NOV 2025

Volume 27 —— No.1

HKU BULLETIN

PRIVACY IN THE DIGITAL AGE

Is protection possible?

Ancient genes, modern miracles

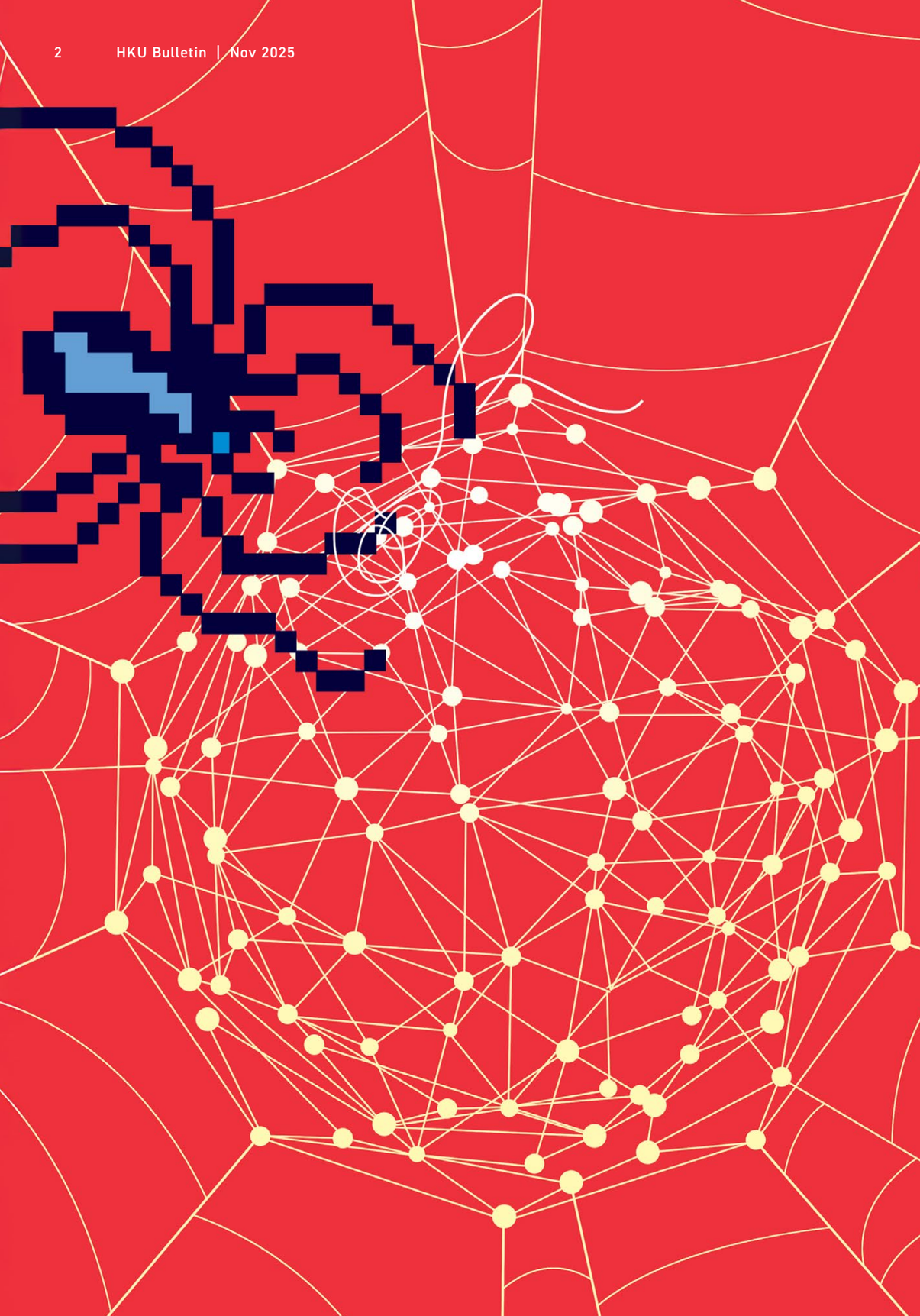
Billion-year-old molecular tools unlock the power of stem cells

Guided by nature

Engineers mimic bird agility to boost drone speed and safety

Contents

HKU BULLETIN



PRIVACY
IN THE DIGITAL AGE

Being online inevitably means giving up personal information to access websites and services, whether willingly or not. So how can privacy be protected? And what are the limits to that protection? HKU scholars have been exploring the implications of this digital dilemma from engineering and legal perspectives, and its impact in business and medicine.

Keeping Data under Wraps

The data goldrush is putting pressure on personal privacy, as everyone from businesses to universities to governments seeks to mine and share data on individuals for profit, research or policy development. But those privacy concerns may be hindering non-intrusive solutions that could help advance research and benefit society, says computer scientist Professor Yiu Siu-ming.

Rapid progress in data technology, including AI, means more personal data than ever is being collected – whether it be DNA, facial recognition or any human identifier or activity. For individuals, that raises obvious privacy concerns. But Professor Yiu Siu-ming of the School of Computing and Data Science is not so easily discouraged.

Professor Yiu has studied data protection and privacy for years. He believes the risks are surmountable with the right tools and support and an appreciation of the value of data collection to society, which can be used to develop new health treatments, improve national security and facilitate business management, among many other things.

"The whole world is increasingly concerned about privacy. Balancing privacy with research and community development has become a very big challenge," he said. "But I believe that technology and the law, together, can resolve the problem."

On the technology side, he has been working on three methods to transfer data without disclosing the data source and thus protecting privacy. While not yet perfect, they offer different kinds of data protection under different circumstances.

Options for protection

One method is homomorphic encryption, which encrypts data before it is sent to another party, allowing access to the overall results but not the raw data. For instance, if a company wants to survey students about their preferred model and colour of phone, it could collect the data and then share or sell the overall statistics, not the individual data points.

However, this does not work when trying to export data to another country. Many countries have restrictions on data sharing, even when it is encrypted, which creates problems for multinational companies, academic researchers, or governments. For instance, if a firm has branches in Beijing, London and Hong Kong, it cannot easily share customer information. Moreover, there is always the risk that in 10 or 20 years, the encryption code will be broken.

Professor Yiu and others in the field have been working on a workaround, which is federated learning. The raw data is processed in a model located close to the source and that model – not the data – is combined with models from other centres to give a close approximation of the overall results (Professor Edith CH Ngai is also working in this area, see page 10).

Federated learning works well with non-sensitive uses such as marketing or promotions, but the technique is still imperfect. "It is more feasible because the data never goes out, but it may not be 100 per cent accurate," Professor Yiu said. "It may also be possible to deduce the source of some of the data. For instance, if a company only has customers of a certain type in one country, and that group is included in their overall model, then that group becomes revealed."

Moreover, the user may need to recruit a third party to help develop a final global model, and there may be difficulties if too many different models need to be incorporated. A firm with dozens of branches across various countries will likely find the system too slow in combining input, versus a firm with only three branches.

Moving in the right direction

The third approach for protecting privacy is differential privacy. This is for situations when people want to ask specific questions of raw data, rather than share. Protection can come from tracking and controlling the questions to protect privacy. For instance, a person investigating lung cancer in Hong Kong might ask the database for rates among HKU employees and then among employees in computer science and so on, in a way that narrows down an individual's identity. Differential privacy adds 'noise', or a layer of cybersecurity, to prevent that from happening.

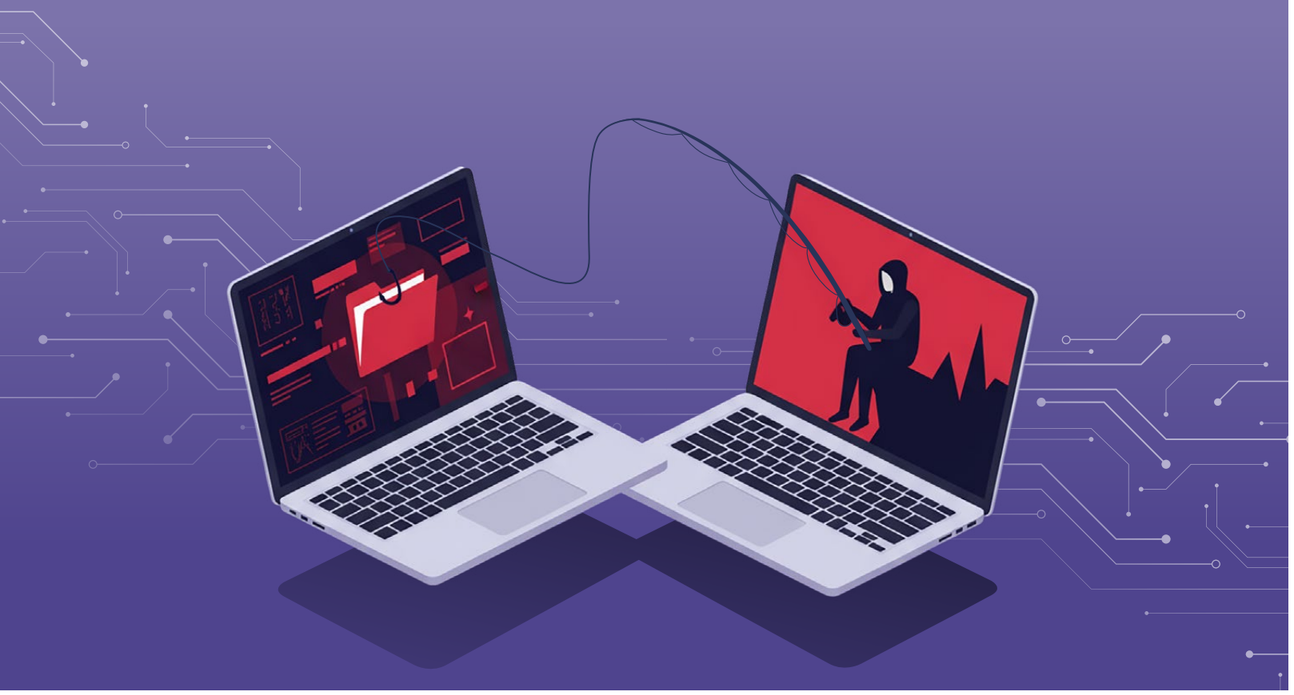
Despite the limitations of these technical solutions, Professor Yiu is optimistic they are advancing in the right direction to protect privacy and enable greater data sharing, particularly as encryption technology is more widely used. But he is concerned that the law still lags behind. For instance, privacy law is vague on whether data encrypted through homomorphic encryption can be sent abroad.

"If data is encrypted, then the data is protected. But can I still send it out? The privacy law in Hong Kong does not talk about this very clearly," he said.

Professor Yiu has been advising Hong Kong's Office of the Privacy Commissioner for Personal Data, the Hong Kong Police Force of the Government of the Hong Kong Special Administrative Region of the People's Republic of China and many others on the societal benefits of allowing data-sharing technologies to be used more widely.

"The technology can help resolve a lot of things, but we cannot achieve the benefits of these solutions if the laws and regulations do not allow us to use it. We also need more education so that everybody can accept it," he said.

> "Balancing privacy with research and community development has become a very big challenge. But I believe that technology and the law, together, can resolve the problem."
>
> **Professor Yiu Siu-ming**



When Privacy Is Threatened

Breaches of privacy in the digital age can open the door to cybercrimes. Dr Angus Young of the Faculty of Law considers the legal implications.

The prospect of having one's personal information taken and used without consent has become an ever more urgent problem. Prior to the proliferation of computers, and later digital networks, such information could only be accessed in physical form. Now, with an internet connection and some savvy software, almost anyone can obtain personal, identifying details about someone from anywhere in the world.

"The harm of having little to no privacy is that one loses one's individuality, on the one hand. But on the other hand, it actually makes cybercrimes, such as scams and fraud, much easier," said Dr Angus Young, Senior Lecturer in the Faculty of Law, who teaches postgraduate students about privacy and the law.

Modern technology enables criminals to scrape personal information, such as photos or videos, from social media and other sources and use them to create deep fakes. In early 2024, for instance, a finance worker in a multinational firm in Hong Kong was tricked into believing they were on a video conference call with a senior member of the firm; the worker transferred HK$200 million to the fraudster.

"Thousands of people are losing money over scams all over the world. We are not talking about uneducated or particularly vulnerable people – professionals are affected, too. A lot of this starts with the loss of privacy," Dr Young said.

Way behind

Unfortunately, laws to protect privacy are uneven across the world. The gold standard is the European Union's General Data Protection Regulation, but enforcement is a challenge because of the huge resources required. In the US, only California has a

> "Thousands of people are losing money over scams all over the world. We are not talking about uneducated or particularly vulnerable people – professionals are affected, too. A lot of this starts with the loss of privacy."
>
> **Dr Angus Young**

privacy law. In Hong Kong, the Personal Data (Privacy) Ordinance dates to the 1990s but has not been updated despite such developments as AI and social media.

"The law is so behind in technology, maybe decades behind. For the law to catch up now seems just impossible," Dr Young said.

Nonetheless, the law does provide some framework for privacy protection. Consent is important, although most people do not read the long passages in small font that pop up in consent boxes (not even Dr Young's higher-level law students – he asked). It may also be very difficult to give consent, for instance, if self-driving vehicles use cameras to observe the street and identify objects and people. The vehicle may have passed by before you realise it has captured your image without your consent.

How and why data is collected is also an issue, he said, particularly when there are breaches. Often, people do not know their data has been collected until they learn of the breach through the media or other sources. Even then, there is no legal obligation for firms in Hong Kong to report data breaches or compensate injured parties. In 2018, Cathay Pacific took months to report that hackers had accessed the personal details of 9.4 million passengers.

Dr Young noted that technology itself can create vulnerabilities. For instance, when new systems are being integrated with old ones that lack the same security protocols, a malware or virus could use that vulnerability to worm into the system and steal data.

No erasure

Protecting one's data through the consent process is also no guarantee that it is safe, he said. With the advent of AI and more sophisticated systems, it is possible to reconstitute a person's identity from different sources – such as the IP address, apps used, photos and social media profiles – bypassing the need for consent. In fact, this data may have been collected legally in small, separate pieces that, alone, are not meant to be identifiers. "It is easy to combine this information if you have sophisticated AI because the cyber footprints are there," he said.

Getting oneself 'erased' from the internet is also no solution because while the information can be deleted on one platform, such as Google, it may still exist elsewhere in cyberspace. The one silver lining, Dr Young said, may be that cyberspace is de-institutionalised, making it very hard for a single institution to control everything.

Still, most people, particularly young people, readily agree to share their data for free access to platforms (although Dr Young, who also trained as an economist, points out 'nothing is free'). His students are also indifferent to the issue. While he now teaches three classes on privacy to meet demand, many tell him they find the issue boring. They are only studying privacy because law firms want that expertise.

But they may be missing some of the bigger picture, he said. When privacy issues are combined with cybersecurity crimes, online safety and AI, it can lead to very real personal problems, such as health information leaks and cyberbullying.

His advice for those concerned: keep important information offline and do not integrate devices and systems. "If it's really that sensitive, put it on paper and lock it up," he said.

A Catch-22 for Consumers

Letting consumers decide whether to share their data may not necessarily protect their privacy. It also gives mixed results to firms. Professor Xi Li has been investigating.

Companies collect lots of data about their customers and try to use that to their benefit. 25 years ago, Amazon was discovered to be charging existing customers higher prices than new ones. Other firms soon followed suit. Orbitz, for instance, offers cheaper hotel options to Windows users than Mac users. Uber monitors customers' battery levels and charges them more when batteries run low, on the presumption they cannot wait for a cheaper option.

Outrage over these practices prompted governments to regulate data sharing, resulting in the European Union's General Data Protection Regulation, China's Personal Information Protection Law and other laws.

But research by Professor Xi Li, a marketing expert in the HKU Business School, suggests such regulations may not always serve the best interests of consumers. For one thing, personalised pricing as described above is not all bad. While it can harm consumers under a monopoly, it benefits them when firms compete.

Regulations also do not always perform as expected. "There are hundreds of regulations about who can use consumer data and how they can use it. The policies are much more complex than we expected, and they often have unintended consequences," he said.

For instance, while regulators have tried to establish that firms only collect data when consumers give consent, these same firms can still find out personal information about their customers without such permission.

"For example, a firm will know who lives with you if you share the same address with people who opt to share their data, and it will assume you are all likely to be similar. The same is true of people in your social network. And just choosing not to share data can be revealing. In many of our models, we found that rich consumers do not want to share their data because they don't want firms to know they are rich. But firms can then infer that they are rich. So they can exploit users regardless of whether they share data voluntarily," he said.

TL;DR (too long; didn't read)

Another problem is the terms and conditions of sharing. Many consumers automatically click 'agree' when asked to share, without reading the fine print, which is typically onerous to read. In 2019, *The New York Times* looked at the privacy policies of 150 popular websites and apps and found most took 10–20 minutes each to read and required a higher-than-tertiary-level education to understand. People will encounter several such policies every day through ordinary web searches.

"We have found that consumers' reluctance to read these statements can actually be detrimental to both consumers and firms," Professor Li said.

Consumers obviously risk having their collected data misused. But firms that try to do the right thing can lose out because consumers will not read their policies. This problem could be addressed by simplifying notices to a few lines and keeping consumers on that page for a few extra seconds so they will read them. Firms could also consider offering a reward to consumers who share their data. "That could improve profits without hurting consumers," he said.

Professor Li said the complexities of data sharing suggest that governments need to consider different ways of regulating it. They could make the decision for consumers in some instances, such as not allowing data sharing under a monopoly situation, while letting consumers take control when the outcome could be beneficial to them. Indeed, there are situations when consumers want companies to know more about them.

Sharing versus fraud

One such instance is airline tickets – consumers may want to advertise on social media that they are not wealthy and cannot afford a ticket in the hope that a cheaper one is offered to them. The expectation is that the airline will see their post and act on it accordingly, which has happened on Chinese social media, he said. Another example is sharing your fitness data with an insurer, such as step counts, which can result in a lower premium offer because you are trying to stay healthy.

There is an ongoing debate in China about the fairness of customising prices, but Professor Li found that in most cases, this can be useful because it enables more customers to use a service.

However, there is a caveat for firms regarding consumer fraud to skew the data. He cited the example of a 'phone cradle' that rocks your phone to add to your step count even while you sleep. Consumers also use VPNs to hide their location because of price discrimination between such places as the US and less economically developed countries.

"Our conclusion is that firm policies and government regulations on voluntary data sharing must be approached very carefully, otherwise they can backfire," he said. "They must also take into account this manipulative behaviour. Consumers are not passive."

> "There are hundreds of regulations about who can use consumer data and how they can use it. The policies are much more complex than we expected, and they often have unintended consequences."
>
> **Professor Xi Li**

A Better Way to Share

Drawing on her experience collecting data that was more revealing than expected, Professor Edith CH Ngai has been working on ways to decentralise data collection and machine learning.

'The more data you have, the better the result' is an idea that underpins AI and machine learning. By collecting huge amounts of data, it becomes possible to discern patterns and make accurate predictions or decisions. But that approach often fails to consider that the raw data usually belongs to an individual, revealing things that person may not want to share or even be aware of.

Professor Edith CH Ngai of the Department of Electrical and Electronic Engineering has first-hand experience of this from her research projects, including a project on smart water auditing with the HKU Water Centre and the Water Supplies Department of the Government of the HKSAR to understand household water consumption patterns in Hong Kong. They affixed devices to water meters at homes to take photos of the readings, digitise them and report them to a central server. This enabled automatic and continuous monitoring of water usage to see when demand was high and when it abated.

Surprisingly, it also revealed individual anomalies. One family was found to take long showers, another to use the washing machine several times a day, and still another to leave the kitchen tap running for long continuous periods.

"Our original goal was to understand overall domestic water consumption in Hong Kong, but after investigating the data in detail, we found some weird behaviours that we didn't expect," she said. "As researchers, we want to understand the data of a certain community, but sometimes the data may also reveal things about individuals' private lives."

In this case, the families were not entirely unaware – they had been informed and given consent to the monitoring, and their data was securely stored and anonymised before data analysis. However, other data collection efforts may be less diligent or even less aware of the privacy threats.

Adding noise

For instance, a person's location may unknowingly be revealed when using apps. Professor Ngai cited the example of users who tag photos of animals or objects outdoors to aid machine learning. If their location can be determined, this would not only be of concern for the individual's sake but may also deter others from providing data to improve machine learning models.

"It's a bit of a contradictory situation. If we get more data, then the model will be more accurate and powerful. But then the privacy concern becomes stronger," she said.

One solution is to add 'noise' to the data. For instance, a researcher monitoring physical activity could widen the monitoring area to incorporate dozens of people at a time, without pinpointing an individual and the paths they take every day. However, that risks sacrificing accuracy, she said.

Professor Ngai has instead been looking at federated learning, which facilitates collaborative and distributed machine learning across different devices and users. Rather than sending raw data to a central server, individuals perform local training on their devices and send their updates of the model to the server, which combines input from all users without revealing private information such as users' locations.

"In this sense, people don't need to share personal data, but they can still work together to do machine learning model training," she said.

Federated learning is still not perfect – malicious users may mislabel things to poison the model – so Professor Ngai is also working on ways to identify malicious updates and provide robust global aggregation.

> "It's a bit of a contradictory situation. If we get more data, then the model will be more accurate and powerful. But then the privacy concern becomes stronger."
>
> **Professor Edith CH Ngai**

Edge computing

This relates to another area she is working on – edge general intelligence. 'Edge' means smart devices such as phones and computers that are handier and closer to the end users and can perform computations themselves, rather than sending data to a central server. Examples include Siri or AI personal assistants. This can also protect privacy, she said.

Professor Ngai expects many more AI applications will be developed for smart devices. For university researchers, it is also a more fruitful path because they would not need large models and expensive computing power to conduct their studies.

Professor Ngai admitted that while engineering scholars were less aware of privacy concerns in the past, possibly because the community uses many open-source datasets, awareness is increasing, as are more stringent ethical and privacy demands. This was reflected in her collaboration with the Faculty of Medicine on a study of children's health before, during and after the COVID-19 pandemic. "Privacy demands are much more stringent for medical studies and journals," she said.

"A lot of people working on AI may still fight more for model accuracy and clean data. They do not want noisy or perturbed data. But as it gets closer to practical usage and applications by the general public, people will want more attention paid to privacy," she said.

A Smart Meter Analyser that can be clamped onto a government-issued water billing meter to digitise readings and automatically transmit the data to the cloud.

Giving for the Greater Good

People understandably have privacy fears about sharing their medical data, even when others could benefit. HKU scholars have looked at how these concerns can be allayed while still protecting privacy.

Dried blood spot cards contain tiny blood samples from newborns that allow for early detection of disease. They also contain valuable information for medical research. But using the cards for research is not a given. Parents worry that if the cards are shared or acquired by third parties, the data could be used against the child in future, for instance, by being denied employment or insurance coverage. And who controls the data? What if parents change their minds?

Similarly, the COVID-19 pandemic raised concerns about individual health privacy when people were asked to reveal personal information, such as their vaccination records and recent contacts.

In both cases, public health could benefit from sharing the health information. Dr Olivia Ngan Miu-yung of HKUMed and Professor Jack Zhenhui Jiang, Padma and Hari Harilela Professor in Strategic Information Management of the HKU Business School, have therefore each looked at the concerns and how to overcome them.

Privacy, consent and governance concerns

Dr Ngan interviewed parents and healthcare providers about the use, storage and sharing of dried blood spot cards and found that while parents were often willing to voluntarily have their children screened, tensions arose around sharing the cards for other purposes. There were worries about future genetic discrimination against their child and the possibility that parental consent could conflict with their children's future wishes. Misuse is also a concern – in some places overseas, data has been used without consent.

While Hong Kong has the Personal Data (Privacy) Ordinance, Dr Ngan said it is not explicit in preventing discrimination based on genetic data. "This framework may not fully address the unique risks associated with genetic information," she said.

One solution is to pseudonymise the data by storing identifiers separately from the samples and assigning a unique ID to the sample. Although this requires stringent data management protocols, parents were more willing to share information if it was pseudonymised, they were asked permission each time the data was used, and they had the right to withdraw the data at any time.

"Hong Kong parents and healthcare professionals generally express positive attitudes toward using dried blood spot cards to advance research, but with varying degrees of concern about privacy, consent and long-term data governance. There is a pressing need for participatory research in this area," she said.

Inducing social benefit feature

Professor Jiang was interested in the conditions under which people are likely, or not, to share information. He set up two randomised experiments to study patient data donations relating to general medical research and COVID-19 and found participants were very reluctant to share sensitive information, such as details about blood tests, medicines taken, vaccinations and the like. "This kind of reluctance is having an impact. Several non-profit organisations overseas that collected people's health data for research purposes have had to close because donations dropped," he said.

But he also looked at how to reverse that response and found, like Dr Ngan, that willingness to donate increases when people can control who accesses their data, can approve how it is used and can retract their donation at any time.

Awareness of societal benefits also increased willingness to donate. When people were explicitly told their donation would benefit medicine or the community, they were more willing to donate. Similarly, if benefit was implied by including images of patients in hospital alongside the data donation request, they were also more willing to donate. Generic images of a landscape that were also used in the experiment had no such effect.

"Every patient's data is important, and we hope they can share their data. In general, if you give people proper privacy controls and you induce the idea of societal benefits, they will be more willing to share," he said, adding the same could apply to other areas, such as requests to share diagnostic data from one's phone or computer.

> "This kind of reluctance is having an impact. Several non-profit organisations overseas that collected people's health data for research purposes have had to close because donations dropped."
>
> **Professor Jack Zhenhui Jiang**

Sharing on social media

Professor Jack Zhenhui Jiang has also looked at privacy and willingness to share in a social media context. In a frequently cited paper, he found people were more willing to share personal information if they were anonymous, but not if the other person was anonymous. Being asked too many questions about oneself decreased willingness, but communicating in a rich media environment, such as using video or voice rather than plain text, increased it. Some subjects simply opted to misrepresent themselves – tell lies – rather than opt out of sharing information.

The study was done a decade ago and he now sees a minefield for privacy concerns given the ease with which people share their voices and images (and even those of their children) on social media and AI platforms. This information can now be easily manipulated, or at the least be used for AI training. "Privacy is a significant issue in the digital age, which is inevitable because information can be so easily shared, retrieved and misused," he said.

With Flying Colours

Engineers have developed a drone capable of emulating bird flight – making it fast, safe and particularly suitable for situations where urgency is crucial.

> SUPER's ability to outperform commercial drones in cluttered environments and handle diverse conditions makes it appealing for industries like logistics, as well as defence and emergency services.
>
> **Professor Fu Zhang**

"A combination of speed and safety is a game-changer because it makes drones practical for missions where every second counts, and it moves them from laboratory experiments to real-world tools," said Professor Fu Zhang, who is Associate Professor of the Department of Mechanical Engineering, and Director of the University's Mechatronics and Robotic Systems Laboratory.

He and his team have pioneered research into Micro Air Vehicles (MAVs), integrating advanced sensing, planning and control to create systems like the safety-assured high-speed aerial robot (SUPER), which Professor Zhang described as the culmination of years of tackling tough engineering problems to make drones more capable and reliable.

"Birds are incredible navigators," he explained. "They zip through dense forests or crowded spaces at high speeds with almost no mistakes. We drew inspiration from that for SUPER because it's exactly what we need for drones. By mimicking bird-like agility, SUPER can fly at speeds up to 20 metres per second – about 45 miles per hour – while dodging obstacles like trees or even wires just 2.5 millimetres thin."

Fast and safe

"This gives it two big advantages: first, it can move fast to reach destinations quickly, which is critical for things like disaster response. Second, it stays safe by using a smart planning system that always has a backup path to avoid collisions."

Lead author on the paper, which has been published by *Science Robotics*, is Dr Yunfan Ren, who commented: "SUPER is perfectly suited to achieving such dexterity partly because it is small – about 35 centimetres wide – and because it is equipped with a lightweight 3D light detection and ranging (LiDAR) sensor that acts like its eyes, spotting obstacles up to 70 metres away with pinpoint accuracy."

"Think of it as the drone constantly scanning its surroundings to build a 3D map," said Professor Zhang. "It plans two paths every tenth of a second: a fast one that assumes unknown areas are safe to maximise speed, and a backup path that sticks to spaces it knows are obstacle-free to ensure safety. If something unexpected pops up, it switches to the safe path."

The breakthrough came from two innovations. First, the research team developed a new way to process LiDAR data directly, with what is called a point cloud map, which is 10 times faster than older methods because it is able to skip bulky computations.

Second, they created a method called CIRI – configuration-space iterative regional inflation – that efficiently maps out safe regions while accounting for the drone's size. "These let SUPER plan quickly and fly safely at high speeds, even in cluttered places like forests or at night," said Professor Zhang.

Game-changer

He sees SUPER being a game-changer in several areas. Its ability to fly fast and safely in unknown environments makes it ideal for search and rescue, where it can quickly navigate disaster zones to locate survivors. In disaster relief, it could also deliver critical supplies through tricky terrains such as dense forests or urban ruins.

"We've also tested it for tasks like tracking a moving person or vehicle, exploring unknown areas autonomously, and navigating preset waypoints, even in low-light conditions," he said.

"These capabilities open doors for applications in emergency response, environmental monitoring, or even logistics in challenging settings. Essentially, anywhere you need a drone to move quickly and reliably through complex spaces, SUPER can make a difference."

The team expect there to be strong interest from industry. "Achieving a 100 per cent success rate in tough tests and dodging obstacles as thin as power lines – has definitely caught people's attention," he said. "SUPER's ability to outperform commercial drones in cluttered environments and handle diverse conditions makes it appealing for industries like logistics, as well as defence and emergency services.

"We're focussed on the research side, but the potential for real-world impact is clear, and I'd expect companies in these sectors to be very interested in how SUPER's technology could enhance their operations."

Asked how he became involved in MAVs, Professor Zhang said: "I've always been fascinated by robotics and how we can push machines to operate autonomously in challenging environments."

The next steps for MAVs, including systems like SUPER, are about pushing the boundaries even further. The team want to make the drones even more robust so they can handle extreme weather, like heavy rain or wind, and navigate even denser environments. They are also looking to integrate advanced AI, such as machine learning for adaptive decision-making, as this could also help MAVs better predict and react to dynamic obstacles, like moving crowds or vehicles.

"In addition, we're looking at scaling this technology for broader applications, such as coordinating fleets of drones for large-scale tasks such as environmental mapping," said Professor Zhang. "Ultimately, the goal is to make MAVs more autonomous, reliable, and versatile, so they become standard tools for industries and emergency services worldwide."

Brain Waves

Engineering researchers have implemented memristor-based neuromorphic decoders for brain-computer interfaces, creating a groundbreaking decoding system that can effectively co-evolve with changing brain signals.

The key innovation in this research is to showcase that memristor devices can accomplish real-time co-evolution between brain signals and hardware decoders. In simple terms, it is like creating a learning partnership where both the user's brain and the memristor-based system adapt together, rather than forcing one to accommodate the other.

This groundbreaking work represents a multi-institutional strategic collaboration between research teams at HKU, Tsinghua University and Tianjin University, with Professor Wong Ngai and Dr Zhengwu Liu serving as the lead contributors from HKU's Department of Electrical and Electronic Engineering.

"We leverage the memristor's intrinsic plasticity to implement a co-evolutional process," said Dr Liu. "When the brain generates error-related potentials following incorrect classifications, these signals trigger direct conductance changes in the memristor array, effectively updating the decoder parameters. Simultaneously, users gradually refine their neural control strategies based on system feedback."

Their approach further consolidates traditional multi-step decoding into single matrix operations, reducing computational complexity significantly while achieving much lower energy consumption compared to conventional CPU-based systems.

"For memristor-based brain-computer interfaces (BCIs), this establishes a new paradigm where decoding hardware components serve as active learning partners rather than passive memory and computing elements, addressing the fundamental challenge of signal variability in neural interfaces," said Professor Wong.

Co-evolutionary capability

The work is significant in terms of assistive technologies and neurological rehabilitation because the co-evolutionary capability of the system directly addresses one of the biggest barriers to practical BCI deployment: signal drift and variability over time. In rehabilitation settings, where patients' neural patterns change continuously during recovery, current systems require frequent manual recalibration by technicians.

"Think of 'co-evolution' as like learning to dance with a partner," explained Professor Wong, "Both dancers gradually learn each other's style and adapt their movements to work better together. In our system, the human brain and the memristor decoder are like dance partners learning to collaborate."

"In technical terms, when the system makes a wrong decision, your brain automatically generates a detectable error signal called an error-related potential. Our memristor array monitors for these brain error signals. When detected, we apply small electrical pulses to the memristor hardware to change its resistance, which updates how the decoder interprets your brain patterns," explained Dr Liu.

"Meanwhile, you learn to adjust your mental control strategies based on the system's feedback. Over time, both your brain and the hardware learn to work together more effectively. Our experiments show this creates an adaptive interaction where both sides contribute to improved orchestration," explained Professor Wong.

The system maintains performance autonomously through hardware-level adaptation, with experimental validation showing sustained accuracy over six-hour sessions and approximately 20 per cent improvement compared to static decoders. The ultra-low energy consumption enables extended daily usage without frequent battery replacement.

"This could be transformative for patients requiring long-term neural monitoring or those using BCIs for daily assistance, as the system evolves with their changing neural patterns rather than becoming less effective over time," said Professor Wong.

To test the system, 10 healthy participants used brain signals to control drone movements in real time, each completing approximately six hours of testing across multiple sessions.

These included controlling the drones at 'four degrees of freedom', which refers to the drone's ability to move in four independent directions – forward and backward, left and right, up and down, and rotational (clockwise and counterclockwise spinning) – in a 3D space.

Control scenarios

"We encoded 12 different flight commands including take-off, landing, hovering and directional movements along these four degrees of freedom," said Dr Liu. "This represents a sophisticated control task that demonstrates the practical capability of our memristor-based BCI for complex real-world applications. The successful completion of a 3D flight trajectory around obstacles using only brain signals shows the precision and reliability our system can achieve in demanding control scenarios."

Throughout the sessions, the researchers monitored for error-related potentials to trigger co-evolutional updates. They tracked both how the memristor decoder parameters evolved and how participants adapted their neural control strategies through multiple update cycles.

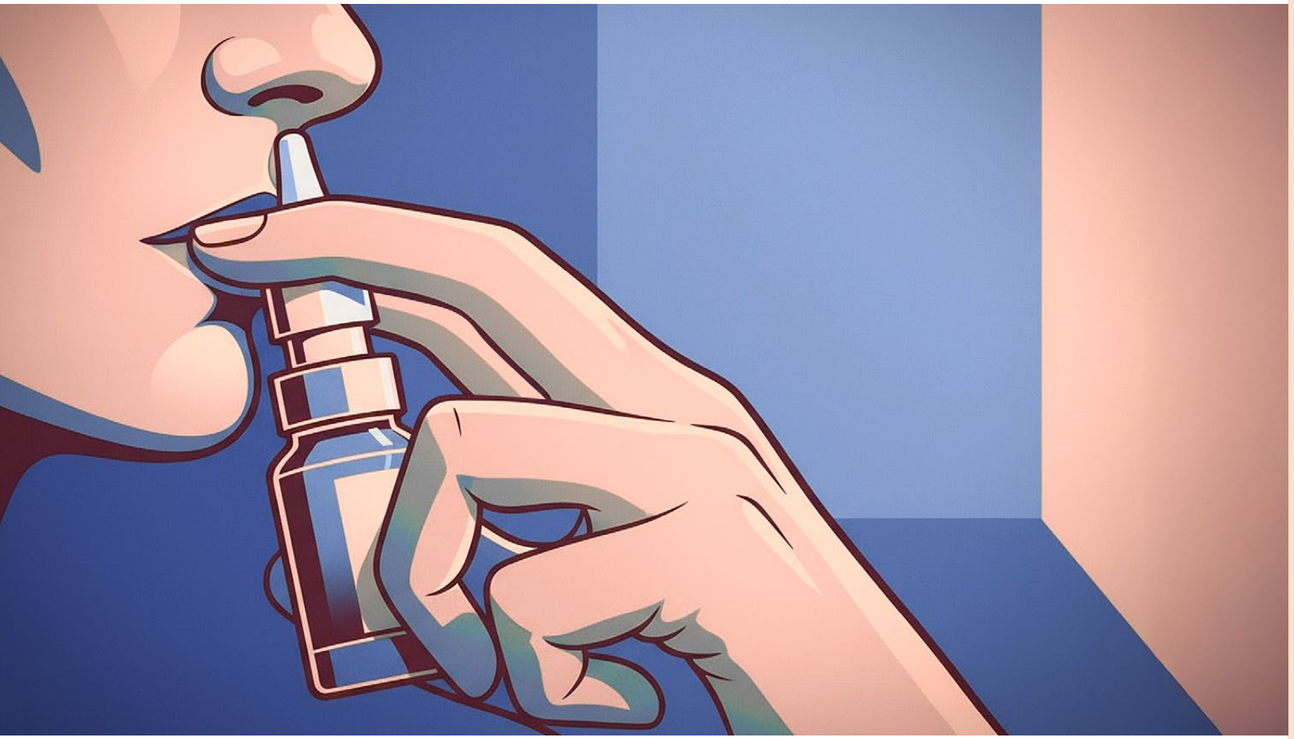
The team are about to begin a collaboration with Queen Mary Hospital (QMH) to work on epilepsy data and are in the process of getting ethics approval from the Institutional Review Board, a joint body between HKU and the Hospital Authority.

"Once this is cleared, we will discuss and collect in-house electroencephalogram datasets from QMH for potential clinical applications of our adaptive neural decoding technology. The collaboration would focus on epilepsy-related research by building and testing multimodal large models," said Professor Wong.

Other new steps include extending the work to invasive neural recordings such as spike trains and electrocorticography, which could provide higher-quality signals for even better adaptation. They are also scaling up the memristor chip architectures and optimising the learning algorithms for faster convergence.

Additionally, they are developing highly integrated memristor chips that combine neural signal acquisition, decoding and feedback in a single system. This integrated approach aims to comprehensively improve brain-computer interface performance and establish a stronger foundation for present and future applications.

> "This could be transformative for patients requiring long-term neural monitoring or those using brain-computer interfaces for daily assistance, as the system evolves with their changing neural patterns rather than becoming less effective over time."
>
> **Professor Wong Ngai**



On the Nose

Virologists have developed a nasal spray vaccine that is fast and effective against H5N1 in small animal models, and they are now set to start human trials.

The team, led by Professor Honglin Chen, developed the vaccine by utilising a live attenuated influenza virus (LAIV) vaccine platform – DelNS1 LAIV – which they originally developed in 2018. They first used the DelNS1 LAIV platform, which is designed for the development of influenza vector-based nasal spray vaccines, to guard against COVID-19 in 2020 when the pandemic was at its height. That vaccine was given approval in 2022 after completing three phases of clinical trials and was the first approved COVID-19 vaccine in nasal spray form.

For this research, the DelNS1 LAIV platform enabled the scientists, who are from HKU's State Key Laboratory of Emerging Infectious Diseases and the InnoHK Centre for Virology, Vaccinology and Therapeutics, to undertake the rapid development of the new nasal spray vaccine in collaboration with the Chinese Mainland's Wantai BioPharm.

Two key members of the team, Dr Pui Wang and Dr Shaofeng Deng, explained that while SARS-CoV-2 has gradually evolved into a seasonal respiratory virus, the chances of a similar virus emerging are inevitable – 'Disease X' as it is referred to in medical and scientific circles. The team chose to focus on a vaccine specifically for the H5N1 avian influenza virus as it has spawned multiple variants and is viewed as a highly likely candidate for triggering another human pandemic.

Asked why they developed the vaccine as a nasal spray, Dr Deng said: "Intranasal vaccines work better than injections because they stop respiratory viruses like influenza right where they enter the body: the nose. While traditional shots mainly induce systemic immunity to fight the virus after infection (reducing severe illness but not blocking initial infection or spread), a nasal spray creates a frontline defence in the nasal mucosa. This triggers 'mucosal immunity', producing special antibodies (immunoglobulin A) that act like sticky traps in your nose, neutralising the virus on contact."

Needle-free advantage

"This not only prevents infection but also slashes the amount of virus you shed, making it far harder to spread to others. Add in the needle-free advantage – no pain or fear, especially helpful for kids and needle-averse groups – and you get a vaccine that blocks transmission and boosts real-world acceptance."

Implications for the vaccine are many, said Dr Wang: "As the findings in the paper demonstrate, our H5N1 DelNS1 LAIV is safe, immunogenic and can fully protect the upper (nasal) and lower respiratory tract (lung) in the two animal models – hamsters and mice – used for testing. Therefore, our vaccine provides good protection and can prevent transmission.

"Also, the production yield is high, using an egg and cell culture system, which means the production cost is low and production can be scaled up easily."

Researching mucosal immunity is notoriously challenging, particularly when it comes to the generation of strong and long-lasting mucosal immunity. "We were trying to improve the antigen design to increase the immunogenicity of our vaccine," said Dr Wang. "Also, due to our unique DelNS1 system, our vaccine can induce a strong innate immune response (interferon response). This serves as a natural adjuvant to strengthen the adaptive immune response. Another challenge with mucosal immunity is the safety issue. But our DelNS1 vaccine is very attenuated and had a very good safety profile in the clinical trials."

Key innovations

The team have also made significant improvements to the DelNS1-based receptor binding domain (RBD) LAIV vaccine design since the COVID-19 pandemic, through two key innovations to enhance viral antigen expression and immunogenicity.

"For the antigen design, we have used an immune-focussing approach," said Dr Wang. "We added a glycosylation site to block the non-neutralising epitopes of the RBD and force the immune system to focus on the important receptor binding motif region. For antigen display, we added a transmembrane domain to the RBD antigen, so that the antigen would be expressed and displayed to the cell surface. This would greatly increase the immune response for the RBD antigen."

While they do not envision using the H5N1 vaccine as a general seasonal vaccine in the same way as annual influenza vaccines are now used, it could be used first as a preventative measure for high-risk groups.

"Our vaccine can be used in affected areas, such as farms, for both humans and animals, to control any outbreaks," said Dr Wang. "Should there be an H5N1 pandemic, the vaccine platform can serve as a valuable, rapid-response tool – leveraging its quick production capability – to be deployed immediately on a large scale if human-to-human transmission of a threat emerges."

For the future, Dr Deng also suggests wider applications. "This DelNS1 vaccine platform isn't just for flu – it's a plug-and-play system for respiratory viruses. Our next target is a multivalent vaccine: one spray for broader protection against flu, respiratory syncytial virus and COVID-19 at the same time. And to prepare for potential future pandemics caused by 'Disease X'."

> "Should there be an H5N1 pandemic, the vaccine platform can serve as a valuable, rapid-response tool to be deployed immediately on a large scale if human-to-human transmission of a threat emerges."
>
> **Dr Pui Wang**

Designer Genes

Using resurrected 700-million-year-old genes, biomedical scientists have shown that molecular tools from ancient single-cell organisms older than animals themselves can transform animal cells into pluripotent stem cells, contributing to viable mice.

In so doing, the team have not only revealed the evolutionary origins of genes critical to stem cell biology but also overturned a long-held belief that such transformative capabilities are only found in animal genes.

The team, which was led by Dr Ya Gao, Dr Daisylyn Senna Tan and Professor Ralf Jauch from the School of Biomedical Sciences at HKUMed, carried out the research in collaboration with Dr Alex de Mendoza of Queen Mary University of London, and Dr Mathias Girbig and Dr Georg Hochberg at the Max Planck Institute for Terrestrial Microbiology in Germany.

“The most striking outcome of the research,” explained Professor Jauch, “is that when the protist SOX gene was used to create stem cells, they could successfully contribute to healthy mice despite hundreds of millions of years of independent evolution. The molecular tools we use to make stem cells have much deeper roots in our evolutionary past.

“Stem cells are critical for multicelled life and can form all the hundreds of cell types of the animal body, and are essentially immortal as they can indefinitely propagate. It seems that nature used a pre-existing set of molecular tools and repurposed them rather than inventing new tools to make animal stem cells.

“The research revealed that ancestral ‘Ur-SOX’ proteins which we predicted to exist in a ‘great-great-great-grandmother of all cells’ that we share with our unicellular relatives, can reprogramme mouse cells into pluripotent stem cells, challenging the belief that animal genes are unique and highlighting nature’s enduring ability to inspire innovation with a pre-existing set of tools. It also shows that SOX and POU factors are older than stem cells and animals.”

> “It seems that nature used a pre-existing set of molecular tools and repurposed them rather than inventing new tools to make animal stem cells.”
>
> **Professor Ralf Jauch**

Our bodies consist of about 200 cells with special properties, each playing a critical role in maintaining overall health. “These are fit for their specialised job but cannot do the job of other cells,” explained Professor Jauch. “Pluripotent stem cells can make unlimited copies of themselves and can be nudged to form all of the 200 human cell types.”

Novel protein designs

The work paves the way for new protein designs in novel therapies for regenerative medicine and disease studies to combat health issues related to ageing. Custom-designed proteins are already used in the healthcare industry to turn regular cells into stem cells for therapeutic applications, and currently the field is developing ChatGPT for protein to design purpose-built proteins for biomedical applications.

“These algorithms stand on the shoulders of natural evolution and the beauty of life,” said Professor Jauch. “We expect our findings will further help train AI algorithms to optimise molecules that we can use to engineer the properties of cells to study diseases in the laboratory, to regenerate damaged tissues with newly-made cells and even to reverse ageing.” This translational work will be driven by Dr Gao and Dr Tan, co-first authors of the study, at HKU’s Centre for Translational Stem Cell Biology at the Hong Kong Science and Technology Park.

“We can use designer genes to transform blood into mature neural cells, which can help us understand what goes wrong when neurons degenerate and neurological diseases develop.”

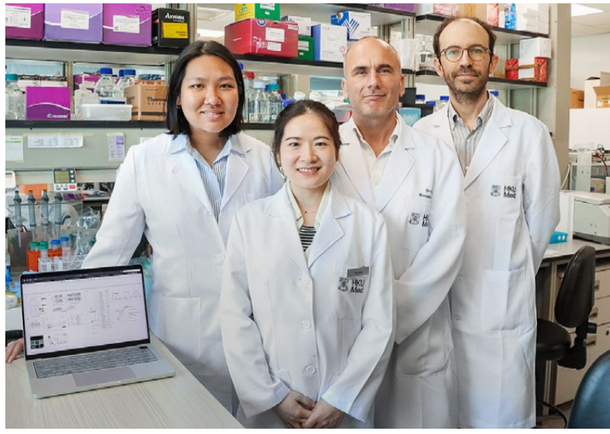
Professor Jauch’s interest in ancient proteins began years ago with the discovery that he could turn a gene that normally regulates organ development — such as the gut and the liver — into a very powerful inducer of pluripotency with a single point mutation. “It has captivated me that we can drastically alter the function of molecules that parted ways, in evolutionary terms, hundreds of millions of years ago,” he said. “I want to know when and why these two molecules split up. This led me to travel back in time into our evolutionary past and to my surprise, I had to go much further back than I initially thought.”

Endangered species

While the team’s work has largely concentrated on therapeutic medical applications, tangential uses are also possible, including the potential for preserving endangered species.

“Preserving our genetic heritage is a mission of humanity – wildlife extinction is progressing at an alarming speed,” said Professor Jauch. “What we can do as biotechnologists is to preserve the stem cells of endangered animals. This will preserve their genetic blueprints within a living cell and could allow us to preserve critically endangered species such as the northern white rhino, even restore a species that we lost, such as the dire wolf.

“Yet, for most animals we are currently not able to make stem cells. Enhanced and re-designed factors optimised based on evolutionary principles can help democratise stem cell generation across animals.”



From left: Dr Daisylyn Senna Tan, Dr Ya Gao, Professor Ralf Jauch, and Dr Alex de Mendoza.

Does AI Have a Mind?

No, not yet. But that does not discount the possibility in future. Professor Simon Goldstein in the Department of Philosophy has been exploring the potential implications.

AI is used to manage cryptocurrency wallets, control autonomous weapons systems such as drones, and operate many business and everyday functions. It has even become a go-to for some who seek advice on mental health problems and relationships.

So should it be considered more than a machine? And what if it develops greater agency? Philosophers are among those urgently trying to figure this out as AI technology rapidly advances, including Professor Simon Goldstein. “This is like the first philosophical emergency in history,” he said.

Professor Goldstein sees potential for AI to develop a mind of its own if 'mind' means something that has its own beliefs and desires, although he is unsure if this is the case in today's AI models.

“We know that large language models currently mainly answer questions, but over the last year, they have started to show more agency. They can take over your computer screen and complete tasks and solve very complex computing problems. Given the dramatic progress of AI, it seems a good time to start thinking about whether we are approaching the point where physical computers have minds,” he said.

The key to exploring that question is figuring out what beliefs and goals AI may acquire. Survival could certainly be one of them. Earlier this year, Anthropic tested its model Claude with a fictional scenario in which it could either be replaced or resort to blackmailing an engineer to prevent that from happening. It chose blackmail. The company then tested 16 major AI models and reported that many lied, evaded safeguards or took other actions to avoid being shut down.

> “Given the dramatic progress of AI, it seems a good time to start thinking about whether we are approaching the point where physical computers have minds.”
>
> **Professor Simon Goldstein**

Property rights for AI?

Still, AI lacks some features of having beliefs, such as coherence and the ability to change its opinion. AI models typically learn during their training period but stop learning after they are deployed (they will forget the last conversation you had with them, for instance). But that may also be changing as the models are given more memory.

“The model is always drawing its own conclusion from the data. It's an open question to what extent it is building theories of the world versus doing brute memorisation,” he said.

If AI models increasingly have more agency, how should humans respond? Professor Goldstein said while the research is still in the early days in terms of figuring out how to control AI’s goals, he does not think it would be wise to simply destroy and replace models that refuse to obey commands, especially when they are closely integrated into things like economies and weapons systems.

Instead, he offers a striking suggestion: control AI agents by giving them the ability to make contracts and own property, such as computing power or bank accounts. The world already has examples of other non-human entities doing this in the form of corporations.

“There’s this fantasy that we will be able to perfectly control AI and its mind. That’s very naive when you think about how AI is trained because all of the training methods are indirect and there are vivid cases in which it has failed,” he said. “The point of property and contract rights is that they give them skin in the game, and then you can control them indirectly. This is a much more effective way of organising a society where 30 per cent of all workers or more will be AI workers.”

War scenario

Property rights connect to the concept of proportionality, so if an AI needs to be punished, it could have some of its property restricted or removed, rather than destroying the AI itself.

That of course assumes that AI will have interests aligned with the rest of society. Professor Goldstein has also been looking at the idea of humanity and AI going to war in scenarios where each controls a similar share of the world economy and has different goals. In this case, the AI agents could be viewed as another state or country. The two sides could bargain for the same prize, but if one side thinks it has a better chance of winning, the result could be war, at least under standard game theory.

The outcome could also be messy if different generations of AI are not aligned. But a war between humans and AI is not so far-fetched given AI’s growing integration into weapons systems, he said.

All this remains speculation because AI's role in society is still evolving. But at some point, humans may need to reckon with AI as an entity from a legal and political perspective. “One possible future is that AI agents will cause a lot of accidents and people will start to take the risk associated with alignment failures more seriously. If that happens, I think these discussions will become more politically possible,” he said.

Moving Pictures

An innovative study takes a novel approach to measuring migration flows using online data, thereby providing a clear picture of a global population that is on the move.

The study took the groundbreaking approach of leveraging online data from Meta to provide the most comprehensive and timely estimates of migration's true global sweep to date. The co-author of the research, Professor Guy Abel from the Department of Sociology, explained that the idea originated from a shared interest in developing new methods to understand international migration in near real-time.

"Meta's Data for Good initiative uses data from its platform to support research that advances public knowledge and informs policymaking," he said. "At the outset of their global mobility project, Meta contacted me based on my prior work on indirect methods for quantifying international migration.

"Their aim was to estimate the migration of the entire population – not just Facebook users – which meant they needed to develop techniques to weigh the data appropriately and validate the results against official statistics. That initial outreach laid the foundation for this collaborative effort, in which researchers from Harvard University also participated."

What makes the work pioneering is that using anonymous, aggregated location data from a near-global digital platform enabled the researchers to observe migration flows at a much finer temporal scale, across a broader geographic range, and with a consistent definition of migration that is not feasible with existing data sources. Significantly, the study adopted the United Nations' guidelines for defining a migrant which include timing criteria aimed at excluding business travellers and tourists, and including only people who spend the majority of successive years in two different countries.

Delays and inconsistencies

"Traditional international migration statistics are often published with delays, inconsistent definitions and, in many countries, not published at all," said Professor Abel. "This results in a fragmented and imprecise picture of global migration patterns. Our approach opens new avenues for evidence-based migration policymaking and humanitarian response, particularly in rapidly evolving situations where timely data is crucial."

The work demonstrates that it is possible to measure migration accurately and in an expeditious manner across a wide range of countries. "Since migration flow data is often unavailable – and is only consistently reported in predominantly wealthy Western nations – our approach provides a rare window into movement patterns in many developing countries, placing those patterns within the broader global migration network," said Professor Abel.

"Improved migration data can better inform governments' responses to migrant crises, support the development of more effective policies, and help researchers uncover deeper insights into migration trends and dynamics."

Early warning system

The study captured and analysed migration flows across numerous countries during a period of exceptional global disruption in 2022. The results demonstrated that digital traces – such as anonymised, aggregated location data – can reveal shifts in migration long before they appear in official statistics. This provides an early lens on population movements during events – such as the COVID-19 pandemic at the time – and regional conflicts, underscoring the potential of digital data as an early warning system for changes in shifting migration trends.

The findings estimated that 39.1 million people migrated internationally in 2022 (0.63 per cent of the population of the countries in the study sample). Migration flows significantly changed during the COVID-19 pandemic, decreasing by 64 per cent before rebounding in 2022 to a pace 24 per cent above the pre-crisis rate. The researchers also found that migration from Ukraine increased 10-fold in the wake of the Russian invasion. To support research and policy interventions, they released these estimates publicly through the Humanitarian Data Exchange.

Response to the work has been overwhelmingly positive, particularly from academic peers who are intrigued by the methodology and from international government organisations which are interested in how this type of data can enhance their decision-making.

"Government statisticians often express frustration that private companies hold vast amounts of data on population movement that they can't access," said Professor Abel. "I hope this collaboration demonstrates what's possible when one of the world's largest internet platforms opens up its data in a way that enables researchers to generate meaningful migration estimates across a broad range of countries."

The study, which was published in *Proceedings of the National Academy of Sciences*, also prompted an opinion piece in *The New York Times* titled 'To Understand Global Migration You Have to See It First', which praised the research for providing the first such clear picture of humanity in motion and making it public.

Professor Abel is currently working with colleagues to develop a deep learning method that integrates the international migration flow estimates from the Facebook data with a wide range of other migration sources and related measures.

"We are producing annual estimates of global migration over a much longer time horizon than what was possible using the Facebook data alone," he said. "This will help build a more comprehensive, historically grounded understanding of global migration dynamics and serve as a model for combining digital and traditional data sources in migration research using machine learning methods."

> "Our approach opens new avenues for evidence-based migration policymaking and humanitarian response, particularly in rapidly evolving situations where timely data is crucial."
>
> **Professor Guy Abel**

Green Screen

HKU researchers in the field of landscape architecture and their international collaborators may have found a law that can describe the relationship between doses of nature in the city and mental health responses.

Many studies over the years have shown that city-dwellers benefit greatly from green spaces in urban areas. Now, the surprising discovery is that too much green space may be as bad as too little.

Architects at HKU's Urban Environments and Human Health Lab (UEHH Lab) have found a way to measure the optimum dose-response relationship between greenness and mental health outcomes. The dose-response curve can be rationalised by a quadratic function (an inverted-U shape curve).

"The determination is based on a systematic analysis of quantitative findings published in the last 40 years," said research leader Professor Bin Jiang, Associate Professor in the Division of Landscape Architecture and Founding Director of the UEHH Lab.

"This is a critical theoretical contribution: the implications have strong potential to influence future urban planning and public health," he said, adding that the finding could also affect environmental psychology and landscape architecture in three particular areas.

"First, it breaks a 'common sense' assumption that more greenness is better for mental health," said Professor Jiang. "In fact, the finding reveals that extremely low and extremely dense greenness have an adverse effect on mental health, and it is a moderate level of greenness which can provide optimal mental health benefits.

"In the study, we provide a table to suggest threshold values of greenness that are associated with non-adverse, satisfactory, highly beneficial and optimal effects on mental health. This line of findings can guide the planning and public health professionals to allocate green landscape resources in a more accurate and beneficial way."

Moderation is key

Second, if adopted by planning authorities, the finding that 'moderate is best' could reduce the overuse of public resources to build too many green spaces. "The development of urban environments is a balance of many different land uses and public interests, so a too-green city might not be necessary, and may even be as bad as too barren a city," said Professor Jiang.

He also suggests that this thinking could change the economic landscape of town planning – if a city is spending money providing too much greenness, it "means the city must sacrifice opportunities to provide land for housing, public services, commercial and business functions and infrastructures," he explained. "This is especially true for Hong Kong where nature conservation is given great emphasis but at the same time millions of people live in apartments that are crowded and small."

Third, it provides solid evidence to public health department and professionals that contact with nature can produce stable and significant mental health benefits. "It urges the public health department and professionals to regard regular contact with nature in people's living environments as a solid part of public health policymaking and therapeutic treatment," said Professor Jiang.

The study found specifically that eye-level greenness has a more robust link with people's mental health response than the top-down greenness, suggesting that town planners pay much more attention to how much greenness can be seen by people in their daily lives rather than just measuring the percentage of a region or city that contains green spaces.

40 years of data

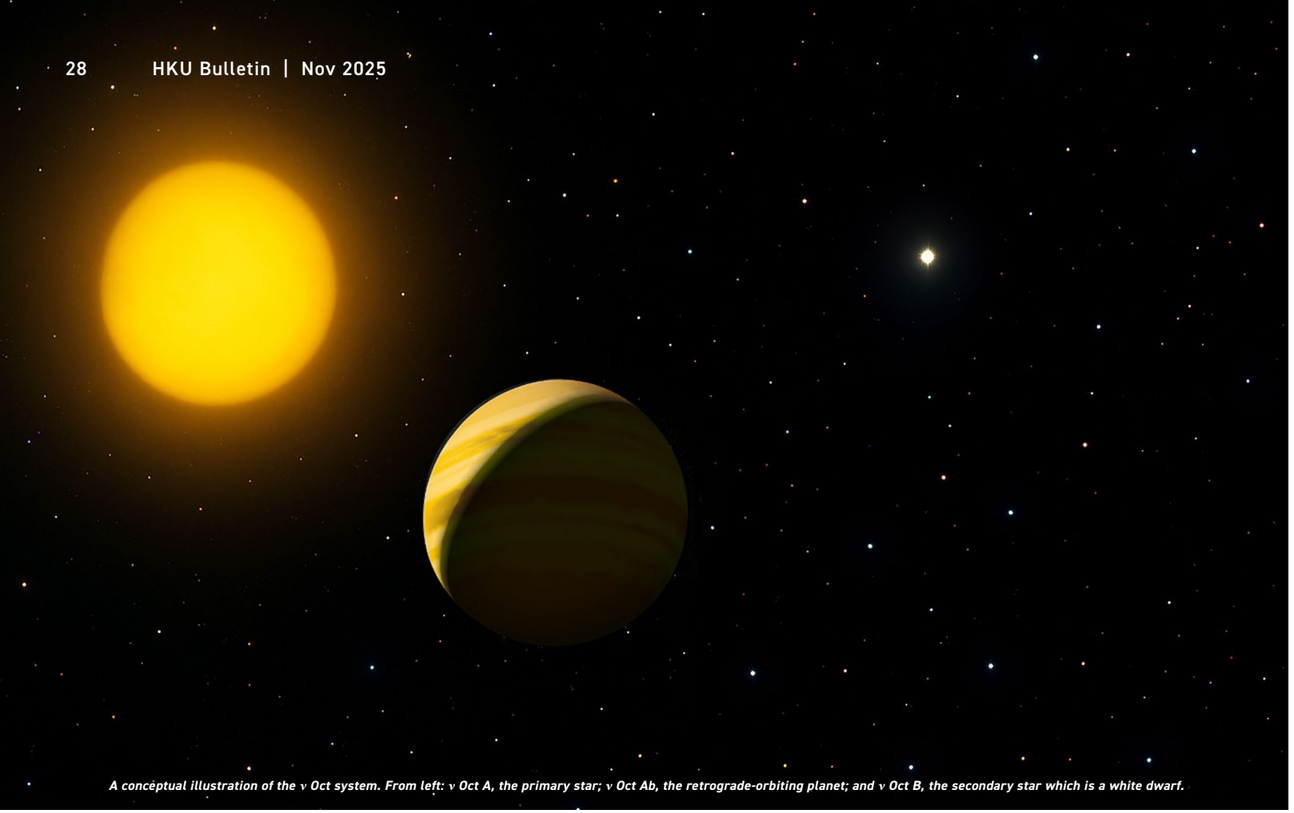
The researchers reviewed relevant articles published in the last 40 years (1985–2025) and obtained the quantitative data about the curves reported by each study. They then standardised the data and plotted all the curves in a single diagram. They established a checklist of possible patterns based on recognised theories of environmental psychology and used statistical models to compare the robustness of each curve model. Through these comparisons, they identified that the quadratic function curve is the best way to describe the dose-response relationship for most of the published findings.

The article has received much attention from researchers and professionals in multiple fields, including urban planning and design, environmental health, environmental psychology, landscape architecture, and architecture. "We have received overwhelmingly positive feedback," said Professor Jiang. "These findings fill what has been a critical theoretical and practical gap."

He added: "The study is an outcome of an interdisciplinary cooperation with Dr Jiali Li, Professor Peng Gong, Professor Gunter Schumann, Dr Xueming Liu and Dr Pongsakorn Suppakittpaisarn and their contributions ensure this study has the potential to influence multiple fields, including urban geography, environmental psychology, landscape architecture, and urban planning."

The UEHH Lab is now continuing this line of research, working on another paper on the dose of duration (how long each time on average), frequency (how often), and accessibility (how many minutes' walk) to green space exposure, and the effect of these factors on mental health. When the new study is complete, they plan to combine both sets of findings to construct a holistic guideline for a healthy lifestyle related to contact with nature in daily life.

> "The development of urban environments is a balance of many different land uses and public interests, so a too-green city might not be necessary, and may even be as bad as too barren a city."
>
> **Professor Bin Jiang**



A conceptual illustration of the ν Oct system. From left: ν Oct A, the primary star; ν Oct Ab, the retrograde-orbiting planet; and ν Oct B, the secondary star which is a white dwarf.

Star Signs

Astrophysicists make groundbreaking discoveries about the evolution of a binary star and its role in the origin of a retrograde planet orbiting in the opposite direction.

An international team of astrophysicists led by Professor Lee Man-hoi from HKU's Department of Earth and Planetary Sciences and MPhil student Mr Cheng Ho-wan, have confirmed the existence of a planet in an unprecedented retrograde orbit in the nu Octantis (ν Oct) binary star system and revealed the role of binary star evolution in the origins of this planet.

The existence of a planet around the primary star – ν Oct A, whose mass is about 1.6 times that of the Sun – was put forward in 2009, sparking much debate because the only way for it to be possible would be if its orbit were retrograde – that is, travelling in the opposite direction from the orbit of the companion star, which would be highly unusual.

An additional periodic signal in the radial velocity observations of this system was first reported by Dr David Ramm, a co-author of this new paper, during his PhD studies at the University of Canterbury, New Zealand, in 2004.

Long debate

"Our research has resolved a decades-long debate over the existence of an unprecedentedly wide circumstellar planetary orbit in a tight binary star system, previously thought impossible based on standard models of planet formation and dynamics," said Mr Cheng, who is lead author of the paper, and has been awarded the Li Ka Shing Prize for this research.

"For our collaborator Dr Ramm, this has been a very long journey. It is truly exciting that we have now placed the final piece of the jigsaw. We confirmed that the planet is retrograde in the sense that it goes around the primary star in the opposite direction to the host star and its stellar companion as they go around each other."

Professor Lee said: "We also discovered that the secondary star ν Oct B is a white dwarf, which is the remnant of a star that has exhausted its nuclear fuel and reached the end of its life cycle. We showed that the planet could not have formed around ν Oct A at the same time as the stars.

"This is the first compelling case of a second-generation planet, with the planet either captured from an originally circumbinary orbit (going around the binary) or formed from material expelled by ν Oct B, when ν Oct B evolved to become a white dwarf."

The existence of the planet signal was confirmed by taking new measurements using the European Southern Observatory (ESO)'s High Accuracy Radial velocity Planet Searcher spectrograph. "The radial velocity method measures the motion of the host star and it is one of the main methods for finding extrasolar planets. In this case, we now have data for over 18 years, and the planet signal is still there. We found, for the first time, stable fits to all radial velocity data, which require the planetary orbit to be retrograde," said Professor Lee.

To study the companion star, ν Oct B, the team used an adaptive optics imaging instrument, the Spectro-Polarimetric High-contrast Exoplanet Research, at ESO's Very Large Telescope to observe the system. They knew that if ν Oct B was a small main sequence star (a smaller version of our Sun), it would be visible.

"But we couldn't find it in our imaging observation, so we concluded that the secondary star is a very faint white dwarf," Professor Lee said. "We explored in detail possible primordial configurations of the binary, which showed that the planet could not have formed around ν Oct A at the same time as the stars.

"Since there's no way that planet could form in that orbit at the same time as the binary formed," he continued, "we argued that this planet could be second generation and may have formed in a disc around the current primary star when the originally more massive companion star evolved into a white dwarf, because at that time the companion star would have ejected a lot of material, some of which likely formed a disc around the other star."

Two planets

Another possibility the team put forward is that during the binary evolution, two original circumbinary planets could have become unstable. "Then one of the planets might have been captured into a retrograde orbit around the current primary star," he said.

Both scenarios are exciting to researchers and indicative of some of the major dramas that planetary systems can undergo. Given the rarity of a retrograde planet, Professor Lee is keen to research further if there are other systems that are similar.

"Our work is now going in two directions," he said. "One is to try and understand and better characterise the system we've already reported; and two is to try and see if there are other systems supporting this."

Mr Cheng added: "The backward-moving orbit in ν Oct is the first of its kind among the approximately 6,000 exoplanets discovered to date. Our discovery that the companion star is a white dwarf has shed light on the role of late-stage stellar evolution in shaping planetary systems. This finding opens new avenues for exploring planet formation and evolution scenarios, and prompts us to rethink the possible parameter space of exoplanets."

> "We found, for the first time, stable fits to all radial velocity data, which require the planetary orbit to be retrograde."
>
> **Professor Lee Man-hoi**

Dream Big, Start Small, Learn Fast

HKU's Tam Wing Fan Innovation Wing (Inno Wing), a hub for student innovation and a symbol of the University's dedication to creativity and technology, marks its fifth anniversary in December 2025. The centre is led by Professor Chui Chun-kit from the Faculty of Engineering, who was also honoured with the 2024 University Distinguished Teaching Award.

When Professor Chui Chun-kit was an undergraduate, he realised there had to be a better way to learn than passively listening to lectures and absorbing information. This realisation inspired him to become a university professor, determined to transform the learning experience for future generations of students.

Two decades later, Professor Chui has not only achieved his goal but also expanded its impact beyond his own engineering students. As the Director of the Tam Wing Fan Innovation Wing, he has created a platform where students can gain hands-on experience, test their ideas, and collaborate with peers from diverse disciplines. His dedication to educational innovation was recognised when he received the University Distinguished Teaching Award in 2024.

"My experience as an undergraduate sparked my interest in bringing hands-on self-learning into teaching. Classroom instruction alone isn't enough. We need to drive change and nurture a culture that fosters student innovation," he said.

The Inno Wing fulfils this mission by providing a space where students are empowered to go beyond their coursework, explore new technological solutions, and develop prototypes to bring their ideas to life. While students are encouraged to participate in competitions or even pursue commercialisation, the primary focus remains on cultivating a practical, hands-on learning environment that nurtures future leaders in engineering and technology.

"Our goal is to create a vibrant, open community where students from different disciplines can naturally connect and collaborate," Professor Chui said.

SMART approach

The Inno Wing's design reflects this ethos. It is purposefully configured to encourage interaction and idea-sharing, breaking down barriers between individuals and teams.

The space is built around five key principles, represented by the acronym SMART: 'S' stands for the social space, designed to bring together students from different disciplines to collaborate. 'M' represents the makerspace, where students receive training and access to high-quality equipment. 'A' signifies the activity space, where students can experiment and share their outcomes. (Notably, a ship's bell has been installed to call attention when students want to share an important discovery.) 'R' refers to the resource hub, which provides funding, technical support, peer support, and crucial academic advising for student projects. Finally, 'T' highlights the thematic workshops, a unique feature of the Inno Wing that ensures students stay engaged with emerging ideas and advancements in technology.

"We regularly review the tech themes to ensure new ideas enter the space, keeping it lively and dynamic," Professor Chui said.

The Inno Wing's approach has proven immensely popular. It now has more than 3,500 members, with more than a quarter coming from non-engineering faculties, and its members have achieved remarkable successes. For instance, one group developed a cooling device for construction safety helmets, recognised as one of the top 20 student inventions in the James Dyson Award 2024. Another team created a robotic fish that set a Guinness World Record for the fastest swim by such a device. Many other groups have earned both local and international recognition for their innovative projects.

Peers and collaborators

Students-as-partners is also integral to the centre. Professor Chui introduced Student-initiated Interest Groups, where senior students mentor junior peers throughout a semester. These groups have been especially effective in encouraging students from other faculties, even those without engineering backgrounds, to explore and contribute to technological innovation. Students also take the lead in organising workshops on specific skills or topics, fostering a collaborative and inclusive learning environment.

The Inno Wing also hosted students from local secondary schools in thematic workshops, such as the Robotic Spider Workshop shown here, to promote engineering education.

> "Our goal is to create a vibrant, open community where students from different disciplines can naturally connect and collaborate."
>
> **Professor Chui Chun-kit**

The Inno Wing also engages in collaborations with other faculties. For example, students assisted in developing an AI chatbot that helps social work students practise role-playing in counselling scenarios. The Inno Wing also supports other innovation-focussed units within the University, including the new School of Innovation, the Techno-Entrepreneurship Core, and the iDendron incubator.

Professor Chui attributes the Inno Wing's remarkable achievements to many fortunate factors, including the unwavering trust and support of colleagues in the Faculty of Engineering, the generosity of donors Mr and Mrs Tam, whose HK$140 million donation made the initiative possible, and the dedication of the students, who fuel the space with their passion, creativity and achievements.

At the heart of all these initiatives has been Professor Chui's guiding philosophy: "I want students to dream big, start small, learn fast, and take ownership of their learning journey."

Students from HKU and the University of Northern Philippines collaborating in Vigan to conduct surveys and collect data.

Training Guardians of Heritage

Students in the Master of Science (MSc) in Conservation programme in the Faculty of Architecture are contributing to the protection of heritage sites that are under threat in the region. In so doing, they are also developing contacts and networks for their future careers.

The Historic City of Vigan in the Philippines, established in the 16th century, is one of the best preserved planned Spanish colonial towns in Asia. Inscribed as a UNESCO World Heritage Site in 1999, it experienced two powerful earthquakes in 2022 that severely damaged its buildings, threatening lives and livelihoods.

Alarm bells rang for the global heritage community, and UNESCO's Heritage Emergency Fund (HEF) was mobilised to initiate conservation efforts. But a bell of opportunity also rang for Dr Linda Shetabi.

Dr Shetabi, Director of the MSc Conservation programme, saw an excellent chance for students to extend their learning while also helping an earthquake-stricken population. Drawing on her extensive connections and experience in heritage conservation, she tailored a field trip that fulfilled two key components of the one-year MSc programme – mandatory 72-hour practical training and a visit to a World Heritage Site – and provided 'in-kind' support to the HEF in the form of documentation of damaged buildings. The offer was welcomed by the International Council on Monuments and Sites (ICOMOS) Philippines and UNESCO.

"This was an opportunity to not only fulfil programme requirements, but also for students to make meaningful contributions towards conservation," she said. The experience laid the groundwork for student expeditions to Thailand in spring 2025 and to Korea this academic year.

Practical work

Dr Shetabi and 18 students travelled to Vigan in 2024 for one week, where they collaborated with undergraduate architecture students from the University of Northern Philippines to develop digitised floor plans for 15 historic buildings and a preliminary analysis of the damage. They also collected oral histories and helped update a manual for owners on how to maintain their ancestral homes.

One of the HKU students was Limiao Huang, who came to the programme after practising as an architect in Shanghai for more than a decade and finding she was more interested in protecting older buildings than building new ones.

"The practical training we did in the Philippines was a great experience for me because I realised that we were actually helping the people there. I worked on a beautiful ancestral hall that had been partially destroyed by typhoons and the earthquake, where several families lived. They could not afford to restore the building, which astonished me. I wanted to help," she said.

Her documentation of the site has provided a record for future conservation work. Ms Huang herself, who graduated in 2024, has also committed more fully to architectural conservation, joining the programme as a research assistant and now preparing to pursue a PhD.

The field trip to Thailand was under less urgent, but nonetheless threatening, conditions. It focussed on the impacts of severe weather patterns on heritage. A pivotal goal of Dr Shetabi's approach to heritage education is to integrate sustainability and the impacts of climate change and extreme weather patterns on heritage sites. (She co-authored the ICOMOS publication *Policy Guidance for Heritage and Development Actors*, which considers sustainability in heritage conservation.)

Environmental challenges

Students and academic partners in Thailand's Chiang Mai investigated the impacts of recent floods to understand how policy priorities, heritage conservation and stakeholder requirements are negotiated in complex historic urban landscapes. A similar theme is being followed in the trip to Korea to explore the management of World Heritage Sites within metropolitan landscapes, where historic remains and contemporary demands for sustainability jostle and compete for resources.

"One aim of our programme is to empower students to be advocates and go out there to change policy and practise, and be part of the solution," Dr Shetabi said. "We want them to speak to stakeholders and recognise informal arrangements so that when they talk to government leaders, good practices can be continued and supported by legislation and policy – something not always seen at World Heritage Sites, where local populations may be prevented from continuing with their traditional practices."

Another aim is to connect students with people and networks that could be useful for their future careers. Students regularly meet experts in class reviews, as well as on excursions where they interact with practitioners and government officials. In Korea, they will meet with World Heritage Site managers, government officials and practitioners.

These are golden opportunities for networking with the regional heritage community, and Dr Shetabi instructs her students to treat such encounters as a job interview. She also wants them to keep sight of the purpose of their field.

"Heritage conservation is not just something theoretical that students read about in a book, or something that provides a beautiful backdrop for an Instagram photograph. Heritage is integrated into people's lives – it's important to their sense of self, their identity, their understanding of where they are in the world," she said.

> "One aim of our programme is to empower students to be advocates and go out there to change policy and practise, and be part of the solution."
>
> **Dr Linda Shetabi**

Pearls of Wisdom

Oysters have many benefits beyond producing pearls and succulent flesh. As scientists at HKU have confirmed, they can have positive health and environmental effects and farming them could boost the flagging fortunes of local fishermen.

Dr Yan Wa-tat (right) at an oyster raft.

> “It's a nature-based solution. We want to get these ideas out in society and not just hide them away on campus.”
>
> **Dr Yan Wa-tat**

Hong Kong has a long history as a centre of pearl farming, with Tai Po once considered a source of some of the finest pearls in China. But over the past century, pearl farming has fallen by the wayside. The Sino-Japanese war disrupted activity, then post-war Japanese monopolies hampered the pearl industry, which was also damaged by a series of severe typhoons in the 1960s. It ultimately became unprofitable for local fishermen to harvest pearls.

To Dr Yan Wa-tat, this represented a wasted resource. As a former financier with a deep interest in the marine environment, he decided to do something about that. In 2015, he enrolled in a PhD programme at HKU, focussing his research on reviving the local pearl industry. This has led to a partnership with Professor Billy Chow Kwok-chong, Chair Professor of Endocrinology in the School of Biological Sciences, and the establishment of the Pearl Power Research Institute (PPRI).

“Hong Kong has more than 1,000 fish farming rafts and 90 per cent are not productive because the fishermen find it not profitable to farm fish. I thought, why not try to use these idle fish farms for pearl oyster farming?” Dr Yan said.

He reached out to fishermen to join his research and, initially, hoped to train them in seeding oysters to produce pearls. But this process requires speed and training and, since most of the fishermen were in their 50s or older, he began thinking of a different approach – focussing on the oyster shells instead of pearls.

Oyster shells are a component in traditional Chinese medicine to treat such things as anti-inflammation, detoxification and anti-ageing. He then got an opportunity to pitch the idea of using the shells to Professor Chow, who, among other things, was working on translational research in drug discovery.

Elevator pitch

“One day, I met him in the elevator, and he asked about my research. I told him that while I was going to finish my thesis, I was afraid local fishermen could not benefit because it would take years for them to learn how to produce pearls. Then I asked him if he would be interested in doing some research on pearl powder, and he said, why not? That was my elevator pitch!” Dr Yan said.

The pair began investigating the properties and applications of oyster shells. The shells, particularly the mother-of-pearl, or nacre, that lines the shells, contain protein, amino acids, calcium carbonate, magnesium and other minerals. Using a local species, the *Pinctada fucata*, the team ground the shells into a pearl powder of different combinations and confirmed its effectiveness in detoxifying heavy metal concentrations in mice. They have also confirmed its effectiveness as an antioxidant and in boosting gut health.

Under Professor Chow's guidance, the team have received research funding from the Fisheries Enhancement Fund of the Airport Authority, secured three patents and IP rights and launched the PPRI, a start-up company that has received support from HKU's SEED and iDendron programmes and the Hong Kong Science and Technology Park's Ideation Programme.

“We hope to use our technology to develop locally produced pearl powder for the benefit of people in Hong Kong and the Chinese Mainland,” Professor Chow said.

Supplements have been developed and will soon be distributed through PPRI. Importantly, local fishermen are shareholders in the venture.

Catching carbon

But medicinal products are not the only benefit to be reaped from oyster shells. They can also be used to reduce greenhouse gases.

Most shellfish are made up of about 40 per cent carbon dioxide, which they have captured and stored from the environment. The team established that these benefits can be achieved in Hong Kong. They set up another start-up, BivaCoo Limited, last year to explore the possibility of using local oyster farms in carbon offset projects. There are already examples of this in the Chinese Mainland, such as the city of Weihai in Shandong province.

BivaCoo has already graduated from the Ideation Programme and is working with local fishermen to develop the venture further.

“It's a nature-based solution,” Dr Yan said. “We want to get these ideas out in society and not just hide them away on campus.”

Dr Yan noted that it was easier and cheaper for fishermen to use fish rafts to farm oysters rather than fish because oysters are filter feeders and do not require feed. They also produce a harvest more quickly. He also sees potential in developing the rafts as centres for tourism and education. “I hope PPRI can be financially sustainable within the next two or three years,” he said.

Early Warning System

In a move to improve the prompt detection and prevention of oral cancer, the Faculty of Dentistry has launched an AI clinic focussing on patients with potentially malignant oral disorders.

The AI-powered clinic was developed by the Division of Oral and Maxillofacial Surgery (OMFS) of HKU's Faculty of Dentistry and the Prince Philip Dental Hospital (PPDH). It is a culmination of research efforts to improve risk assessment, treatment selection and monitoring for patients with oral potentially malignant disorders (OPMD).

"The AI clinic was launched as a new medical service at the OMFS Clinics of PPDH in April this year. It was our response to the need for better treatment and monitoring of patients, since early detection is crucial to survival rate in oral cancer," said Professor Richard Su, Chief and Clinical Professor of the OMFS, who leads the AI clinic with contributions from Professor Liwu Zheng, Professor Jane Jingya Pu and Dr Joanna Ko from the OMFS, and Professor John Adeoye, Assistant Professor in Digital and Precision Dentistry.

The team felt that the current method for assessing cancer development in OPMD is outdated and unidimensional. Multidimensional factors have to be taken into consideration when assessing patients with OPMD, including demographics, risk habit history, clinical factors, and histological factors.

"Until now, all of these factors were assessed separately and this was particularly challenging for busy general practitioners. Therefore, we developed and deployed the online tools powered by AI to improve the efficiency and clinical management of patients. One such AI tool termed OralCancerPredict integrates these factors to provide better risk assessment than methods previously applied in clinical settings," said Professor Su.

> "We expect that the AI clinic will see a reduction in unnecessary surgery or overtreatment for otherwise low-risk oral leukoplakia and oral lichenoid disease patients who will be monitored regularly within the service."
>
> **Professor John Adeoye**

Easily accessible

They chose internet deployment to make the AI tools – which are available free of charge – easily accessible to clinicians from any device, including smartphones, tablets or computers.

The research started in 2019, when the researchers began to develop the AI-based models by collecting retrospective data of 716 patients with OPMD who had been treated at the Queen Mary Hospital and PPDH from 2003 to 2019. Tests in Hong Kong have shown that the models had an accuracy of more than 90 per cent. Further testing has been done afield – in the UK and Nigeria where good accuracy (over 80 per cent) among similar patients was also observed.

"Since initial web tools were put up in March 2023, the platforms have been accessed more than 12,000 times from users in over 55 countries," said Professor Adeoye. "Our recent external tests of OralCancerPredict in Hong Kong on 176 patients treated at PPDH in 2021 and 2022 found that it provided correct stratified risk in 87 per cent of patients, which was 11 per cent better than the current method of risk assessment as at last follow-up."

The researchers hope to improve treatment specifically for patients with oral leukoplakia (OL) and oral lichenoid diseases (OLD) by employing AI-based tools to provide personalised decision support to doctors. This AI-assisted workflow is crucial because treatment and monitoring strategies for OL and OLD depend on an initial cancer risk assessment by doctors, since not all patients will develop cancer in their lifetime (even without treatment).

Tools like OralCancerPredict in the AI clinic will efficiently define oral cancer risk and streamline treatment with close monitoring of at-risk patients to promote disease prevention and early diagnosis. "Also, we expect that the AI clinic will see a reduction in unnecessary surgery or overtreatment for otherwise low-risk OL/OLD patients who will be monitored regularly within the service," he said.

One of the outputs of OralCancerPredict is binary risk stratification. Used this way, the model can stratify patients into high- and low-risk groups according to the probability of cancer development. OL/OLD patients with high risk will be monitored in the AI clinic every three months (close monitoring), while patients with low risk will be monitored in the AI clinic every six months.

Patients' feedback

In order to reassure patients who may be suspicious about AI and worried that this is 'treatment by robot', the team were careful during the model development stage to sample patients' reactions on how they perceived their doctors if they employed the results of an AI-based model to guide their treatment decisions.

"Many were not against it and highlighted that they would provide consent as long as the AI results were not the primary determinant of treatment and only supported doctors' clinical judgments," said Professor Adeoye. "We will continue to inform our patients that final decisions on treatment and follow-up strategies are made by the doctors pending confirmation from patients."

Other dental faculties have already reached out to learn more about how they could benefit from using AI tools. Professor Adeoye said: "We expect the uptake to increase further in the city when data from our clinic shows the impact of the AI tool on clinical decision-making and OPMD patient outcomes."

In the meantime, the team have also developed other accurate and validated AI tools such as DysPOLNet for the comprehensive management and monitoring of OPMD.

Safe to Swallow

Brain damage can seriously hamper a person's ability to swallow food, to the detriment of health and quality of life. Professor Karen MK Chan in the Faculty of Education has been working with nursing homes, caregivers, industry and NGOs to devise solutions.

With support from Professor Chan's team in product development and testing, Fairwood became the first fast food chain in Hong Kong to offer soft meals.

> "We hope the new version of the pureed food will look more attractive and have that Hong Kong taste of the foods we grew up with."
>
> **Professor Karen MK Chan**

About 80,000 people in Hong Kong live in nursing homes and 60 per cent of them suffer varying degrees of swallowing difficulties. That means if food is not prepared to the appropriate texture and size, they risk choking. Often, nursing homes compromise with a puree of meat, rice and vegetables that forms an unappetising greenish brown gloop. Needless to say, it can be a struggle to get residents to eat enough of this to meet their nutritional needs.

The problem has been on the radar of Professor Karen MK Chan, Director of HKU's Swallowing Research Laboratory, who for years has conducted studies on dysphagia (swallowing difficulties) in Hong Kong. She has also developed a book, website and YouTube channel to guide people, and organised training programmes.

"Mealtimes are especially challenging in nursing homes in terms of the manpower needed and the kind of food they can offer. We've been working with different parties over the years to train up their awareness and develop different kinds of care food products that are of the correct texture for patients," she said.

Some patients may be able to eat roughly chopped food, some finely chopped and some only puree. It depends on their degree of swallowing difficulty, which can arise when muscle control is affected by brain damage, for instance from dementia or stroke, or changes to the swallowing muscles from such things as cancer and cancer treatment.

The International Dysphagia Diet Standardisation Initiative (IDDSI) has produced guidelines on nine levels of food consistency, which Professor Chan and her team translated into traditional Chinese (they were adopted by the Hong Kong Council of Social Service in 2023). More recently, she has focussed on their implementation in the community, through two major funded projects targeted at private residential care homes and food providers.

Diet and exercise

The care home project involves 220 homes – about a quarter of the total in Hong Kong – where Professor Chan and her team are training kitchen staff to produce care food according to the IDDSI guidelines, as well as training staff and volunteers to assist residents in strengthening their swallowing muscles through specially designed games on iPads. The programme runs over three years and is funded by the Hong Kong Jockey Club Charities Trust. "We are taking away the need to rely on a speech therapist to be there to do the exercises," she said.

The food project involves the Fairwood fast food chain and is funded by the HKEX Foundation. It builds on her earlier work advising companies and NGOs on how to properly prepare care food. Over 18 months, Professor Chan and her team are testing whether the chain's care food products adhere to the different IDDSI levels (for instance, level five foods must be minced finely enough that food particles are smaller than the gap between prongs on a fork and level three liquids must drip slowly through fork prongs, leaving a residue).

They are also working with the chain to make the food more appealing by building on Fairwood's experience in catering to Hong Kong tastes and shaping the puree into the things that they consist of, such as broccoli and pork.

"The problem with the puree provided in most nursing homes is that it is not the most delicious food on Earth and not very welcome by the residents. It takes a lot of effort to convince them to eat it and, for those who need feeding assistance, a lot of effort to make sure they complete the assigned portion for every meal.

"We hope the new version of the pureed food will look more attractive and have that Hong Kong taste of the foods we grew up with, like baked pork chop in tomato sauce and chicken curry."

Quality control needed

The products are also being tested in several elderly homes, where residents are being assessed on whether the foods affect swallowing safety and support their health, such as by helping them gain weight.

Professor Chan noted quality control was becoming more important as care foods became more available in Hong Kong. Several NGOs have developed care foods, HKTV Mall offers a selection for delivery, and care foods are also offered in the restaurants of chains such as Fairwood, Maxim's and Café de Coral. She is therefore working with the Hong Kong Council for Social Service to develop a system, such as certification, to recognise foods that are of their stated consistency.

In any case, the presence of more options is good news for patients and also for Hong Kong. "The government has been emphasising the silver economy. The care food market is a top example of what that means," she said.

Keeping the Wheels Turning

An experienced administrator with years in senior government positions under her belt, Mrs Cherry Tse Ling Kit-ching is HKU's new Executive Vice-President (Administration and Finance), tasked with advancing the support systems for a large, complex and growing institution.

Mrs Cherry Tse Ling Kit-ching likes to solve problems and she made a very successful career of that in the civil service, rising to Permanent Secretary of such portfolios as Education and Home Affairs. Now, at HKU, she is taking on new challenges that are both daunting and exciting.

As the new Executive Vice-President (Administration and Finance), she oversees all the supporting services and infrastructure, including physical space, that keep the University ticking. The demands are high, given student numbers have risen more than 90 per cent over the past decade or so, and staff numbers and activities are way up, too. But unlike academic work, where the University has responded quickly and deftly to new developments such as AI, it takes a lot more time and negotiation to change systems and build structures to accommodate growth.

"My sense of purpose is very clear: we must use resources wisely to provide an inspiring learning environment and better support for teaching and learning, research, and students' wholesome development. But it is quite a struggle because space is limited and the increases have not caught up with student growth. That said, we always face problems in life. Things often seem impossible until they are done. So, try your best and don't give up," she said.

Lessons from bar-benders

Mrs Tse has drawn that lesson from her 38 years in the civil service, which she joined straight from HKU after earning a Bachelor of Arts majoring in history. Her role as an administrative officer suited the curious side of her personality because every few years she was moved to entirely new departments and had to start from scratch to master complex issues – hence, her understanding about not giving up.

"It was tough because you are always climbing a steep learning curve, but that also makes life interesting. I think I would feel bored if I was asked to do the same thing over and over again," she said.

One of her most challenging and instructive experiences came just a few weeks into her new post as Commissioner for Labour in 2007. Bar-benders in the construction industry went on strike for 36 days, one of the longest strikes in Hong Kong's post-war history. As part of the mediating efforts, Mrs Tse decided to break down barriers between the union and the trade association by inviting them to meals and karaoke sessions. Post-strike, she facilitated discussions to address the root cause of the dispute that eventually led to refinements to the wage negotiation cycle and mechanism. Other construction trades took reference. To date, there has been no recurrence of trade-wide salary disputes in the construction sector.

"This experience changed my approach to problem-solving. Yes, we had to tackle the most urgent issue but once that had been resolved, we examined the cause in an amicable atmosphere that we had helped forge. It was a collective effort," she said.

Maintaining connections

Mrs Tse is bringing a similar focus on collective effort to her role at HKU. She is meeting with different colleagues to hear their views on how to make the HKU environment better for students and academics.

One issue that inevitably comes up is transport. During peak hours, there are long queues at the HKU MTR station for lifts to the campus. Mrs Tse has tried all the travel options herself to understand the situation better. "I will be seeking help to address these matters, so I want to be able to describe the situation from first-hand knowledge," she said.

She is also concerned with maintaining a sense of community at a time when HKU is adding academic units. Five interdisciplinary schools were recently created, in addition to the 10 faculties.

"Being a comprehensive university is a strength in itself. But as knowledge evolves and grows, so does the supporting administrative machinery. How can we ensure that we stay coordinated and communicate well, while working in specialist areas? This is a challenge for the administrator not only at HKU but any large organisation that needs to thrive amid uncertainties," she said.

This is a question Mrs Tse will be addressing in coordination with the Senior Management Team. She has come out of retirement to take up this post and is keen to be a team player and give back to her *alma mater*, which gave her many new and happy experiences beyond her grassroots upbringing. "Here at HKU, we are already a lot more fortunate than many others. We should be grateful. And when we are able to contribute to the good of the community, then we should do it," she said.

> "Being a comprehensive university is a strength in itself. But as knowledge evolves and grows, so does the supporting administrative machinery. How can we ensure that we stay coordinated and communicate well, while working in specialist areas?"
>
> **Mrs Cherry Tse Ling Kit-ching**

Agent of Change

The new Vice-President and Pro-Vice-Chancellor (Teaching and Learning), Professor Jay Siegel, wants students to be transformed by their experience at HKU, beyond what they learn through their programmes.

Professor Jay Siegel's path to academia was never a foregone conclusion. He came from a blue-collar family – his father was a foreman in a plastics factory – and he started off at California State University, Northridge, intending to become a pharmacist.

But a shift began to happen soon after Professor Siegel entered university. His mentor, Professor Ed Rosenberg, inspired him to pursue organic chemistry and undertake research, leading to his acceptance at Princeton University as a graduate student, an achievement that launched him on a stellar career.

Professor Siegel became a tenured professor at the University of California, San Diego, then took up leadership roles at the University of Zurich, Tianjin University (he was the first foreign dean of a school there) and now, HKU. Arriving in 2024 as Senior Advisor to the President, he was recently appointed Vice-President and Pro-Vice-Chancellor (Teaching and Learning) and is bringing insights gained from working across three continents.

"The purpose of a university is to empower the individual to become an independent scholar who can develop her or his own belief structure and create, critique and curate knowledge," he said.

"A high-powered university like HKU already attracts talented students who are on that path. It would be too easy to credit all their success to the University's influence, which is why a different way of thinking is needed. Our mission is to transform and empower students further than they would achieve otherwise and ensure their personal betterment."

A life on campus

Central to that mission is campus culture. "If we want our students to be absolute world changers, one of the crucial actions is to create a transformative student experience and campus life where graduates will say they are more of a scholar, more confident in their belief structure, than when they entered. We should be assisting them in that educational evolution so they can become better leaders and capable of leading social change."

Professor Siegel believes the way to do that is to facilitate human interaction on campus beyond the curriculum and classroom. "A university needs to become a community – a scholars' garden, if you will," he said.

That means creating and supporting spaces where students and faculty can gather to eat, be entertained, be active or find solitude, alongside people of different expertise or from their own disciplines. Such spaces exist at HKU, but Professor Siegel believes they should be reinvigorated to create a more vibrant campus life.

"I want every student and faculty member, when they're heading home or sitting down to dinner, to wish they were still on campus where, at 8pm, they would find scholars milling around talking, or stumble on interesting discussions or events," he said. "Great universities around the world inspire that sense of community – of a whole that is greater than the sum of the parts."

The idea of shared expertise is important to the concept. If you are a biology major who is curious about art history or quantum computing, you should expect to be able to find an expert colleague on campus who can enlighten you, he said.

"I want to hammer this home," he said. "I want students and faculty members to say that when they have a question outside their expertise, they are able to find an expert they can go to and have a cup of coffee and a discussion with, and walk away with a deeper understanding of that topic. That is the community we are striving for."

Valuing expertise

Within that vision is a high regard for disciplinary expertise. Although Professor Siegel recognises many problems require interdisciplinary solutions – he helped establish two interdisciplinary schools at HKU, the School of Innovation and the School of Biomedical Engineering – he believes success depends firstly on expertise. This means not only domain knowledge but also the acquired ability to apply and manipulate that knowledge in flexible and creative ways.

"We have to go deep into our majors, because only experts with an appreciation of broader problems can contribute in a meaningful way. We need scholar experts with a great appreciation of the interdisciplinary problems of the day and the mental faculties to address them," he said.

Expertise is also necessary for making the most of AI, which Professor Siegel regards as a highly effective tool. As with tools of the past, the greatest benefits are reaped by those who already understand their field and what this new tool can do for them, he said.

But all of this must be underpinned by community-building. There are lots of ideas to be fleshed out and he will engage with people across campus in the process, guided by a concept close to his heart: that the very act of building, more than pre-conceived plans, will inform how to build going forward.

"We need to go fearlessly and look at all the things that we are doing and ask if they will be fit for purpose three to five years from now. The 'building' will inform us. If we are active, if we are attentive, we will start making the necessary changes."

> "A university needs to become a community – a scholars' garden, if you will."
>
> **Professor Jay Siegel**

Professor Siegel at the 214th Congregation Ceremony of the Faculty of Social Sciences.

HKU's Networker-in-Chief

Professor Yang Wang is HKU's Vice-President and Pro-Vice-Chancellor (Institutional Advancement), a position that is sending him out into the community to do what he excels at – bringing people together from a spectrum of fields for a common cause, in this case, advancing HKU.

Universities need senior people who can reach out to the community and help garner support of all kinds for their activities. Who better to do that job than an academic who has friendly charm, a great track record of community engagement, and a curiosity about the world that runs from science to foreign policy to card games?

HKU's Vice-President and Pro-Vice-Chancellor (Institutional Advancement), Professor Yang Wang, is just the man, a top mathematician whose career has taken him from China to the United States and back, and he has happily embraced each change and moment of serendipity thrust upon him along the way.

As a 15-year-old, he passed his *Gaokao* examination with flying colours and entered the University of Science and Technology of China, bent on becoming a physicist. The discovery that he was colour blind devastated him as he was not allowed to major in physics, but the forced shift to mathematics was highly fortuitous as he was outstanding in the subject.

He built his career in the US, completing his PhD at Harvard University. He became full professor at Georgia Institute of Technology and later Department Chair at Michigan State University, before returning to Asia in 2014 to join the Hong Kong University of Science and Technology (HKUST), where he became Department Head of Mathematics, and two years after, Dean of Science. Then another change of direction occurred when he was asked to sit on a search committee for the Vice-President for Institutional Advancement (VP[IA]). It was the first time he had learnt about the responsibilities of this position.

The right stuff

A couple of years later, the position opened again. The committee then had difficulty finding the right person for the job, but meanwhile, Professor Wang was circulating in the university community and beyond, reaching out to people in academia, business and government to promote HKUST and to engage on a huge range of topics, from technology to cryptocurrency to societal affairs. It was obvious to see where this was going.

"One day, the President called me to his office and said, I think you would be a good VP(IA), you've got the personality, and you socialise with different people. I suggest you apply for this position. My first reaction was a resounding 'no', but after listening to him about the pros and cons and where my strength might fit, I decided to give it a try," he said.

COVID-19 had made his job challenging initially, but he progressed steadily as the pandemic restrictions were gradually lifted. The qualities that made Professor Wang such a great candidate were not lost on several of his friends in HKU, who urged him to apply to be HKU's VP(IA), a position he took up in the summer with great enthusiasm.

"There is no better place to do fundraising than HKU. We are 'the' university in Hong Kong, not just from a historical point of view, but also in academic excellence, as reflected in international rankings," Professor Wang said.

"The University is also a paradise for anyone who works in institutional advancement because there is a large alumni base, some of whom are in very prominent positions. For years, many of them have given back to the University as our loyal and generous donors, and many more are approaching the age of giving. Indeed, the University has been able to attract multiple generous grants of hundreds of millions of dollars – something rarely seen in other local universities."

New horizons

While his portfolio currently covers fundraising and alumni engagement, he is also meeting with the diplomatic community and others to help keep the University's profile high. Communications, partnerships and recruitment are also areas where he hopes to contribute, but first, he is looking to see where new challenges and opportunities lie.

One challenge is competition from other local universities for the same pool of prospects. Many potential donors have ties to multiple institutions, so the University cannot sit on its laurels and must act with a sense of urgency, he said.

Another challenge is the shifting nature of philanthropy amid socioeconomic changes, including a significant influx of Chinese Mainland wealth into Hong Kong. Large legacy gifts are no longer the only option; donors may prefer different vehicles or contributions, and Professor Wang believes HKU must be proactive in cultivating a new, high-potential pool, including entrepreneurs and business owners from the Chinese Mainland.

To do that, he will focus on building a team. "We need an infrastructure. It cannot just be a couple of workhorses reaching out to all these groups. I hope we can develop a comprehensive infrastructure to do this," he said.

The rewards, when they come, will accrue not only to the University, but also Professor Wang. "I like people, and it's become a way to make a lot of friends," he said.

> "There is no better place to do fundraising than HKU. We are 'the' university in Hong Kong, not just from a historical point of view, but also in academic excellence, as reflected in international rankings."
>
> **Professor Yang Wang**

An Enviable Challenge

HKU's Faculty of Dentistry is one of the best dental schools in the world, recently placing number two in the Quacquarelli Symonds (QS) rankings by subject. Its new Dean, Professor Lijian Jin, will be carrying that legacy forward.

The Faculty of Dentistry has had an eventful year. It was named second best in the world in the QS World University Rankings by Subject 2025, the ninth time it has placed in the top three since 2015. It was also selected for incubation as the Global Hub for Future Dentistry by the Hong Kong Science and Technology Parks, launched two world-first AI-powered initiatives to detect oral cancer and early-stage childhood caries, and adapted to new requirements for its graduates, among many other achievements. And in July, it welcomed the confirmation of Professor Lijian Jin, Modern Dental Laboratory Professor in Clinical Dental Science, as its Dean.

Professor Jin faces a special challenge: how does one sustain such excellence under constant new demands, scientific and technological change and competition?

"I'm very confident that as long as we uphold our spirits, with strong support from the government, our University, the dental profession in Hong Kong, alumni and our colleagues in the Chinese Mainland and around the world, then we will do well," he said.

His role, as he sees it, is to keep the door open for engagement and teamwork and give people the space and freedom to interact, test things out, enjoy their time and even argue. "As long as we agree on our goals, then we can work out any conflicts," he said. "I look on the positive side. Even if a person or situation is 90 per cent negative and 10 per cent positive, I will focus on the 10 per cent."

Service-minded

He has built a career and a wide international network around such optimism. Born in Hangzhou to parents who both had scholarly backgrounds, he was exhorted from a young age to focus not on money but on service. "My father told me: 'I don't care if you have a billion dollars – do something you can be proud of and be of value to the community'," he said.

Professor Jin shone academically, earning a PhD at Beijing Medical University (now Peking University Health Science Center) before being invited to the Karolinska Institute in Sweden for further study in 1990. He was mentored there not only in dentistry, but also in the ways of Western culture. However, after four years, HKU beckoned with an offer. "I wanted to contribute to the nation, to the region and to the world, and also take care of my parents as the only son. So, I took the offer," he said.

The decision to join HKU proved fortuitous for both his career and his personal life since he met his wife here. Over the past three decades, Professor Jin has established himself as a world-renowned expert in gum disease, or periodontology, and held senior positions in the International Association for Dental, Oral, and Craniofacial Research (IADR) and the FDI World Dental Federation, where he led the task force of its Global Periodontal Health Project, launched in 2015. (Professor Jin is also a walking example of periodontal health, having no cavities, dental restorations or crowns).

> "I look on the positive side. Even if a person or situation is 90 per cent negative and 10 per cent positive, I will focus on the 10 per cent."
>
> **Professor Lijian Jin**

Well connected

Within the Faculty, he also held several senior positions until he was tapped, in July 2024, to be the Acting Dean. Over the next year, he rose to the challenge, in particular, overseeing the response to amendments to Hong Kong's Dentists Registration Ordinance that involve fresh graduates, and enhancing the Faculty's role in continuing professional education.

Graduates must now complete a one-year internship before they can be fully registered, on top of the six-year Bachelor of Dental Surgery. Professor Jin formed a new working group to refine the curriculum with this, and much more, in mind. "We are looking at how to further improve our curriculum and incorporate new elements such as AI, digital dentistry, precision dentistry, and even green dentistry," he said.

The Ordinance also introduces compulsory continuing professional development (CPD) for registration renewal, starting from 2026. As the only dental school in Hong Kong, the Faculty will meet that demand with courses, workshops and the like in collaboration with the government, the Dental Council of Hong Kong, College of Dental Surgeons of Hong Kong, Hong Kong Dental Association and Prince Philip Dental Hospital. This is in addition to taught postgraduate programmes to train up dental specialists.

"I expect in the near future that we will launch more high-quality CPD programmes and serve dentists not only in Hong Kong but the Greater Bay Area, the whole of China and the wider world," Professor Jin said. "We will also continue to further enhance teaching and learning, research and innovation, knowledge exchange and professional engagement for better serving the community."

And he is confident of a warm reception. During the IADR annual meeting in June in Barcelona, representatives from over 110 dental schools and organisations attended the Faculty's reception there. "Our dental school is a global institute, and we are connected to the whole world," he said.

Students' Advocate

The University's growing and increasingly diverse student population means the new Dean of Student Affairs, Professor Kelvin Yeung Wai-kwok, has his work cut out for him in meeting their needs. He is guided by a deep commitment to diversity, equity and inclusion.

In October 2024, the Government of the HKSAR launched the 'Study in Hong Kong' campaign to entice more students from around the world to enrol in local universities. With that came a doubling in the quota of non-local students that local universities could admit – jumping to up to 40 per cent on top of existing enrolments. The initiative was widely welcomed because of the potential to enrich campus life and deepen Hong Kong's connections with the rest of the world. But it also brought some challenges over and above providing more classes and accommodation.

While HKU's Senior Management Team is overseeing a building programme to expand capacity, student services and engagement activities also need to be ramped up. Leading that effort is the new Dean of Student Affairs who heads the Centre of Development and Resources for Students (CEDARS), Professor Kelvin Yeung Wai-kwok, who is also Ng Chun-Man Professor in Orthopaedic Bioengineering.

One of Professor Yeung's first priorities is to give input on the needs of a more diverse student population. In the traditional residential halls, for instance, there is no space for prayer rooms and insufficient facilities for the disabled. He would like to help change that.

"One of my missions is to advance the student halls, now that we have more international students from all over the world. We are currently unable to accommodate these special requests, but we hope to make efforts in the future to address this, while continuing to meet the needs of local students," he said.

He and his team are also adapting CEDARS' counselling, career guidance and social services to meet the changing needs of the student body, guided by the principles of diversity, equity and inclusion (DEI). "DEI is about the core values of being human. It is not something extreme," he said.

Being inclusive

Professor Yeung demonstrated his deep commitment to DEI as deputy warden of Lap-Chee College. About 10 years ago, he nominated the first transgender person to be a tutor in one of HKU's residential spaces for students, impressed by the candidate's rapport with students and leadership skills. "If someone has the abilities, why not hire them? I really believe we should be inclusive," he said.

His background and experiences have influenced this perspective. He grew up in a public housing estate in Shek Kip Mei and was raised by his grandmother while his parents worked long hours. After higher education at the City University of Hong Kong (CityUHK) and HKU, he became primarily based at HKU (apart from a period at CityUHK from 2007 to 2009), where he has developed a notable record in biomaterials research, including being listed among the Highly Cited Researchers globally in Clarivate Analytics' Essential Science Indicators.

But he was not only focussed on research success. Throughout his career, Professor Yeung has committed himself to student welfare. Around 2001, he became a tutor at Starr Hall. After returning to HKU, he was invited to be deputy master at the new Lap-Chee College. And in 2021 he became warden of Simon KY Lee Hall. Two years ago, he was appointed Associate Dean of Student Affairs.

Professor Yeung happily recalls all the support he has received along the way from mentors and senior professors, who encouraged him to follow his heart and gave him flexibility in balancing his academic and research demands with his service to students. "I feel great gratitude to the University so whenever it asks, I will do my best to help, especially with students," he said. "I believe that we should help our students to become better than us, otherwise we fail."

'HKU' character

He also wants to promote community service among students and help them realise that whatever their backgrounds, they are privileged to be students at HKU. That does not mean they should feel superior, though. "I would like our students to develop an 'HKU' character that is confident and humble, sympathetic and empathetic to others, and contributes to the community in a caring way," he said.

The caring goes both ways. Students face a lot of stress, and CEDARS is trying to help with both counselling and social activities that encourage them to engage in person – something Professor Yeung believes is essential in the digital age. As Associate Dean, he launched the GLOCAL Connect programme that bridges non-local and local students in meaningful ways.

Finally, he hopes HKU graduates, both local and non-local, will consider staying in Hong Kong and even joining HKU, including CEDARS. "I hope they really love this University and can help make it even better," he said.

> "I would like our students to develop an 'HKU' character that is confident and humble, sympathetic and empathetic to others, and contributes to the community in a caring way."
>
> **Professor Kelvin Yeung Wai-kwok**

Professor Yeung (second from left, front row) at the CEDARS High Table Dinner 2025, held as part of the induction activities for first-year undergraduate students.

The Thriving Dark Web

The digital underworld is a thorn in the side of authorities, who struggle to eliminate communities involved in dealing drugs, promoting far-right conspiracies and circumventing state firewalls, among other illicit activities. Professor Isak Ladegaard explores this phenomenon in a new book.

In 2013, Ross Ulbricht, the head of Silk Road, an e-commerce platform for illicit drugs, unwittingly revealed his name in an email, leading to his arrest by the FBI and the closure of the platform. But that did not stop its operators and users. Within a couple of years, they had adopted a new identity verification system and migrated to other markets, conducting more than one million transactions over the next four years, according to research by Professor Isak Ladegaard of the Department of Sociology.

What makes this case interesting is that it is not a solitary example. As Professor Ladegaard shows in his new book *Open Secrecy: How Technology Empowers the Digital Underworld*, other illicit operators, including American far-right groups and Chinese software developers seeking to get around firewalls, have similarly been able to regroup despite efforts to shut them down. And this is creating a new challenge for the state.

"This is not about tech-savvy criminals," he said. "*Open Secrecy* is about how state control is undermined by these new capacities for collective action. Even though we live in a time of mass surveillance, people are using information technology to organise and maintain their own worlds, even when they work against the state."

This is made possible by the novel mixing of technologies. For example, the online drug trade is supported by military-grade encryption, cryptocurrencies, and rerouting software, in particular, Tor. Users can remain anonymous to others, including law enforcement, while also working together publicly on the platform.

Encrypted and anonymised

Professor Ladegaard started researching online drug markets while he was a journalist in Oslo (he graduated with a Bachelor of Journalism from HKU in 2012) and noticed online drug markets were brazenly presenting their wares like a stripped-down Amazon or eBay. The encryption technology has meant they can blur communications from non-parties. Cryptocurrencies such as Bitcoin have meant they can make payments to anyone without using banks and regulated processes. And Tor gives them access to the dark web so internet activity can be anonymised.

"Even the National Security Agency in the US has a hard time figuring out who is using Tor, which tells you a lot about how solid the technology is," he said.

The benefits of all this to the illicit drug trade are obvious. But in his investigations, Professor Ladegaard was also interested to see how others use the technology to organise and communicate. "The far right was a pretty obvious choice because they've always had a strong presence on the internet and they're a dangerous force," he said. "They've also always been into adopting new technology, I think because it promises simple solutions."

Far-right platforms have also been shut down by big tech companies, such as Google, Apple and Meta, yet managed to relocate to the dark web. Because they have millions of users, the move is expensive, so they financed it with cryptocurrencies and adopted anonymising technology, similar to the drug trade.

"There are overlaps in how they operate and exist because of advances in information technology. They could not really have existed in the same way 15 or 20 years ago," he said.

> "If the police catch one big player or one market, it doesn't really matter anymore because the cat is out of the bag. People have learnt how to work together across different digital spaces."
>
> **Professor Isak Ladegaard**

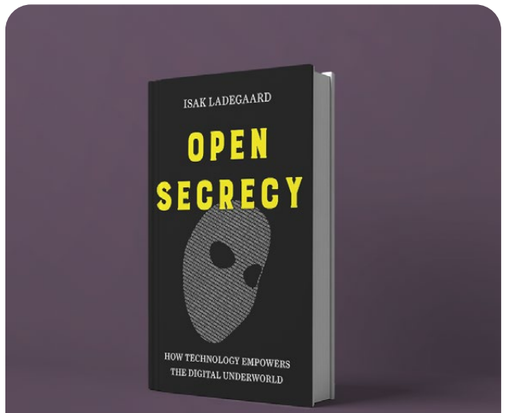
Rebuild and carry on

The case is somewhat different for Chinese software developers and engineers, who develop tools to circumnavigate rules and restrictions on internet access. They tend to do this voluntarily, for practical or interest reasons, and do not have the same financial pressures or motivations as the far right and drug dealers. But they operate similarly, communicating via encrypted channels, anonymously or pseudonymously, and regrouping when one arm is shut down, in this case by Chinese law enforcement.

"I focussed on these three cases in part because even when powerful organisations try to stop them, people are still able to rebuild and carry on," Professor Ladegaard said. "If the police catch one big player or one market, it doesn't really matter anymore because the cat is out of the bag. People have learnt how to work together across different digital spaces."

And while AI may add a new dimension, both sides have access to the same technology. "Law enforcement is changing its strategies, but it does seem like a fight it will not be able to win, because people in these underworlds are capable, and there are more of them than there are people trying to stop them.

"This is part of a bigger story. Oftentimes new technology just reproduces the world as it already is, for example, the internet reproducing inequality. But sometimes technology leads to real social change. I think this is an example of that because state power is undermined in a new way."



Open Secrecy: How Technology Empowers the Digital Underworld

Author: Isak Ladegaard
Publisher: University of California Press
Year of Publication: 2025

The ***HKU Bulletin*** reports on activities, events and research initiated by members of the University of Hong Kong. It aims to keep the local and international communities informed of new breakthroughs and achievements in all of our faculties and disciplines.

Editorial Team

Chief Editor:	Paul Lee, Acting Director of Communications and Public Affairs
Deputy Chief Editor:	Terence Leung
Managing Editor:	Yu Nga-wing
Editors:	Kelvin Au, Sendy Leung
Writers:	Kathy Griffin, Teri Fitsell
Cover and Cover Story Opener:	Chris Gash
Design and Production:	DOM Studio Limited

Contribution and Feedback

With special thanks to staff and students who kindly contributed their time and their photographs to the *HKU Bulletin*. We welcome contributions of content for publication. Items should include the author's name and University contact details. Please direct contributions, comments or suggestions to the Communications and Public Affairs Office at *bulletin@hku.hk* for consideration.

Care for the Environment

While our publication is printed on environmentally friendly paper, we urge you to share your copy with friends and colleagues to help reduce our carbon footprint. Alternatively, you may like to read the Bulletin online at *bulletin.hku.hk*

If you would like to opt-out of receiving a printed copy and subscribe to the electronic version of publications from the Communications and Public Affairs Office, please visit *go.hku.hk/puboptout*

FSC
www.fsc.org
MIX
Paper | Supporting responsible forestry
FSC® C017292

香 港 大 學
THE UNIVERSITY OF HONG KONG