

# THIS WEEK

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## Digital intuition

*A computer program that can outplay humans in the abstract game of Go will redefine our relationship with machines.*

Napoleon had it and so did Charles Darwin. Tennis champion Roger Federer has it in spades. The dictionary defines intuition as knowledge obtained without conscious reasoning. It is decision-making based on apparently instinctual responses; thinking without thinking.

Intuition is a very human skill, or so we like to think. Or, more accurately, so we liked to think. In what could prove to be a landmark moment for artificial intelligence, scientists announce this week that they have created an intuitive computer. The machine acts according to its programming, but it also chooses what to do on the basis of something — knowledge, experience or a combination of the two — that its programmers cannot predict or fully explain. And, in the limited tests carried out so far, the computer has proved that it can make these intuitive decisions much more effectively than the most skilled humans can. The machines are not just on the rise, they have nudged ahead.

Experts in ethics, computer science and artificial intelligence routinely debate whether clever machines in the future will use their powers for good or evil. This latest example of digital discovery puts neural networks to work on a problem that is almost as old: how to win at the board game Go.

Outside business-management seminars, Go is not well known in the West, but it is older, more complex and harder to master than chess. Yet it is simpler to learn and play: two players take it in turns to place black or white counters on a grid. When a counter (called a stone) is surrounded by rivals, it is removed from the board. Winning — like so much in life and war — is about controlling the most territory. The game is wildly popular across countries in east Asia, and players from Japan, China and South Korea routinely compete in televised professional tournaments.

Computers mastered chess two decades ago, when IBM's Deep Blue machine won against then-world-champion Garry Kasparov in 1997, but Go was thought to be safe from artificial conquest. That is partly because all of the possible moves in Go, as well as the resulting combinations of stones on the board, are much too numerous for any computer to crunch through and compare to select one manoeuvre. (The same goes for chess, but the diversity in the value of chess pieces enables some short cuts.) In Go, all stones are worth the same and their influences can be felt through vast distances across the board.

On page 484 of this issue, computer scientists at Google DeepMind in London unveil the successor to Deep Blue. It is a program called AlphaGo, and in October 2015 it beat the human Go champion of Europe by five games to zero. To put that into context, in Deep Blue's time, a human beginner with just a week's practice could easily defeat the best Go computer programs. A match between AlphaGo and the world's most titled player of the decade is lined up for March (see page 445).

AlphaGo cannot explain how it chooses its moves, but its programmers are more open than Deep Blue's in publishing how it is built. Previous Go computer programs explore moves at random,

but the new technology relies on a suite of deep neural networks. These were trained to mimic the moves of the best human players, to reward wins and, using a probability distribution, to limit the outcomes for any board position to a single verdict: win or lose. Working together, these machine-learning strategies can massively reduce the number of possible moves the program evaluates and chooses from — in a seemingly intuitive way.

**“The machine becomes an oracle; its pronouncements have to be believed.”**

As shown by its results, the moves that AlphaGo selects are invariably correct. But the interplay of its neural networks means that a human can hardly check its working, or verify its decisions before they are followed through. As the use of deep neural network systems spreads into everyday life — they are already used to analyse and recommend

financial transactions — it raises an interesting concept for humans and their relationships with machines. The machine becomes an oracle; its pronouncements have to be believed.

When a conventional computer tells an engineer to place a rivet or a weld in a specific place on an aircraft wing, the engineer — if he or she wishes — can lift the machine's lid and examine the assumptions and calculations inside. That is why the rest of us are happy to fly. Intuitive machines will need more than trust: they will demand faith. ■

## In praise of parks

*Our affection for national parks is well founded, but many more areas need protection.*

Yellowstone, the world's first national park, was created in 1872. It took rather longer for politicians to set up an agency to actually oversee such places: they got around to that in 1916. So the US National Park Service celebrates its centenary this year.

The agency also marked a shift in the way people think about parks. Yellowstone, which lies mostly in Wyoming, has little in common with the manicured gardens enjoyed by European gentry or admired by ancient Chinese kings. It and other huge, wild national parks are places where nature can supposedly be seen unmodified and unadorned, far from the pollution and bustle of cities.

Like much contemporary thinking, this rather ignores the history of native peoples and their stewardship of swathes of land before the arrival of Europeans. But this relatively new idea of parks as a wild refuge from the modern world has taken root. The United States' national parks have become some of the most iconic places in the

country. Yellowstone and Glacier National Park in Montana rival the White House and the Smithsonian as tourist attractions.

Similarly beloved national parks exist in other countries. The United Kingdom protected the Peak District in 1951 and now has 15 national parks. China started to protect nature reserves in the 1950s and now has jewels such as the Zhangjiajie National Forest Park and Jiuzhaigou nature reserve. In 2007, Pudacuo National Park became what is sometimes claimed to be the country's first true 'national park' (as it reaches standards laid down by the International Union for Conservation of Nature).

It has even been suggested that cities themselves can be parks, rather than just containing them. A campaign has been launched to have London declared a kind of urban national park. This might seem a backwards device — in general, parks are established in beautiful places that people love, not established to make places beautiful and encourage people to love them. But it goes to show the affection that many feel towards places classified as parks, be they vast national expanses or local patches of scrubby grass.

This affection is not based solely on a misty-eyed yearning for the outdoors. There is an evidence base that parks are a good thing. Many studies have confirmed that they come with significant benefits. They seem to make people who use them healthier and happier. They make local ecosystems more diverse and more resilient. They can even help to mitigate climate change to a small degree.

But not everyone is happy when land is set aside in parks and other uses are limited. In the United States, a group of armed men have seized — and, as *Nature* went to press, were still in control of — the Malheur National Wildlife Refuge in Oregon. Although there are a plethora of issues related to that act of insurgency, this event is linked to a dispute over attempts by the federal government to control cattle grazing so as to protect a species of tortoise.

This situation might be extreme. But the story of conflict between

park authorities and people who may once have worked inside park boundaries, or who wish to work there, is universal. Last week, 60 non-governmental organizations again raised the issue of threats to the Virunga National Park in the Democratic Republic of the Congo, one of the last remaining strongholds for mountain gorillas. The prospect of drilling for oil in the park itself has been of concern in the past, and environmental groups are now warning that oil drilling in nearby Uganda could harm the ecosystem of which the park forms a part.

**“Setting aside an area as a park should not be used as a fig leaf for a lack of a wider environmental approach.”**

Things have been equally fraught at sea. As governments have created more and more 'marine protected areas', fishermen have railed against being excluded from waters they once hauled nets in. Researchers have questioned whether many of these areas are actually protecting what needs to be safeguarded. And there are questions

about just how protected some of these areas are, and whether countries are gaming systems to hit international targets.

The spirit of international targets to protect 17% of terrestrial areas and 10% of marine areas certainly intends that they be reached by protecting places that warrant support, not those that are easy to protect because no one cares about exploiting what is there.

Paradoxically, as it becomes ever more apparent that we need to protect areas of outstanding beauty and delicate ecology, it is becoming increasingly clear that it is not enough to do only this. Setting aside an area as a park should not be used as a fig leaf for a lack of a wider environmental approach. Cities, agricultural landscapes, wasteland and seas open to industry all need to be managed in a sensible and planned fashion.

We need more parks. But the real challenge is to make people treat the whole planet with the respect that most show to their parks. ■

## Found out

*Self-doubt is a pernicious affliction that can overwhelm researchers.*

Oh good grief, why did I ever say that I would write something about imposter syndrome? What do I know about it, really? I'm not a psychologist or a researcher or a proper expert, I'm just a journalist. I thought I knew what imposter syndrome was — that some people don't call it a syndrome as such, because that implies a mental disorder. And I thought that I had suffered from those feelings of doubt and inadequacy about my abilities, but now I'm not sure. Maybe other people just suffer from imposter syndrome more badly than I do.

What if I simply tell people to go and read the Careers feature on page 555 that describes how imposter syndrome can affect people in science, and which offers some useful tips on overcoming what, as it turns out, are very common feelings? But then again, won't that make it clear that I don't have anything else to say?

Maybe I can deflect attention from my own pitiful performance by citing talented celebrities who have admitted to sometimes feeling like frauds and imposters. The multiple-Oscar-winning film star Meryl Streep perhaps? I'm sure I read somewhere, though I might be wrong, that she once said she couldn't understand why anyone would want to watch her on screen because she felt she couldn't act. Or the famous and award-gathering author Maya Angelou, who after each of her eleven books, said she felt that this was the time she was going to be found out.

See, I have done the research. I do know what I am talking about,

so why does it feel as if everyone around me is simply better at this than me? I bet that's the way the editor thinks, too. Maybe this would be a good time to throw in an Einstein quote, and seek some reflected glory: "The exaggerated esteem in which my lifework is held makes me very ill at ease. I feel compelled to think of myself as an involuntary swindler."

I wish I had that Dunning-Kruger effect, the almost opposite experience to imposter syndrome in which people who really aren't qualified or knowledgeable show remarkable (and misplaced) confidence in their abilities and decisions. Life would be so much easier then, or at least it would seem that way.

The thing about imposter syndrome is that it's been known and written about since the late 1980s, and yet each generation of young scientists (and teachers, nurses, jet pilots and so on) feel isolated and anxious because of it. They feel that they are the only ones to have these crippling self-doubts, as if someone is about to tap them on the shoulder and confess that the whole situation — the job, the responsibility, the career — is an elaborate hoax and they should go home and stop being so presumptuous as to believe that they had anything to offer.

They need to know that these thoughts and ideas are common, and in fact are most common among genuine high achievers. They should be told that rejection — of papers, grants, ideas — in science is the norm and that they shouldn't lose heart when it happens. After all, this is a field of human endeavour in which experts boast about how little they know and proudly display their margins of error. Young and vulnerable researchers need to know that if they tell someone — a friend or colleague or mentor — about how they are feeling, then they will almost certainly hear the words 'me too' and will feel better.

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I should tell them that. If only I could find the right words. ■