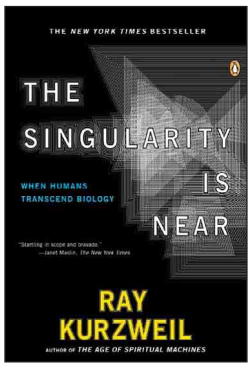

The Singularity Is Near

When Humans Transcend Biology

by Ray Kurzweil

672 pages

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Take-Aways

- The pace of technological change is accelerating: It builds on itself.
- Information-based technologies will let humanity transcend its previous limits.
- The dividing line between biology and technology will dissolve.
- This "singularity" will happen in only a few decades.
- Humans will conquer death, poverty and disease.
- Advances in genetics will enable scientists to redesign the human body.
- Advances in robotics will allow them to augment human intelligence and function.
- Advances in nanotechnology will eliminate physical breakdowns and disease.
- Reverse engineering of the brain and advances in information processing will enable the storage of human consciousness outside of the biological body.
- Advances in artificial intelligence will expand human understanding.

Rating (10 is best)

Overall	Applicability	Innovation	Style
8	**6**	**9**	**8**

Relevance

What you will learn

In this Abstract, you will learn: 1) How accelerating advances in technology will build on themselves exponentially; 2) What new capabilities these advances will offer humanity; and 3) How they will all come together in a few decades to transform humanity forever.

Recommendation

This is a strange and powerful tome. Inventor and futurist Ray Kurzweil makes predictions that are sweeping in their implications and bold in their specificity. In fact, some readers may think they sound more like science fiction than science. He discusses developing artificial intelligence, downloading consciousness, redesigning the body using nanotechnology and other seemingly improbable developments. Then, he goes out on a limb to predict how and when these technological advances will all intersect – a historical moment called the "singularity." At that point, he says, if humans have used technology properly, they will become godlike, solving all their problems. Kurzweil devotes nearly 80 pages to articulating and responding to the criticisms of skeptics. However, even if you reject most of Kurzweil's ideas, you can still benefit from reading his book. It is thoroughly researched, with roughly 100 pages of notes and references, and conceptually challenging. Kurzweil works hard to make it lively and accessible, providing graphs, quotations, sidebars and imaginary debates among spokespersons for various points of view. The result can become overwhelming, but it is always thought-provoking. *getAbstract* recommends this book to executives who are seriously interested in planning for the future, and to curious minds everywhere.

Abstract

"We have the ability to understand our own intelligence – to access our own source code, if you will – and then revise and expand it."

The "Singularity"

Most people observe the changes in the world today and assume that change will continue at a steady pace into the future. They imagine that the future will be a somewhat more advanced version of the present, and that things will continue to change in the same way they're changing now. However, technology advances exponentially. Developments in one area allow developments in others. The changes accelerate and become more dramatic. In the not-so-distant future, technology will permanently and fundamentally transform human nature.

By 2025, humans will create machines that are smarter than they are – a moment called the "singularity." Machine intelligence will augment that of humans in all areas. Machines will actually be able to invent and improve themselves, speeding up the rate of change even more.

"Over the last twenty years, I have come to appreciate an important meta-idea: that the power of ideas to transform the world is itself accelerating."

Along the way, certain sciences and technologies, which are already under development – including genetics, brain scanning, nanotechnology, virtual reality and robotics – will enable people to store and replicate their consciousnesses. They will operate in virtual realms that are as vivid and valid as physical reality. Doctors will be able to make repairs to the body of which people now can only dream, such as reversing a predisposition toward heart disease. Eventually, nanotechnology will enable people to redesign their bodies completely – if they choose to have bodies at all. Immortality will be within their grasp.

"What is the Singularity? It's a future period during which the pace of technological change will be so rapid, its impact so deep, that human life will be irreversibly transformed."

At the singularity, the boundary between human and machine, biological and nonbiological, dissolves. "Nonbiological intelligences" will saturate everything in our region of the universe, using their "matter and energy patterns" as computational tools. These intelligences, rooted in the human realm, but multiplied, augmented and accelerated, will spread throughout the entire universe. How long this takes will depend upon whether these self-multiplying intelligences can overcome the limits of the speed of light.

At this point, you may be thinking that these ideas are crazy or crackpot; that's a reasonable response. You're viewing the singularity from a presingularity consciousness. Because the singularity will have as profound an effect on humanity as the entire course of evolution, you are in the position of a bacterium trying to imagine a human. However, you do have two advantages over the bacterium: a highly developed intelligence and an experiential awareness of change. You can plan for and take advantage of the coming transformations.

"The Law of Accelerating Returns"

"Exponential growth is a feature of any evolutionary process, of which technology is a primary example."

Technology works according to the law of accelerating returns. Advances in one area lead to advances in others. This is especially true of information processing, which multiplies the implications of other sciences and technologies, allowing yet more information to be processed, at higher levels of complexity, producing fundamentally better results.

New discoveries don't just improve or speed up the industries or technologies in their fields; they advance the rate at which humanity as a whole leaps to new levels of understanding. As researchers explore and integrate these new insights, they make additional improvements to knowledge and technology. A small-scale example of this phenomenon is the increasing speed and decreasing cost of microprocessors. As they become better and cheaper, so do the machines which use them. As advanced information technology moves through the economy, technologically driven deflation accompanies it.

"Ultimately, the entire universe will become saturated with our intelligence. This is the destiny of the universe."

With each new tool, you build the next. Thus, you move through the exploration and exhaustion phases of each discovery more quickly, until you get a "paradigm shift" – "a major change in methods and intellectual processes to accomplish tasks: examples include written language and the computer."

"Reverse Engineering the Brain"

"Despite the clear predominance of nonbiological intelligence by the mid-2040s, ours will still be a human civilization. We will transcend biology, but not our humanity."

A significant marker on the road to singularity will arise when computers achieve the "computational capacity of the human brain," in about 2025. Various technologies have the potential to provide this capacity, including three-dimensional computing, quantum computing and using DNA to compute. The particular method doesn't matter. More important is the fact that within a few decades, computers will be able "to recreate human powers of pattern recognition, intellect and emotional intelligence." By 2018, for about $1,000, you'll be able to buy as much memory for your computer as the capacity of the human brain. Ten to fifteen years later, you'll be able to purchase, for a reasonable price, not only that amount of storage but the intellectual capacity itself.

Having the physical computing capacity wouldn't mean much if researchers weren't also "reverse engineering the brain" to understand how it works. Brain imaging and modeling are improving, leading to better understanding of the brain's circuits or neurons; its chemistry, including neurotransmitters and hormones; and its structure, including its

regions and subsystems. By about 2020, researchers will be able to use "nanobots" (extremely small robots) to map the brain, and then to regulate and repair it. In the 2030s, scientists will be able to scan and store the contents of a brain.

"A ramification of the law of accelerating returns is the exponential growth of human knowledge, including intellectual property."

"The Double Helix"

In addition to information technology and neuroscience, three fields will be instrumental in bringing about the singularity: genetics, nanotechnology and robotics (GNR).

Genetics is "the intersection of information and biology." Mapping the human genome is the first step in developing genetics-based technologies that will radically improve human health and longevity. Soon, "RNA [which is similar to DNA] interference" will block genes from producing disease-causing proteins, while "cell therapies" will regenerate cells as they die from age or illness. The most powerful tool under development is "somatic gene therapy," which will change the structure and function of cells, reversing many degenerative diseases, and eventually, aging itself.

"Once a computer achieves a human level of intelligence, it will necessarily soar past it."

Along the way, cloning will contribute to solving world hunger: Scientists will develop and copy disease-resistant plants and animals, and distribute them to people in need. Eventually, meat will also be cloned: Factories will produce pure flesh, eliminating much of the waste and suffering involved in today's food production.

Nanotechnology – The Next Little Thing

Nanotechnology will enable the reconstruction and redesign of the body on an atomic level. Before that can happen, though, researchers will need to make several other tools: computers that can operate on a minuscule scale; "nanobots," or atomic-scale machines; "instruction architecture" to guide the nanobots; energy to power them; and a way to keep external environmental factors from interfering with them.

"The most complex capability of the human brain – what I would regard as its cutting edge – is our emotional intelligence."

Nanobots will have abilities that people lack now; for example, they will be able to deliver drugs to specific tissues, such as cancers. Nanobots will also create raw materials, speeding up manufacturing, and eliminating transportation and power costs. Some researchers think that with nanobots, they will be able to create energy from human waste products.

As all mechanical processes become more efficient, energy transmission will improve through the use of carbon nanotubes, and energy storage will become more sophisticated. Thus, energy use will plummet. Manufacturing will become energy-neutral – or perhaps even generate energy. Hydrogen fuel cells will decentralize the energy economy, reducing transportation costs.

"Nanotechnology promises the tools to rebuild the physical world – our bodies and brains included – molecular fragment by molecular fragment, potentially atom by atom."

The Turing Test

While people will undoubtedly use robots as tireless workers, robotics' most important role will be to advance the development of artificial intelligence. Though you may not have realized it, you've already encountered "narrow AI," or artificial intelligence that does just one thing, if you've used speech recognition or data mining software.

"Strong AI," however, is artificial intelligence that exceeds that of humans. By 2029, an AI machine will have aced the computer scientist Alan Turing's famous test – it will pass for a human in a conversation in natural language. Strong AI will change things even more than nanotechnology. One of the first things to which strong AI will direct its attention will be enhancing its own ability. It will augment, amplify and accelerate itself.

Researchers have already taken a number of preliminary steps in the development of strong AI. In addition to mapping human brain function and increasing storage and computational capacities, they have created the following:

- "Expert systems" – These can follow a set of logically consistent rules to perform a single task.
- "Bayesian networks" – These guide spam filters in sorting messages.
- "Markov models" – These can identify patterns using probabilities in some speech recognition software.
- "Neural nets and genetic algorithms" – These evolve solutions in response to environmental conditions.
- "Recursive searches" – These reflect back on their results.

"The advent of strong AI is the most important transformation this century will see. Indeed, it's comparable to the advent of biology itself."

Dangers of the GNR Revolution

Because of the far-reaching implications and complexity of GNR, responsible development and implementation are essential – yet, these have never been humanity's strong suit. Some dangers are easy to imagine, because they already exist: For example, the widespread use of computers has made the distribution of destructive information, such as how to build atomic weapons, easy.

Other dangers though, could be even more threatening – and they are often the same things that make the GNR revolution so exciting. For example, nanobots must replicate themselves to be effective; they are self-propagating machines. Yet, if that replication process goes on without ceasing, due either to malfunction or malice, nanobots could consume every bit of matter on earth – in as little as "three-and-a-half hours," according to one scientist, although a few weeks is more likely.

"Evolution moves toward greater complexity, greater elegance, greater knowledge, greater intelligence, greater beauty, greater creativity and greater levels of subtle attributes such as love."

While in theory, the scientific community could decide simply to turn away from certain risky fields and never develop them, the reality is that enforcing such a decision would require a repressive totalitarian state. This would drive experimentation underground, where only criminals and rogue nations would engage in it – leaving responsible people and nations unable to counteract their threats. Even though governments may be able to limit some applications, such as the self-replicating capacity of nanobots, their main strategy must be responsible, ethical development. They must streamline development processes for genetic technologies, build cooperation among nations, and educate everyone on the planet about both the promise and the danger of new technologies.

The Implications of the Singularity

The singularity will create a fundamental shift in humanity's understanding of the universe and its place within it. Humans are not limited beings made of matter but rather patterns of information. Death, and the limitations of space and matter will fade away. The singularity is the next step in human evolution.

About The Author

Ray Kurzweil is the author of *The Age of Intelligent Machines* and *The Age of Spiritual Machines*, and co-author with Terry Grossman of *Fantastic Voyage: Live Long Enough to Live Forever*. He is an inventor who received the National Medal of Technology in 1999.