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"Our Automated Future"

By Michael Lee

Surprising as this may sound, nature is full of automatic processes, as will shortly be shown. And computers and mechanical devices are automating social processes on an ever-increasing scale, from assembly lines and the new 3-D printers to self-service devices like ATMs, kiosks and vending machines, from robots to computerized flight programs. As you read this, you may receive a pop up meeting reminder on your Outlook system or perhaps a message texted on your mobile phone indicating it's time to submit your tax returns. That's the efficiency of automation.

In addition, there's the growing phenomenon of biomimicry, or designs imitating nature, with engineers, architects and designers developing an array of products originally inspired by nature's long-evolved efficiencies which can be observed, modelled on computer programs and then reproduced. Given the extent of automation in nature, discussed below, the economic efficiencies gained by computerization and mechanization and the virtually infinite potential of computers to model and reproduce phenomenal designs in nature, the conclusion is becoming inescapable that our future will be more profoundly automated than we could have imagined.

Automation means "running by itself" from the Greek word *automatos*, "acting of itself", with *auto* meaning "self".[1] The idea behind it is for technology to run a process so efficiently it requires little, or zero, direct human control.

Nature itself is largely programmed. Consider the zygote, the starting-point of a human life. It's a single cell created when a mother's egg is fertilized. Despite being miniscule, it contains all the genetic information – the genome - needed to form a new person. That is, its historically unique pattern of chromosomes will determine the genetic characteristics of each individual.

[1] Pearsall, J, ed. 1998. *The New Oxford Dictionary of English*. Oxford: Oxford University Press. 114.

About 30 hours after being conceived, the zygote, containing this DNA blueprint, begins the self-replicating cell division process called mitosis. The growth of a human being in all its complexity is underway, and all according to a built-in plan ingrained in the zygote. At conception, then, each person's future growth is contained inside a code compacted into a cell so tiny it can only be measured on a micrometre scale. For me, this is a wondrous fact of nature.

Despite this vital role in creating a human, the zygote is not conscious during its operations and activities. Nevertheless, intelligence is clearly at work since the cell processes a significant amount of information regarding which steps and actions to take in the right sequence at the right times. For that reason some have called the nucleus of the zygote an information center. For it stores its own instruction manual, nothing less than a program for producing a person. It's as if nature has mass-produced zygote nano-computers loaded with chromosome software. The fact that DNA, a key defining feature of life, is a code says something fundamental about the way existence has been made.

It's also intriguing that the individual's genome inside the zygote, a kind of chromosome source code, seems to switch on and work automatically. Like a computer program, it contains instructions or rules which control a process of execution. To produce a human being, it's estimated there must be millions of rules involved.[2]

The story of how the zygote works shows that much of human life is biologically pre-determined. As we have seen, the future adult is contained within a code inside a single cell. And its evolution is automatic. Other humans have minimal control or influence over the processes of its development. The individual's future is slowly unlocked according to instructions of a conception blueprint.

It's not just the genome in our DNA-packed zygote which determined who we would become, eventually made up from approximately 40,000 genes.[3] We don't get to choose our parents or the genealogy they bring with them in the history stored in *their* genes. Neither do we choose our place and time of birth. Similarly, we choose neither our siblings nor how we are brought up and educated. In short, I did not choose to be me. Nor did you choose to be you. Our conception, birth and growth were automatic processes.

The question, therefore, is not so much, what distinguishes humans from animals, but what unique human features really distinguish us from robots?

[2] Wolfram, S. 2002. A New Kind of Science. Champaign, IL: Wolfram Media, Inc. 383.
[3] Wolfram(2002):1002.

And far from being an exceptional occurrence, the way in which each human blueprint runs its program for the creation of a new individual is typical of a whole range of automated processes operated by nature's invisible software. It seems science is on a journey to discover a cosmic instruction manual. And the invention of computerization has greatly accelerated the pace of that discovery.

For example, scientist and creator of Mathematica[4], Stephen Wolfram, in his monumental *A New Kind of Science* (2002), argues that we live in a digital, mathematical universe which works on the basis of simple and universal computational programs which are able to produce very complex natural systems. He describes in plain language how "our universe is in essence just a simple program" with "a single, simple, underlying rule".[5] In his theory of simple programs, there's an upper limit, or ceiling, to complexity and to computational sophistication.[6]

Wolfram urges us to think in terms of simple programs to understand how nature works: "...just as the rules for any system can be viewed as corresponding to a program, so also its behaviour can be viewed as corresponding to a computation….all processes, whether they are produced by human effort or occur spontaneously in nature, can be viewed as computations…set up specifically to perform particular tasks."[7] Computations calculate according to rules or instructions for set tasks and functions. In Wolfram's worldview, a simple universal order underlies all of nature's complex design. Nature has a rule-book. And its archetypal designs are programmed: "the basic mechanisms responsible for many processes in nature can be captured by simple computer programs based on simple rules." [8] In short, there is a simple program running the world.

Nevertheless, there's an important caveat in the theory that it's still very difficult to work out from an underlying rule what behaviour it will produce.

According to Wolfram, then, simplicity is much more fundamental than complexity. For example, he shows that determining the huge variety of shapes of trees and leaves is a straightforward branching process during growth. Alexander von Humboldt identified 19 types of this underlying branching phenomenon in 1808.[9] Likewise, a few basic patterns underlie the diversity of appearances of animals. There is substantial uniformity across nature. And the processes underlying it are automated and intelligent.

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[4] Mathematica is described in Wikipedia as a computational software program used in scientific, engineering, and mathematical fields and other areas of technical computing. http://en.wikipedia.org/wiki/Mathematica
[5] Wolfram (2002): 471.
[6] Wolfram (2002), 720-721.
[7] Wolfram, S. 2002. *A New Kind of Science*. Champaign, IL: Wolfram Media, Inc. 5.
[8] Wolfram (2002): 547.
[9] Wolfram (2002):1004.

Furthermore, everything that happens in the world operates like the execution of an underlying program and its rules, just as the zygote's program unfolds in the growth of an individual according to its blueprint. Amassing a vast amount of evidence from behavior of computer programs and natural systems, including biological ones, Wolfram has developed a doctrine of a self-organizing "all is computation" universe. He has revealed great similarities between mathematics and nature, and between human thinking and processes in nature. What this all indicates is an intelligent universe in which the laws of physics show "computational sophistication".[10]

Professor of Applied Mathematics at Cornell University, Steven Strogatz, has recently exemplified the prevalence of automatic cycles in nature. Whereas Wolfram demonstrates that natural processes automatically execute simple, programmed rules on a universal scale, Strogatz (2003) explains how a variety of phenomena act in collective harmony, or synch, in what he calls nature's spontaneous order. He states that the new study of synchrony has identified oscillators, defined as entities that cycle automatically, repeating themselves at regular time intervals,[11] as the driving force behind collective harmony seen in such commonplace phenomena as crickets chirping in unison, schools of fish swimming together, flights of birds and even orbits of planets influenced by each other's gravity.

He has studied synchronized behaviour of living or organic oscillators, including cells, as well as inanimate oscillators such as planets, pendulums and electrons. At the cosmic level, think of pulsars, rotating neutron stars, which emit highly repetitive radio signals.[12] They're like clocks keeping excellent time in outer space.

Fireflies flashing in unison without any orchestration indicate the insects have internal clocks in the neurons of their minute brains: "In a congregation of flashing fireflies, every one is continually sending and receiving signals, shifting the rhythms of others and being shifted by them in turn...sync somehow emerges spontaneously."[13] Each insect in the group has an oscillator which vibrates and acts together with oscillators of the other fireflies.

[10] Wolfram (2002): 1191-2.
[11] Strogatz, S. 2003. Sync: the emerging science of spontaneous order. London: Penguin. 3.
[12] Wolfram (2002):1188.
[13] Strogatz (2003):13.

For Strogatz, this kind of pattern of unconscious collaboration through oscillation is widespread at both atomic and macroscopic scales: "…the tendency to synchronize is one of the most pervasive drives in the universe, extending from atoms to animals, from people to planets."[14] The human heart, for example, has its own oscillator – roughly 10,000 cells responsible for generating the electric rhythm behind a typical lifetime of three billion heartbeats.[15] The brain, too, has oscillators which are responsible for the so-called circadian rhythm, or 24 hour biological clock, which is "the internal chronometer that keeps us in sync with the world around us."[16] Even though the brain is reputed to be the most complex phenomenon ever discovered, with about 100 billion neurons, operating electrically, each with an average of thousands of synapses connected to other cells, it's organized into definite areas having specific functions, all working together in one effective system.[17] On a human social level, there is even the well-observed phenomenon of menstrual synchrony among women living closely together which shows yet again how regular cycles in nature can influence one another through some sort of integrating chemical exchange. These synchronizations happen beyond the conscious level and work automatically. They are built into cycles of life.

Driving these recurrences of oscillators, or clock-like cycles in nature, is the mathematics of self-organization, the "spontaneous emergence of order out of chaos."[18]

Strogatz's universal oscillators unveil an essentially mechanical world pulsing behind the richly diverse and beautiful surfaces of nature.

Although the universe itself is not a Newtonian clock, but a dynamic Einsteinian space-time, it is nevertheless filled with clocks: biological clocks, including the circadian clock, planetary clocks, atomic clocks and a multitude of inanimate clocks. Their purpose is to create order, to give the universe a regular rhythm, a gigantic, automatic pulse.

According to contemporary scientists like Wolfram and Strogatz, then, processes seem set up to run automatically according to the instruction manual of nature. There is spontaneous order as well as automatic programming of processes right across the cosmos.

And, in the ultimate mimicry of nature, the computer is harnessing and distributing automatic processes throughout society in a technology revolution.

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[14] Strogatz (2003):14.
[15] Strogatz (2003):15.
[16] Strogatz (2003):69. The synchrony behind the circadian rhythm occurs on three levels, according to Strogatz, (i) cells within an organ are synchronized; (ii) organs are synchronized within the body, and (iii) the body itself synchronizes to the world and its 24 hour cycle (Strogatz: 72). There is, it seems, a circadian code and a circadian clock.
[17] Wolfram (2002):1098.
[18] Strogatz (2003):14.

That's why I forecast a strong and continuous rise in automation throughout the century and beyond.

There are socio-economic implications to consider regarding this automation revolution. Since it's inevitable that there'll be exponential automation in years to come, employment in the formal economy may continue to decline quite sharply. Efficiencies have always driven human survival and it's simply impossible for individuals in the long-run to compete against the efficiencies of computers and machines. I cannot compete against an automated process.

In a highly populated world, which has been discovering in recent decades with a brutal clarity the limits of natural resources and the critical importance of the environment, the increasing automation of social processes in the 21st century conjures up the spectre of mass, endemic unemployment and under-employment.

Consequently, attention of social scientists and policymakers must shift to sectors outside the formal economy. Neither governments nor private companies can save us from the curse of mass worldwide unemployment that is already apparent. Fortunately, they're not the only economic entities. There are other economic systems. Nor can globalization save us because that process is more likely to increase unemployment due to its underlying driver of efficiency in a hyper-competitive system. But there are alternatives to globalization.

I am referring to a new future era of localization – the search for sustainable local communities harnessing their surrounding renewable energy sources. I am also speaking of the growing informal sector, as well as the NGO and voluntary sectors. In the same way that during the Dark Ages, faith-based communities tried to live simply and grow their own food and be self-sufficient, I am predicting in the long-run increases in faith communities like the Amish, along with a proliferation of NGOs, voluntary workers, denominations, cults and environmental groups, all embracing localization as we struggle to adapt an over-populated world to its automated future.

Unfolding in this scenario I foresee a three-tiered and divided society. There would be a top layer comprising the fully automated globally integrated world of the cosmopolitan elite. Let's call them the upper urban formal class. Then there would be an in-between, secondary urban layer ranging from middle-class to lower middle-class groups providing services to the elite and bolstering civil society as it shifts more and more to the values and systems of localization. And finally there would be a third level made up of infinite constellations of localized communities and groups, ranging from urban slums to highly self-organized and harmonious groups like the Amish, all effectively disengaged from the formal sector. Let's call them informal kinships.

As we move into an automated future, let us do so knowingly, so as to pre-empt these social divisions from becoming conflictual or endemically hostile.

Conclusion

As the example of the zygote shows, automation is rife in nature. Wolfram (2002) has shown just how extensively nature is programmed. Increasingly, automation is part of social life, too. But my hunch is that human creativity, which ultimately distinguishes us from robots, will enable us to find fair ways to steer Spaceship Earth into a humanized and automated future.

Michael Lee's book *Knowing our Future – the startling case for futurology* is available at the publisher http://www.infideas.com/pages/store/products/ec_view.asp?PID=1804 or on Amazon.com.

Acknowledgments and websites

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http://www.wolfram.com/
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