REPORT ON TRENDS IN THEORETICAL COMPUTER SCIENCE: CELEBRATING JOSEP DÍAZ'S 60TH BIRTHDAY

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The international conference *Trends in Theoretical Computer Science* was held in Barcelona last Februray 24-25 to celebrate Josep Díaz's 60th anniversary. The venue for the conference was the School of Mathematics and Statistics of the Polytechnical University of Catalonia (UPC). This was a great opportunity to express Josep our gratitude through a nice scientific event.

The celebration was organized by the authors of the report and Maria Serna, with the help of other colleagues and the institutional support of Facultat de Matemàtiques i Estadística (FME), the Algorithmics, Bioinformatics, Complexity and Formal Methods Research Group (ALBCOM), Departament de Llenguatges i Sistemes Informàtics (LSI), Centre de Recerca Matemàtica (CRM), Societat Catalana de Matemàtiques (SCM), Yahoo! Labs Barcelona and Telefónica I+D.

We list below the speakers, together with very short summaries of their talks, in the order of their expositions[1]:

- Christos Papadimitriou : *Games, Algorithms, and the Internet*. Algorithmic Game Theory revisits some of the most important problems in Economics and Game Theory from a computational perspective and plays a fundamental rôle to understand agent interactions in the Net. Papadimitriou surveyed some of the major results and challenges in this fascinating field.

- Jacobo Torán: *On the power of bounded nondeterminism*. Classes defined using bounded nondeterminism are used as moderate versions of the class NP. Examples are LogClique and Group Isomorphism. Torán showed that the parity function cannot be AC-Zero reduced to any of these problems.

- Ricardo Baeza-Yates: *The Power of Prediction*. In Web search engines, performance is a key aspect. Baeza-Yates centered his talk in one technique to improve it: using machine learning to predict if a future event will happen or not and —assuming the prediction is accurate— to use the better algorithm adapted to each situation.

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[1]You can find the abstracts of the talks (and more information about the event, including pictures) in `http://albcom.lsi.upc.edu/ddorg/`

- Burkhard Monien: *A diffusion-based algorithm for computing graph partitions*. Graph partitioning requires the division of a graph's vertex set into k equally sized subsets such that some objective function is optimized. Monien presented his results and of co-authors on a diffusion based algorithm which, among other useful properties, allows a natural parallelization.

- Alberto Marchetti-Spaccamela: *Feasibility analysis of sporadic real-time multi-processor task systems*. In the talk Marchetti-Spaccamela presented some recent results of his joint work with V. Bonifaci on scheduling. In particular, he explained us the first algorithm for testing the feasibility of a sporadic task system on a set of identical processors.

- Jordi Petit: *Addenda to the Survey of Graph Layout Problems*. In 2002, Josep Díaz, Jordi Petit and Maria Serna published "A Survey of Graph Layout Problems". According to ISI Web Of Knowledge, this is Josep Díaz's most cited scientific paper. Petit discussed in his talk several updates to the survey: better bounds and solutions, solutions to open problems, . . .

- Mike Paterson: *Overhang bounds*. Nearly everyone is familiar with the classic problem of arranging a stack of n rectangular blocks at the edge of a tabletop so as to maximize the furthest overhang reached beyond the edge. Paterson gave a lively talk with an overview of the recent results in this problem.

- Xavier Pérez: *Hamilton cycles in the random geometric graph*. Random geometric graphs have attracted a lot of attention from the research community as models for wireless networks. There have been several authors studying the existence of Hamilton cycles in a random geometric graph. Pérez reviewed several recent results in this area.

- Lefteris Kirousis: *Typical Properties of Random Hard Problems*. Kirousis' surveyed several rigorous techniques and results for the computation of the threshold point for the solvability of hard problems. In Kirousis' words, "this was not a bird's-eye view talk but the view of a single bird in the nest".

- Rafel Cases: *On the occasion of Josep's birthday, a brief character sketch*. One of Josep's best friends, in this non-technical talk Cases gave a notable and amusing description of Josep's traits. Some of these traits were very well known to all his friends and collaborators in the audience, e.g., hard worker, solidary in team-effort, very curious about ideas and people. But almost everyone there learned something new about Josep. Cases did not miss pointing out Josep's main life commitment to research.

- Paul Spirakis: *Probabilistic Techniques in Algorithmic Game Theory*. Spirakis described his joint work with S. Kontogiannis in Algorithmic Game Theory, namely several results using probabilistic techniques. He gave examples involving flows, coalitions, approximate equilibria and evolutionary strategies.

- Oriol Serra: *Can trees be laid down iso-efficiently?* Layout problems consist in finding orderings of the vertices which optimize cost. For graphs with an isoperimetric ordering many layout problems can be solved. This raises the question of characterizing this class. Serra explained us some of the results of his work with J. Kratochvíl.

- José Luis Balcázar: *Towards a Logic of Association Rules*. Association rules are widely employed in Data Mining. An association rule is a form of partial implication between two terms. Balcázar discussed some new notions of redundancy among association rules from a propositional logic perspective.

- Leslie A. Goldberg: *H-Colourings, Dichotomies and Complexity*. H-colouring provides a rich setting in which computational complexity questions can be explored. Goldberg gave a short survey of some of the work in the area, including some of the many contributions by Josep Díaz and his co-authors.

- Elias Koutsoupias: *Online Competitive Auctions*. Koutsoupias presented a new model for online profit-maximizing auctions for digital goods in which an adversary selects the bids which then arrive in a uniform random order. The model lies at the intersection of prior-free mechanism design and secretary problems.

- Felipe Cucker: *On a Problem posed by Steve Smale*. The problem asks for a deterministic algorithm for approximate solution of a system of n complex polynomials in n unknowns in polynomial time, on the average, in the size N of the input system. Cucker briefly sketched his extensions of the Beltrán-Pardo approach towards a solution of Smale's problem.

- Nick Wormald: *Methods and results for random regular graphs*. Properties of random regular graphs were discussed by Wormald, as well as some of the main methods used to derive them. Worlmald concentrated in two of these, in particular, the small subgraph conditioning method and the differential equation method.

- Maria Serna: *From the PRAM to the Sensor Field*. Parallel and distributed models for computation and communication have been an active research

area in the last decades. Serna gave a broad overview of techniques, algorithms and models used to understand parallelism and its complexity, based on her joint work with J. Díaz.

After the regular program concluded, it was time for Josep's *Replica*. He thanked all the 'conspirators' (as he called the organizers of the event), and also gave special thanks to all the participants, many of whom traveled from abroad.

He then moved on to the scientific part of his talk: a list of open problems in Theoretical Computer Science that he would particularly like to see solved. His list included six problems in the famous list of the Clay Mathematics Institute. He "confessed" us having worked himself in the well-known "Is P = NP?" in the past, and of course, he would like to see it solved.

Afterwards, he presented three problems in which he had worked and in which he still works from time to time. The first one is the proper classification of *the computational complexity of the Min Bisection for Unit Disk Graphs*. It is known that the problem is NP-hard for grid with holes [4] and, if the problem is NP-hard for planar graphs with $\Delta = 4$ then Min Bisection is NP-hard for Unit Disk Graphs [1]. Josep's conjecture is that the corresponding decision problem is NP-complete.

The second problem is related to *the complexity of finding the metric dimension of planar graphs*. The problem is NP-hard for general graphs [3], but in some particular cases, like trees or cliques, the problem can be solved in polynomial time. For the particular case of planar graphs, Josep conjectures that the problem can be solved in polynomial time.

The third and last problem is concerned with counting the number of solutions of combinatorial optimization problems. Instead of using Markov Chain Techniques for approximate counting, Josep and his coauthors defined a genetic system [2]. They proved that the non-linear system can be parallelized and furthermore it converges to the stationary distribution of the Markov Chain. Josep's open question is: *what is the mixing time of this system?*.

To conclude his *Replica*, Josep wanted to express his gratitude to all the wonderful people that he has known during all his professional life. He referred specially to his co-authors by showing nice pictures of all them, as well as pictures of some other people with who he has not joint publications yet, but he had fun working together. He also made a special mention to the successful series of ALCOM projects.

We want to finish this report with the same words that Maria Serna used at the end of her talk:

> "Thanks Josep for sharing the dream with us and let's continue dreaming theorems together"

References

[1] J. Díaz, M. Penrose, J. Petit, M. Serna. Approximating Layout Problems on Random Geometric Graphs. Journal of Algorithms, 39(1):78–117, 2001.

[2] J. Díaz, M. Serna, P. Spirakis Linear and non-linear systems: a survey. In Contemporary trends in Discrete Mathematics. From DIMACS and DIMATIA to the future. DIMACS: Series in Discrete Mathematics and Computer Science, vol 49, pp 29–47, 1999.

[3] D. Johnson. Unpublished result.

[4] C. Papadimitriou and M. Sideri. The bisection width of grid graphs. Mathematical Systems Theory, vol. 29, no. 2, pp. 97-110, April 1996.