AI springs into action in surprising places

elsevier.com/connect/using-ai-and-game-theory-to-outwit-poachers

A snare used by poachers to trap wild animals in Africa. Dr. Milind Tambe took this photo at Murchison Falls National Park in Uganda.

A park ranger treads carefully through the trees, stopping to listen for signs of the poacher he's tailing. Killed for skins, medicine and trophy hunting, the worldwide population of tigers has been reduced to near-extinction at about 3,200. The scale of destruction is increasing, and it will take a three-pronged approach to battle the corruption and financial incentives

driving the illegal trade: tackling the source, transmission and demand for wild animal products.
Supply could be dealt with by park rangers catching the poachers before they attack, but finding a single poacher in thousands of square kilometers can be almost impossible, and in the poorest areas, resources are so constrained that poachers are not being intercepted at all.

Artificial intelligence and game theory are the surprising elements in the arsenal of weapons used to combat this problem.

Milind Tambe, PhD, is Professor of Engineering and Computer Science at the University of Southern California.

Using simple GPS devices, researchers are delivering intelligent software that helps even the most under-resourced parks protect their animals and tackle the global trade. Engineering and computer science professor Dr. Milind Tambe of the University of Southern California is leading the team behind the technology, which they call PAWS (Protection Assistant for Wildlife Security):

> We're using artificial intelligence to understand and outwit our adversaries, in this case poachers," he said. "It's exciting to see the potential of this technology unfold. We think it will make a real difference.

An early adapter of artificial intelligence, Dr. Tambe is among the growing ranks of science and technology pros who are using AI to extend the limits of human intelligence. They're applying it in wide range of fields, from medical diagnostics to education, counter-terrorism and stock trading. By combining a mastery of technology and machine with creative thinking – and by collaborating with professionals who need problems solved – they can come up with ingenious solutions.

Artificial intelligence in the real world

The inspiration for the poaching idea came from a very different setting halfway around the world. Ten years earlier, Dr. Tambe and his team developed an unusual approach for running airport security at LAX international airport in Los Angeles. In the wake of the attack on Glasgow International Airport in the UK, when a terrorist drove a Jeep laden with gas cylinders into the terminal, airport managers in Los Angeles wanted to step up security, but their resources were tight. One unique feature of the airport is access: there are eight roads leading to it and not enough officers to cover all the roads and terminals at once.

How do you allocate limited security resources? Dr. Tambe's idea was to use game theory to solve the scheduling problem, randomizing the schedule to keep the adversary guessing. The key was unpredictability, Dr. Tambe said:

> We asked ourselves where would you put your officers at checkpoints? It's important to randomize so the adversary can't guess where security personnel will be. But some terminals have more people than others, so they need more protection. And if a terminal has no people in it, say, in the evening, you don't want to give it equal weight. So the logic is trying to be unpredictable while giving more coverage to targets that need more protection. That's what our software does.

The team went on to work with the US Coast Guard, the Transportation Security Administration (TSA) and others – all agencies with the same challenge: limited resources and lots of targets to protect. Then in 2010, a speaking slot at a World Bank Global Tiger Initiative event changed everything.

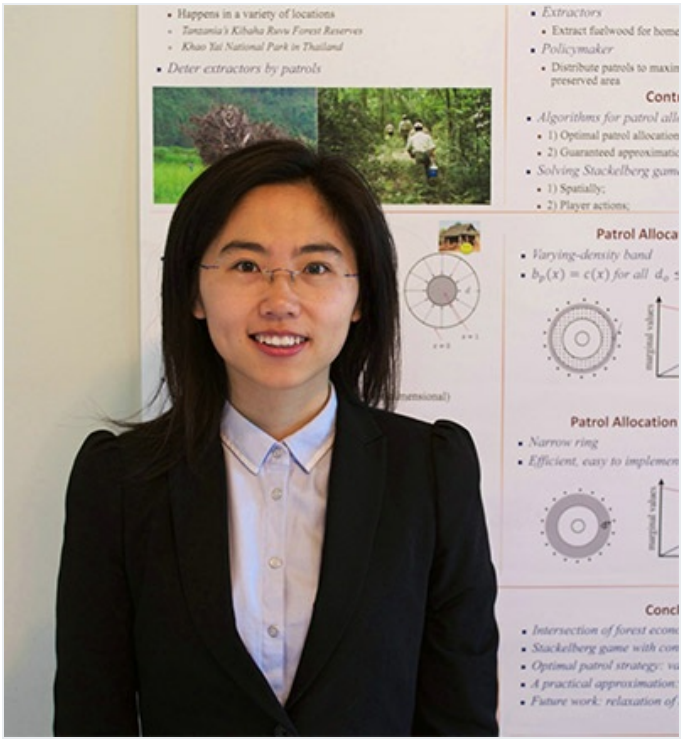
> I was shocked to hear the panelists describing the dire straits situation for some charismatic animals like tigers and rhinos; they were talking about extinction. To me that was shocking, extinction of major species. There were only 3,000 tigers left in the wild; something had to be done. I got motivated to look at how our techniques could be of value for protecting wildlife.

He set out to find the right collaborators, and after a few years of searching, they started developing and testing their approach for allocating security resources with park rangers.

Teaching a computer program to learn

Dr. Milind Tambe and PhD student Fei Fang on a trial patrol of their GPS software in Malaysia. (Photo by Rob Pickles, Panthera) Artificial Intelligence is responsive; it learns and adapts to the situation. Dr. Tambe and then PhD students Fei Fang and Thanh Nguyen figured out a way of using game theory, as they did for the airport, to develop a scheduling pattern for wildlife patrols that responded to the changing situation. The approach incorporates two main types of information: where past incidents occurred and which areas

Dr. Fei Fang received her PhD from the Department of Computer Science at the University of Southern California, where she worked with Prof. Milind Tambe in the Teamcore Research group.



need additional protection. Looking at past incidents helps the software predict more accurately where future attacks might occur so it can decide where to put more weight. The software feeds patrol routes to GPS devices carried by the park rangers, giving each person recommendations to take certain actions, like going to a different area. Data also feeds back to the software and is factored in to future recommendations. That's where artificial intelligence comes in, Dr. Tambe explained:

> The software is learning, adapting to the adversary and what they're doing. One part is to understand your adversary and what they've done in the past, which helps you make predictions. But the second part is changing your approaches as they change theirs – you have to keep up with them if you want to defeat them. Our early results are positive, and we're hopeful it will make a big difference, helping catch poachers before they're able to capture and kill more of these majestic creatures.

A new spring for AI

The use of AI for both airport security and wildlife preservation demonstrates its versatility. At Elsevier, AI machine learning algorithms are applied at scale to vast amounts of data at the platform level, taking these same principles of adaptive learning to systems that advance science and medicine. In nursing education, for example, data, analytics and adaptive techniques are used to track students' interactions with content, assessments and simulations. These technologies "learn" from the user and respond with a personalized education experience.

"Artificial Intelligence, or machine learning, is not some futuristic endeavor," said Elsevier Chief Technology Officer Dan Olley. "It's part of the semantic knowledge platform we are putting in place right now." The aim: "to provide data-driven insights and answers to clinicians and research scientists across the globe."

Dan Olley is Chief Technology Officer at Elsevier.

The resurgence of this technology coincides with the second rise of artificial intelligence, following what many refer to as the "AI winter."

“AI is a term that's been around for years to describe machines that can think for themselves,” Olley explained, citing the defined tests, such as the Turing test, meant to define when machines switch from appearing to think to actually thinking. But Olley noted that in some computer science circles, people have steered away from the term because it conjures up science fiction images.

In fact, artificial intelligence in the form of machine learning has seen a new wave of interest from a broad range of businesses. Machine learning is training computers to solve problems, from picture recognition to self-driving cars. But alongside the hype, Olley cautions that timing is important. As he said in a recent article in *CIO*, “If CIOs invested in machine learning three years ago, they would have wasted their money. But if they wait another three years, they will never catch up.”

When Dr. Tambe joined Carnegie Mellon University in 1986 as a PhD student, he worked with Dr. Alan Newell, one of the founders of AI.

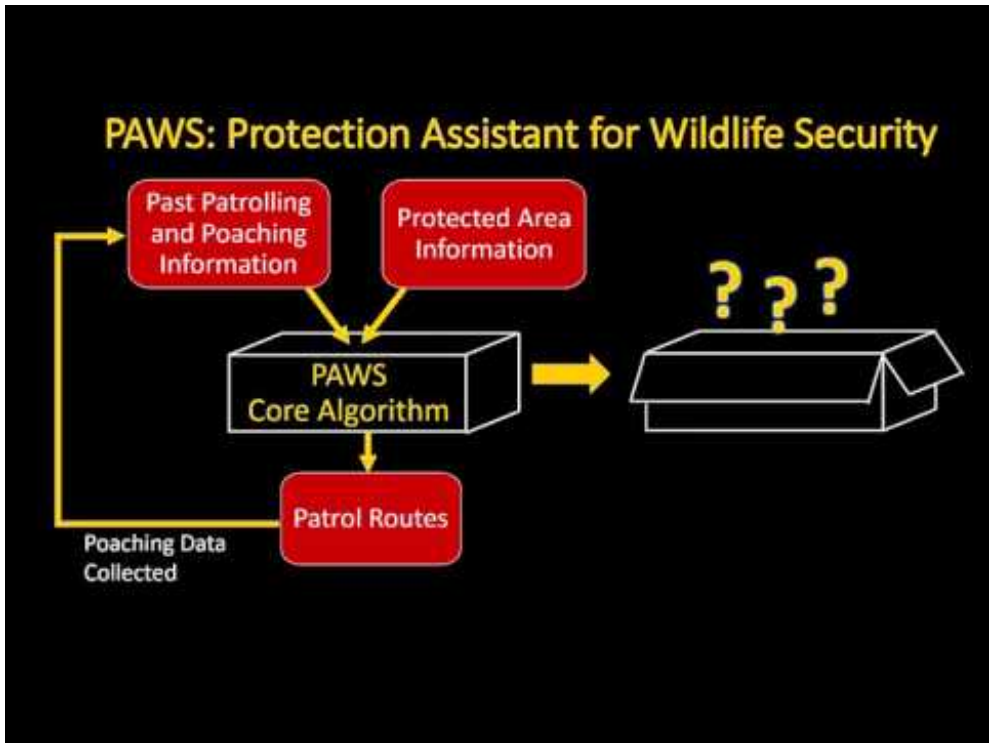
“The field was booming,” he recalled. “There was a huge amount of funding, and thousands of people would turn up to conferences to talk about the latest advances in AI. But then, seemingly out of nowhere, the money disappeared in the early 1990s.

> Suddenly the music stopped. You’d go to a conference and there would be hardly any industry presence, far fewer people – and no free food. It had all dried up within a few years. People warned us not to say we were doing AI because it was considered a failure. But we hadn’t done anything wrong!

Far from shying away from the work, Dr. Tambe pushed through the long AI winter; scientifically the field continued to move forward just as before, changing with the times. Now, 25 years on, we’re seeing a resurgence of attention: last month, Dr. Tambe attended

the second of five workshops on AI run by the White House Office of Science and Technology Policy to raise public awareness. He's expecting something big to happen this fall – an announcement from the White House. That will be a signal that it really is a new spring for AI. In the meantime, with real application in world business and world problems like extinction, it seems that that AI's time has already sprung.

Watch a video about the wildlife protection system



Watch Video At: https://youtu.be/ai6yhbx5iGw

Read the research

Here are the articles Dr. Tambe published in Elsevier's journals.