AsianScientist

Issue 14
July 2023

SUPERCOMPUTING ASIA

CLOSING THE GAP BETWEEN HPC TECH AND EDUCATION

BUILDING CITIES IN THE CLOUDS

PLAYING NICELY WITH AI IN THE CLASSROOM

FAIR USE OF AI AMONG THE NEXT GENERATION

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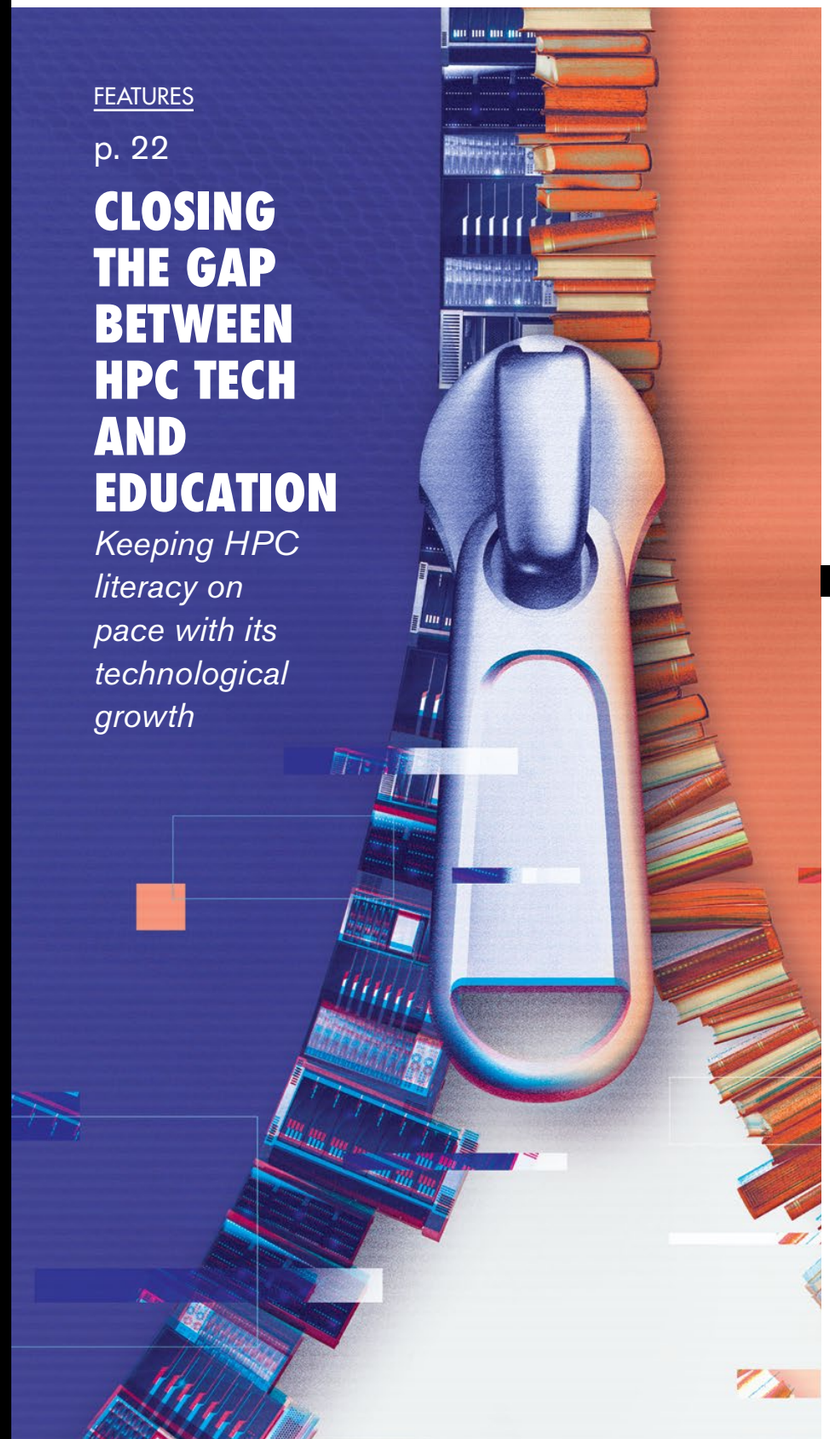

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FEATURES

EDITOR'S NOTE

Most textbooks need to be replaced every few years with newer versions to ensure they are current with the latest advances in science and technology. Staying up to date is particularly essential for the field of high-performance computing (HPC), where the rate of new developments can rapidly outpace education delivery.

In this issue of *Supercomputing Asia*, we look at how research institutions and industry leaders are taking initiatives to maintain a high level of computer proficiency in the region (*Closing the Gap Between HPC Tech and Education*, p. 22). We also explore some of the ways HPC has provided a foundation for digitally-enhanced learning methods—including virtual reality simulations and digital storytelling (*Five Ways HPC is Enabling Digital-Based Learning*, p. 10).

With recent developments in artificial intelligence (AI) such as ChatGPT, we hear from experts on how schools and education systems can best incorporate AI into teaching practices while ensuring that students continue to receive high-quality education (*Playing Nicely with AI in the Classroom*, p. 16).

Beyond schools, HPC-driven technology is transforming nearly every aspect of daily life in Asia—from faster download speeds to AI-grown chilli plants. Supporting this infrastructure are cloud and edge computing networks that make HPC capabilities accessible to anyone (*Building Cities in the Clouds*, p. 30).

Last but not least, I would like to extend a special thanks to Joanne Chow and Rachel Soon for their editorial support and help in putting this issue together.

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Digital Dispatch

SUPERCOMPUTING ASIA 2023 CONFERENCE AWARDEES ANNOUNCED

The SupercomputingAsia 2023 (SCA23) conference have announced the recipients of the annual SCA awards. These awards are given to leaders who have made significant contributions towards pioneering high-performance computing (HPC).

According to Associate Professor Tan Tin Wee, Chair of the SCA23 Awards, this year's winners have demonstrated visionary leadership and exceptional innovation in HPC and related technologies. Their achievements have greatly impacted the HPC communities and advanced HPC both domestically and across the region. The four winners of the SCA23 awards are:

PETER HO

Inaugural Chairman,
Steering Committee, NSCC Singapore

SCA HPC Distinguished Service Award (Singapore)

- *For visionary leadership in establishing HPC as a strategic national research infrastructure, and setting in place policies and long-term strategies to exploit HPC to enhance Singapore's scientific research, technological innovations and economic competitiveness.*

PROFESSOR SHINJI SHIMOJO

Director and Professor,
Cybermedia Center, Osaka University

SCA HPC Distinguished Service Award (Japan)

- *For helping establish the research and development of Japan's HPC networks, and promoting its links with international research networks.*

EMERITUS PROFESSOR LAWRENCE WONG WAI CHOONG

Former President, Singapore Advanced Research and Education Network (SingAREN) and Former Chair, SCA Conference Organizing Committee

SCA HPC Network Achievement Award (Posthumous)

- *For pioneering the establishment of the Singapore Advanced Research and Education Network, linking local and international research collaborations via the network, and mentoring the international SCA conference series.*

PROFESSOR KENGO NAKAJIMA

Professor and Leader of Supercomputing Research Division, Information Technology Center, University of Tokyo, Japan and Deputy Director, RIKEN-CCS, Japan

SCA HPC Pioneer & Achievement Award (Japan)

- *For pioneering work in the development of HPC research in Japan in the areas of large-scale parallel computing and flagship systems; and in promoting HPC education.*

CONGRATULATIONS TO THE NSCC DC TEAM AND PARTNERS FROM THE NATIONAL UNIVERSITY OF SINGAPORE!

The NSCC Data Centre (DC) team and partners at the National University of Singapore (NUS) received the Data Centre Award presented at the Singapore Business Review Technology Excellence Awards 2023, for their sustainable and innovative DC: "NUS-NSCC i4.0 DC - A Tropical Supercomputing DC".

The awards program recognizes the breakthroughs and innovations of Singapore companies in producing high-quality or world-first products and services. NSCC has distinguished itself by designing a DC that incorporates sustainability and promotes the development of more energy and cooling-efficient supercomputing DCs.

This award adds to the accolades of the new data center, which had previously been conferred a Building & Construction Authority (BCA) Platinum Green Mark Award for Data Centers as well as the W.Media Southeast Asia 2022 award for Energy Efficient Innovation.

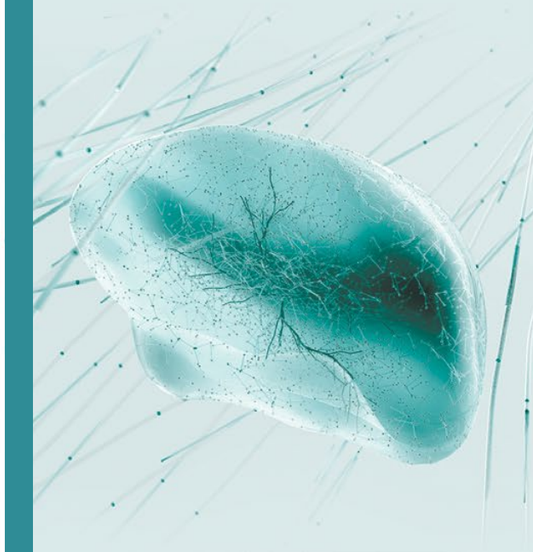
MODELING THE BRAIN USING HPC

The human brain contains billions of cells that are interconnected at trillions of junctions called synapses. To better understand how the brain works, scientists are developing computer models to simulate the brain based on physical data.

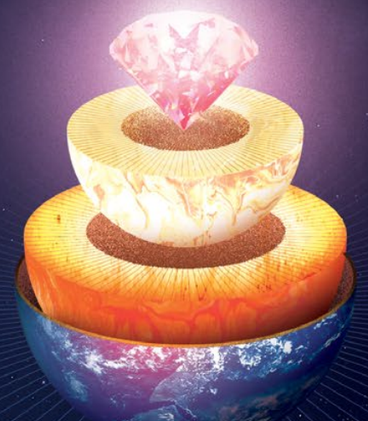
In the past few years, countries in the Asia-Pacific region have been sharing their synchrotron radiation and supercomputing centers in a multinational collaborative project called SYNAPSE (Synchrotrons for Neuroscience: an Asia-Pacific Scientific Enterprise).

In an article published in *Physics Reports*, researchers used state-of-the-art synchrotron X-ray sources and detection systems to map the brain—including its neurons and synaptic connections—at sub-micrometer resolution.

However, this project generates massive amounts of data which needs to be stored, processed and analyzed. As part of the collaboration, NSCC has offered its two petascale supercomputers to provide the processing power necessary to construct whole-brain connectome maps.



Digital Dispatch



HPC TAKES THE LEGWORK OUT OF DIAMOND MINING

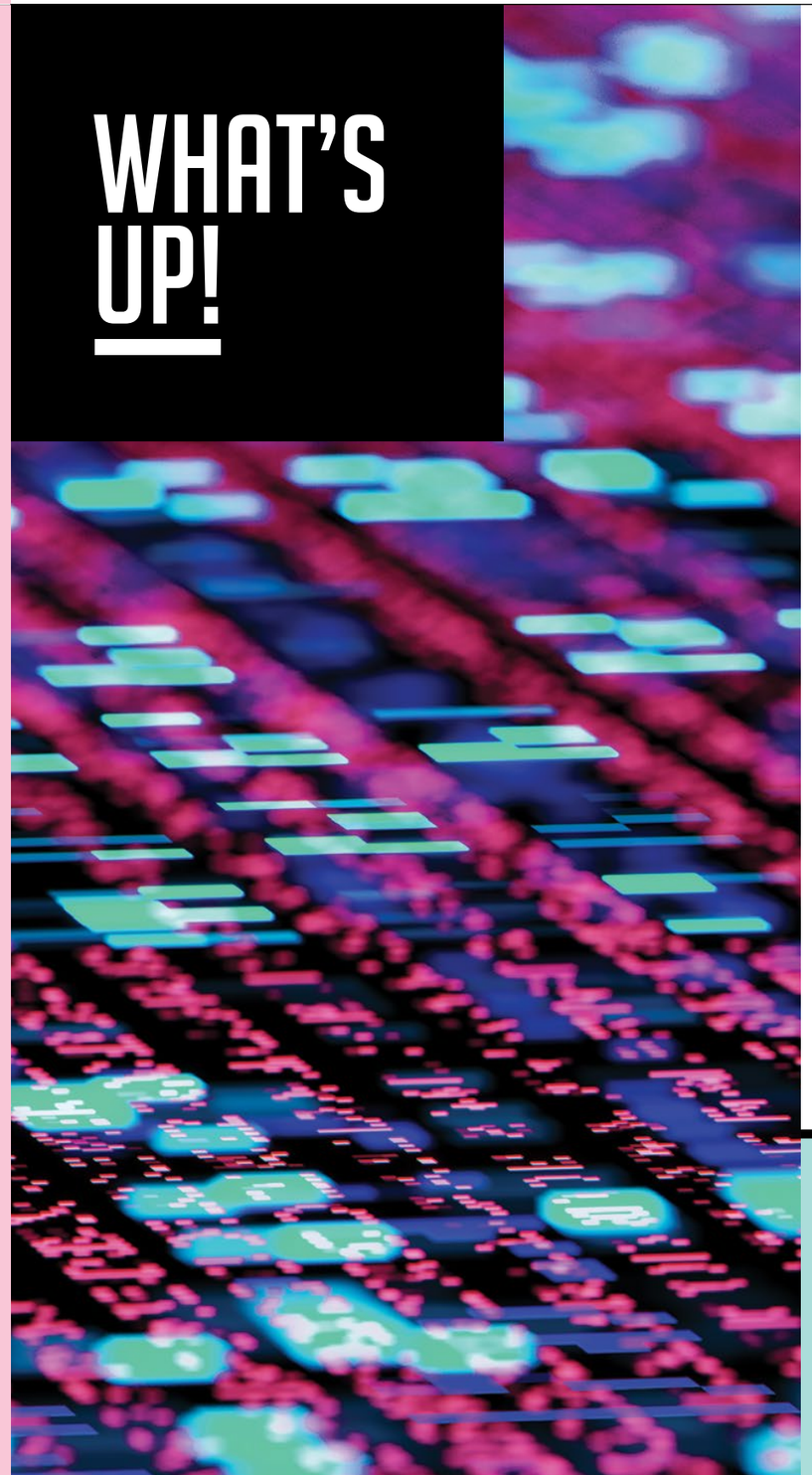
Diamonds have been revered by humans for centuries for their brilliance and rarity—transforming nearly any piece of jewelry into a luxury item. Formed millions or even billions of years ago deep beneath the Earth's surface, it is hard to imagine how these glistening stones found their way into human hands.

Recent research from the University of Wollongong in Australia sheds light on this mysterious journey. After diamonds are formed through the immense pressures underground, volatile-rich magmas called kimberlites transport them hundreds of kilometers to the Earth's surface.

In their research paper published in *Nature Geoscience* in May 2023, the authors used HPC to create a 3D geodynamic representation of the Earth's mantle to model continental plate movements dating back one billion years. Using this model, the authors determined the location where mantle heat from deep within the Earth could be supplied to kimberlites and move diamonds to the surface.

These findings not only provide an explanation as to how diamonds made their way into our hands, but also help us predict the next best place to find them.

WHAT'S UP!



SC23

At this year's International Conference for High Performance Computing, Networking, Storage and Analysis (SC23), titled "I am HPC", be among the thousands of scientists, engineers, researchers, educators, programmers, developers and system administrators coming together to learn, share knowledge and advance their supercomputing skills.

Taking place from November 12–17, in Denver, Colorado, SC23 will be a special opportunity to hear from HPC experts at various sessions, lectures and networking events. For those with accepted abstracts, final papers are due August 26, 2023.

Over the years, SC has implemented innovative measures to enhance reproducibility of accepted papers. To this end, all submitted manuscripts must contain an artifact description appendix which details the significant research products and offers a discussion about further directions for investigation. This measure aims to enhance the scientific rigor of each manuscript.

For more information, visit https://sc23.supercomputing.org/

WHERE

DENVER, COLORADO, US

WHEN

NOVEMBER 12–17, 2023

HIPC 2023

The 30th IEEE International Conference on High Performance Computing (HPC), Data, Analytics, and Data Science (HiPC 2023) is a global platform that brings together researchers from different parts of the world to present their latest research in supercomputing.

HiPC 2023 will be held in Goa, India, and will focus on two domains: HPC and Scalable Data Science. This conference seeks to provide an environment for international collaboration and facilitate the free flow of talent and idea generation to advance technology for humanity.

As part of the conference, HiPC 2023 invites authors to submit original and unpublished research papers in any area of HPC, data science or analytics. The submissions should be in one of the six tracks—algorithms, architecture, applications, systems software, scalable algorithms and analytics, or scalable systems and software—under the two broad themes of HPC and Scalable Data Science.

The final notification to authors on their submissions for HiPC 2023 will be given on October 28, 2023. The conference will also present up to two awards for the most outstanding submissions.

For more information, visit https://hipc.org/

WHERE

GOA, INDIA

WHEN

DECEMBER 18–21, 2023

FIVE WAYS HPC IS ENABLING DIGITAL-BASED LEARNING

New interactive and immersive learning methods, such as educational games, videos and digital storytelling, are entering the education landscape. With high-performance computing at the forefront, education across Asia and the world is experiencing a digital transformation.

By **Chia Pei Ling**

Illustrations by Shelly Liew / *Supercomputing Asia*

The never-ending stream of online content combined with thousands of posts flooding social media have made us a more digitally engaged society today than ever before. However, our use of technology is not just limited to entertainment and socializing. This ability for digital content to engage the new tech-savvy generation is being leveraged to introduce a new form of education delivery: digital-based learning.

Enabled by the massive data processing powers and lightning-fast speeds of high-performance computing (HPC), digital-based learning employs the latest innovations in educational technology (EdTech) applications, online learning platforms, virtual reality and virtual teachers driven by artificial intelligence (AI). Education delivery is poised to enter a new frontier—one that promises to provide students with a highly personalized and engaging learning experience.

TEACHING THROUGH VIDEO STORIES

TikTok has everyone's attention these days—from viral dance videos to digital stories. The platform's predominantly Generation Z users effortlessly navigate the app to splice videos together, generate text, images, audio and music to bring their narratives to life.

This form of digital storytelling (DST) resonates with the new generation and may have applications in the classroom to foster learning. Being a familiar and engaging form of content delivery, DST makes learning a hands-on process by allowing students to create content.

Learning through storytelling is as old as humanity itself. DST is the latest in its evolution and has required HPC to power AI-driven video editors and cloud servers.

For example, back in 2016, the IBM Watson supercomputer helped editors cut together the first AI-made movie trailer for the sci-fi thriller *Morgan*, shortening a process that typically takes weeks into just 24 hours. Even though the average person doesn't have direct access to a supercomputer, the latest smartphones' processing speed of 11–16 teraFLOPS is sufficient to power most AI video-editing mobile apps available today.

Leveraging the accessibility of such video editors, researchers from Syarif Hidayatullah State Islamic University Jakarta, Indonesia, used DST to help local seventh grade English as a Foreign Language (EFL) students learn spoken English. In their study, published in *IEEE Xplore*, the researchers compared the effectiveness of DST with conventional storytelling in teaching students how to describe people, such as sharing stories about themselves and their families.

Teachers used DST videos as pedagogical aids and students practiced by retelling the stories using a self-made video as a guide. The researchers found that giving these DST presentations significantly improved students' speaking abilities compared to standard teaching methods. Furthermore, students brought their own unique touch when putting their videos together, demonstrating that DST is a holistic educational tool that fosters creativity and promotes both digital and linguistic literacy.

SIMULATING FOR SUCCESS IN SURGERY

Amidst the background beeping of medical equipment and the buzzing hospital intercom system, a surgeon masterfully inserts a thin-tubed laparoscopic camera through a small incision in the abdomen—a procedure that requires well-honed psychomotor skills. With a virtual reality laparoscopic simulator (VRLS), this operating room (OR) experience can be recreated for surgical trainees.

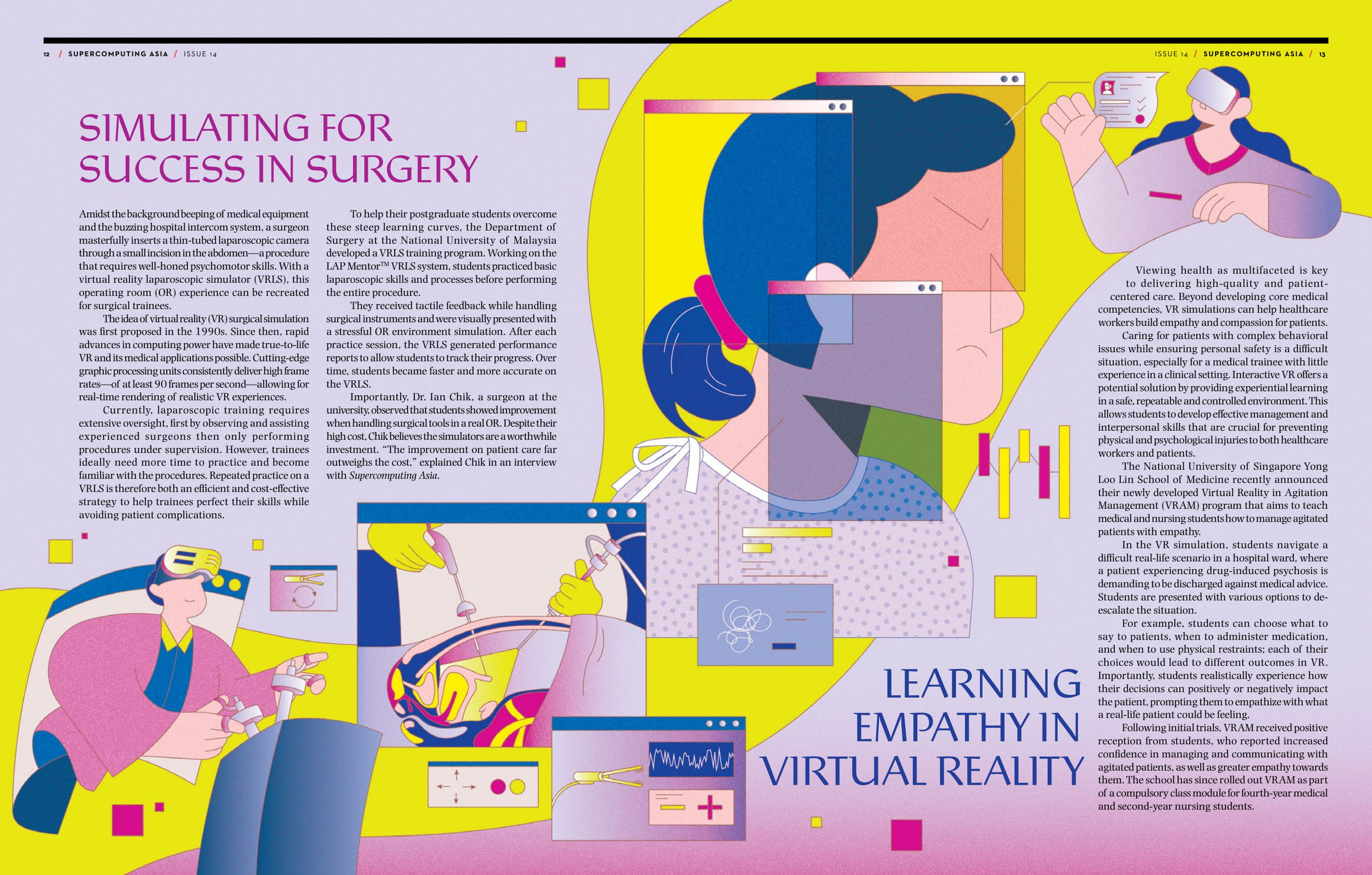
The idea of virtual reality (VR) surgical simulation was first proposed in the 1990s. Since then, rapid advances in computing power have made true-to-life VR and its medical applications possible. Cutting-edge graphic processing units consistently deliver high frame rates—of at least 90 frames per second—allowing for real-time rendering of realistic VR experiences.

Currently, laparoscopic training requires extensive oversight, first by observing and assisting experienced surgeons then only performing procedures under supervision. However, trainees ideally need more time to practice and become familiar with the procedures. Repeated practice on a VRLS is therefore both an efficient and cost-effective strategy to help trainees perfect their skills while avoiding patient complications.

To help their postgraduate students overcome these steep learning curves, the Department of Surgery at the National University of Malaysia developed a VRLS training program. Working on the LAP Mentor™ VRLS system, students practiced basic laparoscopic skills and processes before performing the entire procedure.

They received tactile feedback while handling surgical instruments and were visually presented with a stressful OR environment simulation. After each practice session, the VRLS generated performance reports to allow students to track their progress. Over time, students became faster and more accurate on the VRLS.

Importantly, Dr. Ian Chik, a surgeon at the university, observed that students showed improvement when handling surgical tools in a real OR. Despite their high cost, Chik believes the simulators are a worthwhile investment. "The improvement on patient care far outweighs the cost," explained Chik in an interview with *Supercomputing Asia*.



LEARNING EMPATHY IN VIRTUAL REALITY

Viewing health as multifaceted is key to delivering high-quality and patient-centered care. Beyond developing core medical competencies, VR simulations can help healthcare workers build empathy and compassion for patients.

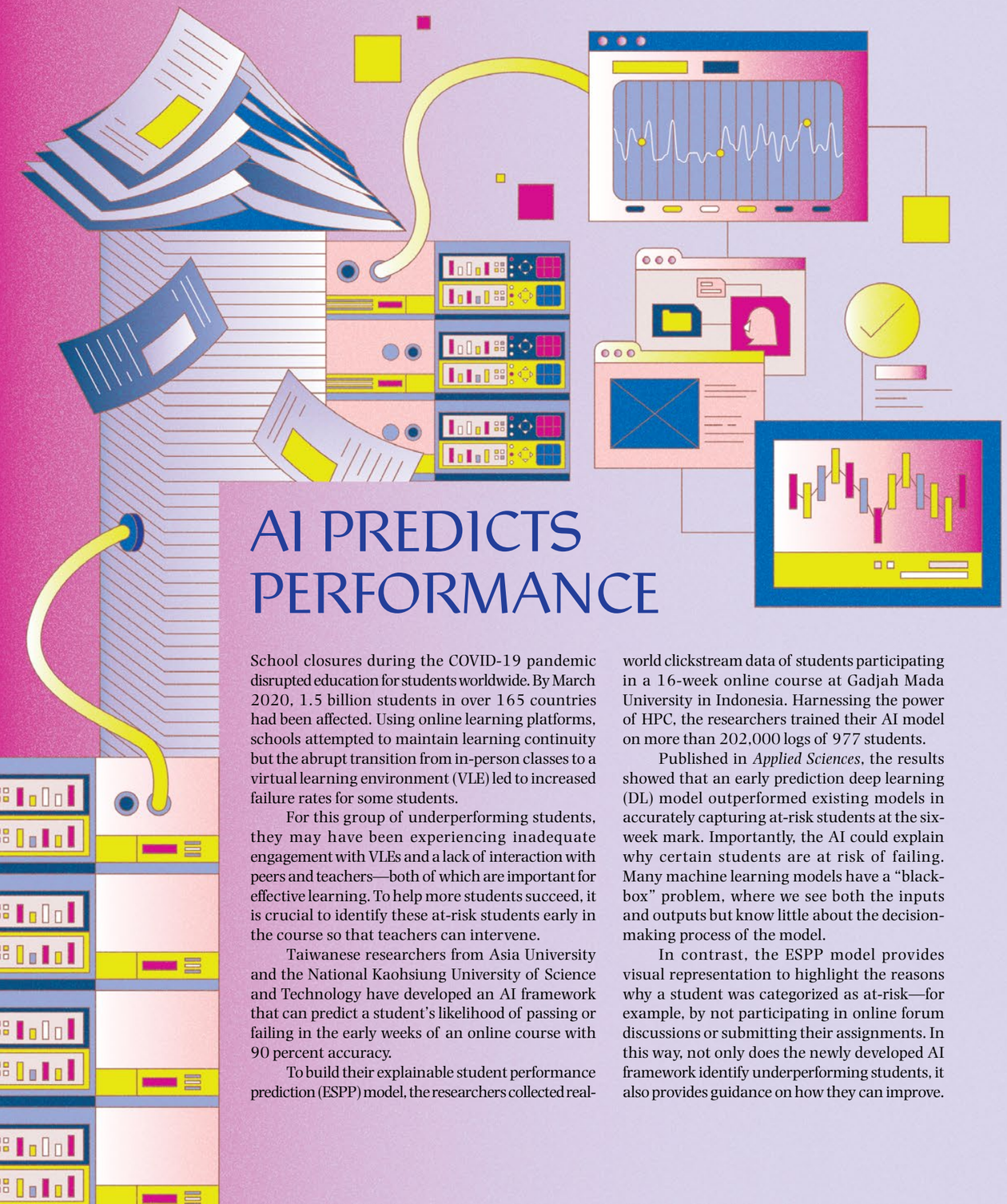
Caring for patients with complex behavioral issues while ensuring personal safety is a difficult situation, especially for a medical trainee with little experience in a clinical setting. Interactive VR offers a potential solution by providing experiential learning in a safe, repeatable and controlled environment. This allows students to develop effective management and interpersonal skills that are crucial for preventing physical and psychological injuries to both healthcare workers and patients.

The National University of Singapore Yong Loo Lin School of Medicine recently announced their newly developed Virtual Reality in Agitation Management (VRAM) program that aims to teach medical and nursing students how to manage agitated patients with empathy.

In the VR simulation, students navigate a difficult real-life scenario in a hospital ward, where a patient experiencing drug-induced psychosis is demanding to be discharged against medical advice. Students are presented with various options to de-escalate the situation.

For example, students can choose what to say to patients, when to administer medication, and when to use physical restraints; each of their choices would lead to different outcomes in VR. Importantly, students realistically experience how their decisions can positively or negatively impact the patient, prompting them to empathize with what a real-life patient could be feeling.

Following initial trials, VRAM received positive reception from students, who reported increased confidence in managing and communicating with agitated patients, as well as greater empathy towards them. The school has since rolled out VRAM as part of a compulsory class module for fourth-year medical and second-year nursing students.



AI PREDICTS PERFORMANCE

School closures during the COVID-19 pandemic disrupted education for students worldwide. By March 2020, 1.5 billion students in over 165 countries had been affected. Using online learning platforms, schools attempted to maintain learning continuity but the abrupt transition from in-person classes to a virtual learning environment (VLE) led to increased failure rates for some students.

For this group of underperforming students, they may have been experiencing inadequate engagement with VLEs and a lack of interaction with peers and teachers—both of which are important for effective learning. To help more students succeed, it is crucial to identify these at-risk students early in the course so that teachers can intervene.

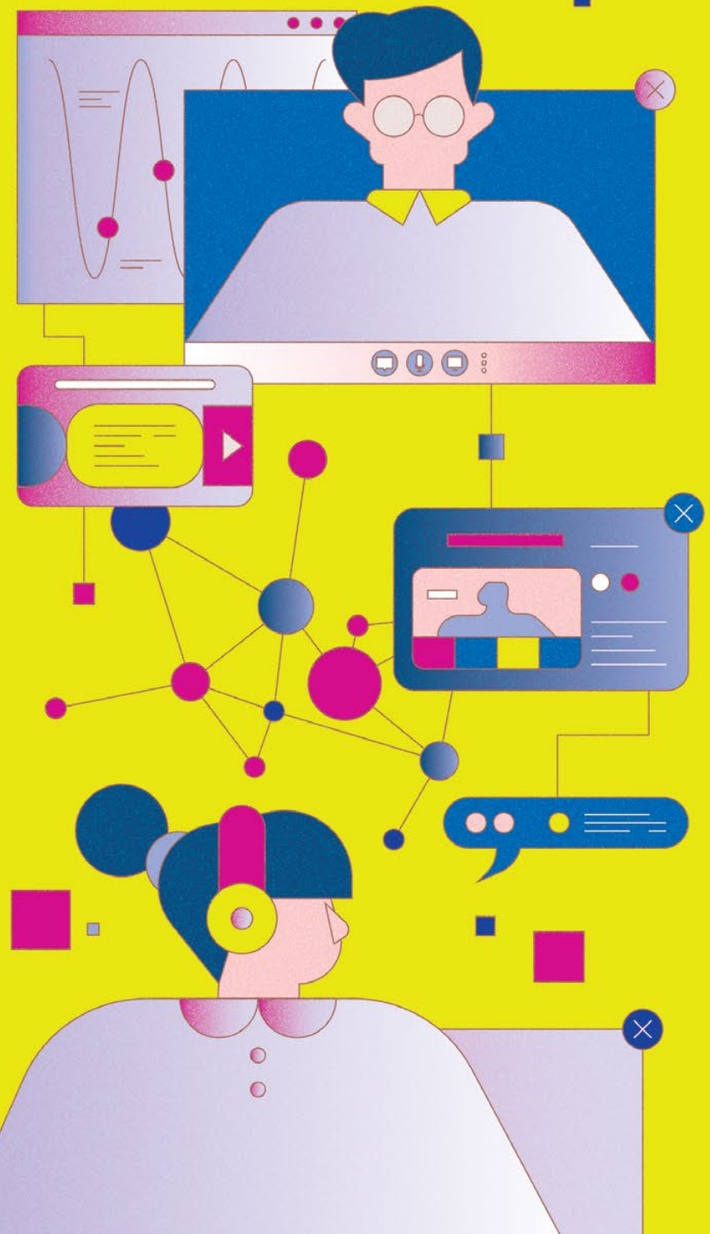
Taiwanese researchers from Asia University and the National Kaohsiung University of Science and Technology have developed an AI framework that can predict a student's likelihood of passing or failing in the early weeks of an online course with 90 percent accuracy.

To build their explainable student performance prediction (ESPP) model, the researchers collected real-world clickstream data of students participating in a 16-week online course at Gadjah Mada University in Indonesia. Harnessing the power of HPC, the researchers trained their AI model on more than 202,000 logs of 977 students.

Published in *Applied Sciences*, the results showed that an early prediction deep learning (DL) model outperformed existing models in accurately capturing at-risk students at the six-week mark. Importantly, the AI could explain why certain students are at risk of failing. Many machine learning models have a "black-box" problem, where we see both the inputs and outputs but know little about the decision-making process of the model.

In contrast, the ESPP model provides visual representation to highlight the reasons why a student was categorized as at-risk—for example, by not participating in online forum discussions or submitting their assignments. In this way, not only does the newly developed AI framework identify underperforming students, it also provides guidance on how they can improve.

A PERSONALIZED TEACHER FOR EVERYONE



Great teachers make a big difference. They bring a personalized touch to the classroom by paying attention to students' needs. However, it is not possible for teachers to create an individualized learning path for every student.

With the availability of big data and the astounding processing speeds of HPC, online learning platforms have transformed into AI-driven systems that can serve as virtual assistants to human teachers. As a student learns on these platforms, AI develops an understanding of the student's strengths and weaknesses, adjusting its content accordingly to provide customized instruction.

By taking over repetitive tasks like reinforcing concepts with practice questions and grading, these AI-enabled systems give teachers more time to address other aspects of students' overall development. For instance, teachers can focus on fostering curiosity and creativity and help students develop effective communication among other soft skills.

China-based EdTech company Squirrel Ai Learning has built an adaptive learning system that provides personalized K-12 after-school tutoring. A recipient of the UNESCO AI innovation award, Squirrel Ai Learning possesses a unique technology—built with over 10 billion pieces of learning behavior data—that finely breaks down a school subject's concepts (or knowledge points).

"By splitting 500 knowledge points to 30,000 ultra-fine knowledge points, Squirrel Ai Learning can precisely pinpoint and address weak areas in students' understanding of study material," said Tom Mitchell, Chief AI Officer of Squirrel Ai Learning, in an interview with *Supercomputing Asia*.

Squirrel Ai Learning has over 10 million registered students spread across its 3,000 learning centers in 200 cities in China.

The access to massive amounts of student data allows Squirrel Ai Learning to continuously improve its AI models. Moving forward, the Squirrel Ai Learning team hopes to create a more interactive interface by applying large language models—the same type of algorithm that underlies ChatGPT. This would create a more open-ended learning environment that encourages students to be more imaginative.

PLAYING NICELY WITH AI IN THE CLASSROOM

As curious students venture the uncharted territory of generative AI, education systems are tasked with ensuring its appropriate use while still delivering quality education.

By **Lee Kai Xiang**

Photo illustrations by Shelly Liew / *Supercomputing Asia*

New toys and gadgets have always been finding their way into schools—from the Tamagotchi to calculators and smartphones. While some are relatively benign, others can be highly disruptive to a student's education.

ChatGPT, one of the best known generative artificial intelligences (GenAIs), is the latest tool to rapidly enter the education scene for its ability to converse and produce written text like a human. Within months of its initial release, millions of users explored ChatGPT's abilities, ranging from content creation and text translation to even code debugging.

Besides writing, other GenAIs, such as DALL-E and Midjourney, can generate original digital images from text prompts—some can even produce entire videos from a script or blog. With such fascinating capabilities, ease of accessibility and increasing popularity, the young and curious minds are inevitably finding ways to use them in the classroom.

Schoolboards are now faced with the difficult challenge of setting guidelines on how to use these technologies to enhance learning, while ensuring an even playing field for all students.

CAN THE AI DO MY HOMEWORK?

With a highly tech-literate generation, the launch of GenAIs saw students zealously applying these tools to their assignments. In a matter of minutes, they could churn out plausible essays, parse simple answers to quizzes, and succinctly summarize reports. In a survey reported by *Forbes*, 89 percent of students confessed to using the platform to complete homework assignments. Some state governments even blocked the service from their networks.

OpenAI, the developers of ChatGPT, are eager to work with educators in finding solutions. As a response to the proliferation of AI-assisted cheating, OpenAI has released a preliminary classifier to identify works produced by their proprietary technology.

OpenAI's classifier positively identified 26 percent of AI-generated content, but incorrectly flagged nine percent of human-written text. Plagiarism detection giants like Turnitin have also released an AI detection software but are facing similar issues—flagging self-written essays as AI-fabricated. Moreover, outputs from ChatGPT and other GenAIs will likely only become harder to detect, as they learn from the feedback of the same classifiers used to catch them.

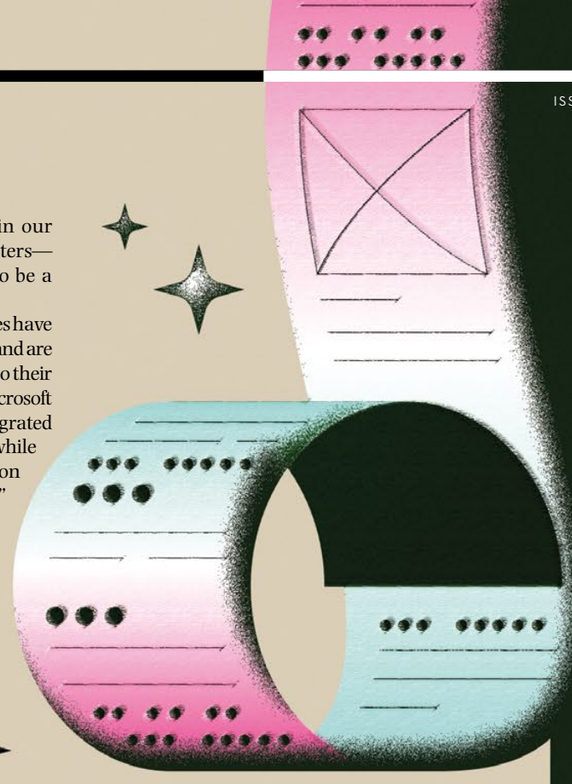
LET THE MACHINES TAKE OVER

Dr. Toby Walsh, a professor of AI at the University of New South Wales, Australia, believes that these are signs that we are testing for the wrong things. "The funny thing is, we don't set essays because there's a shortage of essays, we set essays because that's a way to measure people's ability to build arguments, to think critically about a topic," said Walsh in an interview with *Supercomputing Asia*.

When the task of content synthesis is surrendered to machines, we can focus more on thoughtful curation of the material. As an example, Walsh suggested that students can use ChatGPT to prepare an essay to analyze and critique. This directly allows us to test for the nuanced skills needed for presenting arguments, critical analysis and inquisition.

When the modern calculator was first introduced, it raised similar controversy among educators, but ultimately proved to be a positive force in the classroom. Routine mathematics could be outsourced, amplifying productivity, and allowing students to focus on more advanced mathematics. Similar to how the calculator is now part of every technology—in our watches, phones and computers—GenAIs have the potential to be a routine part of our lives.

Many software companies have already embraced this change and are incorporating AI assistants into their toolkit. Under the moniker "Microsoft Turing", ChatGPT is now integrated into the Microsoft 365 suite, while productivity application Notion introduced their "Notion AI" to automate tedious tasks on their platform. Just as the rest of the world moves to embrace the new technology, students will need to know how to use them as they join the workforce.



"The funny thing is, we don't set essays because there's a shortage of essays, we set essays because that's a way to measure people's ability to build arguments, to think critically about a topic."

Dr. Toby Walsh
Scientia Professor of Artificial Intelligence, University of New South Wales, Australia

A NEW PARADIGM FOR TEACHING AND LEARNING

As schools integrate GenAIs, teachers must consider their features that are most useful in the classroom, such as summarizing or synthesizing texts and breaking down concepts into easily understandable pieces.

For students, this tool is ideal for compiling revision notes or for chunking lengthy articles into digestible bits. Instead of re-writing personal notes, students can utilize the software to more effectively summarize class material and customize them according to their needs and learning styles. For instance, students can instruct ChatGPT to arrange history notes in chronological order in preparation for a biographical essay, or sort by themes to revise for an exam.

AI also makes for an excellent personal tutor, allowing students to ask questions without fear of judgment. "You can sit there and ask it questions, and it doesn't matter how naive or repetitive the questions are," noted Walsh. As an example, a challenging topic for modern students is learning programming languages. These tools can provide well-annotated code with clear explanations of each line to facilitate better learning.

But it's not just students who can benefit from GenAIs. Educators can use these tools in their lesson plans to prepare revision guides for students, design multiple-choice quizzes and even mark essays by highlighting gaps in logic.

"Even assuming that the rightful copyright owner is the person whose queries generated the AI work, the concept of independent creation may preclude two parties whose queries generated the same work from being able to enforce rights against each other."

Margaret Esquenet
Partner at Finnegan law firm

Additionally, GenAI can provide individualized learning catered for each student. One company that offers such services, Carnegie Learning, uses AI to track a student's progress to plan lesson activities. This level of personalization goes beyond what a single teacher can do for a full classroom and can make the learning process more effective for students.

However, these tools are not without flaws. Currently, GenAIs are still prone to inventing fantasies, and proclaiming them as facts. Both students and instructors need to curate content synthesized by these tools carefully before using them.

SHOULD WE BE WORRIED ABOUT GenAI?

Even as society embraces the new technology, we must be aware of concerns perpetuated over its use in the wider context. Surrounding the promotion of GenAIs in education is a haze of legal and ethical concerns.

One issue regards the confidentiality of information shared through these applications. For instance, ChatGPT, which explicitly states that conversations are recorded to improve the chatbot, suffered a data breach on March 20, 2023, leading to leaked conversations and payment information. Coupled with previous security breaches, Italy has currently banned its use while other European nations have imposed strict regulations.

In the US, there are ongoing class-action lawsuits over the use of copyrighted data to train these algorithms. The ethical training of the model raises concerns over the intellectual property rights of artists, such as the ownership of the works produced by models trained on copyrighted data.

Nevertheless, experts are hopeful that a more sustainable solution will emerge. A similar problem faced the music and film industries in the past with the launch of file-sharing service Napster. The surge in internet piracy was tackled by the provision of streaming services, which allowed users to access content while maintaining standards of copyright.

According to Walsh, "We're going to have a similar evolution in terms of GenAI, whether we're returning value back to the people whose text, computer code or images that it was trained on."

As the works of GenAIs produce tangible returns, lawmakers wrestle with policies on ownership rights. When faced with the conundrum of two identical pieces of work produced by the same GenAI, Margaret Esquenet, a partner with Finnegan law firm, noted in a *Forbes* article that under US law, "Even assuming that the rightful copyright owner is the person whose queries generated the AI work, the concept of independent creation may preclude two parties whose queries generated the same work from being able to enforce rights against each other."

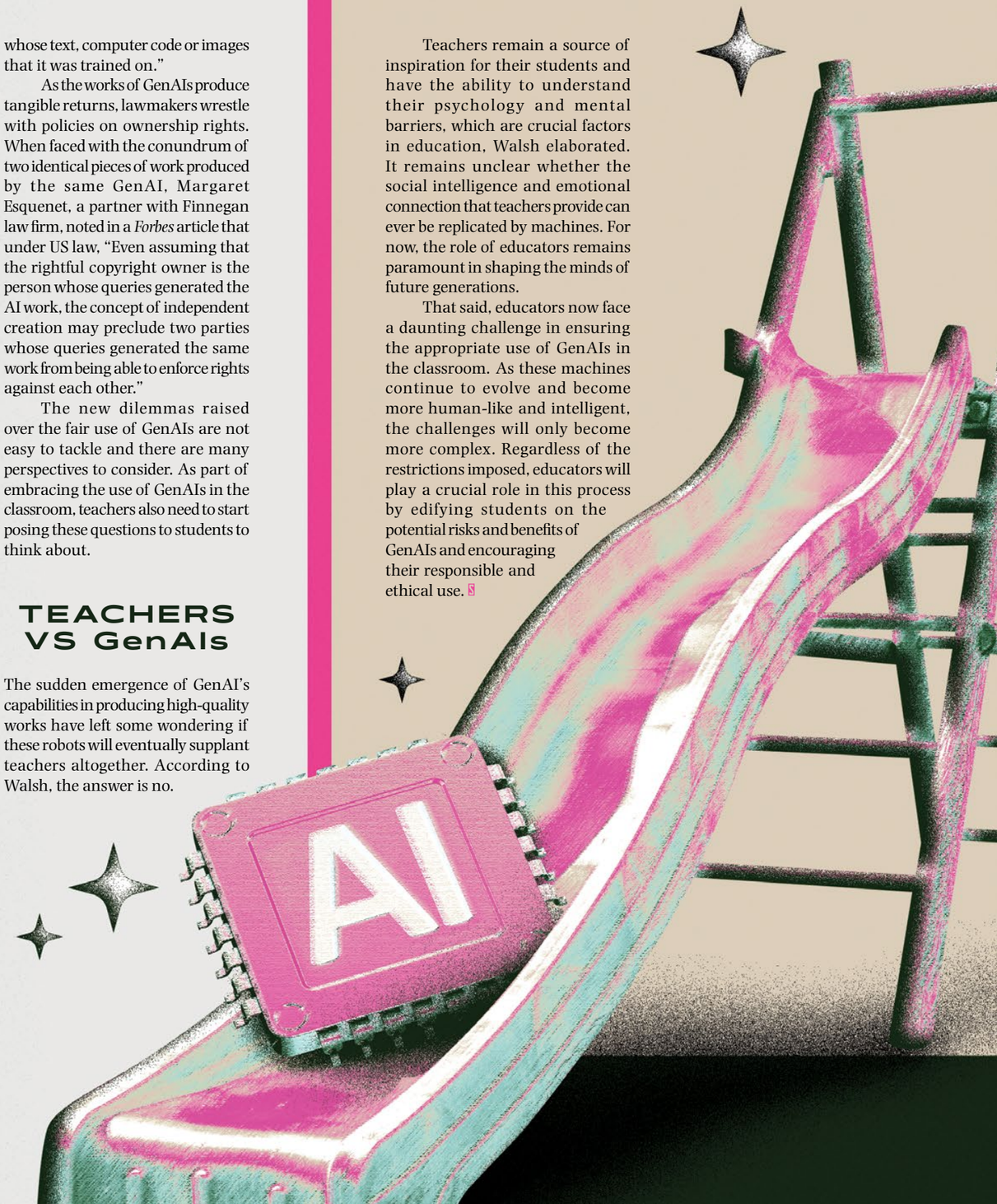
The new dilemmas raised over the fair use of GenAIs are not easy to tackle and there are many perspectives to consider. As part of embracing the use of GenAIs in the classroom, teachers also need to start posing these questions to students to think about.

TEACHERS VS GenAIs

The sudden emergence of GenAI's capabilities in producing high-quality works have left some wondering if these robots will eventually supplant teachers altogether. According to Walsh, the answer is no.

Teachers remain a source of inspiration for their students and have the ability to understand their psychology and mental barriers, which are crucial factors in education, Walsh elaborated. It remains unclear whether the social intelligence and emotional connection that teachers provide can ever be replicated by machines. For now, the role of educators remains paramount in shaping the minds of future generations.

That said, educators now face a daunting challenge in ensuring the appropriate use of GenAIs in the classroom. As these machines continue to evolve and become more human-like and intelligent, the challenges will only become more complex. Regardless of the restrictions imposed, educators will play a crucial role in this process by edifying students on the potential risks and benefits of GenAIs and encouraging their responsible and ethical use.



CLOSING THE GAP BETWEEN HPC TECH AND EDUCATION

The relationship between HPC technologies and its literacy is inextricably intertwined—each relying on the other to advance the field and unlock its full potential.

By **Mitchell Lim**

Photo illustrations by Lieu Yi Pei / *Supercomputing Asia*

The last few decades of human history represent a tiny fraction of our time on Earth. However, the technological breakthroughs within this short period have transformed the human experience, from space probes venturing beyond our solar system in search of the universe's origin to the countless artificial intelligence (AI) innovations that enable more accurate medical diagnoses, new communication methods and efficient renewable energy systems.

But this breakneck speed of technological growth and implementation comes at a cost. Many are left behind when technology races ahead of society's ability to adapt to the new changes. This lag in learning poses a challenge for policymaking and labor markets, and also perpetuates pre-existing inequalities, particularly in developing nations.

High-performance computing (HPC) is especially susceptible to this challenge. While its lightning-fast capabilities have empowered us to solve a myriad of scientific conundrums, maintaining this momentum is critical for the next generation of HPC scientists, experts and the public to keep HPC literacy on pace with its rapidly evolving landscape.

With recent achievements in exascale computing, many challenges and questions are emerging: What educational strategies are necessary to bridge the ever-expanding gap between progress in HPC technology and our understanding thereof? How can we ensure HPC literacy becomes a priority in our educational systems? And, finally, why is bridging this gap so crucial?

DECODING THE DIGITAL DIVIDE

HPC powers many applications—from operating nuclear fusion pilot plants to producing 3D animated films. At the forefront of today's digital renaissance, technology has suffused numerous industries and will likely remain a cornerstone of innovation and progress.

HPC systems—featuring constellations of powerful computers interconnected through blazingly fast networks and sophisticated algorithms—require a deep understanding and a high level of craftsmanship to master. This encompasses a wide range of skills and expertise, spanning hardware, software and specialized domain knowledge.

What is more, the intricacies of HPC demand not only proficiency in programming languages and parallel computing techniques, but also a thorough understanding of numeral algorithms, data management and optimization strategies.

It is for this very reason that cultivating a foundational understanding of HPC is of paramount importance. Piecing together the factors contributing to the burgeoning gap currently faced in the industry is therefore essential, as it threatens our ability to harness the full potential of HPC systems and leverage their vast capabilities in the long term.

One key facet is the rapid pace of innovation in HPC technologies, which often surpasses the ability of community members and the public to acquire and adapt to new knowledge.

Unsurprisingly, the repercussions of this growing HPC literacy gap are manifold. The most pronounced and prevalent consequence is the suboptimal utilization of HPC resources. Many users, ill-equipped with the necessary technical know-how, may not fully comprehend and subsequently deploy these systems to their fullest potential. For instance, bioinformaticians might run genomic simulations on a high-performance cluster using only a fraction of its available cores, leaving a substantial portion of the machine's computational power untapped.

This, in turn, can lead to far-reaching ripple effects—thwarting growth and stymieing research and development as businesses and researchers drown in a sea of HPC speak, jargon and technicalities.

Exacerbating the literacy gap are the increasingly high barriers to entry imposed by the ever-advancing complexity of HPC technologies. To illustrate, modern systems based on graphics processing units (GPUs), which are exceptionally adept at parallel processing, require a high level of technical understanding that can be daunting to newcomers. This situation significantly impacts the training and development of the next generation of computer scientists in the field, making it more challenging for them to acquire the necessary skills and expertise.

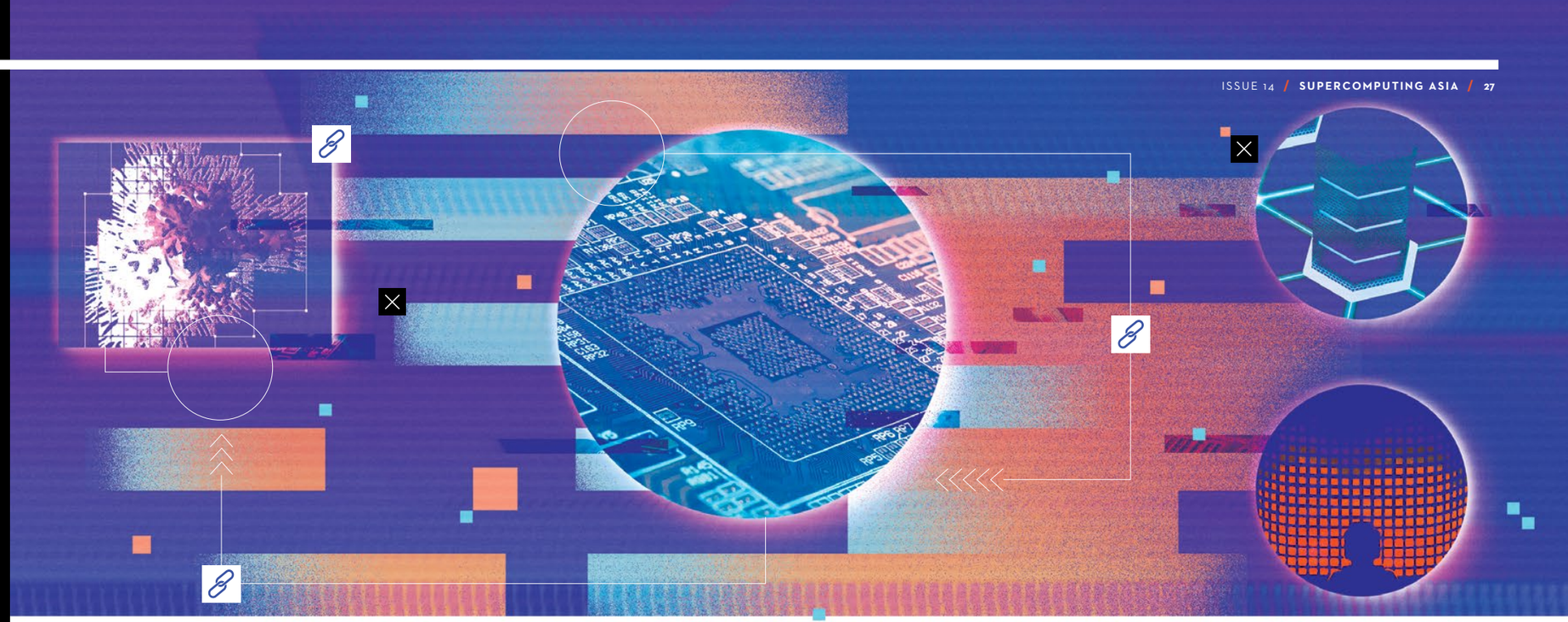
"Even with STEM education at the tertiary level, there remains a gap between the knowledge acquired by students—including at the PhD level—and the engineering required for cutting-edge developments in computing technology," said Professor Sean Smith, Director of the National Computational Infrastructure (NCI) at the Australian National University, in an interview with *Supercomputing Asia*. "In many cases, on-the-job training is relied upon to provide this education, which can be quite happenstance," added Smith.

On the software front, a growing number of scientific domains are pivoting towards exploiting configurations heavy on GPUs, which in turn requires the re-architecting of many algorithms and software platforms.

"This can be a challenge, especially in areas like climate and weather modeling, where extensive software platforms have taken decades to develop. Reconstructing such codes to take advantage of the most efficient hardware is not an easy feat and presents a significant roadblock for many domains," noted Smith.

"Even with STEM education at the tertiary level, there remains a gap between the knowledge acquired by students—including at the PhD level—and the engineering required for cutting-edge developments in computing technology."

Professor Sean Smith
Director of the National Computational Infrastructure (NCI), Australian National University



BUILDING BRIDGES TO BOOST ACCESS

As with many contemporary issues, a multifaceted approach is key, including participation of and collaboration among multiple stakeholders that encompass academia, industry and government.

When executed effectively, education and training programs can serve as powerful tools for fostering HPC literacy. For instance, under the AI & HPC-enabled Education and Talent Development for Singapore initiative unveiled at the SupercomputingAsia 2023 (SCA23) conference, several institutions—including the National Supercomputing Centre (NSCC) Singapore; Institute of Technical Education (ITE); Republic Polytechnic (RP); AI Singapore (AISG); Singapore Polytechnic (SP); Singapore Institute of Technology (SIT); and the Institution of Engineers, Singapore Incubator & Accelerator (IES-INCA)—are joining forces to develop talent in HPC among its populace.

These collaborations aim to establish new curricula, training courses, workshops and student competitions in areas such as HPC, AI, data science, analytics, and advanced simulation and modeling. By nurturing talent in these fields, the workforce will be better equipped to support relevant industry sectors and navigate the complex landscape of HPC.

Low Khah Gek, Chief Executive Officer of ITE, highlighted that the partnership with NSCC offers valuable opportunities for students to learn about HPC applications and gain first-hand experience using a supercomputer. This collaboration equips students with in-demand skills in HPC, preparing them for the jobs of the future economy.

Previously, ITE collaborated with NSCC to offer the SkillsFuture Certificate of Competency (CoC) course, which equips participants with fundamental knowledge of HPC and access to Singapore's first national petascale supercomputer. Co-trained by ITE lecturers and NSCC specialists, students can learn how to harness an HPC system remotely to perform complex calculations at blazing speeds, expediting the development of deep learning AI applications.

Similarly, Soh Wai Wah, Principal and Chief Executive Officer of SP, emphasized his institution's commitment to raising awareness of HPC resources among staff and students and showcasing HPC's potential to efficiently tackle large and complex problems.

In addition to education and training programs, providing access to advanced HPC resources will help level the playing field within the HPC domain in academia. Announced at the SCA23 conference, Singapore's next-generation national supercomputer, the Advanced Supercomputer for Petascale Innovation Research and Enterprise 2A (ASPIRE 2A), has been commissioned and will be made available to the city-state's research communities.

By granting access to the supercomputer's resources, local institutions can advance teaching and education in fields such as AI and machine learning. This initiative also supports professionals in advanced research and IT by offering them the opportunity to hone their skills using cutting-edge HPC resources.

ASPIRE 2A's accessibility enables all researchers to utilize the supercomputer's resources for projects spanning areas such as climate change, biomedical science and smart nation activities. This increase in access to HPC resources and the collective efforts to develop talent in HPC-related fields exemplify a forward-looking approach to bridging the HPC literacy gap and preparing for a future driven by advanced technologies.

Singapore is not alone in its mission to foster HPC literacy. In Thailand, the National Science and Technology Development Agency (NSTDA) Supercomputer Center, commonly known as ThaiSC, not only provides cutting-edge HPC services for Thailand's research and development community, but also actively engages current and prospective HPC users through a variety of tailored programs, workshops and events.

"To raise awareness, share knowledge and promote best practices in HPC, we regularly organize webinars featuring industry partners and academic institutions," explained Dr. Piyawut Srichaikul, Director of the NSTDA Supercomputer Center to *Supercomputing Asia*. "Our latest LANTA supercomputer, which utilizes Hewlett Packard Enterprise's advanced computer architecture, is also open for visits from schools and institutions for educational purposes."

"Our latest LANTA supercomputer, which utilizes Hewlett Packard Enterprise's advanced computer architecture, is also open for visits from schools and institutions for educational purposes."

Dr. Piyawut Srichaikul
Director of the National Science and Technology Development Agency (NSTDA), Thailand

FORGING ALLIANCES FOR A THRIVING LEARNING ECOSYSTEM

At Australia's NCI, outreach activities and internal training programs are conducted to help engineers embrace HPC and AI technologies. Through comprehensive surveys across its user base, NCI identified a significant gap in knowledge for students transitioning from domain-specific fields to HPC as they join the workforce.

Although many of these students have backgrounds in science or engineering, they often lack formal computer-science training. NCI addresses this gap with targeted interventions, providing solutions that differ from conventional university teachings.

"We are partnering with organizations like Intersect Australia, a leading provider of digital-skills training for researchers in Australia, to assist users in becoming acquainted with entry-level programming," explained Smith. "As for advanced-level training, we formulate coursework in collaboration with specialized research groups across the nation, often through internship programs that leverage the expertise of these teams."

Smith underscored the alliance between academia, industry and government as a vital catalyst in nurturing HPC literacy. Synergistic partnerships would give rise to platforms that allow diverse entities to pool their expertise and resources, which could further bolster HPC education and research.

With respect to government, NCI is not the only Commonwealth-funded research infrastructure working to bridge the HPC literacy gap in Australia. Its Perth counterpart, the Pawsey Supercomputing Research Centre, also operates an active skills training program to improve HPC literacy.

The Australian Research Data Commons, another government-funded project, also focuses on upskilling data literacy across various domains throughout the country. Through these concerted efforts, the Australian government is actively contributing to closing the gap in HPC and data literacy.

Collaborations in HPC extend well beyond national borders. The fifth iteration of the regional APAC HPC-AI Student Competition, jointly organized by NCI and NSCC Singapore, recently concluded. Over a challenging six-month period, the event brought together graduate, advanced degree and undergraduate students from across the region.

The competition provided an opportunity for participants to develop their skill sets and deepen their understanding of HPC and AI technologies, all while showcasing their mastery of these disciplines on an international stage.

Rikky Purbojati, Associate Director of Research Computing at the National University of Singapore, told *Supercomputing Asia*, "This competition has united students, researchers and industry professionals to address a specific set of contemporary challenges. It's an excellent platform for educating a significant subset of the community on the potential and capabilities of HPC systems to tackle many of today's critical issues, such as climate change and AI, among others."

Srichaikul also shared some of ThaiSC's global engagements, including their active role in the ASEAN HPC Task Force. Just late last year, with support from the European Union, Thailand hosted the second edition of the EU-ASEAN HPC School, a week-long intensive course on HPC and its applications to applied scientific research.

"These events provide a platform to explore methods of sharing HPC resources across various centers, addressing both technical and governance issues to bridge accessibility gaps," added Srichaikul.

SETTING FARTHER SIGHTS

Looking beyond HPC industries has its benefits too. Gleaning indispensable insights from and emulating established frameworks of other industries can help the HPC community to draw upon proven models of public-private partnerships and interdisciplinary initiatives that have successfully overcome similar conundrums.

Smith points to colleagues in the quantum computing sector who have made significant strides in developing seminars, workshops and public dissemination programs to educate the general public in quantum computing—what they are, their capabilities and limitations.

"Enhancing public literacy is equally crucial, as it fosters greater awareness, interest and support for research in various domains, including HPC," added Smith. "Learning from examples like these can help further bridge the gap between technology and public understanding."

When it comes to educating the public about HPC, harnessing the power of narrative storytelling can be an effective conduit through which HPC knowledge is disseminated in a fun and engaging manner. Coupled with the strategic use of social media, such techniques can demystify the subject and spark curiosity among a wider audience, who might have otherwise been walled off by the technical humdrum often associated with HPC.

Embracing this approach is particularly appealing to the younger generation, who tend to be more receptive to dynamic and interactive learning methods. This not only paves the way for their understanding of HPC, but also better prepares them for the emergence of novel technologies, ensuring they remain adaptive and informed as the field evolves.

LIGHTING A PATH FOR HPC

The future of HPC is brimming with exciting emerging trends and technologies that are poised to further revolutionize the field. From exascale computing to quantum computing and advanced AI techniques, the future promises unprecedented computational power, transforming our ability to address complex scientific, engineering and societal challenges.

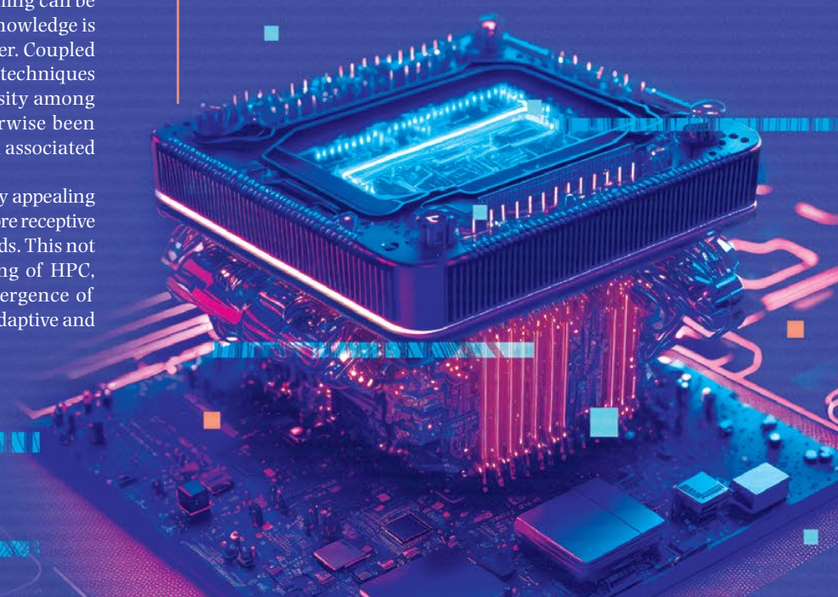
In parallel with these technological advancements, ongoing efforts to advance HPC literacy are evidently more critical than ever. As the field of HPC continues to evolve, so too must the resources that support HPC literacy.

Keeping up to date with the latest HPC developments and actively pursuing education and training initiatives ensure that both current and future generations of users are equipped with the knowledge and skills required to effectively harness emerging technologies.

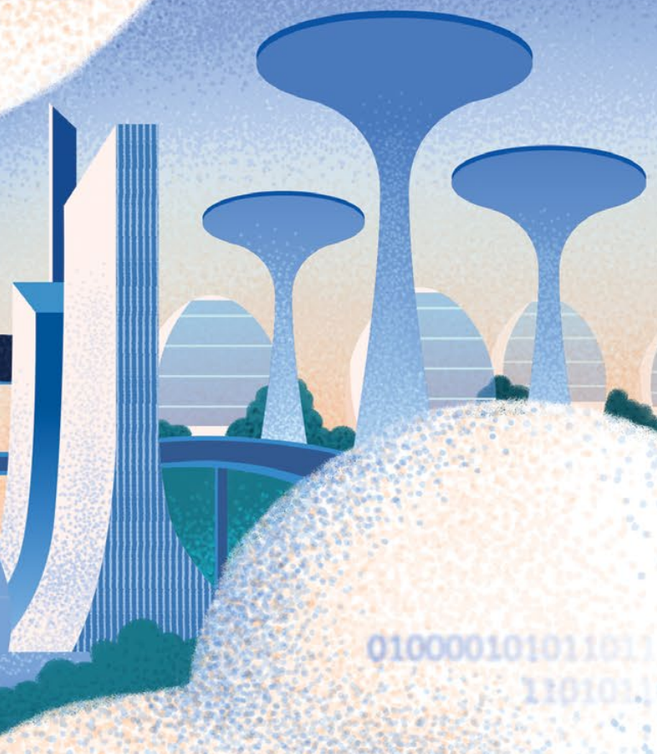
To stay at the forefront of technological advancements, Purbojati suggested, "Individuals can keep tabs on HPC publications, follow relevant social media channels and keep an eye on academic journals for deeper insights."

"Communities can also play an important role by forming organizing bodies that distribute regular newsletters and hosting engaging events, such as user group meetings, to keep everyone informed about current technologies and what the future holds," added Purbojati.

Augmented by interdisciplinary approaches that foster strategic collaborations between academia, industry and government, the collective efforts of the HPC community can help cultivate a thriving and supportive ecosystem that nurtures talent and promotes innovation in HPC and beyond.



BUILDING CITIES IN THE CLOUDS



What does it take to build smart cities on a cloud? High-performance computing promises to grant the massive computational power needed to support the cloud and edge infrastructures revolutionizing daily life in Asia.

By **Chan Li Ting**

Illustrations by Wong Wey Wen / *Supercomputing Asia*

USB flash drives are quickly becoming relics of the past despite only being on the market for about two decades. Those who use USB flash drives as data storage devices likely have more than one, as their memory capacity quickly becomes obsolete compared to newer models, and they are easily misplaced or forgotten.

Platforms like Dropbox and Google Drive have offered a novel solution to these struggles: store files on a massive supercomputer through a remote server—known as the cloud—and access them anytime, from anywhere.

The cloud also grants users the ability to run computationally demanding applications, such as artificial intelligence (AI)-based programs, on their own devices via the internet. This on-demand access to high-performance computing (HPC) has far-reaching implications beyond data storage.

Despite its utility, however, cloud computing has several limitations, such as slow response time over long distances and bandwidth constraints, particularly in areas with limited connectivity.

To help overcome some of these limitations, edge computing is being employed to expand and enhance cloud computing capabilities. Edge devices—ranging from smartphones to firewall systems—serve as contact points or connection nodes to transmit data from the ground locally to a central cloud network.

This method has many advantages, including reducing costs that would have otherwise been used to maintain expensive servers, preserving data privacy, and allowing scalability with increasing demand.

In Asia, these developments in HPC-backed cloud and edge services are starting to take effect on people's daily lives—from faster download speeds to advanced healthcare services. To be at the forefront of the digital revolution, industry leaders are seeking a foothold in Asia's burgeoning markets.

AT THE EDGE OF COMPUTING POWER

Known for its distributed computing platform and content delivery network, the US-based internet company Akamai is no stranger to edge computing. By operating a network of servers around the world that holds its own cache of requested internet content, Akamai allows its users to access the internet with greater speeds and reliability.

"We're taking a fundamentally different approach to cloud computing—building on 25 years of experience in scaling and securing the internet for the biggest companies in the world."

Dr. Tom Leighton
Co-founder and Chief Executive Officer of Akamai

Earlier this year, the company launched Akamai Connected Cloud, its solution to meet greater demands for higher computational power and faster speeds through cloud and edge computing.

In Feburary 2023, the company announced that the Akamai Connected Cloud will add seven more new core edge computing sites, bringing its total to 18, with more planned on the horizon. Four of the seven additional core sites are in major cities in Asia—an acknowledgement of the digital needs of the world's most populous continent. According to the International Data Centre, the public cloud servers' market in Asia is expected to grow to US$165.2 billion by 2026.

"We're taking a fundamentally different approach to cloud computing—building on 25 years of experience in scaling and securing the internet for the biggest companies in the world," said Dr. Tom Leighton, Akamai's Co-founder and Chief Executive Officer. "Akamai is building the cloud the next decade needs." These sites will extend Akamai's reach and solidify its position in the cloud services market.

LAYING THE CLOUD-WORK

Despite the expansion of cloud leaders into the Asia-Pacific region, Asian businesses hoping to move to the cloud often face many barriers. "Industries encounter regulatory uncertainties related to data privacy, cybersecurity, cross-border data flows and compliance requirements," said Eric Hui, Chair of the Asia Cloud Computing Association (ACCA) in an interview with *Supercomputing Asia*, adding that navigating these complex and evolving regulations can pose challenges for organizations considering cloud adoption.

As the foremost industry association in the Asia-Pacific region for cloud computing, the ACCA serves as a platform for industry players to find common ground with regulatory bodies, governments and other stakeholders. Its key aim is to promote the adoption of cloud computing through dialogue between these parties.

In addition, the ACCA develops materials and provides recommendations that will enable businesses to adopt cloud computing technologies in a safe and consistent manner. For example, because of Asia's rapid urbanization, increased energy consumption, detrimental environmental impacts and poor resource management are becoming complex and problematic issues. According to Hui, these can be addressed using cloud-enabled technologies.

"If organizations in the Asia Pacific are empowered to move IT workloads to cloud data centers powered by 100 percent renewable energy, their carbon emissions savings could increase to 93 percent on average," Hui explained.

To this end, ACCA has formed a sustainability workgroup to develop best practice recommendations and other thought leadership programs relating to sustainable development. In 2022, the workgroup published a concept note to illustrate how cloud computing can help states achieve their sustainable development goals, calling for governments and enterprises alike to commit to and support these efforts.

Besides sustainability, ACCA also has workgroups ranging from financial services to next-generation technologies like edge computing.

"Cloud computing has constantly worked behind the scenes to provide the technological foundation upon which much of today's digital economy rests and which tomorrow's capacity for growth may be built on," said Hui. ACCA's role, then, is to help pave the way for cloud computing to live up to its potential.

SMART FARMING NEEDS CLOUDS

Agriculture is another major industry to reap the benefits of high-performance cloud computing. In Malaysia, farmers are being empowered with advanced technologies to enhance agricultural productivity and reduce costs. For example, the Digital AgTech program is one of many initiatives set up by the Malaysia Digital Economy Corporation (MDEC) in a move towards "smart farming".

Under the program, animal farms are equipped with HPC-powered sensors to monitor individual animal growth and provide tailored nutritional guidance. To survey agricultural land, drones can capture and process data on how well crops are performing and alert farmers on potential environmental issues, such as pestilence.

Through Digital AgTech, Malaysian farmers can learn how to use these new technologies in a lab to manage their farms more efficiently. Kampung Sijangkang, for instance, is a "smart" chilli farm that saw a 22 percent increase in its yield and a 30 percent reduction in operational costs in its third year of operation as a result of this program.

"These opportunities allow Malaysia to foster an innovative AgTech community. Harnessed well, the ecosystem can improve the national agricultural productivity, boost our food security and help promote Malaysian agricultural products at international markets. The potential for growth is limitless," said Raymond Siva, Senior Vice President and Chief Digital Investment Officer at MDEC.

"These opportunities allow Malaysia to foster an innovative AgTech community."

Raymond Siva
Senior Vice President and Chief Digital Investment Officer, Malaysia Digital Economy Corporation (MDEC)

CONNECTED CARE IN THE CLINICS

In neighboring Singapore, public healthcare institutions are adopting cloud and edge HPC technologies to improve clinical care.

The National University Health System (NUHS), in collaboration with Singtel, is deploying a 5G indoor network with Multi-Access Edge Compute capabilities at its main wards and operating theaters—a first in Singapore. The introduction of 5G will provide a foundation for new services such as augmented reality (AR), advanced robotics and The Internet of Things to improve patient experience.

SingHealth, the largest public healthcare cluster in Singapore, will also be developing and deploying a supercomputer on Singapore General Hospital's premises to support a greater number of AI research projects through a large collaboration including NVIDIA and NSCC. Like those at NUHS, the AI research projects run by SingHealth promise to aid clinicians in making more accurate diagnoses for improved patient care.

"These public-private partnerships linking the entire value chain of infrastructure, software, digital tools and researchers will accelerate scientific outcomes, and in this case support Singapore's healthcare and medical services," said Dr. Janil Puthucheary, Senior Minister of State in the Ministry of Communications and Information, and the Ministry of Health, and Minister-in-Charge of GovTech. "The NSCC, SingHealth and NVIDIA agreements serve to deepen collaboration and will open up many more possibilities in other fields of medicine, beyond the initial use cases."

REACHING NEW HEIGHTS

With the ability to help solve some of the world's most pressing problems, the utility of HPC is only becoming more widespread and accessible through cloud and edge services. Close collaborations between governments and industries to implement cloud and edge HPC across sectors as diverse as healthcare and agriculture are already starting to make waves in Asia. As more state-supported tech companies with cloud and edge HPC expertise compete for footholds in fast-growing Asian economies, the region is set to build smart cities on the clouds.

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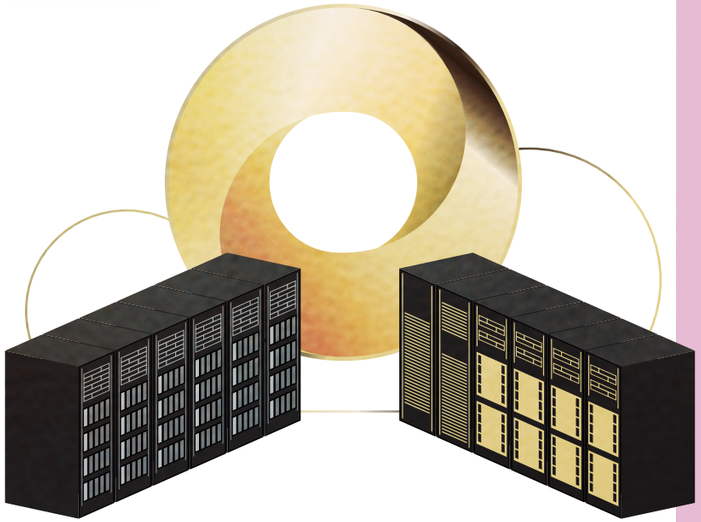
Dr. Janil Puthucheary
Senior Minister of State, Ministry of Communications and Information, and Ministry of Health, Singapore

Business Bytes



MAKING DIGITAL TWINS IN AN ALTERNATIVE REALITY

NVIDIA will be teaming up with Microsoft to offer a new cloud service where users can create 3D simulations of large-scale, physically accurate virtual worlds for industrial and scientific applications.

Called the Omniverse Cloud, users will leverage the power of NVIDIA RTX™ technology and Universal Scene Description to design, develop, deploy and manage industrial metaverse a
the cloud environmen

"Every manufac
from massive physical f
handheld consumer g
someday have a digital twin
to build, operate and optim
object," said Jensen Huang, fou
and Chief Executive Officer of NVI

Examples of its applications in the automotive industry include the ability to design, build and test complex manufacturing systems, said Milan Nedeljković, board member for production at BMW AG. "[This] means we can plan and optimize a next-generation factory completely virtually before we build it in the physical world," he added.

The Omniverse Cloud is set

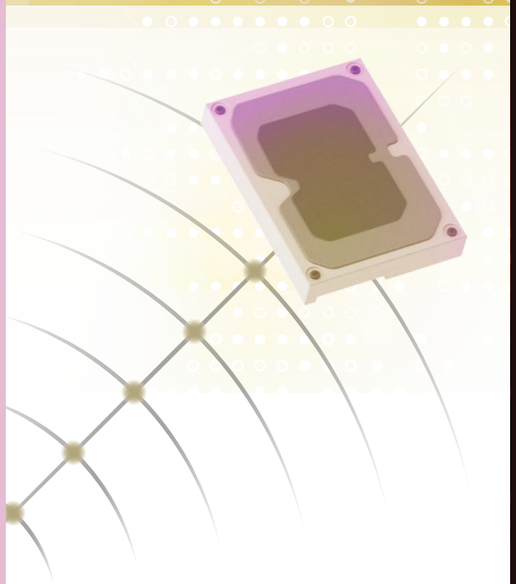
MOVING ON TO ZETTASCALE

At the 61st edition of the TOP500 shows, the US' Frontier supercomputer retained its title of fastest computer ever made and currently remains the only true exascale machine—topping out at a whopping 1.194 exaFLOPS. Although Frontier can perform calculations at an unimaginable rate—up to two quintillion per second—computer scientists are still pushing the boundaries of HPC.

On May 19 this year, RIKEN and Intel announced a joint venture towards achieving the next level in high-performance computing: zettascale, realizing speeds at least 1,000 times faster than Frontier. Their collaboration was made official at the signing of a memorandum of understanding (MOU).

With the latest technological advances in fields such as artificial intelligence, digital healthcare and cybersecurity, the world is placing a greater demand on faster and more powerful computers.

Under the terms of this MOU, RIKEN and Intel Foundry Services will combine RIKEN's research expertise with the industry and manufacturing capabilities of Intel to reach the zettascale goal.



FUGAKU GOES QUANTUM

In the international race to make the world's fastest supercomputer, the winners may be those using quantum physics.

While standard computers use binary digits (0 or 1) to process information, quantum computers use a novel type of computation called quantum bits, or qubits, which allow them to perform calculations in parallel and offer exponentially faster solutions to problems.

To bring quantum computing technology into practical use, Japan's RIKEN research institute has recently announced plans to integrate quantum computing into Fugaku—the world's second fastest supercomputer—in a hybrid model by 2025, as reported by *Nikkei Asia*.

Despite being among the fastest supercomputers ever made, Fugaku's processing speeds cannot match those of quantum computers, which can perform calculations millions of times faster than Fugaku.

However, to remain stable and function without error, existing quantum computers require extreme sub-zero temperatures to operate, thereby reducing their practical utility. According to *Nikkei Asia*, RIKEN intends to overcome these challenges by operating their quantum computer in a separate facility through a communication link with Fugaku.

To explore the practical applications of their hybrid machine, RIKEN has sought collaborations with leading Japanese companies, including Toyota, Hitachi and Sony. Through this joint effort, the applications for this technology could have widespread implications for many sectors of science and technology, including medicine, drug discovery, artificial intelligence, cryptography and more.

TOWARDS 100,000 QUBITS

Despite the impressive performance of quantum computers, they are still relatively new and in the early stages of their evolution. Compared to classical supercomputers, they have a long way to go before reaching their full potential.

This is fundamentally an issue of scalability—increasing qubits while ensuring coherence and minimal error. IBM, a world leader in quantum computing, has set their sights on achieving 100,000 qubits of computation. This would both set an unprecedentedly high bar in quantum computing and prove their potential application in solving real-world problems.

IBM announced in May this year that it will partner with and sponsor The University of Tokyo (UT) and the Chicago Quantum Exchange (CQE)—two high-profile computer research institutes—in a collaborative effort to achieve this milestone over the next decade.

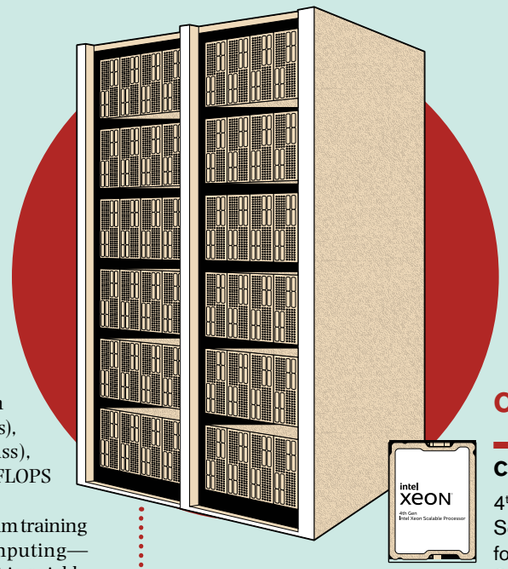
UT will run the demonstrations of quantum algorithms, leading efforts in scalability, and building a supply chain to expedite the integration of new components into larger systems.

Meanwhile, the team at CQE will work on long-range quantum communication studies, leveraging on CQE's 124-mile quantum network.

Through these partnerships, IBM hopes to address some of the key issues in scalability and error correction currently lacking in quantum computing and achieve the goal of a 100,000-qubit supercomputer.

Super Snapshot

BETTER MEMORY FOR BIGGER DATA



Japan's University of Tsukuba has launched their new supercomputer named Pegasus, which is among the first in the world to use 4th Gen Intel Xeon Scalable processors (previously called Sapphire Rapids), Intel Optane persistent memory (called Crow Pass), and NVIDIA H100 Tensor Core GPUs with 51 teraFLOPS of acceleration.

Big data analytics and massive machine algorithm training requires more than just high-performance computing—it needs a way to store the information at scale that is quickly accessible. The upgraded hardware in Pegasus allows 2.7 times faster computer performance and provides twice the memory bandwidth compared to previous models.

"Big data and AI applications are one of the most important research topics we have been focusing on so far, in addition to high-performance computational sciences," said Professor Taisuke Boku, Director of the Center for Computational Sciences, the University of Tsukuba.

"Introducing a new machine with a large-capacity memory system and high-performance AI processing should be our new tool to expand our research field toward excellent data science," he added.

Planned Specifications

System name	Pegasus
Manufacture	NEC
Total performance	> 6.1 petaFLOPS
Number of nodes	120
Interconnects	Full bisection fat-tree network interconnected by the NVIDIA Quantum-2 InfiniBand platform
Parallel file system	7.1PB DDN EXAScaler (40 GB/s throughput)

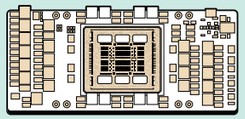
Compute node

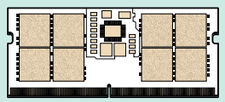
CPU

4th Gen Intel Xeon Scalable processor formerly codenamed Sapphire Rapids (48-core)

GPU

NVIDIA H100 Tensor Core GPU with PCIe Gen5 (51 teraFLOPS in FP64 Tensor Core, 80 GB HBM2E, 2 TB/s)



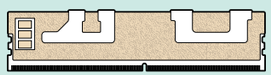


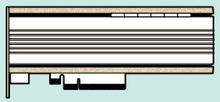
Memory

128 GB DDR5 (282 GB/s)

Persistent memory

Intel Optane persistent memory (codenamed Crow Pass)



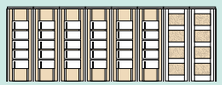


SSD

2 x 3.2 TB NVMe SSD (7 GB/s)

Networking

NVIDIA Quantum-2 InfiniBand platform (200 GB/s)



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