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What Do We Do When the Jobs Are Gone, and Why We Must Embrace Active Learning

Moshe Y. Vardi ponders the outlook for people when all work is automated, while Mark Guzdial emphasizes the importance of Active Learning in teaching computer science.

Moshe Y. Vardi
**"The Future of Work:
But What Will
Humans Do?"**

<http://bit.ly/1geYbLj>
September 11, 2015

While artificial intelligence has proved much more difficult than some early pioneers believed, its progress has been nothing short of inexorable. In 2004, economists argued that driving was unlikely to be automated in the near future. A year later, a Stanford autonomous vehicle won a DARPA Grand Challenge by driving over 100 miles along an unrehearsed desert trail. A decade later, one hears regularly about the exploits of the Google driverless car. I believe that in 30 years it will be quaint, perhaps even illegal, for humans to drive on public roads.

Once driving is automated, delivery will be quick to follow; companies such as Amazon are already working hard

on fully automating their whole supply chain. The list of jobs likely to be automated grows daily, as AI increases its cognitive ability (it won at chess in 1999 and "Jeopardy!" in 2011), and its situational awareness and physical dexterity.

The unstoppable march of AI suggests that Herbert Simon was probably right when he wrote in 1956 that "machines will be capable ... of doing any work a man can do." I do not expect this to happen soon, but I do believe that by 2045 machines will be able to do much of the work that humans can do. So the question is: If machines can do almost any work humans can, what will humans do?

A typical answer is that if machines will do all our work, we will be free to pursue leisure activities. Of course, our economic system would have to undergo a radical restructuring to enable billions of people to live lives of leisure. One can imagine perhaps a society of a small number of haves and a

large number of have-nots, supported, say, by government subsidies. This is reminiscent of "panem et circenses," the Roman practice of free bread and entertainment to the masses. Yet I do not find this a promising future, as I do not find the prospect of leisure-only life appealing. I believe work is essential to human well-being. Is this our future?

It is instructive to recall the biblical story of the Garden of Eden in the book of Genesis (Chapters 2 and 3). God places Adam and Eve in the Garden and tells them: "But of the tree of the knowledge of good and evil, thou shalt not eat of it." The Serpent then tempts Eve, who, in turn, tempts Adam, to eat from the Tree of Knowledge. This leads to the expulsion of Adam and Eve from Eden. Furthermore, God metes punishment on the Serpent, Eve, and Adam: "And unto Adam he said, 'cursed is the ground for thy sake; in sorrow shalt

thou eat of it all the days of thy life; in the sweat of thy face shalt thou eat bread’.” So, according to this biblical story, our need to work for a living is an outcome of the failure of humanity to follow the word of God.

But let us contemplate humanity before and after the expulsion. Before the expulsion, Adam and Eve spent their time frolicking naked in the garden, where food is amply available without work; one could say they were no better than apes. One could even see the story as a metaphor for the roots of humanity in pre-human primates. After the expulsion, humans had to work for a living, but they have eaten from the fruit of the Tree of Knowledge. They were inventive. They have learned to hunt, mastered fire, invented agriculture, and eventually launched the Industrial Revolution. We are about to launch another Industrial Revolution, where work will be almost fully automated.

In a sense, humans used the knowledge they gained from the Forbidden Fruit to overcome God’s punishment; they will no longer need to work for a living; no more “by the sweat of thy face.” But can humanity go back to the Garden of Eden? Will we be happy just frolicking? Furthermore, human progress has been driven to a large extent by our desire to eliminate work or, at least, to lighten the toil. What will drive humanity once that goal has by and large been accomplished?

Thus, even if we manage to solve the economic implications of the complete or almost-complete automation of work, the question of the consequences to quality of life remains wide open. The classical Greek philosophers, starting with Socrates, discussed “Eudaimonia,” often translated as “the good life”—in other words, human flourishing. Aristotle viewed this question as one of the most central in philosophy. So the question facing us today is whether we can achieve the good life without work.

I believe the question of how humanity will occupy itself in the presence of intelligent machinery is one of the most central challenges facing society today. To repeat my earlier question: If machines are capable of almost any work humans can do, what will humans do?

Mark Guzdial “Be It Resolved: Teaching Statements Must Embrace Active Learning and Eschew Lecture”

<http://bit.ly/1RkVbuC>

August 14, 2015

In 1964, the U.S. Surgeon General produced a report unequivocally stating that smoking was a health hazard. The report had a dramatic impact on public policy and how people viewed smoking. Fifty years later, we know that the impact of that report was to save thousands and maybe millions of lives (see 50-year retrospective report at <http://1.usa.gov/1RkVyoM>).

We are at a similar point in understanding that lecture is an ineffective way of teaching. Active learning methods lead to better learning and greater retention. More, there is increasing evidence that poor teaching disproportionately impacts students from disadvantaged and under-represented groups.

Last year, the *Proceedings of the National Academy of Science* published a meta-analysis of 225 studies (<http://bit.ly/1Lovtqb>). The conclusion appeared as the title of the paper, *Active learning increases student performance in science, engineering, and mathematics*. There is increasing evidence that improved teaching reduces the achievement gap between disadvantaged and more advantaged students, for example, in biology (<http://bit.ly/1j5Kp06>) and in computer science (see new paper from ICER 2015 at <http://dl.acm.org/citation.cfm?doid=2787622.2787728>).

Now, *Nature* has just published a paper (<http://bit.ly/1Od6G8U>), “Why we are teaching science wrong, and how to make it right,” which includes the quote, “At this point it is unethical to teach any other way.” *Wired* magazine’s article on the active learning papers (<http://wrd.cm/1VvLAXa>) makes the connection more explicit: “The impact of these data should be like the Surgeon General’s report on ‘Smoking and Health’ in 1964—they should put to rest any debate about whether active learning is more effective than lecturing.”

It is now a matter of science, not opinion. *Active learning methods are more effective than lecturing*. We should encourage use of active learning methods in our classrooms. The blog post at <http://bit.ly/1MOMMxO> connects to resources for improved teaching methods in computer science. There are active learning methods that we can use even in large classes, like Peer Instruction (see PeerInstruction4CS.org).

Here is something concrete that we in academia can do. We can change the way we select teachers for computer science and how we reward faculty.

All teaching statements for faculty hiring, promotion, and tenure should include a description of how the candidate uses active learning methods and explicitly reduces lecture.

We create the incentive to teach better. We might simply add a phrase to our job ads and promotion and tenure policies like, “Teaching statements will be more valued that describe how the candidate uses active learning methods and seeks to reduce lecture.” We should read these critically. We should be convinced the candidates are not just mouthing active learning rhetoric, but are actually investigating and using active learning methods.

It is a small step, but it is an important one. Incentives change behavior. Stating clearly what we value in teaching statements will send messages that change how CS faculty teach over time. This step will likely have a critical impact on how we teach and who succeeds in computing.

I do not know if any other STEM disciplines are changing how they evaluate teaching statements in response to the *Nature* and *PNAS* papers. Let us lead. Let us be first. In 50 years, we might be looking back to find that our response to these reports brought more and more diverse students to computing. **C**

Moshe Y. Vardi is the Karen Ostrum George Distinguished Professor of Computational Engineering at Rice University, and editor-in-chief of *Communications*.
Mark Guzdial is a professor in the College of Computing at the Georgia Institute of Technology.