Commentaries on "MAC and combined heuristics: two reasons to forsake FC (and CBJ?) on hard problems" [CP 1996]

Christian Bessiere[1] and Jean-Charges Régin[2]

[1] CNRS, University of Montpellier, France
[2] Université Nice-Sophia Antipolis, France

1 Commentary by Christian Bessiere

This piece of text describes how I remember the story of this paper 23 years later. In the early 90s, forward checking (FC) was considered by the academic community as the best algorithm for solving CSPs. In 1993, I had proposed AC6, an algorithm for enforcing arc consistency (AC). By chance, in the office next to mine there was a very good student, Jean-Charles Regin, who accepted to implement a solver maintaining AC during search (MAC) based on AC6. (Several other algorithms maintaining AC during search with other AC algorithms had been proposed before by Gaschnig, Nadel, Sabin and Freuder.) Regin also implemented a heuristic dating back from my PhD (1992) that was not yet published: `dom/deg`. We immediately saw that we were able to solve quite large instances. A few months later, I attended a workshop at ECAI 1994, where Barbara Smith presented the amazing result about exceptionally hard problems. These problems are located at the left of the phase transition (i.e., all very satisfiable) and her solver was requiring hours to solve them whereas most of the other instances in the same region were solved in milliseconds. When back home, Regin tried to generate such instances to see how our MAC combined with `dom/deg` behaves on them. He told me that all his instances were solved in milliseconds. I asked Smith to send us the files containing the exact specification of a few of these instances. Regin told me they were solved in milliseconds too! After having checked that the solver was not buggy (easy to do on satisfiable instances: just check the solution) we had to find another explanation. The explanation was simply that these instances are *not* exceptionally hard to solve. This is the solver (FC with minimum-domain heuristic in the case of Smith) which was making an exceptionally big mistake high in the search tree. The solver was making one of the few variable-value assignments that lead to an inconsistent subtree (remember we are at the left of the phase transition), and then was spending hours proving it is a mistake. Smith described this behavior very well in a paper at ECAI 1996. Our MAC combined with `dom/deg` was not making such mistakes. It was solving all these instance in milliseconds. (Later, Romuald Debruyne, another brilliant student from my lab, showed that if we increase enough the size of the instances –around 500 variables with large domains– MAC combined with `dom/deg` starts facing exceptionally hard problems too.)

Another thing I observed with Regin was that if your solver is smart enough in look ahead (MAC instead of FC and `dom/deg` instead of minimum domain), even the beautiful conflict-directed backjumping (CBJ) of Prosser becomes almost useless. The jumps back of 3 to 10 or sometimes more variables that were making FC-CBJ tremendously better than FC are replaced by steps back of 1, or sometimes 2 variables, leading to an overhead more than to a speed up. This last observation led us to the unfortunate title of this paper, whose rudeness I regret today (in addition to the awkward English). It has put distance in my friendship with Patrick Prosser, a guy whom I appreciated so much. Fortunately, Patrick is such a nice guy that after a few years, he made like if nothing had happened and I could again enjoy his company.

2 Commentary by Jean-Charles Régin

I had just arrived at ILOG and people were swearing by MAC. I had finished my thesis and implemented MAC-CBJ. I found the idea of CBJ very pretty and subtle but also very complex when combined with MAC (and I'm not even talking about the non-binary case). I had trouble making a correct implementation. Especially since something was inconsistent with the experiences. We then decided to look at the random generators following a warning from Olivier Dubois. From there, was born the generator that was later proposed with R. Dechter. Then we took much larger domains and the difference was clearer. Then when I did the tests again, the idea of `dom/deg` came up and the results were very good. Hence the idea of writing the paper.

At the time we were young and full of energy so we wrote an article that was a little polemical and above all very affirmative, certainly because we were upset with the experiences and the difficulty of finding the results of others. I don't think I would rewrite such an article these days, but I don't regret it either.

Looking back, I remember an anecdote at ILOG. Any newcomer absolutely wanted to implement MAC-CBJ pretending that it would work better, so we told him: "ok you can do this next to your work for two months but if it doesn't work then you stop". The newcomers were happy and ready to impress us but no one ever managed to achieve a positive result and ILOG never proposed MAC-CBJ.