# Maria Serna and her years in Patras

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It was the year 1988 (I think Spring ) when my good friends from Barcelona (namely Joaquim Gabarro and Josep Diaz) told me that there is a young very bright student that can come to Patras (Greece) and work towards her PhD. The name of the student : Maria Serna. Maria was awarded a pre-doctoral scholarship from the Spanish Ministry of Education. This fact , together with the approval (a bit later) of the EC Research Project ALCOM , solved the problem of financing Maria for her research towards her PhD. Let me note here that ALCOM (Algorithms and Complexity) is a project that wrote history in Europe by funding (via the sequence of ALCOM , ALCOM II, ALCOM IT , and ALCOM FT) most of the currently active Algorithms and Complexity researchers in Europe.

So , some morning Maria appeared in my office in Patras. At that time I was interested in the topic of Parallel Algorithms and Parallel Complexity (in the sense of PRAM shared memory algorithms and the P-Completeness notion for problems hard to parallelize). Naturally , I proposed to her to work in such topics.

Let me say here that all my team in Patras was very friendly with Maria right form the beginning of her arrival. In fact the hardest person for her to meet with was myself (being very busy at that time because I was the Chairman of the local department of Computer Engineering and Informatics). I remember having Maria to wait outside of my office for a meeting for hours because I managed to always confuse my schedule and mismanage the required time for meetings , thus adding delays). However , after a few first meetings I understood that the student in front of me (that is Maria) was one of the smartest scientists I had seen at her age ! So , I became more consistent with the schedule time of our research meetings.

Maria and myself started working on the notion of P-Completeness because it is a good way to indicate that a problem cannot be efficiently parallelized (in the sense that if a problem is Complete for P under log space reductions then most probably it cannot be solved in poly-logarithmic parallel time with a polynomial number of available processors and shared memory). Let me note here that the class of problems that can have a parallel shared memory algorithm running in poly-logarithmic time with a polynomial number of processors , is the Class NC (named by Nick Pippenger). Thus it is believed , even today , that P is not equal to NC. The most well known P-Complete problem is the so-called Circuit Value Problem (which admits a linear sequential algorithm).

Pretty soon, Maria and myself proved that the following problem is indeed P-Complete : To test if a Graph G contains a vertex connected induced subgraph C (of at least 4 vertices) so that no two vertices of C can be separated by removing fewer than 4 other vertices of C . (a 4-connected subgraph or a 4-block a la

Harary). After discussing this also with Lefteris Kirousis , we all were convinced that the same holds for testing if G contains a 3-block ! This made us not to be able to sleep at night , because we knew that there were nice algorithms in NC to find all the triconnected components of a graph ! For some days we thought that P=NC. We even wrote a letter explaining all this to 16 different scientists all over the world. The person that explained the mystery was Mihalis Yannakakis who told us that 3-blocks are essentially different from triconnected (or Tutte) components. Quite funnily , 2-blocks are the same with biconnected components !

Thus both our result and all the parallel algorithms for finding triconnected components were correct at the same time. Lefteris , Maria and me submitted our result (about the P-Completeness of finding 3-blocks and in fact k-blocks for any k at least 3) in FOCS 1989 and it was accepted. Later , the paper appeared in SIAM Journal of Computing (in 1993).

However , Maria and myself managed to get tight RNC (randomized parallel) approximations to the problem of Maximum Flow (this appeared in STAC 1991). Let me note that for the connected sub-graph problem , we proved that it is hard even to approximate in NC a k-block (k at least 3) with an approximation factor better than 1/2.

With Maria (and with Hermann Jung who was then working in a country called East Germany ... ) we were also the first to get an efficient Deterministic Parallel Algorithm for the 2-Processors Precedence Constraint Scheduling (this appeared in ICALP 1991 and very later as a Journal paper in Theoretical Computer Science in 2003 ).

The above and some other results resulted in a very strong PhD Thesis of Maria !

In addition to nice science , Maria's period of time in Patras was nice in several other respects : She was (and still is) friendly with most of us , she became very familiar with the way Greeks think (she even speaks and understands some Greek) and she was a great source of inspiration and creativity. Let me mention that each February (to beginning of March ) Patras celebrates its carnival , about a month of events and dances and wine drinking. All this results in a big parade of young people (all with costumes and masks) at the end. Maria , with her unique Spanish personality , managed to merge extremelly well with such events and in fact most Greeks considered her as a Greek !

All of us in the Computer Engineering and Informatics in Patras have the best memories of Maria's time in Patras. I am honoured to claim Maria as one of my PhDs (well , at least co-guided by me ). She is now an established Professor in Barcelona. Still , we keep good contact and we continue to cooperate ! I wish her to continue proving great theorems and to continue inspiring younger scientists.