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Bringing AI into the real world

Even before countries began rolling out their vaccination campaigns, Pfizer, Moderna and AstraZeneca's announcements had already proved fortifying shots. Stocks rallied and healthcare workers celebrated in the wake of the vaccine news late last year. But months on, that early euphoria has evaporated, replaced by uncertainty and debate over vaccine safety, possible side effects and varying degrees of citizen reluctance.

Artificial intelligence (AI) researchers and health experts modeling COVID-19's spread have warned that for vaccines to be useful in curbing the pandemic, a significant percentage of the population must be vaccinated to reach herd immunity. But, as SMU's Vice Provost of Research Professor Archan Misra pointed out at an AI-centered panel discussion, held in conjunction with the SMU- Global Young Scientists Summit (GYSS) on 15 January 2021, from a purely self-interested point of view, each person would be best served if all the others got vaccinated and they themselves did not have to vaccinate—because that would stop the spread of the virus without their having to take on the possible risks of side effects.

To account for these considerations, Professor Misra explained, the most powerful AI-based epidemiology models actually need to incorporate concepts from the behavioral sciences and game theory. "To solve a practical problem, you can't just solve the computational piece, you have to incorporate the human behavioral piece," he said.

An interdisciplinary approach to AI

The vaccine conundrum effectively illustrates the difficulties involved when we bring machine learning and AI into the real world, where it meets our complex and messy human systems. Discussing the influence of social sciences such as economics and psychology on AI, the panel, comprising SMU School of Computing and Information Systems' Professor David Lo,

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Associate Professor Akshat Kumar and Assistant Professor Qianru Sun, concurred that AI researchers need to approach their work from an interdisciplinary angle and integrate knowledge from other fields to solve problems holistically.

"[AI researchers] can learn a lot from cognitive psychology, especially in explainable AI," Professor Lo said. Traditionally, AI systems have been thought of as black boxes, with data processes that have been difficult for researchers and programmers to interpret. Yet when these experts bring AI into the real world and use it to solve practical problems, they have to answer questions such as why the AI made a specific prediction or decision, and whether it gives enough confidence for us to act on it. Explainable AI therefore helps to make decisions actionable, Professor Lo pointed out, and established methods and principles of cognitive psychology can be applied to design solutions that can make AI black boxes more comprehensible.

For AI to be effective at real-world problem solving, domain knowledge is crucial, Professor Kumar added. When AI researchers work with domain experts, they can break through traditional constraints in the relevant fields, he said, raising the example of using AI to optimize decision-making in maritime transportation systems, which radically improved both productivity and safety instead of having to sacrifice one for the other.

Singapore's ports regularly experience heavy traffic, and sometimes it may result in unsafe navigation behavior, Professor Kumar explained. By modeling the maritime transportation system, he and his collaborators found that if they adjusted the vessels' schedules slightly using AI-based coordination algorithms, they could significantly reduce traffic hotspots while keeping the traffic throughput high. "We still maintain the productivity of the system, but we also increase the safety," he said.

An ecosystem of collaborators

Professor Kumar shared that while working on the maritime project, they have consulted domain experts, and government agencies were critical in facilitating such access.

Not only are local public institutions willing collaborators, they are also significant funders of AI projects, according to Professor Sun. "The government agencies are quite generous in terms of their support of AI research. Some of them even offer the full funding for the project. They're also quite willing to deploy the applications yielded from the research of the project for public use," she said.

This ample support has led to Singapore becoming a hotbed for AI technology and development. In 2019, the city-state topped the list of 105 cities most ready for AI disruption, beating places such as London, San Francisco and Beijing—and attracting both researchers and companies hungry for talent from across the world. Explaining how industry partners could benefit from collaborations with researchers, Professor Lo said, "They have the data, they have the domain knowledge and they want to use AI. But industry players may not know how to put that data, domain knowledge and AI together to improve the quality of their products. That's where they may benefit from collaborating with AI researchers."

Professor Sun added that unlike their commercial counterparts, university researchers have the privilege of spending a longer amount of time building deep expertise in AI methodologies, but they may not have the computing resources and data to apply them. "[The companies] have more real data collected, so they can provide us with a more realistic testbed for our proposed methodology and theories," she said. In doing so, researchers and their industry partners will bring novel AI approaches developed in the lab one step closer into the real world.