CAMPUS REVIEW

By: Nicole Madigan in Policy & Reform, Technology, Top Stories April 1, 2019 0

Half-living, half-synthetic bio-computers will soon be able to reason and multi-task like humans, paving the way for a world where computers can help solve 'unsolvable' problems, if QUT researcher Associate Professor Dan Nicolau has his way.

Nicolau, who recently published a paper in the Royal Society's *Interface Focus*, was awarded a $978,125 Australian Research Council Future Fellowship last year to develop the technology he hopes will disrupt computation – a living, breathing device made from living things.

The funding will allow him to split his time between QUT and Oxford University in the UK where he earned his PhD in mathematical biology and a medical degree.

"The Future Fellowship programme is a unique opportunity to pursue your own research with near-complete intellectual freedom for four years," says Nicolau.

"It's every scientist's dream, basically. It's a programme virtually without a counterpart anywhere in the world, and that's why I came here from Oxford."

Nicolau will be working with international colleagues on the new computing technology, combing what he describes as the best of life with the best of electronics.

"Our hope with this project specifically is to show that the prototype living computer that we built can be scaled up enough to be useful for real-world problems.

"That will require new mathematics as well as new biology and nanotech."

The new technology will be designed to mimic how animals, including humans, think, by doing millions of tasks at the same time.

"For example, as you're reading this line of text, your brain is orientating you in space, your memories are being accessed without your thinking about it, your kidneys are regulating your blood pressure, your skin is

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responding to changes in temperature and millions of other such tasks – all at the same time, all in parallel.

"Those are all computational tasks.

"Computers don't work like that.

"They do one small thing at a time, though with high precision. And that's why they can't solve the really big problems we care about in our lives, like what will the economy do next year, what kind of leaders does the country need, can creativity be automated or is there something special about the human mind, and so on.

"The hope here – and it is just a hope right now – is that these biocomputers can either do, or teach us how to do, these thinking tasks."

It's difficult to ascertain how this type of technology would impact society, either positively or negatively, because of the limits of the process.

"We're now just at the start of veering into the realms of science fiction.

"But let's assume for a moment that the biocomputers did scale up to be really powerful.

"Then they could compress any data down for us – the works of every poet past or present, the stock market, the firing signals of the neurons of the brain – whatever you want.

"Well, what we can compress down to something manageable, we can analyse, with maths, or simple human reasoning, or even by deploying art.

"And what we can analyse, we can understand and thereby predict, or control.

"In such a world, we would all have the creativity of van Gogh, we could all be millionaires on the stock market, we could know the future of human civilisation, we could find our perfect match in love.

"We would be demigods, basically.

"Obviously, such a world is extremely difficult to imagine but, perhaps more modestly, along the way to such a place, we'd learn a lot about computation, life and our place and meaning in the world."

From a more immediate perspective, Nicolau says the problem of how long it was taking a computer to wade through extreme amounts of data kept cropping up in different guises.

In part it was due to a computer's inability to accept imperfection, just like in choosing the perfect love match.

"For example, when drugs for medical treatment are created, we have to accept they do not always perfectly bind and therefore do not always work, or only work on some people," he says.

"We have to accept sub-optimal sometimes — that's life — but we cannot have the same attitude to things like cyber security, nuclear codes or aeroplane design.

"These we need to be perfect and so we need our computers to be up to the challenge."

According to Nicolau, much of what society calls 'intelligence' or 'reasoning' reduces to solving an NP-complete problem called 'satisfiability' — SAT.

"Whether it's scheduling meetings, finding a mate or creating art, all roads flow through SAT.

"My Future Fellowship project aims to design bio-computers that can carry out reasoning tasks like this and also to bring this nascent technology back to Australia, where it was conceived.

"Our microscopic bio-computer has proved it is capable of working in parallel to do a hard problem, like a millipede moving all its legs at the same time."

This is achieved through the combination of the properties of living things — multitasking — with the best of technology — precision.

"And besides helping us solve real-world problems, what we learn from creating these bio-computers may also help us think about profound theoretical/metaphysical questions, like P vs NP, the deepest problem in all of mathematics and, arguably, all science.

"If Australia is to be and remain a world leader in research, we need our universities and funding bodies to support risky but potentially world-changing technologies and it is wonderful to see the ARC and QUT doing just that here.

"Right now, we are quietly confident — the biocomputers are getting better fast but can we keep the party going? We'll see."

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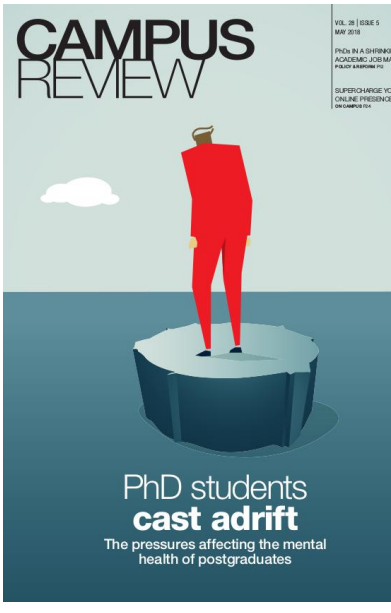

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