Boundary logic
The Cork Constraint Computation Centre is achieving a level of success on a par with Ivy League colleges in the US. JJ WORRALL goes on site for a lesson in making better choices.

Look up and down the aisle of your train or bus home each evening and most likely you’ll see a few heads being scratched as tired eyes look over half-finished Sudoku puzzles. At the core of the puzzle is a basic set of parameters in which the player must make decisions of which numbers go into which boxes. It’s an infuriating constraint at times, but one that must be obeyed to complete the puzzle successfully.

In fact, the basis of most of life’s decisions is based on constraints. If you have to get 10 things done today, but also have to be at the cinema for a date at 6.30, that time is another, albeit nicer, constraint. In short, they’re all around us and we are continually bound by them.

Prof Eugene Freuder, director of the Cork Constraint Computation Centre (4C), often gives such examples of what a constraint is when he’s explaining the work that goes on in the University College Cork-based unit. It is work which is not only world-renowned in the area of ‘constraint programming’ but in terms of awards, published research and speeches given to major conventions in recent years, the 4C group is now on a par with work carried out at the hallowed halls of Stanford University.

“When people ask me what we do I like to say we help computers help people to make better decisions,” said Freuder, “that’s our motto really.”

The seeds of the Centre were established at UCC with initial funding from Science Foundation Ireland in the form of a ‘principal investigator award’ to Freuder in 2001. 4C would become fully formed when Freuder moved his lab from the University of New Hampshire in the US, in October that year, to merge with the UCC Department of Computer Science Constraint Processing Group, headed by Prof James Bowen.

Environments
Fast forward to the present day, and to describe the entrance to the 4C offices as not wholly representative of their global standing in the field of constraint programming is a bit of an understatement. On the corner of what could be mistaken for an abandoned building on Washington St in Cork city, there’s only a small sign to indicate who resides within. Once inside, the office is buzzing with academics and research students working on a vast array of projects.

The varied nature of what 4C do – using constraint programming to solve problems in fields from telecommunications to e-commerce, electronics and bioinformatics to transportation, network management, supply chain management and beyond means that they have their finger in some surprising pies. Some examples would be the innovation partnership is seeking to develop a ‘decision support system’ with forestry measurement company Treemetrics; smart procurement technologies for Cork City Council; and various medical projects from prescription management to cancer treatments.

Indeed, as he sat in one of 4C’s main meeting rooms, Freuder – a fellow of the American Association for the Advancement of Science (AAAS) – explained that “4C is not one specific project, it is more a laboratory where
academics and research students are using constraint programming on lots of different projects at any one time. Those of us in 4C are brought together by common scientific interests, pursued in various combinations with the help of various sources of funding. 4C has a number of grants from a variety institutions, SF! provides roughly 60% of our funding.

He continues, "Things like the projects with Cork City Council and with hospitals are ways of giving back reward to the tax payer. It's about value for Ireland, which is a big thing for us. With the economy in its current state it's important we try to contribute."

Artificial intelligence
Constraint programming already has wide commercial application, but much remains to be done to fully explore and exploit the technology, explained Freuder, who adds that 4C's work generally involves applying advances in artificial intelligence (AI) and to make constraint programming more powerful and practical.

The buzz topic that is AI is key to the work at 4C. "The AI community see constraint programming as a major area," revealed Freuder, "if we look at the major AI conferences around the globe in terms of the papers presented by ourselves, we're right up there with the most world-renowned institutions."

AI, he said, is important to 4C in that the overall idea is to solve complex decision making problems using computers that are 'taught' to weigh up potential pros and cons while operating under the restrictions of any given situation. All this talk of choice might sound a little like the scene between Neo and The Architect from The Matrix: Reloaded but don't let that scare you. Indeed, the more Freuder and his colleagues go into what his team does, the more you can't help but be impressed.

James Little, who carries the lengthy title of staff scientist and external liaison officer, tells how interaction with industry associates has led to a contact database with almost 400 collaborators such as circuit manufacturers Xilinx, NEC, TDK, IBM and Google. "Contacts and partnerships range from the small to large scale," he added.

"We often use our core technologies to solve constraint problems for our partners. What is often the case is that we go to present the concept to them, set up a problem - one that many find it very hard to solve - then we use a hybrid approach of many perspectives to prove that our technology will solve their problems."

Another key name in the 4C universe is associate director Prof Barry O'Sullivan, who is also president of the International Association for Constraint Programming, of which Freuder was recipient of their first research excellence award.

Freuder, now fully settled in Cork, added, "We consider ourselves to be a world class scientific centre, benchmarking ourselves against the world's best, and we're punching our weight too."

Prof Barry O'Sullivan