algorithm.
Keywords: Haplotype Assembly Problem, Efficient Algorithm