



Recreational Mathematics Colloquium II

BOOK OF ABSTRACTS

University of Évora
April 27th - April 30th, 2011



Organization:

Ludus Association
University of Évora
Museum of Science, University of Lisbon

Organizing Committee:

Alda Carvalho (ISEL, Portugal)
Ana Santos (University of Évora, Portugal)
Carlos Santos (ISEC, Portugal)
Jorge Nuno Silva (University of Lisbon, Portugal)
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Robin Wilson (Open University, England)
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Sponsors:



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1 Foreword

“Recreational Mathematics” is a problematic expression. For some people, like most professional mathematicians, Mathematics is lots of fun; but for others, like some students, Mathematics can be a nightmare.

Historically, we know that some mathematical research areas are deeply linked to puzzles and games, probability and chance games, graph theory and the Brigdes of Königsberg.

The University of Évora, the Ludus Association, and the Museum of Science of the University of Lisbon organize the Recreational Mathematics Colloquium II.

Our Colloquium will be a Show and Tell of bright pearls of Mathematics, with varied levels of sophistication, entertaining many audiences. Its main goal is to foster mathematical appreciation, an important step if we are to see improvements in its practice. More information can be consulted in the following web page:

<http://ludicum.org/rm11/>

The Organizing Committee

2 Invited Speakers

COLIN WRIGHT

(born in Australia, President of the Liverpool Mathematical Society)



Colin Wright graduated in 1982 from Monash University, Melbourne, Australia, with a B.Sc.(Hons) in Pure Mathematics, and went on to receive his doctorate in 1990 from Cambridge University, England. While at Cambridge he also learned how to fire breathe, unicycle, juggle and ballroom dance. Since then he has worked as a research mathematician, a computer programmer, and an electronics hardware designer. Colin also enjoys sailing small boats and playing bridge, although not (so far) at the same time. Colin is a co-founder of Solipsys Limited along with Andrew Lipson and he is the presenter of the popular science *Juggling Talk Series*. He is a former President of the Liverpool Mathematical Society.

EDWARD PEGG

(born in USA, Wolfram Research)



Edward Pegg is an expert on mathematical puzzles and is a self-described recreational mathematician. He creates puzzles for the Mathematical Association of America online at Ed Pegg, Jr.'s Math Games. His puzzles have also been used by Will Shortz on the puzzle segment of NPR's Weekend Edition Sunday. In 2000, he left NORAD to join Wolfram Research, where he collaborated on A New Kind of Science (NKS). In 2004 he started assisting Eric W. Weisstein at Wolfram MathWorld. He has made contributions to several hundred MathWorld articles. He is one of the chief consultants for *Numb3rs*.

KEITH DEVLIN

(born in England, Stanford University)



Dr. Keith Devlin is a co-founder and Executive Director of the Stanford University's H STAR institute, a co-founder of the Stanford Media X research network, and a Senior Researcher at CSLI. He is a World Economic Forum Fellow and a Fellow of the American Association for the Advancement of Science. His current research is focused on the use of different media to teach and communicate mathematics to diverse audiences. He also works on the design of information/reasoning systems for intelligence analysis. Other research interests include: models of reasoning, applications of mathematical techniques in the study of communication, and mathematical cognition. He has written 28 books and over 80 published research articles. Recipient of the Pythagoras Prize, the Peano Prize, the Galileo Prize, the Carl Sagan Award, and the Joint Policy Board for Mathematics Communications Award. In 2003, he was recognized by the California State Assembly for his "innovative work and longtime service in the field of mathematics and its relation to logic and linguistics." He is "the Math Guy" on National Public Radio.

We hardly suggest the site www.stanford.edu/~kdevlin.

LENNART GREEN

(born in Sweden, World Champion close-up/card Magician)



Lennart Green is known worldwide as the Eccentric Swedish Misdirector. He is a master of mental manipulation, misdirection and magic entertainment! He is a specialist in crooked gambling, rigged bets, puzzles and paradoxes: A World Champion in Card Magic. Lennart invented his technique by observing inmates and patients in prison whilst studying medicine and psychology. After 15 years of practice as a General Practitioner, he decided to pursue a new career focused on his love for magic and entertainment. He says he was inspired by the creative methods of some con artists!

Lennart travels the world giving motivational talks, lectures, public performances (e.g., TED in Monterey) and TV shows. His interests/hobbies include repairing old violins, collecting strange objects, enigma-puzzles, optical illusions and special books. He enjoys legends, proverbs, aphorisms, and mottos like:

It doesn't matter how fast you run - If you run in the wrong direction.

RICHARD NOWAKOWSKI

(born in England, Dalhousie University)



Richard Nowakowski is a Professor at Dalhousie University in Canada. His research interests include graph theory and combinatorial game theory but even his graph theory work involves games and puzzles such as cops-and-robbers and cleaning a graph. He has helped organize the *Games-of-no-Chance* conferences at MSRI and BIRS and has edited the proceedings.

SARA SANTOS

(born in Portugal, Royal Institution of Great Britain)



Sara Santos is Clothworkers' Fellow for Mathematics at the Ri, responsible for the Mathematics Masterclasses for secondary school students. Sara is one of the founders of Maths Busking, award winning project for Seed of Science 2011 on the category of science communication. Sara's desert island book is Byrne's Six Books of Euclid.

3 Program

Wednesday, 27th April

- 8:30 **Welcome and registration**
- 9:15 **Opening Session**
- 9:30 **Recently Solved Problems**
Edward Pegg, Wolfram Research
- 10:30 **Bodies Invisible in Several Directions**
Vera Roshchina, CIM-UE, University of Évora
- 11:00 Coffee-Break
- 11:30 **Fooling around with Stable Marriages**
Jorge Buescu, University of Lisbon
- 12:00 **Szygies played by elementary school students**
Dores Ferreira, University of Minho
- 12:30 **Vogeler's Diagram and Rational Derived Polynomials**
Alda Carvalho, ISEL
- 13:00 Break for lunch
- 14:30 **Juggling: Theory and Practice**
Colin Wright, Liverpool Mathematical Society
- 15:30 **Medieval Problems**
Joaquim Eurico Nogueira, New University of Lisbon
- 16:00 Coffee-Break
- 16:30 **The Football Pool Problem**
António Machiavelo, University of Oporto
- 17:00 **Shannon Switching Game and Variants**
Ilda Perez, University of Lisbon

17:30 **A dynamical approach to necklaces and words**
Cristina Serpa, University of Lisbon

18:00 **Mathematical Circus**
Adelaide Carreira, University of Lisbon

19:00 Welcome Cocktail (Évora Town Hall)

Thursday, 28th April

9:30 **Masterclasses and Maths Busking**
Sara Santos, Royal Institution of Great Britain

10:30 **On a Certain Chaotic Game**
Carlos Ramos, University of Évora

11:00 Coffee-Break

11:30 **Using Empirical Map Projections for Research, Education and Fun**
Joaquim Alves Gaspar, University of Lisbon

12:00 **Some Math Problems with Trains and Railways**
Helder Pinto, University of Lisbon

12:30 **Predominance Game**
Helena Sousa Melo, University of Azores

13:00 Break for lunch

14:30 Visit to Vila Viçosa

Friday, 29th April

- 9:30 **Games for Lazy but Intelligent Parents**
Richard Nowakowski, Dalhousie University
- 10:30 **The shape of the sound: from bird singing to western music**
Carlota Simões, University of Coimbra
- 11:00 Coffee-Break
- 11:30 **The Mathematics of Cartoons: A Brief Survey**
Natália Bebiano, University of Coimbra
- 12:00 **Extreme Alphametics**
Michael Keith
- 12:30 **Sangaku**
Antonietta Constantino, ES de Miraflores
- 13:00 Break for lunch
- 14:30 **Magic Show**
Lennart Green, World Champion close-up/card Magician
- 15:30 **Mathematical Quilts**
Andreia Hall, University of Aveiro
- 16:00 Coffee-Break
- 16:30 **Bocage and Mathematics**
Filipe Papança, Militar Academy
- 17:00 **Five Years of Ludus Association**
Carlos Pereira dos Santos, ISEC
- 17:30 **Leonardo of Pisa (Fibonacci)**
Keith Devlin, Stanford University
- 18:30 Wine Tasting (Rota dos Vinhos do Alentejo)
- 19:30 Conference Dinner

Saturday, 30th April

- 9:30 **What if all middle school mathematics education were presented as recreational mathematics?**
Keith Devlin, Stanford University
- 10:30 **One Notices on the Creation and use of Pedagogical Games in the Mathematics Lessons**
Ana Júlia Martins, University of Évora and ISEC
- 11:00 Coffee-Break
- 11:30 **Winning Nim with Beatty and Fibonacci**
Maria Joana Torres, University of Minho
- 12:00 **Treason Game**
João Cabral, University of Azores
- 12:30 **Slimetrail for the Visual Impaired**
Carlota Dias, High School Matias Aires
- 13:00 Break for lunch
- 14:30 **The Last Geometric Argument in the History of Pi**
Carlos Pereira dos Santos, ISEC
- 15:30 **Games ClubeMath**
Maria do Céu Soares, New University of Lisbon
- 16:00 Closing Session

4 Abstracts

Mathematical Circus

ADELAIDE CARREIRA, University of Lisbon

ALEXANDRE SILVA, University of Lisbon

ANA ELIETE, University of Lisbon

ANABELA TEIXEIRA, Museum of Science, University of Lisbon

ANDREIA HALL, University of Aveiro

FILOMENA CARREIRA, University of Lisbon

INÊS LEITAO, University of Lisbon

JOANA FERNANDES, University of Lisbon

JORGE NUNO SILVA, University of Lisbon

MARTA DUARTE, University of Lisbon

TERESA INÁCIO, University of Lisbon

TIAGO SANTOS, University of Lisbon

VALTER NUNES, University of Lisbon

Inspiring, informative, entertaining and astonishing. This is our circus:
Good mathematics, lots of fun!



Five Years of Ludus Association

ALDA CARVALHO, ISEL

ANTONIETA CONSTANTINO, ES Miraflores

CARLOS PEREIRA DOS SANTOS, ISEC

CARLOTA DIAS, High School Matias Aires

HELDER PINTO, University of Lisbon

JOÃO PEDRO NETO, University of Lisbon

JORGE NUNO SILVA, University of Lisbon

LILIANA MONTEIRO, University of Lisbon

SANDRA VINAGRE, University of Évora

Ludus is 5 years old. Portugal is not the same since the child was born!

Vogeler's Diagram and Rational Derived Polynomials

ALDA CARVALHO, ISEL

CARLOS PEREIRA DOS SANTOS, ISEC

Students usually don't like problems with irrational solutions: humans like the whole numbers! In this work we present some ideas on the construction of problems (geometry and calculus) with whole solutions. We illustrate the little-known Vogeler's diagram and the problem of rational derived polynomials.

Hidden Secrets of Times-Tables

ANDREIA HALL, University of Aveiro

ROSA AMÉLIA MARTINS, University of Aveiro

Mathematics play an important role in quilt making. Tiling, symmetry, fractals, reptiles and Voronoi diagrams are just a few of many mathematical concepts that can be used and explored in patchwork. In this talk we shall present some quilt examples that use mathematical models.

*One Notices on the Creation and use of
Pedagogical Games in the Mathematics Lessons*

ANA JÚLIA MARTINS, University of Évora and ISEC

With this research we intend to contribute for the improvement of mathematics' learning results of the students of third and fourth grades of Elementary School of Serra da Vila . In this way, we tried to create pedagogical games to induce in pupils the motivation for learning this subject. With this purpose, we created and used games based on the preferences that students revealed in school and in the difficulties they have showed in the application of some curricular concepts.

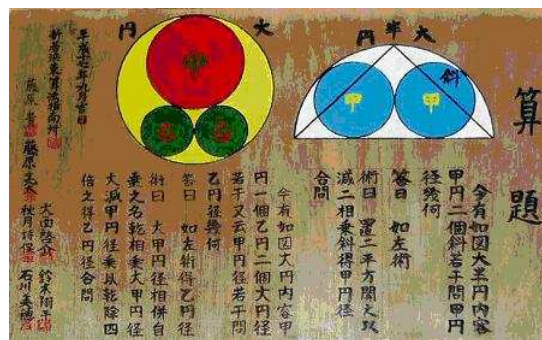
It is an almost-experimental study, where two classes from the third and fourth grades of Elementary schools participated. The class from Serra da Vila school worked as an experimental group and the class of Bordinheira school as a control one.

In the final part of the work, we compare the results obtained by the students before and after the application of the games, and we found that after its use there was a positive change in their results. Thus, we concluded that these games created from tastes and preferences of pupils show some potential on improving pupils' attitude in the class under study towards math lessons, and also in obtaining better results in the evaluation tests, allowing to increase students' success in this area.

Sangaku

ANTONIETA CONSTANTINO, ES de Miraflores

Sangaku are Japanese geometrical puzzles painted on wooden tablets created during the Edo period (1603-1867), when Japan was isolated from the rest of the world. The *Sangaku* hung in the precincts of shrines as offerings to the gods.



The Football Pool Problem

ANTÓNIO MACHIAVELO, University of Oporto

Football pools gave rise to a combinatorial problem related to coding correcting errors that is still far from solved. In this talk we will describe this problem, some of what is known about it, and some of what we would like to know. But mostly, we will try to show how to have some real fun with it!

The Last Geometric Argument in the History of π

CARLOS PEREIRA DOS SANTOS, ISEC

ALDA CARVALHO, ISEL

Archimedes presented a classical geometric method to obtain a good approximation of π . Other issues, such as a proof of the irrationality of π were only possible with the rising of calculus (it is still not known any geometric proof). In this work we present a very recent geometric justification related to π (presented in a Wastlund's paper (Am. Monthly, 2007)) and its consequences.

On a Certain Chaotic Game

CARLOS RAMOS, University of Évora

MARTA RIERA, University of Évora

We propose a family of games which involves the chaotic behavior of a purely mechanical system. Perturbations in the game parameters changes the game from a trivial one to an almost purely chance game. We discuss if, in between the two extreme cases, we can (or not) obtain interesting games, involving ability, perception and strategy.

Slimetrail for the Visual Impaired

CARLOTA DIAS, High School Matias Aires

PEDRO PALHARES, Institute of Education, University of Minho

JORGE NUNO SILVA, University of Lisbon

Our perception of the world around us depends on our visual perception, the same happens in identifying and learning a mathematical game. The child with poor vision has other difficulties when apprehending a game, and its adaptations must take dimension and color of the material into account. “The final area in which information must be collected is the accessibility of both materials and the presentation of information. (...)” (Castellano, 2010a).

According to Blanco & Rubio (1993) most of our judgments concerning what goes on around us, under normal circumstances, including a significant part of our knowledge of the world and ourselves, present themselves in the form of visual images. Thus, being blind keeps one from accessing a certain type of information, which makes it impossible to represent the world as being seen.

The repercussions of the visual deficits affect merely adaptive questions, known as Activities of Daily Life, as well as the capacity to access cultural information through the usual means. Therefore, a visually impaired person must optimize his/her sensory systems.

A blind child apprehends a game mainly by touch. “Blind people recognize objects by touch or by sound. Recognition is not dependent on a particular sensory modality. (...)” (Smith, 2009). Tactile identification is essential to learn the rules of a game to handle its pawns and identify the moves. The haptic system is the foundation of this whole process.

“The haptic system, unlike the other perceptual systems, includes the whole body, most of its parts, and all of its surface. The extremities are exploratory sense organs, but they are also perforatory motor organs; that is to say, the

equipment for feeling is anatomically the same as the equipment for doing. This combination is not found in the ocular or the auditory system. We can explore things with the eyes but not alter the environment; however we can explore and alter the environment with hands. (...)" (Gibson, 1966).

But playing games is also understood as a method of acquiring social skills as soon as possible. "Get your child ready for the many structured and unstructured play situations he/she will encounter in the early years(...)" (Castellano, 2010b).

The prime objective of this research is the creation of conditions that enable the participation of children and youngsters with visual handicap in the National Championship of Mathematical Games, as well as the implementation of the practice of its games in the educational system, developing gaming skill through the creation and perfection of strategies. The method used falls in the qualitative research, with information being collected through direct observation in two separate stages. During the first stage a series of tests to the different game boards and respective pawns with variety in dimension, form, texture and color were conducted. A set a rules in braille, enlarged, or orally explained, depending on the needs of the student, was made available. The second observation stage assumes that the student already has a good domain of the game that allows him or her to develop skills at the levels of communication and strategy creation. The investigation project is, at this time, at the end of stage one. The evolution process of the adapted game *Slimetrail* is being presented in this communication. It resulted in two different versions, one for low vision and another for blindness.

References:

- Blanco, F. & Rubio, M. (1993). Perception Sin Vison In Psicología de la Ceguera, 3, (p. 51-110). Madrid: Alianza Editorial.
- Castellano, C. (2010a). Academics In Getting Ready for College. Begins in Third Grade, 2, (p. 17). Charlote, North Carolina: Information Age Publishing, Inc.
- Castellano, C. (2010b). Social Awareness and Social Skills In Getting Ready for College. Begins in Third Grade, 5, (p. 71). Charlote, North Carolina: Information Age Publishing, Inc.
- Gibson, J. (1966). The Haptic System and its Components In The Senses Considered as Perceptual System, VI, (p. 99). Westport: Greenwood Press, Publishers.
- Smith, E. & Kosslyn, S. (2009). Achieving Visual recognition: Have I seen you before? In Cognitive Psychology, 2, (p. 70). New Jersey: Pearson Education.

The shape of the sound: from bird singing to western music

CARLOTA SIMÕES, University of Coimbra

The solid but discrete relationship between Mathematics and Music is at least as old as Pythagoras. Mathematics relates with Music at the moment of tuning an instrument, since consonant notes are produced by sounds whose frequencies have interesting mathematical relationships.

The problem of tuning a musical instrument began as a problem of proportions, when the instrument was the vibrating string, but became even more interesting when the piano was created, requiring a tempered tuning discovered only after the intervention of mathematicians.

However, without any knowledge of arithmetics, birds from all over the world accurately reproduce the several intervals of the diatonic scale and sing melodies in different musical scales created by man throughout the ages, from the Greek modes to the diatonic scales of our days.

Juggling: Theory and Practice

COLIN WRIGHT, Liverpool Mathematical Society

Juggling has fascinated people for centuries. Seemingly oblivious to gravity, the skilled practitioner will keep several objects in the air at one time, and weave complex patterns that seem to defy analysis.

In this talk the speaker demonstrates a selection of the patterns and skills of juggling while at the same time developing a simple method of describing and annotating a class of juggling patterns. By using elementary mathematics these patterns can be classified, leading to a simple way to describe those patterns that are known already, and a technique for discovering new ones.

A dynamical approach to necklaces and words

CRISTINA SERPA, University of Lisbon

JORGE BUESCU, University of Lisbon

We use concepts from dynamical systems, namely periodic orbits in circle maps, together with combinatorial and counting arguments, to generate aperiodic necklaces and Lyndon words.

Syzygies played by elementary school students

DORES FERREIRA, University of Minho

PEDRO PALHARES, University of Minho

JORGE NUNO SILVA, University of Lisbon

The mathematician Charles Lutwidge Dodgson, well known by the pseudonym of Lewis Carroll, besides being the famous author of “Alice’s adventures in wonderland” he was also the inventor of a variety of games and puzzles. Lewis Carroll liked to play with words and one of his inventions was a word-puzzle that he named Syzygies. As part of a research involving games, in the last few months elementary school students have played Syzygies. In this presentation we will present the results of this practice as well as the learning process and others possible connections with mathematics.

Recently Solved Problems

EDWARD PEGG, Wolfram Research

Today, nearly everyone has access to a supercomputer. This has allowed many problems to be expanded or solved, such as Paterson’s Worms, Mrs. Perkins’s Quilts, Fusible numbers, Rubik’s cube, the first 5 trillion digits of Pi, Setups for Texas Holdem Poker, and other problems. There are some problems that haven’t been looked at recently, such as the no-3-in-a-line problem. The talk will answer “What can you do with a supercomputer?”

Bocage and Mathematics

FILIPE PAPANÇA, Militar Academy

This communication analyzes the Mathematic knowledge in some poetry of Bocage and the politic and scientific context in the second part of the eighteenth century. Also, it analyzes the influence of his military formation in acquisition of Mathematic knowledge.

Shannon Switching Game and Variants

ILDA PEREZ, University of Lisbon

The Shannon switching game, introduced by R.W. Shannon circa 1960, is a two-player game on an undirected graph with two distinguished vertices. The players, Join and Cut, alternately choose one unplayed edge of the graph. Join makes the chosen edge invulnerable to deletion and Cut deletes the chosen edge. The objective of Join is to make invulnerable a path connecting the distinguished vertices while the objective of Cut is to prevent Join from succeeding.

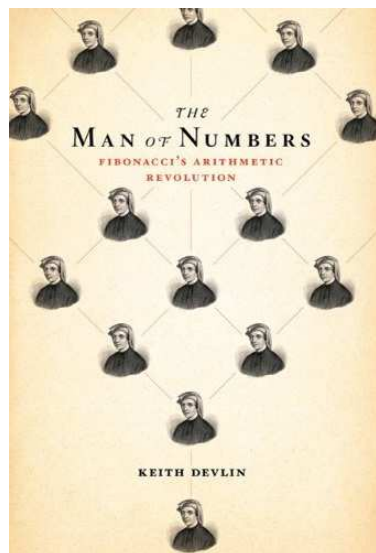
The game was completely solved by A. Lehman in 1964 by considering its

natural extension to matroids. In 1987, Y.O. Hamidoune and M.Las Vergnas introduced and solved directed versions of the game for graphs, conjecturing naturally their generalization to oriented matroids. Despite some recent results Hamidoune-Las Vergnas conjectures remain wide open. We review the main ideas of the analysis of the graphical, undirected and directed, games.

Leonardo of Pisa (Fibonacci)

KEITH DEVLIN, Stanford University

A new book on Leonardo of Pisa (Fibonacci) is coming out in July. This book is the first ever complete biography of him. This talk is about Leonardo's contribution to establishing modern recreational mathematics.



What if all middle school mathematics education were presented as recreational mathematics?

KEITH DEVLIN, Stanford University

With videogames, this is starting to look like a real possibility. To be sure, the term “recreational mathematics” has come to be regarded as meaning a particular subset of mathematics, but that is largely a result of the media of presentation. At heart, recreational mathematics is about doing mathematics as a pleasant pastime – for fun. Videogames offer an opportunity to present the entire middle school mathematics curriculum in that fashion. My talk is based on five-years experience working with a large videogame company in Silicon Valley.

Some Math Problems with Trains and Railways

HELDER PINTO, University of Lisbon

One of the most important teacher's tasks is to find problems that are appealing to their students. There are many interesting problems/puzzles that are true classics (for example, the riddles of Sam Loyd, Henry Dudeney and Lewis Carroll), but do not always have a sufficiently appealing and attractive context to today students - although they remain current and relevant, in their mathematical aspects, as the day they were created. However, with a little imagination and work, these problems can be adapted to different contexts, more modern as, for example, transports, sports, and the everyday life. The talk that will be presented will show some examples of well known problems/puzzles which have been adapted to trains and railways (theme, so the author has found, that seems to be part of the imaginary of everyone, whether kids or grown-ups) and published on a book by the Portuguese Society of Mathematics (*Matemática & Comboios*, 2010). The choice of this particular theme is due to the author's own interest in this subject and will try to show that the same mathematical problem/puzzle may have various formulations in the quest to find something that is truly meaningful and interesting to the audience (usually children and adolescents) that is intended.

Predominance Game

HELENA SOUSA MELO, University of Azores

JOÃO CABRAL, University of Azores

Predominance is a new strategy game for two-player played on a Penrose's tiling board with a time control. This game is played in two stages. The first stage is played by the two players putting in position the seventy two pieces on board. The pieces are divided in white and black sets, placed in an alternate way. Each set has four different ranking pieces, ordered by value: four commanders, six knights, ten soldiers and sixteen conscripts. In the second stage of the game, the players can move the pieces and make captures. The movement without capture is characterized by a path on the board that is formed by only adjacent empty cells, but a movement with the intention of capture can be made over non-empty cells. The capture is made replacing one piece, the captured, by the other, the captor. The commander moves the maximum of four adjacent cells; the knight moves the maximum of three adjacent cells; the soldier two cells, and the conscript one cell. The piece can only capture pieces of the same ranking or below. Predominance is a cunning game, playable at several levels of complexity. The game ends when a player reach forty five points in captured pieces. Some winning strategies are explored.

Treason Game

JOÃO CABRAL, University of Azores

HELENA SOUSA MELO, University of Azores

Treason is a two player game played with the usual rules of the checkers game, but played in a different board, with the needed adaptations. Instead of squares we have triangles, and the initial position of the pieces is similar to the checkers game. The board has also in the main diagonal a free battle zone that allows the players to diversify the strategies until a level of complexity very high. One of the main differences between this game and the checkers is that a player has, at least, from one triangle, three possibility lines to play. The name of the game comes from the most important move that allows one player to promote pawns to queens, behind enemy lines. This move gives a chance to queens to sweep literally the enemy pawns by the back, working as a spy in enemy lines. If we imagine a movement of a real soldier with the sword in the hand, he can kill to the left, to the right, in front or to the back. This game reproduces exactly these moves, which are limited in the usual checkers game.

Using Empirical Map Projections for Research, Education and Fun

JOAQUIM ALVES GASPAS, University of Lisbon

A numerical model based on the concept of 'multidimensional scaling', here generalized to spherical distances and directions, was developed and tested, with the objective of simulating the main geometric features of early nautical charts. Starting with a sample of routes defined on the spherical surface of the Earth, the process consists in re-arranging the positions of the points on a plane so that the differences between the initial (spherical) and final (planar) distances and directions between them are minimized. The model proved to be an effective and easy-to-use research tool and may be used, not only for simulating and assessing the various factors affecting the geometry of early charts, but also for educational purposes e.g. for illustrating the properties of map projections.

Medieval Problems

JOAQUIM EURICO NOGUEIRA, New University of Lisbon

The "desert-crossing problems" (also known as the "Jeep problems") have been around since Alcuin of York presented some earlier versions to Charlemagne, emperor of the Franks. In this talk I give a brief account of the history of these problems since Alcuin's era to modern times, explaining their solutions in full detail.

Fooling around with Stable Marriages

JORGE BUESCU, University of Lisbon

In this talk we address a classical combinatorial game known as the *stable marriage problem*. We review classical results as the Gale-Shapley algorithm and present some recent developments.

Games ClubeMath

MARIA DO CÉU SOARES, New University of Lisbon

MARIA DE FÁTIMA RODRIGUES, New University of Lisbon

NELSON CHIBELES MARTINS, New University of Lisbon

ClubeMath is a Club that aims to show a different side of Mathematics, through fun and recreational activities, in order to stimulate skills and interest in this science. Primarily directed to its members, which are students from basic and high schools, *ClubeMath* also involves their parents and groups of mathematical teachers in its activities. We will present some games that were developed for *ClubeMath*'s activities. Namely we will talk about *BingoMath*, *MathTrivial*, *Quem quer ser Mathmático?*, *Jogo da Glória Mathmático*, *Sabes MathMais do que os teus Pais?*, *Assalto às MathMasmorras* and, finally, the most recent *Tetr4Math*, that we intend to develop for future commercialization. All of the aforementioned games were initially created for use in *ClubeMath*'s regular sessions but, meanwhile, they were already applied in different basic and high schools, either for recreational purposes or in the context of reviewing the mathematical knowledge acquired in the classroom.

Winning Nim with Beatty and Fibonacci

MARIA JOANA TORRES, University of Minho

In this talk we describe how Fibonacci representations play a role in determining winning moves for Wythoff's Nim very analogous to the role of binary representations in Bouton's Nim. We relate the winning moves for Wythoff's Nim with Beatty sequences, so named after Beatty's beautiful theorem, first proposed as a problem in The American Mathematical Monthly in 1926.

Extreme Alphametics

MICHAEL KEITH

In this talk we will discuss the construction and solution of new alphametics (puzzles like SEND + MORE = MONEY, where the letters are to be replaced with digits so that the arithmetic is valid) that stretch the boundaries of the form. Our results include base-10 addition problems with thousands of distinct words, new records in doubly-true alphametics (those of the form

SEVEN + SEVEN + SIX = TWENTY), large alphametics in prose and poetry, and other "extreme" variations.

The Mathematics of Cartoons: A Brief Survey

NATÁLIA BEBIANO, University of Coimbra

JASON BOLITO, University of Coimbra

F. CRAVEIRO DE CARVALHO, University of Coimbra

Roughly, a cartoon is a short text and a drawing. The text is incisive, ironic or tragic, however, the text may not exist if the drawing is self-sufficient. The quality of the drawing is important, but not essential. Almost every newspapers publish cartoons, often political cartoons, but, sometimes, they arise in other contexts, the scientific being a particular case. In this paper we intend to analyze some published cartoons with Mathematics as base, looking at some non-trivial examples.

Games for Lazy but Intelligent Parents

RICHARD NOWAKOWSKI, Dalhousie University

Many a long-suffering parent has played the same game over and over with their offspring. The kids want to win but not too easily else they get bored which is even worse than playing the game for the parent. I'll present some games and strategies that promise to keep the kids busy.

Masterclasses and Maths Busking

SARA SANTOS, Royal Institution of Great Britain

Two extremes of maths communication: classes for keen young mathematicians and maths as street entertainment for shoppers and strollers. Two models apparently so different share a common point: exploit the innate human curiosity. We describe the Royal Institution Mathematics Masterclasses for Young People (established in 1981) and the new project Maths Busking and explain how you can get involved to share your passion for mathematics.

Bodies Invisible in Several Directions

VERA ROSHCINA, CIMA-UE, University of Évora

ALEXANDER PLAKHOV, University of Aveiro

We consider bodies moving in a rarefied flow of non-interacting particles (as in the theory of billiards or in geometrical optics) and show that it is possible to construct fractal bodies invisible in 3 directions simultaneously. There are still many open questions, for example, what is the maximal number of directions of invisibility, and whether it is possible to construct connected bodied invisible in 2 directions in 3 dimensional case.

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| | 27/04 - Wednesday | 28/04 - Thursday | 29/04 - Friday | 30/04 - Saturday |
|---------------|----------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------|
| 8:30 - 9:15 | Registration | | | |
| 9:15 - 9:30 | Opening Session | | | |
| 9:30 - 10:30 | Recently Solved Problems Edward Pegg, Wolfram Research | Masterclasses and Maths Busking Sara Santos, Royal Institution of Great Britain | Games for Lazy but Intelligent Parents Richard Nowakowski, Dalhousie University | What if all middle school mathematics education were presented as recreational mathematics? Keith Devlin, Stanford University |
| 10:30 - 11:00 | Bodies Invisible in Several Directions Vera Roshchina, CIMA-UE, University of Évora | On a Certain Chaotic Game Carlos Ramos, University of Évora | The shape of the sound: from bird singing to western music Carlota Simões, University of Coimbra | One Notices on the Creation and use of Pedagogical Games in the Mathematics Lessons Ana Júlia Martins, University of Évora and ISEC |
| 11:00 - 11:30 | Coffee-Break | Coffee-Break | Coffee-Break | Coffee-Break |
| 11:30 - 12:00 | Fooling around with Stable Marriages Jorge Buescu, University of Lisbon | Using Empirical Map Projections for Research, Education and Fun Joaquim Alves Gaspar, University of Lisbon | The Mathematics of Cartoons: A Brief Survey Natália Bebiano, University of Coimbra | Winning Nim with Beatty and Fibonacci Maria Joana Torres, University of Minho |
| 12:00 - 12:30 | Syzygies played by elementary school students Dores Ferreira, University of Minho | Some Math Problems with Trains and Railways Helder Pinto, University of Lisbon | Extreme Alphametics Michael Keith | Treason Game João Cabral, University of Azores |
| 12:30 - 13:00 | Vogeler's Diagram and Rational Derived Polynomials Aida Carvalho, ISEL | Predominance Game Helena Sousa Melo, University of Azores | Sangaku Antonieta Constantino, ES de Miraflores | Slimetrail for the Visual Impaired Carlota Dias, High School Matias Aires |
| 13:00 - 14:30 | Break for Lunch | Break for Lunch | Break for Lunch | Break for Lunch |
| 14:30 - 15:30 | Juggling: Theory and Practice Colin Wright, Liverpool Mathematical Society | Visit to Vila Viçosa | Magic Show Lennart Green, World Champion close-up/card Magician | The Last Geometric Argument in the History of Pi Carlos Pereira dos Santos, ISEC |
| 15:30 - 16:00 | Medieval Problems Joaquim Eurico Nogueira, New University of Lisbon | | Mathematical Quilts Andreia Hall, University of Aveiro | Games ClubeMath Maria do Céu Soares, New University of Lisbon |
| 16:00 - 16:30 | Coffee-Break | | Coffee-Break | Closing Session |
| 16:30 - 17:00 | The Football Pool Problem António Machiavelo, University of Oporto | | Bocage and Mathematics Filipe Papança, Militar Academy | |
| 17:00 - 17:30 | Shannon Switching Game and Variants Ilda Perez, University of Lisbon | | Five Years of Ludus Association Carlos Pereira dos Santos, ISEC | |
| 17:30 - 18:00 | A dynamical approach to necklaces and words Cristina Serpa, University of Lisbon | | Leonardo of Pisa (Fibonacci) Keith Devlin, Stanford University | |
| 18:00 - 18:30 | Mathematical Circus Adelaide Carreira, University of Lisbon | | Break-Time | |
| 18:30 - 19:00 | Break-Time | | Wine Tasting (Rota dos Vinhos do Alentejo) | |
| 19:00 - 19:30 | Welcome Cocktail (Evora Town Hall) | | | |
| 19:30 - 20:00 | | | Conference Dinner | |
| 20:00 - 0:00 | | | | |