

The Future of Technology

Logan Leger

Living in a society in which modernity is defined by the exponential progress of the human race, it's easy to lose sight of the future. Our race is experiencing a phenomenon: an unprecedented amount of information is literally at our fingertips, thanks to the introduction of that "super information highway" called the internet. Websites such as Wikipedia make available virtually everything about anything¹ and search engines such as Google make this immense web of information easily accessible with indices of billions and billions of webpages². This access to all information is utterly unique to our generation. Consider that the great fire at the Library of Alexandria over which historians are still heartbroken to this day consumed only about one DVD (or 4.7GB) worth of data.³ Today, the scientific community has seemingly solved or at least considered every empirical problem and is constantly making new discoveries that will drive humanity forward. All of this will, inexorably, be totally eclipsed by what the future holds. What will become of the human race in 20 years? Will we live as the Jetsons in the famous 1960's eponymously titled cartoon? Flying cars, robots, cures to cancer or the pandemic of AIDS, or a truly connected living experience, as predicted by Bill Gates,⁴ might be a few of the momentous inventions of the coming age. However, the most salient of all these inventions, some of which will,

¹ Wikipedia currently has about 2.25 million articles, more than any other encyclopedia in print and is growing daily. "Size of Wikipedia." Wikipedia. 2008. WikiMedia Foundation. <http://en.wikipedia.org/wiki/Wikipedia:Size_of_Wikipedia>.

² The last official number of the Google index was published in 2004 and put it somewhere around 8 billion pages. "Google Milestones." Corporate Information. Google Inc. <<http://www.google.com/corporate/history.html#2004>>. Estimates as of 2006 put the index somewhere around 25.5 billion pages and growing daily. Lenssen, Philipp. "Increased Google Index Size?." Google Blogoscoped. 29 Jan 2006. Blogoscoped. 9 Apr 2008 <<http://blogoscoped.com/archive/2006-01-29-n14.html>>.

³ This is a rough estimate proposed by many professionals. The actual number, however, is indiscernible because while we may know what was in the Great Library, we don't know how much was in it.

⁴ Gates, Bill, *et al.* The Road Ahead. Revised Ed. New York: Penguin Books, 1996.

inevitably, transcend the current realm of knowledge, is the advent of true artificial intelligence. Don't misunderstand, modern artificial intelligence is not true artificial intelligence — that is, the program cannot think according to the Turing definition.⁵ True artificial intelligence will change the world even more dramatically than the introduction of the internet and when this occurs, the human race will incontrovertibly enter into the "Age of Artificial Intelligence."

Logical progression, however, dictates that before something as profound as Artificial Intelligence is invented, general society must have at least a superficial understanding of the invention. Society's current understanding is limited and often marred by misleading representations by modern science fiction. Writers, however, aren't entirely to blame. These misrepresentations are the product of both their creativity and their ignorance of the subject, which reflects a pervasive social unawareness. For example, Issac Asimov's 1950 novel *I, Robot*, popularized by the 2004 film starring Will Smith, villainizes artificial intelligence on a draconian level. The entire plot line, as will be demonstrated later, is totally implausible. Not all of representations in the media, however, are ineffectual. As time goes on, society's current understanding of the technology and future iterations increases and so media depictions become more accurate. For example, the *Halo* video game trilogy released in 2001 by Microsoft game studio Bungie has probably one of the most believable delineations of AI in modern media. Studying a video game, however, isn't the best means of understanding a mostly theoretical technology. Therefore, it benefits society

⁵ "Turing Test." Wikipedia. 2008. Wikimedia Foundation. <http://en.wikipedia.org/wiki/Turing_test>.

to set aside the postulations of the media and to come into an original and valid understanding of artificial intelligence.

An easy, non-technical way of understanding artificial intelligence is to look at quantifications and potential applications. Because neither true AI nor the market for it exists yet, this is highly speculative and should only be taken as potentialities, not inevitabilities. Ideally, true AI will be hosted on a handheld device that is powerful enough to run the complex computer program. The host device should be so compact that users will have personal AIs, less complex, of course, than larger AIs illustrated below, in their pockets, smaller, even, than modern cell phones, yet powerful enough that they could calculate the quadrillionth digit of pi in just a few nanoseconds, a feat that was completed by a modern supercomputer over the course of two years⁶. Don't misunderstand; true AI will be vastly different from anything we know today but ultimately it still is a computer program running on a computer. It should, be able to operate alone without any input from a third party as illustrated by the many AI tests, including the Turing Test. True, current programming includes automation of miniscule tasks such as auto-correction in a word processing document or auto-fuel injection in a car, but this is coded to make predetermined decisions based on a variety of given situations with data received from a number of sensors, and is consequently not true AI. In contrast, true AI, will actually be able to think for itself, making decisions on its own based upon what it perceives as the most logical choice in a situation; computers, after all, are purely logical machines. Hand in hand with cognitive ability is adaptation. True AI will be a dynamic program and as such will adapt to its situation by altering its code

⁶ "Pi." Wikipedia. 2008. Wikimedia Foundation. <<http://en.wikipedia.org/wiki/Pi>>.

to better serve its current situation. Essentially, it will be cognitive, possessing the ability to learn. It will think and reason like a human, employing infallible logic to make rational decisions that lie within a hard-wired code of morals and ethics. It will act like a human, utilizing the most comprehensive lexicon ever compiled. This will allow it to hurdle both language and generation barriers because the lexicon will contain not only every language on earth but also any related slang terms, metaphors, and idioms. The cognition of an AI and that of a human, however, are radically different. There is a major disparity between the two because AIs have a near unlimited potential, with instant access to all knowledge via the internet. Their knowledge, therefore, will increase at a rate equal to the sum of all current knowledge and all future knowledge, which it would absorb instantly. Since this computer is independent from a third party and is also devoid of any input device so, how will humans interface with this new technology? True AIs will be programmed to act like humans, given distinct voices, mannerisms and personalities. A digital representation of the AI would also help bridge the human-computer interaction gap. Add a display technology, most likely some form of yet to be developed holographic display, and the AI would be even more realistic, nearly human like.

The next step in understanding AI is to develop potential applications for the technology. It would affect every area of humanity, enhancing governments, commercial enterprises, and residential life. The key to understanding these applications is to remember that AI is still essentially a computer and thus can perform calculations and make decisions at a rate exponentially greater than any human, if a human could perform the calculation at all. Consequently, government agencies and

bureaucracies would benefit tremendously such as the massive Metropolitan Transport Authority in New York City, which manages all transportation to and from as well as within New York City and its suburbs. The entire system, which manages the subways and buses, employs somewhere around 68,000 people.⁷ Every single miniscule and monotonous task these employees perform operating the system daily could be done easily by an AI. Running a subway from one place to another or driving a bus even in the midst of heavy traffic is nowhere near the total processing capacity of an AI. It could easily supplant the entire work force, making the MTA a more efficient bureaucracy. Furthermore, it could automate the other staple of city transportation—taxi cabs. If an AI were to control a vehicle, a feat possible with the future invention of autonomous vehicles, enforcing limits for precautionary reasons would no longer be of concern; safe driving speeds, for example, would increase precipitously simply because the nature of AI dictates perfection. Imagine the efficiency of inter-city transportation if the entire system were controlled by a single AI. Because computers are perfectly logical machines, a situation such as another 9/11-type attack would be handled considerably better. The system would adapt instantly to the sudden disaster, rerouting all resources to evacuate the greatest amount of people safely and effectively. Given that other city infrastructures, life supporting (such as water or electricity) and otherwise (such as traffic control or garbage collection) would also be run by an AI, this could happen in minutes by shutting down the entire grid and devoting all resources to moving people. The sheer magnitude of the loss of life that could be averted if a similar situation should again occur is staggering. Imagine another Hurricane Katrina. If the entire city were

⁷ "The MTA Network." MTA. Metropolitan Transportation Authority. <<http://www.mta.info/mta/network.htm>>.

run by a single AI, which is more than possible given a powerful host machine, the nightmare arising in the aftermath of that unparalleled natural disaster could be easily prevented. The large exodus during the evacuation would be more efficiently handled by an AI than by even the best officials. Additionally, the AI would make infinitely better decisions in a fraction of a second because of both the power and purely logical nature of its processing core.

AI would also have radical consequences in commercial industries. In fact, the creation of true AI will likely result from the potential impact of such a technology on large international corporations; the promise of higher profits coming from higher efficiency and lower costs. The most accessible illustration is the impact on modern manufacturing. Since Henry Ford introduced the assembly line in 1908,⁸ it has been the staple of modern manufacturing. Even after 100 years, Ford's system of mass production remains the most efficient. Imagine, however, if we could make it more efficient. If an assembly plant introduced an AI, there would be no need for the extensive labor system needed to support an assembly line. The system would instantly become more efficient because there would never be any mistakes, it would run constantly and all labor expenditures would be eliminated. The potential savings could save American car manufacturers billions and save companies like Ford from their multi-billion dollar debt.⁹ Consequently, entire country economies would benefit tremendously from the positive impact on corporate finances. Even if all the other

⁸ "Assembly Line." Wikipedia. 2008. Wikimedia Foundation. <http://en.wikipedia.org/wiki/Assembly_line>.

⁹ "Financial Statements for Ford Motor Company." [Google Finance](http://finance.google.com/finance?fstype=ca&q=F). Google Inc. <<http://finance.google.com/finance?fstype=ca&q=F>>.

benefits didn't exist, the resulting economic prosperity should be enough of a reason to pursue this technology.

Another consequential industry to speculate with is research. A true AI would be a tremendous asset in both commercial and academic research and development labs. Imagine if a research doctor who was working on a cure for AIDS or cancer used an infallible AI instead of a team of fallible human research assistants. He could delegate tasks that are exponentially harder than anything a human could complete and receive results in a fraction of the time. Moreover, the load with which an AI could bear is much higher than anything a human could handle. Imagine modeling and calculations that could take a research assistant hours or more to complete delivered by an AI in seconds with higher accuracy and more depth. Moreover, because the AI could be directly integrated into the laboratory machinery the efficiency of routine lab tests would increase tremendously. Because of the dramatic increase in research efficiency, solutions could arise in mere years instead of decades or centuries. Imagine life in a world where no disease was incurable and the cure was affordable? How greatly would this increase the quality of life? If all other speculations presented here never come to fruition, the promise of both longevity and conservation of human life is important enough to make the advent of AI the most consequential of the 21st century.

The aforementioned speculations are macro but they are not the only areas where AI will have a significant impact. There are applications that strike closer to home. What if all household chores were taken care of? What if you never had to worry whether or not you turned off the stove? An AI could easily handle all administration

and other aspects of family life for an entire household, no matter how big. Imagine never forgetting an appointment or other engagement. What if all appointments were scheduled for you? And with the invention of autonomous vehicles, the AI could drive the family to the destination using GPS navigation with much shorter traveling times because, again, AIs are perfect and mistakes are impossible. This delegation within the home could have social impacts such as lower divorce rates by making happier, stress-free marriages or supplementing the educational system by making sure kids understand their homework. Overall higher jocularity within the home combined with greater productivity, will be another factor in the push for true AI.

This paper has thus far been speculative but this is not the entire purpose. Now that possibilities have been developed, the framework needs to be laid. Certain implausibilities as well as the means by which this could be possible need to be developed. The core power of AI will come from quantum computing, a contemporary development and a product of the quantum physics discovery. Computers operate in a binary world where everything is a *bit*, or either a 1 or 0. Unlike the ordinary computing world, however, a quantum bit—or, *qubit*—can either be a 1 or 0 or a quantum superposition of the two all at the same time, essentially allowing an infinite number of states. A quantum computer, syllogistically, operates on the manipulation of these *qubits*. This will unlock the power of computing because it will allow a computer to try every possible combination at the same time. It is said that if a quantum computer is unable to determine an answer after a large number of combinations, that problem should be believed to be impossible. A good illustration of the power of quantum computing is modern cryptography, which is based on the fact that factoring large

numbers is harder than multiplying them together. A quantum computer, however, could easily solve this problem in an exponentially shorter time span. In the 2007 blockbuster, *Transformers*, the evil Decepticons used quantum computing to break the US Army's uber-secure data transmissions. By comparison, the movie claims that it would take any modern super computer 22 years.¹⁰ Given the complexity of the deciphering needed to break such a secure transmission, much less one with the encryption used by the US Army, that figure is entirely believable. While quantum computing hasn't been proven impossible, it has yet to be proven possible and is now nothing more than a theory. More than likely, quantum computing will come to fruition because it is an extension of quantum mechanics, and therefore if it proves to be impossible the entire theory of quantum mechanics will then either be impossible or incomplete. Scott Aaronson's asserts in his March 2008 article in *Scientific America*, titled *The Limits of Quantum Computing*, that:

Though many other questions about the power of quantum computers remain, by now a tentative picture has emerged. By exploiting the bizarre phenomenon of interference, a quantum computer really could achieve dramatic speedups for a few problems, like factoring integers. But for the problems that really excite the imagination—like searching for mathematical proofs or programs that predict the stock market—even a quantum computer would quickly run up against the wall of intractability. If that wall can ever be breached, it seems like we'll need an entirely new type of computer—one that would make quantum computers look pedestrian by comparison.

Aaronson, however, doesn't take into account the utilization of such a fantastic technology as the logical core, essentially the brain, of an artificially intelligent machine. Quantum computing combined with artificial intelligence turns into Quantum Artificial

¹⁰ "Quantum Computing." Wikipedia. 2008. Wikimedia Foundation. <http://en.wikipedia.org/wiki/Quantum_computer>.

Intelligence, the true nature of artificial intelligence. A machine with the ability to solve every instance of a problem simultaneously combined with the ability to not only make decisions as to which problem it will solve but also how to interpret the data is so far beyond the ability of anything we have today. To use his own examples, mathematical proofs, such as any of the 7 Millennium Problems,¹¹ or stock market predictions would be effortless for such a machine. Not only would such a machine be more efficient but also it would push the bounds of our limitations to the edges infinity.

How will humanity recognize true AI upon its invention? Luckily, the fathers of the field devised some simple tests which upon passing labels the taker as an intelligent machine. As mentioned earlier, the Turing Test is the paragon. Alan Turing proposed this test in his 1950 paper “Computing Machinery and Intelligence.” The basic principle to the test is this:

A human judge engages in a natural language conversation with one human and one machine, each of which try to appear human; if the judge cannot reliably tell which is which, then the machine is said to pass the test. In order to keep the test setting simple and universal (to explicitly test the linguistic capability of the machine instead of its ability to render words into audio), the conversation is usually limited to a text-only channel.¹²

Logically, a true AI as described above would pass the Turing Test. The combined power of its lexicon will allow it to communicate effectively to any human, regardless of intelligence level. Moreover, the personality of the AI will allow it to, as mentioned earlier, interface flawlessly with a human. True AI, therefore, would mislead the human

¹¹ "Millennium Prize Problems." CMI. 24 May 2000. Clay Mathematics Institute. <<http://www.claymath.org/millennium/>>.

¹² Wikipedia “Turing Test.”

judge into thinking that it was also a human and would, unequivocally, pass the Turing Test and be technically classified as an intelligent machine.

Prevalent media misrepresentations, as mentioned earlier, are, for the most part, totally implausible. Popular movies such as *I, Robot* and the *Terminator* trilogy purport AI as evil sentient machines with the sole purpose of taking over the world. This idea gives a bad name to AI and largely scares the general populace. This idea is the antithesis of true AI and is totally impossible. To illustrate this, let's assume the existence of an Intelligent Creator. In the same way humanity's relationship with such a creator could never transcend into equivalence with the creator, so could AI never become equal to human cognition. Humans could never begin to understand the dimension in which the creator lives and in the same way AI could never begin to understand ours. Because of this, it is simply impossible, and rather absurd even to entertain such a possibility of an AI hatched plot of a global hostile takeover. AI is a controllable, domesticated technology whose benefits are so tremendous that society should be anything but afraid of the consequences of such an glorious invention.

Artificial intelligence may seem like a creative concept of contemporary science fiction authors but in reality the advent is well within the reach of the current generation. Sure, hover cars, nuclear fusion energy, and world peace may all be great innovations that we see coming in the near future but without a doubt true AI will be the greatest. In fact, the estimate of many industry leaders may very well put its invention ahead of these other critical modern innovations. It might be in as little as 20 years¹³ that we see this wonderful invention come to fruition and consequently change the course of human

¹³ Briggs, Helen. "Machines 'to match man by 2029'." [BBC](http://news.bbc.co.uk/2/hi/7248875.stm) 16 Feb 2008 <<http://news.bbc.co.uk/2/hi/7248875.stm>>.

history. As discussed above, the advent of this technology will drive the human race forward with its many promises including, but certainly not limited to, increased productivity, economic stimulation, and a better quality of life. Moreover, its extensive applications are so vital for the advancement of our race that its importance should push the development of this vital technology forward at such a rapid pace. Do not underestimate its importance; artificial intelligence is the key, it is the future of technology.

Endnotes