Is Culture Computable?

Fei-Yue Wang, *Chinese Academy of Sciences*

Editor: Fei-Yue Wang
Chinese Academy of Sciences
feiyue@ieee.org

Intelligent readers,

I enjoyed reading the articles in this special issue on AI and cultural heritage, thanks to the great efforts of our guest editors. The issue summarizes the state of the art in this area with interesting and successful results. Clearly, AI has played and will continue to play a vital role in preserving, enhancing, and presenting our cultural heritage.

Here I'd like to discuss a related topic: the emerging field of social and cultural computing, which is a natural extension of the research described in this issue. The demand is urgent for effective computing methods to deal with social and cultural problems such as homeland security and the world financial crisis. AI should and must play a key role in addressing these issues.

However, this begs the question, is culture really computable? At this point, I have no definitive answer; it all depends on the answer to the follow-up question, "In what sense?" To a large degree, I believe that if we can solve the problem of reasoning or computing with common sense, then we should be able to conduct cultural or social computing effectively. But "common sense" is currently out of the question because it itself remains one of the most difficult challenges in AI research.

An Emerging Field

Although the answer to the fundamental computability of culture isn't clear, we must forge ahead because we simply can't afford the consequences of avoiding cultural computing now. Over the past three years, our magazine has been leading the effort in promoting this new field by publishing important articles and dedicating a related special issue to this emerging field.

Since last May, *Science* has also published at least four articles directly related to social and cultural computing, and I'm glad to see that some articles are based on research reported earlier in *Intelligent Systems*.

Will those activities bring us hope or hype toward a solid scientific foundation for social and cultural computing? I am hopeful and optimistic, and believe this could be the beginning of a new era in computing that would seamlessly integrate information technology with social sciences in a connected world. Of course, this is far from futurist Ray Kurzweil's "singularity," the point where the functionality of the human brain is quantifiable in terms of technology that we can build (some also claim that, at the singularity, machine intelligence will surpass human intelligence, for good or bad). But I do hope the final success of social and cultural computing will bring us close to statistician I.J. Good's "intelligence explosion." To this end, our R&D for social or cultural computing must incorporate concepts and methods from several other related emerging areas.

Computational Thinking

Computer scientist Jeannette M. Wing, in her "Computational Thinking" (*Comm. ACM*, Mar. 2006, pp. 33–25; www.cs.cmu.edu/afs/cs/usr/wing/www/publications/Wing06.pdf), argued that computational thinking "represents a

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universally applicable attitude and skill set everyone, not just computer scientists, would be eager to learn and use." She also advocated that "to reading, writing, and arithmetic, we should add computational thinking to every child's analytical ability." When this vision becomes reality, then everyone will benefit from a solid discipline of social and cultural computing. This will require a long-term project of tremendous effort, but the concept of computational thinking could bring instant help and long-term benefits to research and education regarding social and cultural computing.

With computational thinking, descriptive hypotheses and processes in social sciences and cultural studies can be reformulated into computational procedures for quantitative analysis. Furthermore, various derivatives of "social laws," such as Robert Merton's self-fulfilling prophecy, might serve as governing laws for social dynamic systems, similar to governing laws for natural or physical processes such as Newton's laws. For example, in social-technological areas, Moore's law has been quite helpful in facilitating business planning and product development for semiconductor-related industries. Other eponymous laws, such as Metcalfe's, Reed's, and Sarnoff's laws on the dynamics and values of a networked world, might also prove valuable for social computing and cultural modeling.

Cultural and Social Learning

Computationally or philosophically, we can't just think; we need real actions. Many approaches have been proposed so far, from my mechanism based on ACP (*a*rtificial societies for modeling, *c*omputational experiments for analysis, and *p*arallel execution for control), to decision support and decision making through parallel execution, to the cultural reasoning architecture for sociocultural analysis. However, we still haven't fully and systematically investigated machine learning and data mining techniques for social and cultural computing.

For more than a decade, machine learning has transformed statistics. Statistics departments commonly hire computer scientists, and computer science departments commonly embrace statistics programs. Machine learning's success in statistical learning suggests that social learning and cultural learning are also promising directions for social computing and cultural modeling. After all, statistics is the most important tool of modeling and analysis in the social sciences and cultural studies. With machine learning, we can proceed in a unified fashion toward the analysis of social and cultural issues, from individual conditions and behaviors, to social activities and processes, to organizational states and behaviors. That is, we can proceed from individual clustering to social stratification, and eventually to various functionalities of social organizations. Social and cultural learning would be even more powerful if it were combined with or embedded in the construction of artificial societies.

A few years ago, I discussed with some of our editorial board members the choice between social computing and social learning for a special issue, and we ended up with a social-computing issue in 2007. I'm glad to inform you that, to continue that effort, we've scheduled another special issue on social and cultural learning in 2010.

Computational Culture

To me, culture is embodied in how people interact with other individuals and with their environment. Therefore, it's a way of life formed under specific historical, natural, and social conditions. Culture isn't and won't be a science, no matter what we accomplish with social and cultural computing. However, with the accelerated advancement of IT technology, we might arrive at an age of computational cultures in the near future, where digital natives with computational thinking are ordinary citizens. In many aspects, we've already witnessed new computer-based lifestyles and their impact on our society during the past decade.

The establishment of a computational culture depends on the spread of computational thinking throughout every fabric of our society. I believe, as Wing pointed out, that just as the printing press facilitated the spread of the three "Rs," computing and computers will greatly facilitate the spread of computational thinking. As we enter a truly connected world, the speed and scale of this spreading process can be greatly enhanced through new developments in and the effective application of social and cultural computing techniques.

In many ways, we'll be forced to enter the age of computational culture because survivability and sustainability might otherwise be at risk, owing to the unprecedented speed and scale of social changes caused by new scientific and technological developments. From the Semantic Web to Web science to our last special issue on semantic scientific knowledge integration, *IS* has significantly contributed to promoting new research, development, and applications in this new digital age, and we'll continue to be a leading force in this endeavor.

Back to my original question: Is culture computable? My answer for now is, let's focus on the current tasks and potential consequences of social and cultural computing. ■