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Advanced game theory goes to work for homeland security

Game theory is not new to government. It has been used by intelligence agencies for more than 20 years to analyze events around the globe and to make predictions about future events.

With that in mind, it's a bit surprising that game theory is only recently being applied to homeland security. Yet according to Milind Tambe, professor of computer science and engineering at the University of Southern California, that's the case. And he should know because he directs USC's Teamcore Research Group, which receives funding from the Department of Homeland Security and is focused on applying artificial intelligence and game theory to optimize security deployments.

In 2004, USC was the first university to get a Homeland Security Research Center. "That was really the beginning of trying to think about the set of problems whereby my specialty -- artificial intelligence and game theory -- could be applied toward problems that come up in homeland security," Tambe said.

Since then, Tambe and his team have developed applications for the Transportation Security Administration to protect airports and for the U.S. Coast Guard to defend ports. Most recently, the team announced in February that they had, with funding from the National Science Foundation and the Army, adapted its work to develop PAWS -- Protection Assistant for Wildlife Security -- an application that uses artificial intelligence and game theory to catch poachers.

While the applications are all related, Tambe said, each security scenario requires individual analysis and custom coding. "In the case of PAWS, problems come up that are not seen in other ... settings, such as with the TSA or the Coast Guard," Tambe said.

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With patrols dispatched to forests with dramatically uneven terrain, he noted, it's critical to find the right routes so that patrols don't waste time and energy. "Those sorts of challenges don't come up in urban settings," he said.

In addition, each scenario has different types of relevant data to process. "There is a lot of past poaching data, on the basis of which we can learn about our adversaries, the poachers," Tambe noted. The team found that relevant historical data was sorely lacking for their projects aimed at protecting airports and ports.

While the details and available data may be different for each security scenario, however, there's also much in common, and that's where game theory comes in.

"Imagine that we have eight inbound roads," Tambe said. "And imagine that we can only set up two checkpoints. Game theory is a mathematical tool that allows us to reason about strategic interactions between two intelligent adversaries -- in this case the police are on one side and the terrorists are on the other side."

Tambe declined to go into detail about the actual factors considered, though he did say that they might include such things as the importance of facilities that could be accessed by each road. "For example, one road may only go to the back of the airport, so the adversary doesn't have as much of an incentive to use that road," he said.

In addition to considering such factors, Tambe said, "you want to come up with a randomized method of allocating checkpoints such that the adversary can't quite figure out by doing surveillance exactly where you will be, but at the same time the more important roads will be covered more often."

While Tambe said he can't go into detail about how the applications work, he said that they have been successful. All the applications are, in fact, still in use and are being deployed in more locations. The Coast Guard's application – called Protect – is currently being used in Boston, New York, Los Angeles and Houston and is being considered for even wider deployment. The application developed for airports – called ARMOR – has been moved to a private company called Armorway, which is run by Tambe's former students.

The team is also looking to include additional kinds of data in its security applications. When the software was adapted for the Coast Guard to generate patrols in the Gulf of Mexico to search for illegal fishing, for example, the application did not include data about weather conditions. Because fishing boats are unlikely to be out in particularly bad weather, however, including that data could conserve patrol deployment resources. "That's an active research topic," Tambe said.

Tambe's team is also in the initial stages of applying its AI and game theory skills to another entirely new area: cybersecurity. According to Tambe, the team is working with the Army and the Coast Guard on developing better cybersecurity tools. "We're hopeful that within six months to year something will be available," he said.

Posted by Patrick Marshall on Jun 07, 2016 at 11:52 AM

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8609 Westwood Center Drive, Suite 500
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