BULLETIN

INTERNACIONAL CENTER FOR MATHEMATICS

June 1997

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Coming events

Summer School on Mathematical Methods of Science and Engineering of Materials

CIM (Coimbra, Observatório Astronómico), August 23 - September 6, 1997

During the first week there will be one basic course of introduction to variational methods in nonlinear elasticity (including Young measures), and two of introduction to models of engineering for material and structural optimization and to homogenization techniques for composite materials (including numerical methods).

These courses are directed to graduate students and young post-docs in Mathematics (functional analysis, differential equations, numerical analysis, ...) and in Engineering (mechanics, materials, ...), interested on research in this area. They will be lectured by: Pablo Pedregal (Ciudad Real, Spain), Noburo Kikuchi (Michigan, USA) and José Guedes (IST, Lisbon, Portugal).

During the first 3 days of the second week there will be specialised courses, aimed at dealing with research topics in this area, lectured by: Allaire, Chipot, Francfort, Kinderlehrer, Luskin, Rogers, Sigmund.

During the last 2 days there will be a workshop in which researchers and students will explain their research results and will present ongoing research works.

Informations:
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via e-mail: mater97@hermite.cii.fc.ul.pt
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Summer School on Mathematical Foundations of Computation

CIM (Coimbra, Observatório Astronómico), September 8 - 11, 1997

The school aims at providing the participants with an overview as complete as possible of the formal methods and techniques useful in computing, namely computability, complexity and semantics of specification and programming languages.

PROGRAM

Courses:

Semantics of Logic Programming
Prof. Dr. José Júlio Alferes (U.Évora)

Logic Programming introduced to computer science the important concept of declarative – as opposed to procedural – programming. Ideally, a programmer should only be concerned with the declarative meaning of the program, while the procedural aspects of programs' execution are handled automatically. Due to its declarative nature, logic programming quickly became a candidate for knowledge representation.

For its proper use as a tool for knowledge representation, logic programming must be equipped with a precise meaning or semantics. In this course we begin by motivating for the need of a semantics for logic programs with negation, and presenting the problems involved in making such a definition. Several attempts to the definition of a semantics for logic programs are then presented, such as the completion semantics, stable models, answer-set, and the well-founded semantics. We proceed by relating logic programming semantics to some well known formalism for non-monotonic reasoning and knowledge representation. Finally, it is shown how logic programming equipped with a proper semantics can be used to solve knowledge representation problems.

Domains and Denotational Semantics

Prof. Dr. Luís Monteiro (FCTUNL)

The generalized use of recursion is one of the more salient features of the nature of definitions in computer science. What is typical of the nature of recursion is that an entity is defined in terms of itself, where the parts already defined are systematically used in the definition of the remaining parts. At the end of the decade of 1960, Scott proposed a theory of computation based on the notion of partiality, to give meaning to any kind of recursive definitions, like procedures, functions, relations and types. Scott's theory had an enormous impact in all areas of computer science, including the denotational semantics of programming languages. In this course we review the main constructions of Scott's theory and its application to denotational semantics. Several areas where the theory has not found so far a satisfactory application, like concurrency, and recent proposals to deal with such problems will be mentioned.

Algebraic Combination of Logics

Prof. Dra. Cristina Sernadas (ISTUTL)

The field of combination of logics has recently attracted much attention triggered namely by software engineering and artificial intelligence applications. In this course, several mechanisms for combining logics are analysed from the point of view of category theory. The relevant categories (such as interpretation systems, satisfaction systems, Hilbert calculi, derivation systems and consequence systems) are presented and related via adjunctions. Both (co)limits and (co)cartesian liftings are used for the categorial characterization of combination mechanisms like synchronization (on formulae and on models) and (possibly constrained) fibring. Illustrations are provided with special emphasis on temporal logic. Some preservation results (soundness and completeness) are established. Some open research problems are identified.

Special Sessions

Category Theory, moderated by Prof. Dra. Manuela Sobral (FCTUC).

Computational Geometry, moderated by Prof. Dra. Ilda Perez (FCUL)

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Workshop on nonparametric and semiparametric methods

International Center for Mathematics - Human Capital and Mobility Network

The Group of Probability and Statistics of the Department of Mathematics of the University of Coimbra is organizing a workshop integrated into the programme of activities of CIM and within the HCM project Nonparametric and Semiparametric Statistical Methods. The aim of this workshop is to promote and disseminate information, particularly amongst young researchers, in new scientific areas like Non-linear Models and Nonparametric and Semiparametric Inference and to bring together various teams involved in the project. The general programme will include invited and contributed papers and two short courses on those areas presented by Profs. M. Hallin (Univ Libre de Bruxelles) and K. F. Turkman (Univ. Lisboa).

Invited speakers:

M. Hallin (Univ. Libre de Bruxelles)
K. F. Turkman (Univ. de Lisboa)
J. Beirlant (Catholic Univ. of Leuven)
H. Tong (Univ. of Kent) (to be confirmed)
W. Hardle (Humb. Univ. zu Berlin) (to be confirmed).

Place: Dep. de Matemática - Universidade de Coimbra

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Mathematical research in Portugal: trends, organization and perspectives

Debate - International Center for Mathematics

Coimbra, December 1997

The assessment of Portuguese research units carried out last year, with immediate effects on their respective grants, yields a good opportunity to reopen the debate on the orientation of research activities and policies in Portugal.

The abovementioned assessment had novel characteristics and, without challenging the quality of the evaluation panel nor the relevancy of its comments, it's undisputable that this process raises broad questions to which the Portuguese mathematical community, unless it forfeits its very right to existence, can and should give thought.

CIM organizes the present debate with this intention in mind. It is not the first time, nor will it be the last, that these issues are considered. But the discussion is useful in itself, and contact in some depth with the problems and the diversity of perspectives will make the Portuguese mathematical community more responsible and better prepared.

The debate will be established around dichotomies or "tensions" assumed to be present in the Portuguese mathematical community, or even in each individual mathematician. This does not aim at resolving these tensions, but rather at using them as points of departure for the debate.

News

The CIM Scientific Committee had its first ordinary meeting on the 22nd March 1997. All the european members were present. The members from America (Richard Brualdi, Jacob Palis and Efim Zelmanov) were unable to come to Coimbra.

In this meeting Professor Hugo Beirão da Veiga was elected President of the Scientific Committee and Professor Paula Oliveira was elected Secretary.

The Scientific Committee discussed the activity plan submitted by the Directors. ∇

The CIM congratulates Professor José Luiz Fiadeiro on his being awarded the IBM 96 Prize for his work *Emergência em Sistemas de Software Complexos*.

Professor Fiadeiro gained his Ph.D in 1989 from the Instituto Superior Técnico, under the supervision of Professor Amílcar Sernadas and he is Associate Professor at the Departamento de Informática da Faculdade de Ciências da Universidade de Lisboa. ∇

On the 25th and 26th March 1997 a cycle of talks on Convex Bodies by Prof. S. A. Robertson took place. These talks are the subject of Publication n° 3 of CIM – Three talks on convex bodies, already available. ∇

Prof. J. A. Green delivered a talk entitled One hundred years of Group Representations on the 5th May 1997. The text of this talk will be published by the CIM. ∇

Stewart Alexander Robertson was born in Dundee, Scotland, in 1933. He studied at the universities of St Andrews and Leeds, lectured at the University of Liverpool, and has held a Chair of Pure Mathematics in Southampton since 1970.

In his career he supervised some twenty Ph D theses and introduced several important geometrical concepts (*Transnormality, Exact Fillings, Parallel Immersions*, to mention a few).

His interest in the popularisation of Mathematics led to the participation in *The French Museum Competition*, organized by *The Mathematical Intelligencer*, in 1981, in which he was awarded third prize, and to an invitation to contribute to the London Mathematical Society's Popular Lecture series in 1994.

Professor Robertson has strong links with Portugal and in May 1996 the Maths Department of Coimbra University held a *Topology and Geometry Day* in his honour.

May be you would like to start by telling us when you first realized that you would become a mathematician. Was there an adequate atmosphere for maths at school, or a particularly influential teacher?

'When I was very young, maybe only five or six years old or thereabouts, I wanted to be a scientist, which I imagined involved wearing a white lab coat and making all kind of marvellous discoveries that would make the world a wonderful place to live in. The source of this was the illustrations in a serial publication by one of the national newspapers, dedicated to the proposition that science was the key to future happiness. The second world war, ending with the two atom bombs, rather changed that fantasy, and besides, one day in the chemistry laboratory at school, I got a mouthful of caustic soda in an accident with a pipette. So I came quickly to the conclusion, at the age of about thirteen, that perhaps theoretical pursuits were a lot safer. I retain, however, a strong liking for the design ideas that permeate the Art Deco movement, which was very much part of the childhood experience of my generation. I attended the local school in the town (Broughty Ferry) where I grew up, a fairly large coeducational comprehensive in the long-established Scottish tradition. My teachers were very dedicated, and all were well-qualified academically. I remember the day when we were introduced to the idea that mathematical theorems did not just have to be learned as facts, but could be proved in the spirit of Euclid. This seemed to me very exciting, and I suppose that set me on course towards a mathematical career, although at that time I had no idea of what such a life could be. Like many of my generation, I was the first member of my family ever to attend a university. Of all the many people who have helped me, I think I owe most to D.E Rutherford, who was a great teacher at the University of St Andrews, with a wonderfully ironic sense of humour and sceptical outlook.'

You contributed to several areas in Geometry. Is there one you would like to single out, either because you obtained major results or the results were particularly pleasing?

'Every professional mathematician hopes that some of their work will survive as part of the mathematical corpus stored up in the textbooks and studied by future generations. I should like to think that I have made a small contribution to the theory of symmetry for convex bodies, as a foot soldier in the Euclidean army. Geometrical symmetry has been my main interest since I came across the Platonic solids in my early undergraduate days, and I now feel that I am beginning to understand these and associated strange objects quite well. This has given me a great deal of pleasure.'

You have had a long career in research. Was or is there a problem whose solution eluded you?

'We all have a private file of pet unsolved problems. The one I should most like to see someone resolve in my lifetime concerns a topic that developed from a study of paper folding. This lead to the concept of isometric folding for Riemannian manifolds. In particular, an isometric folding of an ordinary two-dimensional sphere is a map of the sphere to itself that sends each piecewise geodesic path on the sphere to another of equal length. It is conjectured that the space of all such maps that are not actual isometries, with the 'obvious' topology, is pathwise connected. So any such isometric folding can be deformed, through isometric foldings, to the map sending (x, y, z) to $(x, y, |z|)$, $x^2 + y^2 + z^2 = 1$. So far, all efforts to decide this one way or the other have run into the sand. Another favourite is the conjecture that the only nontrivial automorphism of the symmetry type structure in the space of convex bodies is the duality involution. I have not the faintest idea about how to tackle this problem.

There is a third problem that I first thought about more than thirty years ago, and which has been taken up by various colleagues, who have succeeded in solving some special cases, even if the original problem remains tantalisingly out of reach. This concerns the set of focal points of a smooth (say C^∞) connected compact hypersurface M without boundary, embedded in euclidean $(n+1)$-space E^{n+1}. Any such M partitions E^{n+1} into two connected regions with M as common boundary. One of these is unbounded, and we call this the *outside* of M. The other is bounded, and we call this the *inside* of M. Now there is a map η from $M \times \mathbf{R}$ to E^{n+1} which assigns to each pair (x, t) the unique point $\eta(x, t)$ of E^{n+1} that lies at (signed) distance t along the inward-pointing normal line to M at x. This map conjecture in full generality, even for $n = 2$, remains unsettled, to the best of my knowledge.

I am not as confident as I once was that the conjecture is true.'

How do you see the development of Mathematics in this century? Which is the mathematical achievement you would like to point out as the most important one?

'I think that questions of this kind should be asked of much better mathematicians than myself. I don't really know enough about the general shape of the subject, nor do I have a good enough grasp of the detail

is smooth and the image of any singular point of η is called a **focal point** or *centre of principle curvature* of M. I suggested to my very first research student, Sheila Carter (now at the University of Leeds), that 'as an exercise' she should prove the conjecture that the intersection of the set of focal points of M with the inside of M is nonempty. It soon became clear that this was by no means a straightforward 'exercise', and it took a lot of effort to make any progress at all. It is known, for example, that the conjecture is true if the inclusion of M in the closure of its inside induces an epimorphism of fundamental groups. Likewise, the conjecture is true if the fundamental group of M is abelian. However, the in many key areas of current research. From my colleagues, I have gained some sense of how the really big discoveries of the nineteenth century are still being worked out. For example, the interaction of hyperbolic geometry, group theory and topology looks like one of the most fruitful and exciting areas of current research, with the prospect of great things still to come. Others might draw attention to the cross-fertilisation between geometry and theoretical physics in recent years. This is of course not new to the extent that it continues a tradition going back at least as far as Pythagoras, but it is important that it does continue: topics in pure mathematics tend to degenerate, in my opinion, if they lose contact with the world of physical experience; conversely, the progress of science can be impeded by failure to recognise known mathematical structures and patterns. For reasons already indicated, I feel incompetent to judge which are the most important results of this century, but one obvious candidate is Gödel's theorem. Likewise, a candidate for the most dramatic achievement must be Wiles' solution of the Fermat problem. At a more general level, there is a striking difference in the way that mathematics is written down by present day mathematicians, compared with their predecessors in earlier centuries. There is now a standard language, and apparently a much higher level of rigorous argument. Unfortunately, this does not help much in the avoidance of errors, and clarity of expression is no substitute for creativity and insight.'

Now that you are about to "ride off into the sunset", how would you like to be remembered by your former students? You have had quite a large number of research students over the years. Would you like to comment on the two-way process involved in the supervision of a PH D dissertation?

'I hope that most of my research students will remember their years at Liverpool or Southampton with nostalgia for a time that may have seemed dominated by hard work but also included lots of laughs. Supervising research students is very stimulating because it forces you to focus on problems that you might otherwise leave aside, and it also creates a feeling of urgency to get things finished, since nearly all students are short of both time and money. It is also very rewarding to see young mathematicians developing self-belief as they begin to produce original work of their own. Good research students always produce good ideas, and it is a great feeling when a research project starts to succeed in a variety of directions at once as a kind of community effort. One of the longer term benefits for me is that almost all of my students have obtained permanent university positions, and several have continued to work with me on joint research projects over many years. I shall miss that part of my professional life very much, even if I shall no longer be under continuous pressure to finish that proof, or produce those diagrams, by yesterday at the latest. I have been lucky to have research students not only from the UK, but also from various parts of the Middle East, Africa, and mainland Europe, including Portugal. This has given me an insight into other cultures and intellectual traditions, and a sense of belonging to a world-wide community, much of which is struggling to survive in difficult economic and social conditions. I believe that the learned societies have a big responsibility to provide leadership and to try to help mathematicians all over the world both directly and by advising policy makers. I am pleased to have had seen the progress of such work in close-up as an officer in the London Mathematical Society and in the now emerging European Mathematical Society.'

What do you think the future holds for you in terms of intellectual work? We know that you do not want to pursue further mathematical research.

Although I have no plans to start new research projects, I hope to finish a couple of expository pieces of work that might one day appear in book form. I should like very much to develop other interests that began in early childhood, and now find expression in the study of poetry, painting, drawing, photography, aesthetics and philosophy. One dream, which I shall probably fail to turn into reality, is to produce a study of the aesthetics of pure mathematics. Retirement brings escape from the hurly-burly of everday university life, but it isn't really feasible to continue at professional level in technical mathematics without being a full-time member of the working community. Besides, I'll soon be too old and doddery for that sort of thing, and may have reached that state already.

Professor Mira Fernandes

Mira Fernandes was born on the 10th June 1884.

He came to be known as a man of exceptional qualities, whose success was due not only to his remarkable gifts, but also to a rigorous self-awareness and unremitting hard work.

He gained his doctorate degree in March 1911 from the now defunct Faculty of Mathematics, of the University of Coimbra, and in November of the same year was invited by Alfredo Bensaúde to take up a lectureship in the Technical College (*Instituto Superior Técnico*), which had been founded that same year. He began by lecturing in General Mathematics, but the subjects in which he excelled and which he taught until his retirement were Integral, Differential and Variational Calculus (2nd year) and Analytical Mechanics, in the 3rd year. From 1918 he became head of Mathematical Analysis at the former Business School (*Escola Superior de Comércio*).

rigour. His lessons and dealings with his students revealed the calm of a contented man. However, he was not ambitious, despite being of meagre means, and did not pursue a structured career or concern himself with posterity.

He died on the 19th April 1958. It was justly decided that his body should lie in state at the Technical College, of the Technical University of Lisbon, and the vigil and funeral procession was attended by many people. Most of these were former students come from all over the country to pay their last respects to their former teacher. It was a grand and moving spectacle, befitting such a great man.

The following extract is taken from his speech '25 years' which he made at the already-existing College of Economics and Finance (*Instituto Superior de Ciências Económicas e Financeiras*):

Aureliano de Mira Fernandes aged 70, in 1954

Professor Mira Fernandes was an unassuming personality. Although sensitive, he tended to be very direct and spoke his mind. However, he was of sound character, clearly defining the rules of any game, and, almost ingenuously, expecting the same treatment from others.

As far as his professional life was concerned, he was a wise and thorough teacher, always presenting original work, and simplifying without sacrificing academic

'I do not wish to tire you by referring to every one of the amazing achievements of theoretical research, which has moved at a rapid pace during these twenty five years. However, I do wish to remember and honour the great efforts and unending struggle for knowledge of all those involved in the teaching profession, men who finished their own studies at the beginning of the century but who had a great passion for learning... All this so that teaching would not be a treacherous mission.'

He would go on to define the greatest precept of ethical responsibility of the university lecturer.

During the first seventeen years of his career as a lecturer, Mira Fernandes went beyond the requirements of the syllabus and prepared excellent courses that he would perfect and update each day. He continued in this way throughout his career. By his own definition, his first work was the paper 'Sur l'écart géodésique, la courbure riemannienne et la associée de Bianchi', published in *Rendiconti della Realle Academia Nazionnale dei Lincei*, March 1928. This work was actually the outcome of another, presented in Coimbra in 1925 at the conference of the combined Portuguese and Spanish Associations for Scientific Progress, in which he presented a fundamental formula generalizing another developed by Levi-Civita.

This was the start of a long and fruitful correspondence between the two men. Between 1928 and 1938, the results of his most important research into Analysis, Differential Geometry, Mechanics and Mathematical Physics were handed over to the Linces Academy, and almost all works were presented by Levi-Civita. The most notable from this period were three notes upon the unitary theory of physical space (1932-34), before the exchange was rudely interrupted by the Second World War.

A brief reference to a publication 'Conessioni finiti' (Port. Math. 1945) is also in order. In this work, he very courteously proved that Einstein's article 'Bivector Fields II' contained a mistake in a certain formal inference.

His last piece of scientific research was in 1957, one year before his death. This was published in the Journal of Lisbon Science Faculty, and was entitled 'Estensori jacobiani parziali e derivati'. Nowadays, when it seems that more attention is given to the publishing of scientific research than to the quality of the work itself, these efforts of Mira Fernandes are notable as works of true research, dedicated to extending the boundaries of knowledge.

Besides his extensive courses, which he taught but never wrote down, Mira Fernandes left approximately a hundred pieces of written work, including essays, historical pieces about great scientists, and courses for the Institute for Advanced Studies at the Academy of Science on Modern Conceptions of Mechanics, in which he analysed the Theory of Relativity and Quantum Mechanics, among others. Everything to which he turned his attention was given a new perspective by him, as all who knew him will vouch.

We might apply to Mira Fernandes words which he himself used about Lagrange, the father of Analytical Mechanics, on the bi-centenary of that scientist's birth:

'To define, clarify and generalize were the main objectives of his scientific work.'

Mira Fernandes was always at the vanguard of scientific knowledge, and was at ease in the company of the great personages who have constructed World Science and, ultimately, World History.

We will conclude with a snatch of conversation brought to our attention indirectly by his elder daughter, with the characteristic sincerity that she has inherited from her father. It concerns a certain letter:

'...a letter, yes, there was a letter, but at this distance it is difficult to be precise... There was an invitation to Princeton, that is certain... for him, the family, all of us, and it was certainly not just for one day or one week... He did not accept.

Princeton! It is well-known that Einstein left Europe in 1933 and made his base there. That must have been around the same time...'

Manuel José de Abreu Faro
(Universidade Técnica de Lisboa)

(Adapted translation)

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