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Computing and Sustainability: How can technology lead us to a better future?

In the information age, pursuing speed and efficiency seems to have become the default setting of humankind and our technology development. People constantly ask how to be better, faster, and stronger, but the question of sustainability is often left neglected. Meanwhile, controlling carbon footprint, reducing energy consumption, a healthy ecosystem, and a social environment that embraces diversity and equality are crucial and fundamental topics that take place slowly and require sustained and persistent effort. If the original goal of technology development was to create a better future, then have we already diverged from the planned route? Can we leverage the abundant knowledge and creativity that we have today to develop new greener technology? And how can we upgrade the existing ones to be more sustainable?

In this issue, we curated a collection of articles ranging from the work of renowned academic researchers to interviews with innovators, showcasing the unlimited possibilities where computing and technology can contribute to a better future. The articles demonstrate the breadth of effort that can be made toward sustainability through comput-

ing, and we hope they will inspire you to come up with your own creative idea to address the great challenge faced by society.

The issue begins with Sara Beery, a Ph.D. candidate in computing and mathematical sciences at Caltech, who introduces the importance of biodiversity monitoring systems in understanding the changes in planet and animal behavior in reaction to human activities. She describes how advances in data collection, data processing, and data management are protecting global biodiversity.

Sustainability also involves our daily life. The Internet of Things (IoT) describes the network of objects and extends computing to our physical environment. While switching to completely new smart home devices incurs cost and waste, Kristin Wil-

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liams, a Ph.D. student at Carnegie Mellon University, together with Prof. Jessica Hammer and Prof. Scott E. Hudson, developed a way to build an upcycled IoT. They introduce the IoT Codex, a book of inexpensive battery-free interactive devices to support customizing everyday objects with software and web services using stickers.

The next group of authors presents a specific case where AI is applied to understand the full cycle of migration birds. Zezhou Cheng, a Ph.D. student at the University of Massachusetts Amherst, and his supervisors Prof. Subhransu Maji and Prof. Daniel Sheldon, dive into their research on detecting communal bird roosts using weather radar and demonstrate the power of AI in detecting broad-scale patterns.

When thinking about

sustainability, renewable energy might be the first idea that comes into our minds. But how efficiently are we using it? Jennifer Switzer, a Ph.D. candidate in the Computer Science and Engineering Department at the University of California San Diego, raises the point that solar and wind availability fluctuates widely, and sometimes the excess amount of energy that is potentially useful is often time discarded instead. Jennifer shares her research on redesigning the computer systems built to work within the limits of renewable energy intermittency. By taking advantage of the flexibility in time and space of computing, she proposes two technical strategies that provide a fundamental shift in the way we consume energy.

Malika Khurana is a master's student at Carnegie Mellon University, as well as a designer and artist whose work details the relationship between humans, technology, and the environment. She shares her vision on how sensing and design can reframe our perception of the natural world and make a lasting impact on our awareness.

Next is our interview with Matthew L. Mauriello, assistant professor and human-

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Association for
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2030 Microsoft pledges to be carbon negative by the end of the decade.

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computer interaction researcher at the University of Delaware. Matthew shares his journey from a young kid who dreams of saving the rainforest to a researcher who inspects building insulation quality and promotes energy literacy by designing in-home energy visualization hardware. What follows is a conversation with Owen McCall from Global TREE Project, a company that created the first digital hardwood asset in the world. Owen gives an overview of the company's mission to drive reforestation in Paraguay. He also explains how cryptocurrency allows for global investment and how blockchain technology can facilitate transparency and security.

We wrap up the issue with a report on the state

of sustainability of virtual conferences. Kristin Williams, Bridget Kane, Chris Clarke, and Kelly Widdicks are the past, current, and future ACM sustainability chairs for UIST, CSCW, and CHI. The ACM research community works on making conferences more sustainable and advocates for global collaboration on addressing climate change. We have the same goal with this issue of XRDS: to raise awareness of sustainability in technology development by presenting research that aims to make positive impacts on Earth, and by sharing insights into where more efforts are needed.

Sustainability has become a global issue to which each one of us can contribute. We firmly believe in the near future, we will not only ask the question of speed and accuracy, but the questions of sustainability; we will not ask the question of if, but how, technology can lead us to a better future.

—Yingfei Wang,
Guest Editor

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Biography

Yingfei Wang is a Ph.D. student in the Quantitative and Computational Biology (QCB) department at the University of Southern California. She is also pursuing a master's degree in computer sciences. She received a bachelor of science in statistics from the University of Hong Kong. Her research work includes applying machine learning and deep learning methods to understand the physical properties of DNA, genome organization, and gene regulation.

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