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Perspectives from the second Global Forum on Development of Computer Science

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Background of global forum. To explore the nature of computer science and promote the development of computer science discipline, Tsinghua University organized the first global forum during the 60th anniversary of Computer Science in Tsinghua. The forum aimed to bring together the heads/deans of the top computer science departments/schools in the world to discuss the fundamentals of computer science, improve the quality of talent cultivation, and promote the development of global computer science discipline. Thirty-seven professors invited from all over the world attended this forum. All of them are or were (associate) department heads or faculty deans of computer science division in their universities. As expected in the forum theme, the experts who participated in the forum had an energetic discussion on what is the nature of computer science and how to promote the development of computer science discipline. After an in-depth discussion, several consensuses were made, including reasonably determining the scale of student cohort in computer science, developing different training programs for academic and technical talents, constructing the core curriculum and encouraging new courses, balancing general education and professional education, promoting the development of interdisciplinary fields, and organizing and maintaining a competitive faculty team.

Structure of the second global forum. Now, three years later, industries and labs across the spectrum are increasingly adopting computer science techniques to improve their businesses or accelerate research. As computer science penetrates ever more industries and research fields, universities are beginning to find themselves faced with a new challenge, that of restructuring programs in order to meet this new interdisciplinary reality. Amid this backdrop, the second Global Forum on Development of Computer Science (GFDCS 2021) took place on September 17, 2021 at Tsinghua University in Beijing, China. Due to worldwide travel restrictions from the ongoing COVID-19 pandemic, the forum adopted a hybrid approach where international attendees participated online while local attendees participated in person. In total, over 4300 participants attended the forum. The theme of the 2021 GFDCS was "Mission and Responsibilities of Computer Science". In particular, the forum aimed to discuss the changing role of computer science departments within universities, the leading trends and directions impacting the future of computer science, and ways to foster creativeness and mastering skills in computer science education. Leaders of computer science departments were invited to give their thoughts on these topics.

The forum was hosted by

- Yuan Chen, vice chairperson of the 12th National Committee of the Chinese People's Political Consultative Conference,
- professor Yang Bin, vice president and provost at Tsinghua University (THU),
- professor Andrew Yao, dean of the Institute for Interdisciplinary Information Sciences at THU, and
- professor Xia Yin, dean of the Department of Computer Science and Technology at Tsinghua University (THU).

Complications from the global pandemic meant that the 2021 forum had to be substantially scaled back compared to the 2018 forum. Three deans of computer science departments were invited to present keynote speeches and to participate in a panel discussion. They were

- professor Daniel Huttenlocher, dean of Schwarzman College of Computing at the Massachusetts Institute of Technology (MIT),
- professor Michael Huth, head of the Department of Computing at Imperial College London, and
- professor Mohan Kankanhalli, dean of the School of Computing at National University of Singapore (NUS).

Additionally, a fourth dean, professor Jun Murai, former dean of Faculty of Environment and Information Studies at Keio University, joined in the panel discussion on "The Role of Computer Science in University Development Strategy", which was moderated by professor Andrew Yao.

Global forum consensus on new missions and responsibilities. After the discussion, some common threads emerged. All the keynote speakers agreed that computer science is becoming more interdisciplinary, meaning that computer science techniques are increasingly being used in state-of-the-art research across a wide variety of research domains

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and across industry. This trend may have started with the emergence of data science within the past decade, but has strengthened particularly in the past few years as machine learning and artificial intelligence techniques become increasingly adopted. As computer science branches out into other areas, computer science departments must pay special attention to four areas in order to keep up with the changes.

(1) Develop research programs that encourage collaboration across departments. Many of the recent advances in various fields such as biology, chemistry, and physics have been made possible by computer science techniques. One example from biology is predicting how proteins fold using artificial intelligence. The breakthrough technique, introduced in the past year, has enabled researchers to predict the entire human proteome and proteomes of other organisms with groundbreaking accuracy. This and other advances are made possible by experts in artificial intelligence working alongside experts in biology. In order to drive more advances in non-computer science fields using the latest computer science techniques, research programs should be designed to facilitate this kind of cross-domain collaboration. Restructuring computer science and engineering departments to support these types of collaborative programs is one approach. Another approach is to develop research centers and institutes targeted at interdisciplinary studies.

(2) Teach interdisciplinary skills alongside computer science fundamentals. To meet the growing demand for researchers and professionals that can work across disciplines, universities may need to adjust their approaches to education. One way to train interdisciplinary professionals is to offer specific cross-discipline majors for undergraduate students. To support these new majors, curricula may need to be revised, for example in order to teach fundamental mathematical concepts from a computational point of view. Introducing project-based coursework where the team members are from different disciplines can also be an option.

(3) Cooperate with industry while maintaining unique strengths of the campus. In the same way that research is being revolutionized by advances in computer science, industry is also undergoing tremendous changes. These advances have made certain industries incredibly lucrative, and some industrial labs today are on par with or even surpass those on university campuses in terms of research quality and resources. To keep university campuses relevant, universities can work together with industry to combine their unique strengths. For example, industry can provide funding to set up research centers and purchase equipment while universities can provide faculty from diverse backgrounds. To keep up with the demand from industry leaders for technical understanding of new techniques, executive education can be provided jointly by the computer science department in addition to the business school. To keep the campus vibrant, special programs can be developed that invite industrial leaders onto campus to interact and work together with faculty.

(4) Train students and faculty to be aware of social responsibilities. The 21st century has been shaped largely by digitization. Computing technology has become ubiquitous in our daily lives, from running financial markets to designing personalized medicines. But just as computing technology has enormous potential to be helpful, it can also be equally harmful. Some examples of the negative side of computing technologies include racial bias in machine learning algorithms and issues surrounding data privacy, especially as massive data stores are being harvested to train artificial intelligence algorithms. To equip students and faculty with awareness of these issues, one approach is to introduce case studies into courses and to design programs that can engage with policy task forces, public forums, and civic groups. Another approach is to introduce entrepreneurship and innovation as core activities within a university next to traditional education, research, and outreach activities. In this way, students can be exposed to some of the social issues that surround technology and its commercialization.

(5) Other issues. Throughout the course of the discussion, a couple of other challenges to the development of computer science were brought up and discussed. These issues are as follows.

(i) How to prepare industrial leaders for the digital age? As the pressure to modernize and join the digitized economy grows, there has been a surge in demand for training from industrial leaders on artificial intelligence, data science, Internet-of-Things, cloud computing, and other topics. How can universities meet this demand? There is an ongoing trial of using the computer science department to offer executive education in these areas as a supplement to the business school. While this arrangement has brought benefits to the department in terms of greater engagement with industry, the experience has shown that most faculty are not interested in carrying out this education. Whether or not this approach is sustainable remains to be seen.

(ii) How to share the experiences from other universities and departments? The massive growth of computer science is a global phenomenon, and the associated challenges are faced by all universities around the world. To overcome these challenges, different universities may try different approaches. However, currently there is no formal system of sharing the results of these experiences with other universities, so universities are mostly left with trial-and-error. How to encourage universities to share their experiences so that other universities do not have to start from scratch is one challenge that remains to be discussed.

Conclusion. Despite complications from the pandemic, the second global forum inspired fruitful and engaging discussion around the development of computer science in today's modern era. The strong trend of computer science becoming more interdisciplinary means that universities must pay special attention to their approach to education and research, managing growing industrial influence, and training the next generation of professionals to be aware of the broader societal impacts of their work. On the other hand, there are questions about how universities can position themselves to meet the demand for technical training from industrial leaders, and how universities can share their experiences and support each other as they navigate through these changes.