

## FEATURE

## Singular Simplicity

The story of the Singularity is sweeping, dramatic, simple--and wrong

BY ALFRED NORDMANN // JUNE 2008

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**Take the idea** of exponential technological growth, work it through to its logical conclusion, and there you have the singularity. Its bold incredibility pushes aside incredulity, as it challenges us to confront all the things we thought could never come true—the creation of superintelligent, conscious organisms, nanorobots that can swim in our bloodstreams and fix what ails us, and direct communication from mind to mind. And the *pièce de résistance*: a posthuman existence of disembodied uploaded minds, living on indefinitely without fear, sickness, or want in a virtual paradise ingeniously designed to delight, thrill, and stimulate.

This vision argues that machines will become conscious and then perfect themselves, as described elsewhere in this issue. Yet for all its show of tough-minded audacity, the argument is shot through with sloppy reasoning, wishful thinking, and irresponsibility. Infatuated with statistics and seduced by the power of extrapolation, singularitarians abduct the moral imagination into a speculative no-man's-land. To be sure, they are hardly the first to spread fanciful technological prophecies, but among enthusiasts and doomsayers alike their proposition enjoys an inexplicable popularity. Perhaps the real question is how they have gotten away with it.

**The trouble begins** with the singularitarians' assumption that [technological advances have accelerated](#). I'd argue that I have seen less technological progress than my parents did, let alone my grandparents. Born in 1956, I can testify primarily to the development of the information age, fueled by the doubling of computing power every 18 to 24 months, as described by Moore's Law. The birth-control pill and other reproductive technologies have had an equally profound impact, on the culture if not the economy, but they are not developing at an accelerating speed. Beyond that, I saw men walk on the moon, with little to come of it, and I am surrounded by bio- and nanotechnologies that so far haven't affected my life at all. Medical research has developed treatments that make a difference in our lives, particularly at the end of them. But despite daily announcements of one breakthrough or another, morbidity and mortality from cancer and stroke continue practically unabated, even in developed countries.

Now consider the life of someone who was born in the 1880s and died in the 1960s—my grandmother, for instance. She witnessed the introduction of electric light and telephones, of automobiles and airplanes, the atomic bomb and nuclear power, vacuum electronics and semiconductor electronics, plastics and the computer, most vaccines and all antibiotics. All of those things mattered greatly in human terms, as can be seen in a single statistic: child mortality in industrialized countries dropped by 80 percent in those years.

So on what do intelligent people base the idea that technological progress is moving faster than ever before? It's simple: a chart of productivity from the dawn of humanity to the present day. It shows a line that inclines very gradually until around 1750, when it suddenly shoots almost straight up.

But that's hardly surprising. Since around 1750 the world has witnessed the spread of an economic system, by the name of capitalism, that is predicated on economic growth. And how the economy has grown since then! But surely the creation of new markets and the increasingly fine division of labor cannot be equated with technological progress, as every consumer knows.



### Age of Invention

*Click for a large version of this timeline*

Technological optimists maintain that the impact of innovation on our lives is increasing, but the evidence goes the other way. The author's grand mother [see photo] lived from the 1880s through the 1960s and witnessed the adoption of electricity, phonographs, telephones, radio, television, airplanes, antibiotics, vacuum tubes, transistors, and the automobile. In 1924 she became one of the first in her neighborhood to own a car. The author contends that the inventions unveiled in his own lifetime have made a far smaller difference.

Even if we were to accept, for the sake of argument, that technological innovation has truly accelerated, the line leading to the singularity would still be nothing but the simple-minded - extrapolation of an existing pattern. Moore's Law has been remarkably successful at describing and predicting the development of semiconductors, in part because it has molded that development, ever since the semiconductor manufacturing industry adopted it as its road map and began spending vast sums on R&D to meet its requirements. Yet researchers and developers in the semiconductor industry have never denied that Moore's Law will finally come up against physical limits—indeed, many fear that the day of reckoning is nigh—whereas singularitarians happily extrapolate the law indefinitely into the future. And just as the semiconductor industry wonders nervously whether nanotechnology really can give Moore's Law another lease on life, singularitarians accept that this will occur as a given and then appropriate the exponential growth curve of Moore's Law not only to all the nano- and biotechnologies but to the cognitive sciences as well.

A typical example is the therapeutic development of brain-machine interfaces. In 2002, people were able to transmit 2 bits per minute to a computer. Four years later that figure had risen to 40 bits—that is, five letters—per minute. If this rate of progress continues, the argument goes, then by 2020 brain communication with computers will be as fast as speech. This isn't just the breathless cant of a true believer. The idea that an enhanced communication of thoughts will exceed speech can also be found in the 2002 report "Converging Technologies for Improving Human Performance," issued by the U.S. National Science Foundation and the Department of Commerce. It says that such methods "could complement verbal communication, sometimes replacing spoken language when speed is a priority or enhancing speech when needed to exploit maximum mental capabilities." Presumably, the singularity will be reached soon afterward, when transmission rates exceed the speed of thought itself, allowing the computer to transmit our thoughts before we think them.

This fantastic vision works only by ignoring the critical limit, which is the great concentration you have to muster to send the bits. It is a procedure far more tedious than speech. To ease that requirement—to make a brain-machine interface into a true mind-machine - interface—we'd have to know a lot more than we do about the relation between specific thoughts and corresponding physical processes in the brain.

The seductive power of extrapolation has also been applied in ways less spectacular but no less foolish. The "lab on a chip" and other technologies for biochemical analysis have significantly increased the number of measurements—blood lipids, for instance—that can be obtained from a single drop of blood. It's a fine achievement, no doubt, but visionaries stretch the imagination when they assume that a second Moore's Law is about to produce astounding success stories and a transformation of all medical diagnostics.

Yet that assumption, which extrapolates an extrapolation—Moore's Law—to another field, is precisely what lies behind the now commonly expressed fear that increasing diagnostic

powers are creating ethical problems in medicine. Physicians, we are told, will routinely inform patients of impending diseases for which they can offer no cure.

Yet in fact the path is very long from quicker blood analysis to instantaneous detection of the near certainty of a dread disease in a patient's future. A lab on a chip may provide mountains of data, but without great advances in many other fields—notably systems - biology, pathology, and physiology—no one will be able to do much with it. Doctors already have more physiological information than they can profitably use.

Both examples of mindless extrapolation constitute wishful thinking. And in both cases, public debate is diverted from the real moral issues and quandaries that technology raises.

Rather than dream about how technology will soon effect an almost magical transformation of human life, societies need to debate the many real problems connected with technological changes that are already under way. These problems belong to the here and now.

**Why, then, are** so many people captivated by the simple story of exponential growth that culminates in a life-altering singularity? Part of the appeal lies in simplicity itself, part in technological optimism—yet both of these tendencies are very old. What's new, though, is the changing role of technical expertise.

Plainly put, it is getting harder than ever to know whom to believe. Policy makers and members of the public have always had to put a degree of trust in experts. But now, when considering highly complex phenomena—in cellular processes, in chips containing billions of transistors, or in programs numbering hundreds of thousands of lines of code—even the experts must take a great deal on trust. That is because they have no choice but to study such phenomena using a cross-disciplinary approach.

These experts greet extraordinary claims made from within their own disciplines with skepticism and even indignation. But they can find it very hard to maintain such methodological vigilance in the hothouse atmosphere of a high-stakes collaboration in which researchers want desperately to believe that their own contributions can have wonderfully synergistic effects when combined with those of experts in other fields. And so, modest researchers recruit one another into immodest funding schemes.

The electronics engineer and the physiologist, the cognitive scientist and the physicist, the economist and the manufacturing specialist—all must take one another's statements on trust. They must trust in the contributions from other disciplines, trust in the power of visions to motivate the cooperation, trust in techniques and instruments that remain somewhat opaque to their users, trust in the trajectories of technical development.

Where trust has become a virtue even for scientists, there is little incentive to challenge outrageous claims or to hold singularitarians accountable. They describe the progressive realization of technical possibility, after all, and their story has a pleasant ring to it. Indeed, there is nothing wrong with the singular simplicity of the singularitarian myth—unless you have something against sloppy reasoning, wishful thinking, and an invitation to irresponsibility.

*For more articles, videos, and special features, go to [The Singularity Special Report](#).*

#### About the Author

ALFRED NORDMANN, author of "Singular Simplicity", is a professor of philosophy and the history of science at Darmstadt Technical University, in Germany. His interests include the philosopher Ludwig Wittgenstein, the physicist and philosopher of science Heinrich Hertz, and the birth of new scientific disciplines, such as nanotechnology.

#### most recent comments

**LUKE STANLEY** 11.11.2009

What a terribly weak argument by Alfred Nordmann.

**EXAPTED** 10.03.2009

This article was a poor analysis of the singularity meme. If technology has not progressed faster for me than my parents, or faster for my parents than my grandparents, then doctor Nordmann certainly didn't provide much reason or evidence to that effect. In contrast, there is plenty of evidence that a double exponential rate of processing power growth has existed starting in the 1940s, if not earlier. The evidence is admittedly limited, but certainly exponential growth in processing power started well before Moore's law. And it is acknowledged by singularitarians that not all technologies are progressing very quickly. It is also acknowledged that sometimes, even with exponential growth, social implications of technological progress can lag. Of course the invention of the microchip was more significant, in many ways, than much of the exponential growth afterwards. Then along came the internet. Not everything is smooth, but processing power growth has been smooth. Although it might not continue to be smooth into the future, we can't afford not to assume, to some extent, that it will. We need to use fuzzy logic, and assume both that the singularity won't happen, and that it will. The singularity represents massive potential that should be taken seriously, regardless of how limited our understanding of the future may be. Artificial intelligence, computational neuroscience, biotechnology and nanotechnology have the potential to change human biology. Although the singularity is quite speculative, it is also quite plausible. We should prepare for the singularity, just like we should work on nuclear disarmament. We should absolutely invest more money in research on AI, AGI, nanotech, biotech, neuroscience. These are the fields that will either bring the singularity or possibly save us from global warming or pandemic. Most singularitarians that I have spoken with have been willing to accept that they might be wrong. No one needs

to specifically "hold singularitarians accountable". I found this article to be extremely dismissive. I learned absolutely nothing from it. Thank you.

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**MARTY 09.10.2009**

When was it that we last used nuclear weapons on each other. That was a singularity. (well a duality(?), they did it twice) Barbarism seems to have peaked in your Grannies lifetime too.

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**SUE LANGE/SINGULARITY WATCH 09.08.2009**

Lots of important points here. The most important statement is: "...societies need to debate the many real problems connected with technological changes that are already under way. These problems belong to the here and now."

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**CHRISTOPHE 09.04.2009**

I believe that you can't see the singularity when you are in the middle of it. I'd argue that major singularities have happened in our lifetime, e.g. the invention of the pocket calculator, the first easy to use intelligence enhancement (how can \*this\* not be listed on the diagram?) This is an example of singularity because even the brightest people pre-singularity would have been unable to extrapolate the evolution after the singularity. See <http://grenouille-bouillie.blogspot.com/2008/06/singularity-has-already-happened.html>. Other inventions that caused a singularity include obvious ones, like the web, which everybody mentions (including this article), but also many less obvious ones, such as new materials for clothing (color clothing, fashion, advertising on clothing, showing one's individuality through clothing, political statements on clothing, all things that were hard to conceive in 1940). Other examples: plastics; programmable machine tools; consumer credit & banking products; consumer appliances; glues (e.g. glues that don't stick for diapers, glues that help healing tissues for band-aids, ...); human-powered transportation devices (skateboards, rollers, bicycles, ...); throwaway food storage (soda cans, ...); I'm only giving examples that are not on the diagram as far as I can tell, and mostly happened in my lifetime.

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**SRT 09.04.2009**

I am reminded of the scene in the Singularity inspired novel by Charles Stross, "Accelerando", where a group of uploaded human personalities have a debate about whether or not a singularity in human development has taken place in a nonexistent bar-room simulated on a computer traveling on a coke-can sized interstellar probe moving at a good fraction of the speed of light... Yes, simple minded extrapolation on a log-log plot is bound to be in error ultimately. Technology generally follows a characteristic S-curve with a slow early rise and an quasi-exponential phase and, ultimately, a slow saturation of a bound... Generally, the asymptotic limit of one technology kicks off the development of a similar pattern in the growth of one or more related technologies... We are nowhere near the limits imposed by physics yet. As Feynman said in his visionary talk on nanotechnology, "there is plenty of room at the bottom." There still is today despite the march of Moore's "law" for the past several decades.

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**TOMC 09.03.2009**

Oh well, I posted a nice, if long, list of non-trivial, life impacting changes we've seen in the last ~50 years to demonstrate how much change we HAVE seen, but often forget about - but it seems to have been killed by moderation..... I guess take that as evidence that the list was LONG. I compiled the list after starting out with the same idea as the author - that I haven't seen much change over my life - and proved myself wrong as I thought of more and more stuff.....As to the author's arguments against a singularity - a history of accelerating technology is only supporting evidence, not a necessary condition. The real question is whether we can muster enough processing power to (somehow) generate a self-improving AI. That's an interesting question, but the author's comments don't really touch on the subject, rendering them pretty much off target.

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**JULIEN COUVREUR 09.03.2009**

I think it depends on how big you make the icons. For example, you have a very large light bulb, but a very small personal computer. ;-) Kidding aside, one fallacy in your article is that you cannot extrapolate any single technology (such as throughput of input into a computer). The beauty of technology is that it continuously surprises. I'm not sure that I support the singularitarian view, but stuff like 3d object printers, handwriting recognition that works, voice recognition and body input (Project Natal) are as many small bricks enable new innovation. Also, your illustration is quite appealing, but cannot constitute proof in any way, as it depends on your selection of innovations. What metric to use? One factor which does not seem discussed in the comments so far is the size of the population. Double the number of brains (along with communication technology) and you get a surge in development.

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**TOMC 09.03.2009**

Our grandparents got a few big changes in their lives - we got so many improvements that we tend to forget them until someone says "Well, what about X?" and then we say - "Well of course we saw a few changes, but that's just the exception that proves the rule!" Here's a partial list I've made for ~1957 to now - and I'm sure I've missed some big and obvious stuff. Note that this is not a list of "first invention" but of "major impact on lives". Transistors were still replacing tubes early in the period. Integrated circuits replacing discrete analog electronics digital displacing much analog semiconductor RAM/DRAM microprocessor, Moore's Law Plastic

everything everywhere Hand held calculators Personal computers portable computers (notebooks/laptops) handheld computers (Newton, Blackberry, iPhone) eBook readers computerized billing and accounting, spreadsheets, power point, email, word processing, on-line forms, networking/file sharing, biz2biz transactions, product information online credit/debit cards for "everyone" phone modems cable data service/modems home networking WiFi public wireless data services BBS systems/forums online chat global email, CB radio pagers 800 (toll free) numbers, 900 numbers Cellphone texting internet phone video conferencing web conferencing social networking eBay online retail Freeware/Open source/GPL/Creative Commons crowd-sourcing (wiki) Web apps / Cloud blogging Project Gutenberg Google, digital cameras digital video GPS - military, commercial and personal impacts sonogram Magnetic Resonance Imaging CAT scan analog electronic watches digital watches LEDs LCD displays White dental fillings mostly replacing silver and gold Near painless dentistry Workable dental implants. heart pacemakers stints for heart attack victims numerous chemotherapy advances Cable TV Digital cable digital broadcasts TV internet video/TV ATMs Color TVs (becoming common) wireless remote control big screen TVs flat plasma and LCD TVs (and computer monitors) tiny portable TVs/media players Videotape and DVDs BluRay disc, 8 track audio cassettes Sony walkman CD audio, MP3 and other digital audio players floppy disc hard disk drive CD ROM DVD ROM BD ROM Computer graphics (design, simulation, etc) computer animated movies/special effects DnD / roleplaying games Video game consoles and PC games handheld game units Jets replacing prop planes for commercial travel private jets cheap/mass air travel e-Tickets UAVs in the military robots in the factory automated people movers overnight express mail/package delivery cargo container shipping Interstate Highway system development/build-out, Increase of interstate trucking Sputnik communication satellites spy satellites earth-observing satellites telescope satellites robotic space probes Man in space Man on the moon Skylab Space Shuttle International Space Station

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**STEVE BLOM 09.03.2009**

You are looking at inventions in a linear time scale instead of an exponential time scale, which makes it seem that all the important inventions happened since 1830, but these inventions depend on former inventions which each took many years longer. And the whole thing that made most of the inventions possible since 1950 is the increase in computing power which can both store and process more and more information. You give lipservice to moores law but can't dispute all the charts and graphs of increased computing power which are constant in their growth for hundreds of years, if you look at it exponentially instead of linearly. Linear thinking comes naturally to us, exponential thinking does not. It might be that we get to a certain technological level and blow ourselves up so the singularity doesn't happen exactly as described, and nuclear power development is a bit disturbing, as we have had the power to blow up the planet for 50 years now, which never happened before. Even this method of communication you are using, a blog, we never even heard of before 2 years, yet the power of blogging has already revolutionized publishing and devastated newspapers that had been ongoing for hundreds of years. I submit that this is exponential change you are benefiting from and just can't bring your head out of the sand to face it.

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**ME 09.03.2009**

Seems the author is unable to take criticism. Keep moderating those comments and living in the dark, buddy. This entire website is worthless.

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**EXTRAPOLATED VOLITION 09.03.2009**

It's so simple I don't know why more people don't get it: The rate of information exchange in this world has been exponentially increasing since the first single-celled ancestor. It will continue until the Universe is saturated by our intelligence. This guy's narrow-minded focus on certain technologies is pitiful. "Hey the birth control pill isn't getting exponentially better, duhhhhhhh, therefore: stupid conclusion." FFS, neither of us would've heard this guy's thoughts 10 years ago. Isn't that proof enough? Even retards get a say now! "But who the fuck's listening", you say? THE INTERNET ITSELF.

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**ALAN BARTON 09.03.2009**

When trying to convince someone of something new, there are usually 4 stages to peoples reactions. To quote Mohandas Gandhi, "First they ignore you, then they laugh at you, then they fight you, then you win." Sorry but this article against the Singularity is somewhere between the "laughing" and starting to "fight" back stage. While the far out erroneous claims by some misguided dreamers for the Singularity are easy targets to laugh at, that doesn't change the overall trend towards accelerating technological progress. There are many examples of progress I could give, but firstly I have learned some people somehow prefer to find comfort and happiness in laughing rather than studying the overall trends involved and secondly, as with almost all new technology, it takes not just years but decades before it starts to impact onto everyday life. The problem is many people often greatly overlook the difficulty and importance of the early years of considerable struggle to get a new technology into a scale where it can finally start to change the lives of millions. Its easy to take technological progress for granted yet the technology we have even now would have been unthinkable by most people in even just 1970. For example, Mobile phones, the Internet, even just home computers with graphics cards now more powerful than room sized 1970s super computers. Its also interesting how this web site article is so easily broadcast globally, yet look back to the excitement of the

worlds first transatlantic television broadcast and see the difference between then and now. Now anyone can broadcast globally and knowledge helps many people progress. We have far greater information technology which in turn will help accelerate even more progress. Anyone on the Internet can now gain access to more information than was available to all the scientists in the world even just a few decades ago. (Understanding what they find is another story, but everyone can access it and many are showing they want to learn from the Internet). So in a way, I find it fascinating your article shows signs of starting to fight back against the Singularity, as I consider that far better than people just ignoring the Singularity. That shows real progress. So perhaps the real question should be why laugh and fight back at the idea of progress at all. What would anyone have to gain from doing that? But I'm sure there will be some who will continue to laugh at what I and others say, but I don't really care. After all, Mark Twain summed it up brilliantly when he said, 'Let us be thankful for the fools. But for them the rest of us could not succeed'. The point is, some do believe in accelerating technological progress and are aiming to benefit from it and so are continuing the struggle to push progress forward. So if you want to be left behind, by all means keep laughing and ignoring it. But you certainly won't have the last laugh. For anyone who does believe in accelerating technological progress, remember Mark Twain also said, 'Keep away from people who try to belittle your ambitions. Small people always do that, but the really great make you feel that you, too, can become great.' ... and remember, the first step in achieving anything is believing you can achieve something, because without that, you will not even start trying to achieve something.

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**PHILIP 09.02.2009**

I definitely agree with the author. I was born in 1955, and have worked as an engineering professional for the past 35 years. In the field of computer science, software advances have been particularly lacking. Although the improvements in computer hardware speeds and costs have been incredible, software development is still a slow, laborious, and error prone activity. And AI has been a total failure. Given the 'software problem', there is no clear path to the age of intelligent machines in the near or far future. The Singularity proposed by Kurzweil is a joke.

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**ROBERT 09.02.2009**

Trying to argue that all the recent advances are predictable is not saying much. Very little of the advances in the authors grandmothers lifetime were not predicted in the science fiction of the time, then known as speculative fiction. Jules Verne predicted travel to the moon, submarines, and many other real life advances. There are vast fields of knowledge the author is dismissing, practically with a wave of a hand, including everything involving genetics, particularly in agriculture. If we were on the same agricultural system that was in place at the authors grandmothers birth then the majority of us would still be farmers. In 1880 farmers were 49 percent of the labor force, in 2000 they were 2.6 percent of the labor force ([http://www.agclassroom.org/gan/timeline/farmers\\_land.htm](http://www.agclassroom.org/gan/timeline/farmers_land.htm)) We have seen the first viable consumer robots which promises to relieve us of even more of our work freeing us to work on more and more complex problems and less on survival and other manual work. a technological singularity may be fantasy, but the author dismisses great advances that help him every day without him ever realizing it.

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**E. KOREMAN 09.02.2009**

Interesting, fresh article. Technological singularity is not really about exponential progress. It's about prediction. There is a great blog online which has scanned articles from the, say, 1890's until the 1980's. Articles about technology, science and the future. What you see is that in the earlier years quite accurate predictions were being made about a then still far future. People understood very well what i.e. electricity was good for in the long run. However, if you go up in time the predictions become less accurate because new technology arrived much earlier and changed the world ever more profoundly. That is the basic idea behind that technological singularity: it becomes harder and harder to predict future developments and predict what impact technologies have. That event horizon comes closer and closer. What will happen when that horizon is at the doorstep is unknown, but virtually everything is possible. And that's where wild fantasies and wishful thinking jumps in. Agree, people uploading their minds and other new age like stuff is nonsense. Not even new since such things have been the plot of many SF novels for over a century. And yes, I agree that the doubling part only accounts for a field of technology that happens to live at the core of about anything artificial, but there you have it. What you see is your own interpretation. Being born in the late 60's I must say I cannot agree with some of your arguments. Your claim about mortality from diseases like cancer is simply wrong. Look up the figures. Diagnosis and treatment gets better and better and it pays. Life expectancy grows steadily and significantly with a few years every decade, ever since that leap when living standards dramatically improved. About progress in science and technology: nanotech does affect your life. You probably didn't notice that nanotech is in tooth paste, in textile, the food industry, transportation, sun protection, glasses, paint, medicine, the PC you used to write this article, whatever. It's everywhere and it makes things possible that weren't possible a decade ago. You didn't notice and you may never will. Astronomy is literary booming with fascinating discoveries every month. You won't see that if you are not interested in it, if you don't understand it or you are just too busy doing other things. But then that would be you. Not the world. Physics is booming. Nanotechnology is booming. Maths is booming. The internet is booming. Communication is booming. There are

many discoveries being made every month and it is not just because of easier access to sources. According to you, if I am correct, Moore's Law is probably the only reason why we see a kind of exponential progress in certain fields. However, Moore didn't invent it. He noticed it. Besides that, it is impossible that this law sustained for decades without significant fluctuations, worldwide, just because of business planning and meeting goals. We would then be talking about free market economics and we do know about the fluctuations in that field. Technological progress is hardly affected by the state of world economy. For decades now. To conclude, I do not believe in a future with smarter-than-humans AI. Humans are not that smart on their own. Collaboration has always been the key and the technology we have now is way stronger finding solutions for problems than any sophisticated (imaginary) AI ever. 42 was the answer. You cannot dismiss the factor 'human' since humans decide goals. Not machines. Technology is a set of tools and that won't change. Ever. Sure, for somebody who was born in 1880 the world changed dramatically. Automation was completely new. But so was the rise of computers, the internet and mobile phones. The difference was probably that we were more used to change. My opinion is that the 'technological singularity' is happening right now. We are seeing progress at an incredible rate and our lives change. However, although many people are really excited about all the new gimmicks and gadgets that rain down everybody just goes on with their lives. We take change for granted. As said before, we got used to change. Even rapid change. I dare to say, if moon travel were to become possible for ordinary people in, say, 2025, most people would be excited about the experience. Only a few would really wonder about the leap in technology that was needed to get us there.

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**WINKLER CHAM 09.02.2009**

"There is not the slightest indication that nuclear energy will ever be obtainable. It would mean that the atom would have to be shattered at will." -Albert Einstein, 1932 Just because some people are critical of the premise does not mean that it will not come to pass. The Singularity Hypothesis is opening our eyes to a whole new level of existential risk and i think it is irresponsible to be as dismissive as the author is.

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**UGLY AMERICAN 09.02.2009**

Phase 1: Collect Technology Phase 2: ? Phase 3: Profit Singularitarianism is a messianic religion for technophiliacs. There is no magical computer fairy that can fix all our problems because we're the ones causing our problems. We've had rockets & reactors for generations yet still we wallow in our own filth, murdering each other for oil that's poisoning the environment. It's not the technology that's lacking, it's the people.

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**SPACEBAT 09.02.2009**

I concur with the author, for different reasons. I think the singularity concept is conceptually flawed for the simple reason that every advance in technology carries with it a significant energy cost. Eventually, the price becomes one you simply cannot afford. Visit [http://amazingscifi.com/?page\\_id=38](http://amazingscifi.com/?page_id=38) to learn more...

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**MOIKE 09.02.2009**

The argument that we may be approaching a limit with Moore's law was made in the 70's. For many reasons it was considered impossible for the rate of progress to continue. Yet it did and still does. In fact it has accelerated. If the rate of progress continues through about 2023 (the not-too-distant future), the processing power of a \$1,000 computer will be roughly equivalent to a human brain. Having affordable computing power equivalent to a human brain will produce a singularity in itself, even before you consider the possibility that 5 years later home computers may be 30 times more powerful. Creativity is often cited as a limitation, but it overlooks an important lesson from psychology: conscious decisions are largely made after the subconscious mind has already made a decision or taken an action. The raw processing power of the brain is largely subconscious, and may be creating the illusion of creativity by sheer power of computation over millions upon millions of computations. After a best choice is selected, the conscious mind becomes aware of it, and the process appears to be spontaneous. But that spontaneity is only an illusion. In fact it is the processing power that was responsible for the creativity. There is further evidence for this hypothesis in reading accounts of Kasparov's famous chess battles with IBM's Big Blue in 1996 and 1997. As far as whether Grandmother experienced greater technological leaps in her lifetime, that is a matter of perspective. Einstein refined Newtons approach, but Newton already was very close to reality. We are refining and drawing closer to truth. The leaps may seem smaller, but they are far more numerous. My lifetime witnessed the birth of the cell phone, the personal computer and the internet. These are so ingrained in our society that we can no longer imagine life without them. The car and airplane are amazing inventions, but for speed they have nothing on email. Space travel is equally amazing, but certainly less relevant to our everyday lives. In contrast, personal computers so dominate my life that virtually all of my working hours and many of my leisure hours center around them. I would have to say that the rate of change has not declined at all.

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**STEPHEN MEADOWS 09.02.2009**

You fail to take into account the synergy created through worldwide access to instant communication (cell/smart phones) and to information (smart phones, netbooks/laptops). Just because your middle class American life hasn't changed as much as your grandmother's



middle class American life doesn't mean that many areas of the world aren't currently undergoing farm-to-iPhone transitions this generation (e.g., India, China, etc.). Don't discount the effects that bringing a billion or two more people into the technology of the 21st century will have, especially once those people are able to share knowledge instantly and with ever-decreasing communication barriers, creating millions of new Silk Roads of innovation across the planet. I mean, does the fact that 100x more people are reading your article now than those would have read the print version even just 10-15 years ago not amaze you? Are you that blind and/or cynical about recent technological progress?

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**BRIAN 09.02.2009**

It is ludicrous to think that if we aren't producing dramatically obvious inventions without predecessors, that the speed of innovation is decreasing.

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**RANDALL HELZERMAN 09.02.2009**

Yes, a trip to the computer museum, for example is a bit depression; seems like every innovation in computer architecture already happened in the 1960s, and all we are doing is making them smaller and faster.

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**STEVEN KNUDSEN 09.02.2009**

I believe that Kuhn has an appointment for you and some of the dogmas you've implied. Good thing that people keep producing new, less-jaded versions of themselves. I'm near your age and while I don't naively hold with the timeline for a singularity-type "event", I think you've taken too short a perspective. True, Nature uses nonlinear systems to advantage, but she also knows all systems saturate and, hence, the argument for infinite acceleration of progress is flawed from the get-go. However, to support that you have been quite selective in your arguments. Looking at brain interfaces, you select only one bit of work in that area; speech-enabled control. What about prosthetic interfaces, retinal interfaces, the recent reverse-engineering (signal processing) of motor commands or stored images. Speech is arguably the worst example; it's highly anthropomorphic, at least in terms of machines in a man-machine interface. Just because you haven't been impacted by bio-engineering, nano sciences, etc. doesn't mean that there will not be a huge impact, and one with consequences you've not imagined. Was your grandmother directly impacted by the atomic bomb, fission power sources? Probably not as even her use of electricity wasn't spawned by them. From her perspective, how were they revolutionary? I would argue that we are at the dawn of several new important fields of endeavour that will change us in ways we can't see. Just as the potential for radio was underestimated at the start of the 20th century (it might be used only for educational purposes), who's to say what new materials being developed today might lead to. What if nano-materials made a space elevator practical and we were able to colonize the Moon? Maybe that's a big nothing. What if the same materials made solar photovoltaics competitive with any other power source, would that cap the industrial revolution with a sustainable energy model? People think the industrial revolution is over, but if it's not sustainable, it's not been a revolution but an experiment. Anyway, the author makes some good arguments, but I like the idea of saturation; no singularity because the system saturates. But like Mother Nature when she sees a good thing, it doesn't mean she won't use a nonlinear system elsewhere. Steven Knudsen, Ph.D., P.Eng., (M'84)

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**JS 09.02.2009**

The sentence relating the fall in child mortality with technologies including nuclear power, electricity, and antibiotics is misleading. The greatest portion of the decrease in child mortality, and increase in longevity in general, came simply from the creation of modern plumbing and sewer systems which effectively separated fecal wastes from the drinking water system. The other technologies mentioned have had a zero or small effect on mortality, with the exception of antibiotics – which came into play mid-century, after the bulk of the decrease in mortality.

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**ANONYMOUS 09.02.2009**

And let's not forget quantum computers, optical computers, DNA modification, DNA computers

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**ANONYMOUS 09.02.2009**

Universal Computers, Touch Screens, ATMs, Cell-phones, Wi-Fi, Witricity, Internet, LHC, Laptops, Bluetooth, 3D printing, Commercial Space Shuttles, Faster Than Sound Commercial Airplanes, Giant Airplanes, cure for a lot, almost all except AIDS and Cancer, diseases; music all the time, flat screen, intelligent refrigerators, intelligent homes, pens that can write in space, the number 42, etc, etc, etc,

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**MARK BAHNER 02.03.2009**

"You reasonably question claims that progress has accelerated over the last century,..."

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**SP 11.24.2008**

If this article isn't shortsighted enough, It wasn't until I got to the comments section that I got to read something truly ridiculous, by Peter Robinson: "I've been contending for a long time that we have not seen any significant advance in at least 60 years. There has been virtually no new invention, simply innovation on existing themes."

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**DCCARLES 10.24.2008**

For a long time I've been baffled by singulatarians. I mean, we can take the singularity seriously but laugh at [these guys](#)? The element of wish fulfillment (and quasi-religious thinking) seems to be discounted by singulatarians entirely.

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**KCRADY 10.12.2008**

I think technology has advanced, just not in the ways we were expecting. Consider the movie *2001: A Space Odyssey*. The movie was made in 1968, and featured a sensible extrapolation of the Apollo Era space program. When we first went to Jupiter, how would we do it? A giant rocket crewed by young, virile white men, of course!

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**PETER ROBBINSON 06.26.2008**

I couldn't agree more. I've been contending for a long time that we have not seen any significant advance in at least 60 years. There has been virtually no new invention, simply innovation on existing themes.

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**CHRIS BETTS 06.26.2008**

It's worth noting that there exist theories about a 'singularity' in a future and most predate Kurzweil's 'technological singularity'. Terence McKenna, for example, formulated a theory called 'timewave', which is based on the King Wen sequence of the I Ching, in the 70s that he claimed tracked the ebb and flow of novelty (rather than technology) towards a \*teleological\* attractor at the end of time that drives the increase and conservation of complexity in material forms. Certainly, a stretch, but no more so than the technophilic cornucopia envisioned by many others.

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**SHAUN CHAMBERLIN 06.26.2008**

You identify capitalism as one of the key factors in the spurt in measured economic productivity (correctly I would say), but surely another critical factor is the availability of useful energy.

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**WILLIAM SCHREIBER 06.09.2008**

I was appalled at the publication of the report, commented on here, in an IEEE magazine, and very pleased that a rebuttal was also published.

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**PETER B 06.05.2008**

Right on. The singularity folk seem to imagine that this 'event' will occur in a social vacuum. I believe that as it gets closer, more outside folk will realise what is happening and resist it in every way possible. Remember civilisations can fall: Hittite, Egypt, Rome, Mayan, etc. Mostly because the centre became chaotic.

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**BRILIGG 06.04.2008**

Science fiction and futurism are children of industrialization. Before that the future was not considered to be greatly shaped by technology, only the philosophy and religion mattered. During the feverish changes of the Industrial Revolution in the 19th century, many intellectuals convinced themselves that all of humanity's ills were on the verge of being solved, and the whole cosmos and everything in it would shortly be described by elegant mathematical laws. They were quite wrong, but for the first time technology was named the engine of human change. The word 'progress' emerged.

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**BABUA 06.04.2008**

The author mentions self-improving intelligence at the beginning yet none of the refutations address the impossibility of such a happening. Sure Moore's Law will hit a physical limit, but what if that limit is more than enough to bring a self-improving intelligence into being? I think I can safely say that a great deal of singularity base their arguments on the existence of self-improving intelligence, and a common argument is that it will facilitate the rest of the technological progress. Bashing on the whole idea of singularity based on a partial criticism is overgeneralization at best.

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**RICHARD 06.04.2008**

This author is obviously an idiot.

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**GUNOME 06.03.2008**

i agree with gimmi. your comparative listing is not objective in anyway. it consists of inventions that are important to you, recalled off the top of your head. beyond your personal bias there is also a aspect of hindsight analysis that can not be applied to contemporary changes. that is you can not know now what is a highly significant new invention. when was the automobile definitively considered a revolutionary reality?

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**AVARANA 06.03.2008**

What if the rate of development of new tech or their improvement hasn't slowed but as of today already addressed the necessities they were meant to satisfy? Meaning there's not a pressing need for a better X vaccine, just it's widespread use. Same applies to mp3 players and such.

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**ROBIN HANSON 06.02.2008**

You reasonably question claims that progress has accelerated over the last century, and that Moore's law will go on forever or apply to other technologies. But as my article shows, there are reasons to expect a singularity that are *not* based on these claims.

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**GIMMI 06.01.2008**

singularity or not, the feeling that today's rate of progress is lower than it was between 1880 and 1960 is even more simplistic than the extrapolation of Moore's law. Maybe the rate of "scenic impact" is lower.