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Preface

Many problems are naturally expressed in terms of constraints, for example, scheduling, design, configuration, and diagnosis problems. The constraint programming community is providing the infrastructure for understanding and computing with constraints. The Second International Conference on Principles and Practice of Constraint Programming brings together members of this community to share recent progress.

The conference is dedicated to Paris Kanellakis, who died in a tragic airplane crash in December of 1995. He was one of the founders of this conference and a pillar of this community. A Kanellakis Prize was awarded to the paper that best exemplifies the interdisciplinary spirit of the conference.

Thirty-six papers will be presented at the conference, selected from over one hundred submissions. Twenty-two selections will be presented at a conference poster session. Full text of the papers and abstracts of the posters are included in the proceedings.

The conference has received support from Applied Logic Systems, Inc. (ALS) and the Office of Naval Research (ONR). The Kanellakis Prize has received sponsorship from MIT Press, Peter Revesz, and Springer-Verlag. The Conference is being held in cooperation with the American Association for Artificial Intelligence (AAAI), the Canadian Society for the Computational Studies of Intelligence (CSCSI), and Tufts University. The Program Chair received invaluable assistance from Daniel and Mihaela Sabin.

Updated information about the conference will be posted at the conference web site: <http://www.cs.ualberta.ca/~ai/cp96/>. The conference will be held in Cambridge, Massachusetts, USA, August 19–22, 1996.

July 1996

Eugene C. Freuder, Program Chair
Durham, New Hampshire, USA

In Memoriam: Paris C. Kanellakis



On December 20, 1995, Paris C. Kanellakis died unexpectedly and tragically, together with his wife, Maria-Teresa Otoyá, and their children, Alexandra and Stephanos. They were heading to Cali, Columbia, for an annual holiday reunion when their airplane crashed in the Andes.

Paris was born in Greece in 1953. He graduated in electrical engineering from the National Technical University of Athens in 1976; his undergraduate thesis was entitled *Easy-to-test Criteria for Weak Stochastic Stability of Dynamical Systems* and was supervised by Prof. E.N. Protonotarios. In 1978, Paris received his M.Sc. thesis in electrical engineering and computer science from the Massachusetts Institute of Technology. His M.Sc. thesis, *Algorithms for a Scheduling Application of the Asymmetric Travelling Salesman Problem*, was supervised by Profs. R. Rivest and M. Athans. In 1982, he was awarded his Ph.D. degree from the same institution; his thesis was supervised by Prof. C.H. Papadimitriou and was entitled *On the Complexity of Concurrency Control for Distributed Databases*.

Paris joined the department of computer science at Brown University as assistant professor in 1981. He was promoted to associate professor with tenure in 1986, and to full professor in 1990. He was awarded an IBM Faculty Development Award in 1985 and an Alfred Sloan Foundation Fellowship in 1987. He served as an associate editor for the *Journal of Logic Programming* and for the new journal *Constraints*, as well as for *Information and Computation*, *ACM Transactions on Database Systems*, *SIAM Journal of Computing*, and *Theoretical Computer Science*. He served as invited speaker, program chair, and program committee

member at many prominent conferences. In the constraint programming area, he was program chair (together with J.-L. Lassez and V. Saraswat) of the First International Workshop on Principles and Practice of Constraint Programming, held in Newport in April 1993. This workshop, and the subsequent one held in Orcas Island by Alan Borning, were instrumental in starting the series of constraint programming conferences and Paris played a critical role in organizing the community and the conferences. In the related area of logic programming, he was an invited speaker at the 6th International Conference on Logic Programming in Lisbon, where his talk was entitled *A Logical Query Language with Object Identity and Strong Typing*. He was on the program committees of logic programming conferences in 1989, 1990, 1992, 1993, and 1996.

As a scientist, Paris was a careful thinker, investigating fundamental issues in computer science, opening new technical areas, and challenging conventional belief whenever appropriate. He made numerous contributions to computer science in areas as diverse as databases (relational, object-oriented, and constraint databases, concurrency control), programming languages (lambda calculus, logic programming, rewriting systems, type inference), distributed computing (concurrency and fault-tolerance), complexity theory, and combinatorial optimization. Underlying those contributions was a unifying theme: the use of logic, complexity theory, and algorithmics to understand the foundations of practical systems, to analyse their efficiency, and to improve their functionality. This theme was nicely exemplified in his work on object-oriented databases featured at the logic programming conference in Lisbon. Here his desire to understand the object-oriented database O_2 led him to invent, in collaborative work, an object-based data model, a new formalization of object identity, new programming tools, and new indexing algorithms.

A beautiful account of Paris' recent research accomplishments by S. Abiteboul, G. Kuper, H. Mairson, A. Shvartsman, and M. Vardi appeared in the March issue of *ACM Computing Surveys*. It was a major source of inspiration for this short article, in which only some of Paris' contributions to constraint programming (taken broadly) can be outlined.

The first issue of the *Journal of Logic Programming* featured an article by C. Dwork, P. Kanellakis, and J. Mitchell entitled *On the Sequential Nature of Unification*. The paper shows that the decision problem "*Do two terms unify?*" is complete for PTIME which, informally speaking, means that unification cannot be sped up with a polynomially bounded number of processors. This paper was published during a period of intense activity on the parallelization of Prolog. Together with J. Mitchell, Paris subsequently used the essential idea behind the proof to show that type inference in ML was PSPACE-hard, i.e., as hard as any problem that can be solved in polynomial space. This result contradicted the popular belief at the time that ML typing was efficient. His subsequent joint paper, in collaboration with H. Mairson and J. Mitchell, showed the problem to be complete for EXPTIME. Paris' most recent work on the lambda calculus (in collaboration with G. Hillebrand and H. Mairson) led to a new syntactic characterization of the complexity classes, which emerged from their research on

a functional programming foundation for a logic-based database query language.

Together with G. Kuper and P. Revesz, Paris was the founder of the area of constraint databases, whose essential idea is to replace, in the relational model, the concept of tuples by a conjunction of constraints. They investigated the query complexity of this scheme (which parallels in the database world the area of constraint logic programming) for various classes of constraints. Together with his colleagues and his students, he was also engaged in a long-term research to build the implementation technology (in particular, the indexing structures) necessary to make this technology practical. In particular, together with D. Goldin, he investigated constraint query algebras, a class of monotone constraints that allows an efficient projection algorithm, and similarity queries with scaling and shifting. Part of this work was featured in CP'95 and in a journal article to appear in *Constraints*.

Those of us who collaborated closely with Paris have lost not only an outstanding scientist but also an esteemed colleague and a dear friend. As a colleague, Paris had the poise, the personality, and the energy to rally communities behind him and he used these skills to improve our academic and professional environment. We also mourn a friend with a charming and engaging personality and a mediterranean passion —and a family whose warmth and hospitality will be sorely missed.

In writing these few pages, I came to understand one more time how fortunate I was to collaborate with Paris, to observe him in his daily scientific and family life, and to benefit from his insights, vision, and broad expertise; and of course to realize how my life has changed since I met him. He was a very special person.

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Invited Lecture

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Lectures in Honor of Paris Kanellakis

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Kanellakis Prize Paper

A Test for Tractability
Peter Jeavons, David Cohen, and Marc Gyssens

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The Future of Constraint Programming

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An Inventory and Taxonomy

Constraints and Databases

Set Constraints

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Constraint Programming over Nonlinear Constraints
Jean-François Puget and Pascal Van Hentenryck

Constraint-Based Scheduling
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Finite Domain Constraint Programming
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