MASSEE International Congress on Mathematics MICOM 2018

Abstracts List

PLENARY PRESENTATION

JAMES BOND'S MOST SECRET WEAPON

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Before creating James Bond in 1952, Ian Fleming (1908-1964) conducted intelligence activities for the UK. During WW2, among other things, he initiated the so-called "Operation Ruthless", a plan aiming to obtain the Enigma codes used by the German Navy. The plan was never implemented, much to the annoyance of Alan Turing, who was at that time heading the cipher school at Bletchley Park. Nowadays it is known that the efforts made by the team of mathematicians at Bletchley Park to break Enigma saved numerous lives, and probably shorten the war. Since this dramatic period, security of communications has known a huge development, even a kind of "revolution" in the mid 1970's. If during thousands of years symmetric-key cryptography mainly dominated the way messages were safely exchanged, the mid-1970's saw the emergence of a new concept: Public-Key Cryptography. Cryptology progressively left the sphere of art to become a science. The security of public-key crypto-systems relies on the difficulty to solve mathematical problems. Nowadays, there are mainly two problems used in this setting: the Integer Factorization Problem (IFP) and the Discrete Logarithm Problem (DLP) in well-chosen groups. In the mid-1980's, Koblitz and Miller (independently) proposed to use elliptic curves, and defined the Elliptic Curve Discrete Logarithm Problem (ECDLP). According to today's knowledge, ECDLP is algorithmically safer than the other public-key crypto-systems. The increasing importance of mathematics in secure communications a posteriori legitimates the provocative title of this hopefully beautifully illustrated and entertaining conference.

PRESENTATIONS

THE MATHGAMES METHODOLOGY

Gregory Makrides, President of the Cyprus Mathematical Society, Cyprus
Andreas Skotinos, Vice-president of the Cyprus Mathematical Society, Cyprus

The MathGames Methodology is the outcome of the MathGames Project, a project realized as an Erasmus Plus study. The partners in the project, coming from 9 countries, produced Ideas and material aiming to help under skilled adults to develop mathematical skills and provide to them the means for social integration and participation in society through a variety of traditional and famous games. The Methodology sets the forum for using the material produced for motivating lower skilled adults in raising their mathematical literacy. This forum consists of a compendium describing a broad range of games in relation to the mathematical content that can be elicited from them, a Guidebook   providing lesson plans and examples on how to use the material in the learning process, and the Content of a Training Course for Teachers that would be interested in adopting the idea. Furthermore the methodology is supported by a website that makes available to the user the structure of the MathGames project and its constituents.

EFFECTS OF VARIABLE PERMEABILITY AND DIFFUSIVITY ON NATURAL CONVECTION IN A FINITE PERMEABLE ENCLOSURE

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The buoyancy dominated flows of a viscous incompressible fluid in 2-D permeable enclosures have been studied extensively in the literature because of numerous industrial applications. When the enclosure has 4-sided walls, the thermal conditions prevailing on these boundaries play significant roles on the flow and thermal characteristics. There are a number of technological applications where the thermal wall conditions are typically adiabatic on the side vertical walls while the lower and upper walls are isothermal with different temperatures. Moreover, depending upon the nature of applications, one has to consider the isotropic or anisotropic features of the hydrodynamical and thermal characteristics of the porous material. This paper deals with steady laminar natural convective Darcian flow of a viscous incompressible fluid in a finite trapezoidal cavity whose side walls are vertical and the upper wall is slanted. The vertical side walls of the cavity are assumed to be subject to no heat flux condition while the remaining walls are kept at uniform temperatures. We have solved numerically the governing non-dimensional partial differential equations together with the appropriate sets of boundary conditions for velocity and temperature. In order to bring out the salient features of non-isotropy versus isotropy, the effects of a number of important non-dimensional quantities, namely, Rayleigh-Darcy number, aspect ratio, inclination parameter, permeability ratio and thermal diffusivity ratio parameters have been discussed in relation to the streamlines and isotherms.

TWO-DIMENSIONAL LAMINAR INCOMPRESSIBLE BOUNDARY LAYER FLOWS OF A CLASS OF PSEUDOPLASTIC FLUIDS

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Theoretical analyses of laminar incompressible boundary layer flows of inelastic non-Newtonian fluids have been a subject of intense and extensive investigations. In particular, shear thinning inelastic liquids, commonly known as pseudoplastic fluids, have numerous industrial applications in areas such as chemical engineering and biomedical engineering. In this paper, some two-dimensional boundary layer flows, namely, stagnation point flow and Blasius flow, of a special class of pseudoplastic fluids over a flat rigid impermeable surface have been investigated. The non-Newtonian model used in this study is a 3-parameter Williamson constitutive equation. Our approach to solve the governing PDEs is a semi-analytical one comprising perturbation expansion and numerical integration of the associated boundary value problems. The similarity analysis of the boundary layer partial differential equation leads to a nonlinear ODE involving a non-Newtonian parameter. The main focus of this work pertains to assessing higher order effects in the perturbation expansion of the similarity functions. There arise systems of boundary value problems which have been solved numerically. It has been shown that the consideration of higher order terms beyond second order, usually employed in the literature, is important for the more accurate description of the flow in the boundary layer region. The effect of the rheological parameter describing the non-Newtonian features of the fluid has been illustrated extensively.

ELEMENTARY SCHOOL PRINCIPALS' PERCEPTIONS ABOUT INCLUSIVE EDUCATION WITH SPECIFIC REFERENCE TO GIFTEDNESS

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Although studies conducted during the last few decades have demonstrated both the need for and the benefits of programs specific for students who are gifted; recent reports by many task teams in South Africa showed that schools present an environment that fails to meet the needs of gifted students. In most of the task-teams' recommendations, inclusivity is now fore-grounded, and giftedness is identified as one of the 'exceptionalities' that need addressing. One of the key actors in the implementation of these recommendations is the school principal and their perceptions about inclusive education are critical given that research confirmed instructional leadership as having the greatest impact on student outcomes. With this background the purpose of this study was to examine elementary school principals' perceptions, regarding the inclusion of learners considered gifted. The study used a qualitative research approach. The researchers interviewed twenty principals of selected primary schools around Bloemfontein. We were particularly interested in the types of inclusive practices that were being used at the participating schools. The results show that principals perceived inclusive education as consisting of remedial teaching, referrals to other specialist schools, didactic programs and mixed grouping. However, when we probed the mixed grouping further most school principals perceived gifted students as teachers' assistants. We found this to be problematic in that gifted students do not grow to their full potential under such circumstances.

TECHNIQUES USED BY TEACHERS TO CHALLENGE GIFTED LEARNERS IN MATHEMATICS CLASSROOMS IN SOME SELECTED SECONDARY SCHOOLS IN THABA-NCHU, MOTHEO DISTRICT

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South Africa has countless learners with exceptional talents in Mathematics. These learners hold extraordinary potential for enriching our society by contributing creative products and competing in global economies. In their later life as adults, they have the potential to hold important leadership roles and be entrusted with obligations and resources for making critical decisions about individual and organisational well-being. However, such potential can only benefit society if the gifted learners are properly identified and nurtured. In South Africa gifted learners are found in every regular classroom following the dismantling of special schools for the gifted. Although it was hoped that inclusive classrooms would meet the needs of gifted learners, research has shown that most teachers focus on meeting the needs of at risk learners but do not provide support to the gifted learners. The aim of this papers is to examine techniques teachers used to challenge and meet the needs of mathematically gifted. From 50 teachers only twelve grade 35 mathematics high school teachers from Thaba- Nchu in Motheo District participated in the study. Both qualitative and quantitative methods was used, hence data were collected through questionnaires and interviews. The results are consistent with other studies which have shown that not all teachers offer gifted learners challenging tasks. Nevertheless challenging gifted learners in classrooms help in improving their results, self-esteem and reduces discipline as learners are motivated to work hard and most impotently their needs are being catered for. Given that only a few teachers took part in this study, it is recommended that further studies be done to see how prevalent such practices are.
Keywords: learning needs, mathematically gifted

DEVELOPING LEARNING TASKS WITH THE USE OF DYNAMIC GEOMETRY ENVIRONMENTS (DGES) IN GREEK PRIMARY SCHOOLS

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This paper initially describes the value of the introduction of Information and Communication Technology (ICT) in Mathematics Education and specifically in teaching Geometry. There are many important tools that successfully help teachers teach Geometry in Primary Schools. Each of these online tools has a significant role. Particular reference is made to a specific category of educational software with the general title "Dynamic Geometry Environments (DGEs)". These popular, interactive softwares of geometric visualization, utilizing mainly the functions of dynamics modification, transformation and "drag and drop" are nowadays of great importance in teaching and learning of mathematics. Finally, in this paper, it was attempted to explore the learning outcomes after the use of the friendly and easy-to-use Cabri Geometry software. At the same time, the use of the Van Hiele's geometric thinking model was the basis of our theoretical framework. In general, by incorporating the educational software into the teaching process during the study of simple geometric shapes, it was revealed that learning and pedagogical benefits may arise, after the implementation of educational software with a normal frequency in class.

CAREER GUIDANCE STRATEGIES TO CURB GIFTED LEARNER DROPOUT IN BLOEMFONTEIN

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The justification that gifted or talented people need to be our concern is often made through contributions that such people have made in society. Many lists have been generated for such prominent people including Time 100 which is the annual list of the 100 `s most influential people in the world assembled by American News Magazine Time (2010) which include the following names: Bill Gates, Paul Allen, Steve Jobs, Michael Dell, Mark Zuckerberg, Larry Ellison, Albert Einstein, The Wright Brothers and many more. Despite the fact that they are all prominent people, there is evidence that dropping out of school is a common characteristic that cuts across all of them. Another observation is that these prominent people were all lucky to rise from the ashes. The South African system is extremely inefficient with a high repetition, failure and dropout rate and has reached a national crisis. Amongst all the dropout learners the is a certain number of gifted students of which the country is losing that cannot be able to easily rise from the ashes. The aim of the research is to understand the extent to which schools around Bloemfontein provide support and guidance to their at risk- of –dropping out students. A qualitative approach will be used and a sample population of 20 grade 7 learners aged between 13 and 14.

NUMERACY FOR DESIGN AND STUDIO ART STUDENTS

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At Central University of Technology, it is a requirement for all programmes without a Mathematics module to offer Numeracy module to their first-year students. The Department of Mathematical and Physical Sciences was requested to facilitate this module from 2014 within the first semester. However, Numeracy was offered in a general manner without considering the applicability to the Design and Studio Art programme. The aim of this study is to revise the current curriculum and modify it to be applicable to Design and studio Art programme, by firstly identifying the gap in the current curriculum, which was that concepts within the Numeracy were not applicable to this programme. Secondly to identify the concepts within the Numeracy module that could be applicable to this Programme and modify them. These concepts were identified as geometry, ratios and proportions, grid system, units and conversions. There were 70 Design and studio Art students at CUT and they all participated in the study. Quantitative and qualitative methods were used, hence data was collected through questionnaires and interviews. The results showed a huge improvement in the performance of students in the Numeracy module, including the gifted students. This suggests that making Numeracy applicable to a programme may improve the students' performance in the module. Since there were only few students that took part in this study, it is recommended that further studies be done to see if the results will yield the same positive results.

Keywords: Numeracy, art and design, geometry, ratio and proportion

MODELING NON-LINEAR AND DELAYED EFFECTS OF TEMPERATURE ON MORTALITY COUNTS

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The world is experiencing climate change in the form of heat waves and large temperature fluctuations, potentially leading to increased mortality. Empirical evidence has shown that the temperature-mortality relation exhibits two main characteristics: first, non-linearities, where we have higher mortality at temperature extremes, and, second, "delayed" or "lag" effects, where high temperatures have an effect on mortality not only on the same day, but on the next days as well. The present study uses a procedure that captures these two characteristics simultaneously, in a comprehensive modeling framework based on "Distributed Lag Non-Linear Models". The study area is Cyprus, an island with a typical Mediterranean climate. The results show that high temperatures do have a significant effect on public health, even after adjusting for the potential effect of other factors like humidity, seasonality or air pollution.

STRATEGIES OF PRIMARY SCHOOL TEACHERS TOWARD MATHEMATICALLY GIFTED LEARNERS IN AN INCLUSIVE CLASSROOM IN XHARIEP DISTRICT OF FREE STATE PROVINCE

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In South Africa, Schools are defined as full-service schools (FSS) that are inclusive and welcoming of learners to develop their full potential irrespective of their background, culture, abilities or disabilities, their gender or race (Department of Basic Education, 2014). However, the public schools' mass production approach to learning is not well appropriate towards the education of the gifted learners. This suggests that mathematically gifted learners are not properly catered for in the current inclusive classrooms. Based on this concern, this study has aimed at investigating the strategies that the foundation phase teachers use toward mathematically gifted learners in Xhariep district's primary schools of Free State province. This paper is therefore guided by Gagné's fifth commandment about the education of gifted students. The commandment suggests the need for earliest intervention – as early as kindergarten. This study has focused on foundation phase teachers' ability to explore the grouping strategies to use in catering for the needs of mathematically gifted learners in regular classrooms. In attempt to explore such strategies, a survey research design of purposively sampled 55 foundation phase mathematics teachers has been used, followed by a qualitative analytical approach in which participants have been interviewed. Data has been collected by means of a 3-point Likert scale questionnaires and the face-to-face structured interview schedule for teachers and principals respectively, from all ten selected primary schools. The results have shown the frustration of teachers of being unable to meet the gifted learners' needs due to lack of special training.

THE APPROACH TEACHERS CAN USE TO IDENTIFY GIFTED LEARNERS IN MATHEMATICALLY MIXED ABILITY CLASSROOM TO MEET THEIR LEARNING NEEDS IN MANGAUNG PRIMARY SCHOOLS, MOTHEO DISTRICT

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The purpose of this study was to investigate different approaches teachers use to identify gifted learners in their mixed ability classrooms. It further sought to establish whether or not these teachers were equipped with relevant skills and competencies to promote and nurture the needs and talents of such learners. The lack of knowledge to identify giftedness was promoted and prolonged by inability of South African Education system to produce quality mathematics learners who can pursue further studies in institutions of Higher Learning and Further Training. The study used 20 grade four to seven mathematics teachers of few Primary Schools from Mangaung at Motheo Education District. A mixed method approach was used and the data was collected with the permission of the principals through the interview and questionnaire, which was distributed to the few schools that were involved in the study. The findings revealed that most teachers could not distinguish between mathematically giftedness and learners of average ability in their classrooms. It was further revealed that the teachers were not competent and professionally trained to identify and teach mathematically gifted learners in their classrooms. The paper proposed that the Department of Education should invest in programs and initiatives that are aimed at empowering mathematics teachers on how to identify and teach mathematically gifted learners. It also recommended that universities which offer teacher training qualifications should partner and collaborate with mathematics teachers to design a curriculum that provides for any identified gaps in teacher training.
Keywords: giftedness, mathematically gifted, identification

HIGH SCHOOL TEACHERS' ATTITUDES TOWARDS MATHEMATICALLY GIFTED LEARNERS

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Gifted learners, when properly supported throughout their education system, have the potential to contribute in the development of societies. Therefore, teachers' support is necessary to provide the appropriate conditions for the education of the gifted. In uncovering the potential of the gifted learners and establishing appropriate support, it is important to raise awareness among teachers. This would assist in promoting positive attitudes towards the support of differentiated education to gifted learners. The aim of this study is to examine the attitudes of high school teachers towards the education of mathematically gifted learners. The participants of this study are high school mathematics teachers. Teacher responses were compared and contrasted to identify differences and patterns. The study found that teachers felt they were adequately enriching curriculum for gifted high school mathematics learners. However, in many cases, gifted learners were not given enrichment tasks that extended beyond those that were given to the entire class. Though participants felt that they were using appropriate grouping methods, the study revealed that teachers often grouped gifted learners with the purpose of boosting the performance of struggling learners. In such circumstances, gifted learners were not grouped with other high achieving learners for the improvement of mathematics ability.

PRIMARY SCHOOL TEACHERS' RELATED BARRIERS PERCEIVED TO HINDER TEACHING AND LEARNING OF THE GIFTED LEARNERS IN INCLUSIVE CLASSROOMS

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In South Africa, MST task teams have reported the negligence of the gifted learners and learners with MST potential in provincial schools but rather focused on the underperforming schools. Currently gifted learners are found in mainstream classrooms where teachers have to deal with a wide diversity of learners. Empirical studies have shown that teachers lacked the educational training particularly in meeting the needs of the gifted learners through inclusive education (Oswald & de Villiers, 2013) but have acquired training specifically for learners who struggle in such classrooms. One of his five commandments that deal with developing the talent into gifts, Gagné (2011) emphasized that the intervention of these gifted learners should begin at the earliest age as kindergarten or first grade. However, this remain a puzzle for teachers, irrespective of the argument that the ultimate health of the mathematical sciences depended upon the foundation of mathematics in schools (Department of Science and Technology, 2008). This pointed to a gap in the foundation phase and it is against these observations that this study aimed at investigating the teacher related barriers perceived to hinder the teaching and learning of the gifted learners in inclusive classrooms. A survey research design was used for purposively 50 foundation phase mathematics teachers in Thaba Nchu. The researchers collected data by means of a 3-point Likert scale questionnaires. The results indicate that teachers still lack training that result in attitudes which unfortunately disadvantage the gifted learners to perform to their full potential.

CHALLENGES ENCOUNTERED BY INTERMEDIATE PHASE EDUCATORS IN IMPLEMENTING INCLUSIVE EDUCATION WITH SPECIFIC REFERENCE TO MATHEMATICALLY GIFTED LEARNERS IN UMLAZI DISTRICT SCHOOLS IN KWAZULU-NATAL

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South Africa like many countries worldwide, is currently practicing inclusive education in its schools. The fundamental principle behind inclusive education is that all children should learn together, regardless of any difficulties or differences they may have. However, implementation of inclusive education has been problematic with critics arguing that mathematically gifted learners are still being neglected in the classroom for all. In South Africa, teachers interviewed by Oswald & de Villiers (2013) unanimously concurred that they had never received training on how to identify and support gifted learners. In view of such findings this study aims at investigating the extent to which instructional practices of Intermediate Phase educators support the growth of mathematically gifted learners to their full potential. This is important because unless we increase the quantity and quality of learners who can become the next generation of scientists, engineers and technical specialists, South Africa's vision for a sustainable democracy will not come to fruition. A mixed method design will be followed in this study, involving ten schools from the Umlazi district. At each school 2 Intermediate phase teachers will be purposively sampled for the research. Both questionnaires and interview schedules will be used to gather the information. Quantitative statistics will be used to analyse questionnaire responses and interviews will be analysed qualitatively. From the findings, it is hoped that the researcher will be able to draw some conclusions and make some recommendations that might assists regular classroom educators to properly modifying curriculum and instruction to enhance the learning of gifted learners.
Keywords: Challenges, Inclusive Education, Mathematically gifted learners, Intermediate Phase Educators.

A CLUSTERING SOLUTION APPROACH FOR THE CAPACITATED LOCATION ROUTING PROBLEM

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In the Capacitated Location Routing Problem (CLRP) there are strategic, tactical and operational decisions. The strategic decision concerns the placement of facilities (Facility Location Problem - FLP) and the tactical and operational decision concerns the routing of the fleet (Vehicle Routing Problem - VRP). We propose a two phase clustering algorithm for the CLRP. In the first phase, we solve a P-median problem, which minimizes the total location and assignment costs. Then, for each cluster a CVRP is solved. In the proposed solution, the two phases are solved iteratively. In every iteration, we store and remove the current P-median solution from its solution space, so that the CLRP solution space is explored efficiently. Computational results, based on well-known literature datasets will be presented.
Keywords: Branch and Cut, Location, Vehicle Routing, Location Routing, Clustering

SOLVING MINIMUM SPANNING TREE PROBLEMS WITH CAPACITIES AND ARC TIME WINDOWS

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We consider the Capacitated Minimum Spanning Tree Problem with Arc Time Windows (CMSTPATW), i.e., associating time windows with the arcs of a connected acyclic graph. We propose a linear programing model and develop a heuristic to solve the CMSTPATW. Furthermore, we generate CPLEX solutions for moderate size problem instances and compare the results of the proposed heuristic and of exact solutions when applied to literature data sets.
Keywords: linear programming, spanning tree, arc routing, time windows, heuristics

DISCRETE ANALOGUES OF CONTINUOUS BIVARIATE PROBABILITY DISTRIBUTIONS

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In many real-world applications, the random variables modeling the phenomena of interest are continuous in nature, but their observed values are actually discrete and hence it is reasonable and convenient to choose an appropriate multivariate discrete distribution generated from the underlying continuous model preserving one or more important features.

In this work, two methods are discussed for deriving a bivariate discrete probability distribution from a continuous one by retaining some specific features of the original stochastic model, namely 1) the joint density function, or 2) the joint survival function. These methods can be regarded as the bivariate extension of two popular methods used for deriving a univariate discrete distribution from a continuous one; they can be also used as viable alternatives to extant techniques of construction of bivariate discrete random variables. Examples of applications are presented, which involve two types of bivariate exponential distributions and a bivariate Pareto distribution, in order to illustrate how the procedures work and show that some bivariate discrete distributions that were recently proposed in the literature can be actually regarded as discrete counterparts of well-known continuous models. A numerical study is presented in order to illustrate how the procedures are practically implemented and to present inferential aspects. A real dataset is eventually fitted using two discrete analogues of a bivariate exponential distribution.

APPLICATION OF MATHEMATICAL MODELS FOR DETERMINATION OF STRUCTURAL CHARACTERISTICS OF GRAPHENE AND MWCNT AND ITS TOPOLOGICAL INDICES RELATED PROPERTIES

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A model is used to perform the average number of layers on experimentally obtained graphene samples produced by high-temperature electrolysis in molten salts which indicates that studied graphene samples are few layered. Furthermore, the first direct application of graph theory upon nanotubical structures obtained by electrolysis in molten salts using non-stationary current regimes is performed. Using the graph representation and the chirality of the studied samples, different distance based topological indices (Wiener, Balaban, Sum-Balaban, and Gutman indices) have been evaluated in order to enable further prediction of index-related properties of the molecules.

PETROVIC'S POLYGON: ANOTHER APPLICATION OF NEWTON'S POLYGON

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In his dissertation, approved in Paris in 1894, famous Serbian mathematician Mihailo Petrovic Alas (1868-1943) introduced a new method for analysis of zeros and poles of solutions of a first order ODEs with rational functions coefficients. He constructed a polygonal line related to the equation and analyzed slopes of its segments This method is actually a modification of the so called Newton polygon, which was first described in Newton's letter to Oldenburg, dated October 26th, 1676 and used in determining solutions of algebraic equations. The method has been forgotten and much later reappeared in the work of Puiseux in the 1850's, and then forgotten again. It has revived in the school of V. I. Arnold around 1970's. The general idea is to treat qualitative behavior of polynomials by the combinatorial geometry of the convex hull of the set of points representing its exponents. In Petrovic's case, the method is slightly different, polynomial variables are y, y' with functional coefficients $\phi(x)$. We transform Petrovic's polygon into Newton polygon and analyze his results from this point of view. In this way it is possible to generalize Petrovic's first order ODE results to higher order ODEs, using the higher dimensional polyhedra instead of polygons – an approach developed in the work of Arnold and his school, and also of the author.

E- DEBATE – A NEW APPROACH IN INCREASING MOTIVATION FOR LEARNING MATHEMATICS TROUGH DEBATE

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Abstract: In this paper will be presented the electronic platform within the new teaching method MATHDebate, the possibilities and ways of its use, the opinions of the users (teachers and students) as well as the impact of the new method in the connection of the increasing motivation for learning mathematics and improving the results of the process of learning.

EHRLICH-LIKE ACCELERATED METHODS WITH JARRATT'S CORRECTION FOR THE SIMULTANEOUS APPROXIMATION OF POLYNOMIAL ZEROS

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Luiz Guerreiro Lopes, University of Madeira, Portugal

The great importance of the problem of finding polynomial zeros in science and engineering has led to the development of many different numerical methods for their determination. In this paper, we present a new family of accelerated iterative methods for the simultaneous approximation of simple complex zeros of a polynomial. These simultaneous methods are constructed on the basis of the third order Ehrlich-Aberth iteration, accelerated by using the so-called Gauss-Seidel approach and combined with a correction based on the Jarratt's family of optimal fourth order iterative methods for solving nonlinear equations. Using Jarratt's correction, the R-order of convergence of the basic accelerated method is increased from at least 3 to at least 6. Some numerical examples are provided to illustrate the convergence and efficiency of the proposed combined accelerated methods for the simultaneous approximation of polynomial zeros.

THE ASYMPTOTIC COMPLEXITY OF MATRIX REDUCTION OVER FINITE FIELDS

Demetris Christofides, UCLan Cyprus, Cyprus

Consider an invertible $n \times n$ matrix over some field. The Gauss-Jordan elimination reduces the matrix to the identity matrix using at most n^2 row operations and in general that many operations might be needed. Andrén, Hellström and Markström considered matrices in $\mathrm{GL}(n, q)$, the set of $n \times n$ invertible matrices in the finite field of q elements, and provided an algorithm using only row operations which performs asymptotically better than the Gauss-Jordan elimination. More specifically, their 'stripped elimination algorithm' has asymptotic complexity $\frac{n^2}{\log_q n}$. Furthermore they proved that up to a constant factor this algorithm is best possible as almost all matrices in $\mathrm{GL}(n, q)$ need asymptotically at least $\frac{n^2}{2\log_q n}$ operations. In this talk we will show that the 'stripped elimination algorithm' is asymptotically optimal by proving that almost all matrices in $\mathrm{GL}(n, q)$ need asymptotically at least $\frac{n^2}{\log_q n}$ operations.

POISSON BRACKETS AFTER JACOBI AND PLUCKER

Pantelis Damianou, University of Cyprus, Cyprus

We construct a symplectic realization and a bi-Hamiltonian formulation of a 3-dimensional system whose solution are the Jacobi elliptic functions. We generalize this system and the related
Poisson brackets to higher dimensions. These more general systems are parametrized by lines in 3-dimensional projective space. For these systems the Jacobi identity is satisfied only when the Plucker relations hold. Two of these Poisson brackets are compatible only if the corresponding lines in projective space intersect.

OPTIMAL ANALYTICITY ESTIMATES FOR NON-LINEAR DISSIPATIVE EQUATIONS

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We investigate the spatial analyticity of solutions of a class of evolutionary pseudo-differential equations with Burgers' nonlinearity, which are periodic in space, and possess global attractors. We examine their analyticity by utilising a criterion involving the rate of growth of suitable norms of the partial derivatives of the solution, with respect to the spatial variable, as the order of the derivative tends to infinity. An estimation of the rate of growth of the n-th derivative is obtained by fine-tuning the spectral method, developed in earlier works. We prove that the solutions are analytic if the order of dissipation of the pseudo-differential operator, is higher than one. We also present numerical evidence suggesting that this is optimal, i.e., if the order of dissipation is not larger that one, then the solution is not in general analytic. These ideas can be applied to a wide class of dissipative-dispersive pseudo-differential equations.

THE EVOLUTION OF EDUCATION FROM EDUCATION 1.0 TO EDUCATION 4.0 IS IT AN EVOLUTION OR A REVOLUTION?

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The education systems implemented in most countries today are characterized by the definition of Education 2.0, while very few countries are pushing for reforms defined by Education 3.0. The presentation will discuss the features at the development stages of Education from Education 1.0 to Education 4.0 and will try to answer to the question whether this is revolution or an evolution directed by the modernization of technology in parallel with the upgrade of student and industry needs.