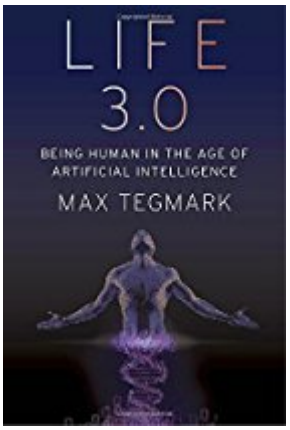
Reading Book Life 3.0: Being Human in the Age of Artificial Intelligence By Max Tegmark



How will Artificial Intelligence affect crime, war, justice, jobs, society and our very sense of being human? The rise of AI has the potential to transform our future more than any other technology—and there's nobody better qualified or situated to explore that future than Max Tegmark, an MIT professor who's helped mainstream research on how to keep AI beneficial. How can we grow our prosperity through automation without leaving people lacking income or purpose? What career advice should we give today's kids? How can we make future AI systems more robust, so that they do what we want without crashing, malfunctioning or getting hacked? Should we fear an arms race in lethal autonomous weapons? Will machines eventually outsmart us at all tasks, replacing humans on the job market and perhaps altogether? Will AI help life flourish like never before or give us more power than we can handle? What sort of future do you want? This book empowers you to join what may be the most important conversation of our time. It doesn't shy away from the full range of viewpoints or from the most controversial issues—from superintelligence to meaning, consciousness and the ultimate physical limits on life in the cosmos.

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Review “Original, accessible, and provocative.…Tegmark successfully gives clarity to the many faces of AI, creating a highly readable book that complements The Second Machine Age’s economic perspective on the near-term implications of recent accomplishments in AI and the more detailed analysis of how we might get from where we are today to AGI and even the superhuman AI in Superintelligence.… At one point, Tegmark quotes Emerson: ‘Life is a journey, not a destination.’ The same may be said of the book itself. Enjoy the ride, and you will come out the other end with a greater appreciation of where people might take technology and themselves in the years ahead.” —Science “This is a compelling guide to the challenges and choices in our quest for a great future of life, intelligence and consciousness—on Earth and beyond.” —Elon Musk, Founder, CEO and CTO of SpaceX and co-founder and CEO of Tesla Motors “All of us—not only scientists, industrialists and generals—should ask ourselves what can we do now to improve the chances of reaping the benefits of future AI and avoiding the risks. This is the most important conversation of our time, and Tegmark’s thought-provoking book will help you join it.” —Professor Stephen Hawking, Director of Research, Cambridge Centre for Theoretical Cosmology “Tegmark’s new book is a deeply thoughtful guide to the most important conversation of our time, about how to create a benevolent future civilization as we merge our biological thinking with an even greater intelligence of our own creation.” —Ray Kurzweil, Inventor, Author and Futurist, author of The Singularity is Near and How to Create a Mind “Being an eminent physicist and the leader of the Future of Life Institute has given Max Tegmark a unique vantage point from which to give the reader an inside scoop on the most important issue of our time, in a way that is approachable without being dumbed down.” —Jaan Tallinn, co-founder of Skype “This is an exhilarating book that will change the way we think about AI, intelligence, and the future of humanity.” —Bart Selman, Professor of Computer Science, Cornell University “The unprecedented power unleashed by artificial intelligence means the next decade could be humanity’s best—or worst. Tegmark has written the most insightful and just plain fun exploration of AI’s implications that I’ve ever read. If you haven’t been exposed to Tegmark’s joyful mind yet, you’re in for a huge treat.” —Professor Erik Brynjolfsson, Director of the MIT Initiative on the Digital Economy and co-author of The Second Machine Age “Tegmark seeks to facilitate a much wider conversation about what kind of future we, as a species, would want to create. Though the topics he covers—AI, cosmology, values, even the nature of conscious experience—can be fairly challenging, he presents them in an unintimidating manner that invites the reader to form her own opinions.” —Nick Bostrom, Founder of Oxford’s Future of Humanity Institute, author of Superintelligence "I was riveted by this book. The transformational consequences of AI may soon be upon us—but will they be utopian or catastrophic? The jury is out, but this enlightening, lively and accessible book by a distinguished scientist helps us to assess the odds." —Professor Martin Rees, Astronomer Royal, cosmology pioneer, author of Our Final Hour "In [Tegmark's] magnificent brain, each fact or idea appears to slip neatly into its appointed place like another little silver globe in an orrery the size of the universe. There are spaces for Kant, Cold War history and Dostoyevsky, for the behaviour of subatomic particles and the neuroscience of consciousness....Tegmark describes the present, near-future and distant possibilities of AI through a series of highly original thought experiments....Tegmark is not personally wedded to any of these ideas. He asks only that his readers make up their own minds. In the meantime, he has forged a remarkable consensus on the need for AI researchers to work on the mind-bogglingly complex task of building digital chains that are strong and durable enough to hold a superintelligent machine to our bidding....This is a rich and visionary book and everyone should read it." —The Times (UK) "Life 3.0 is far from the last word on AI and the future, but it provides a fascinating glimpse of the hard thinking required." —Stuart Russell, Nature "Lucid and engaging, it has much to offer the general reader. Mr. Tegmark's explanation of how electronic circuitry–or a human brain–could produce something as evanescent and immaterial as thought is both elegant and enlightening. But the idea that machine-based superintelligence could somehow run amok is fiercely resisted by many computer scientists....Yet the notion enjoys more credence today than a few years ago, partly thanks to Mr. Tegmark.” —Wall Street Journal "Tegmark’s book, along with Nick

Bostrom’s Superintelligence, stands out among the current books about our possible AI futures.…Tegmark explains brilliantly many concepts in fields from computing to cosmology, writes with intellectual modesty and subtlety, does the reader the important service of defining his terms clearly, and rightly pays homage to the creative minds of science-fiction writers who were, of course, addressing these kinds of questions more than half a century ago. It’s often very funny, too." —The Telegraph (UK) “Exhilarating….MIT physicist Tegmark surveys advances in artificial intelligence such as self-driving cars and Jeopardy-winning software, but focuses on the looming prospect of “recursive self-improvement”—AI systems that build smarter versions of themselves at an accelerating pace until their intellects surpass ours. Tegmark’s smart, freewheeling discussion leads to fascinating speculations on AI-based civilizations spanning galaxies and eons.…Engrossing.” —Publishers Weekly About the Author MAX TEGMARK is an MIT professor who has authored more than 200 technical papers on topics from cosmology to artificial intelligence. As president of the Future of Life Institute, he worked with Elon Musk to launch the first-ever grants program for AI safety research. He has been featured in dozens of science documentaries. His passion for ideas, adventure, and entrepreneurship is infectious. Excerpt. THE THREE STAGES OF LIFE The question of how to define life is notoriously controversial. Competing definitions abound, some of which include highly specific requirements such as being composed of cells, which might disqualify both future intelligent machines and extraterrestrial civilizations. Since we don’t want to limit our thinking about the future of life to the species we’ve encountered so far, let’s instead define life very broadly, simply as a process that can retain its complexity and replicate. What’s replicated isn’t matter (made of atoms) but information (made of bits) specifying how the atoms are arranged. When a bacterium makes a copy of its DNA, no new atoms are created, but a new set of atoms are arranged in the same pattern as the original, thereby copying the information. In other words, we can think of life as a self-replicating information processing system whose information (software) determines both its behavior and the blueprints for its hardware. Like our universe itself, life gradually grew more complex and interesting, and as I’ll now explain, I find it helpful to classify life forms into three levels of sophistication: Life 1.0, 2.0 and 3.0. It’s still an open question how, when and where life first appeared in our universe, but there is strong evidence that, here on Earth, life first appeared about 4 billion years ago. Before long, our planet was teeming with a diverse panoply of life forms. The most successful ones, which soon outcompeted the rest, were able to react to their environment in some way. Specifically, they were what computer scientists call “intelligent agents”: entities that collect information about their environment from sensors and then process this information to decide how to act back on their environment. This can include highly complex information-processing, such as when you use information from our eyes and ears to decide what to say in a conversation. But it can also involve hardware and software that’s quite simple. For example, many bacteria have a sensor measuring the sugar concentration in the liquid around them and can swim using propeller-shaped structures called flagella. The hardware linking the sensor to the flagella might implement the following simple but useful algorithm: “If my sugar concentration sensor reports a lower value than a couple of seconds ago, then reverse the rotation of my flagella so that I change direction.” Whereas you’ve learned how to speak and countless other skills, bacteria aren’t great learners. Their DNA specifies not only the design of their hardware, such as sugar sensors and flagella, but also the design of their software. They never learn to swim toward sugar; instead, that algorithm was hard-coded into their DNA from the start. There was of course a learning process of sorts, but it didn’t take place during the lifetime of that particular bacterium. Rather, it occurred during the preceding evolution of that species of bacteria, through a slow trial-and-error process spanning many generations, where natural selection favored those random DNA mutations that improved sugar consumption. Some of these mutations helped by improving the design of flagella and other hardware, while other mutations improved the bacterial information processing system that implements the sugar-finding algorithm and other software. Such bacteria are an example of what I’ll call “Life 1.0”: life where both the hardware and software is evolved rather than designed. You and I, on the other hand, are

examples of “Life 2.0”: life whose hardware is evolved, but whose software is largely designed. By your software, I mean all the algorithms and knowledge that you use to process the information from your senses and decide what to do—everything from the ability to recognize your friends when you see them to your ability to walk, read, write, calculate, sing and tell jokes. You weren’t able to perform any of those tasks when you were born, so all this software got programmed into your brain later through the process we call learning. Whereas your childhood curriculum is largely designed by your family and teachers, who decide what you should learn, you gradually gain more power to design your own software. Perhaps your school allows you to select a foreign language: do you want to install a software module into your brain that enables you to speak French, or one that enables you to speak Spanish? Do you want to learn to play tennis or chess? Do you want to study to become a chef, a lawyer or a pharmacist? Do you want to learn more about artificial intelligence (AI) and the future of life by reading a book about it? This ability of Life 2.0 to design its software enables it to be much smarter than Life 1.0. High intelligence requires both lots of hardware (made of atoms) and lots of software (made of bits). The fact that most of our human hardware is added after birth (through growth) is useful, since our ultimate size isn’t limited by the width of our mom’s birth canal. In the same way, the fact that most of our human software is added after birth (through learning) is useful, since our ultimate intelligence isn’t limited by how much information can be transmitted to us at conception via our DNA, 1.0-style. I weigh about 25 times more than when I was born, and the synaptic connections that link the neurons in my brain can store about a hundred thousand times more information than the DNA that I was born with. Your synapses store all your knowledge and skills as roughly 100 terabytes worth of information, while your DNA stores merely about a gigabyte, barely enough to store a single movie download. So it’s physically impossible for an infant to be born speaking perfect English and ready to ace her college entrance exams: there’s no way the information could have been pre-loaded into her brain, since the main information module she got from her parents (her DNA) lacks sufficient information-storage capacity. The ability to design its software enables Life 2.0 to be not only smarter than Life 1.0, but also more flexible. If the environment changes, 1.0 can only adapt by slowly evolving over many generations. 2.0, on the other hand, can adapt almost instantly, via a software update. For example, bacteria frequently encountering antibiotics may evolve drug resistance over many generations, but an individual bacterium won’t change its behavior at all, while a girl learning that she has a peanut allergy will immediately change her behavior to start avoiding peanuts. This flexibility gives Life 2.0 an even greater edge at the population level: even though the information in our human DNA hasn’t evolved dramatically over the past 50,000 years, the information collectively stored in our brains, books and computers has exploded. By installing a software module enabling us to communicate through sophisticated spoken language, we ensured that the most useful information stored in one person’s brain could get copied to other brains, potentially surviving even after the original brain died. By installing a software module enabling us to read and write, we became able to store and share vastly more information than people could memorize. By developing brain-software capable of producing technology (i.e., by studying science and engineering), we enabled much of the world’s information to be accessed by many of the world’s humans with just a few clicks. This flexibility has enabled Life 2.0 to dominate Earth. Freed from its genetic shackles, humanity’s combined knowledge has kept growing at an accelerating pace as each breakthrough enabled the next: language, writing, the printing press, modern science, computers, the internet, etc. This ever-faster cultural evolution of our shared software has emerged as the dominant force shaping our human future, rendering our glacially slow biological evolution almost irrelevant. Yet despite the most powerful technologies we have today, all life forms we know of remain fundamentally limited by their biological hardware. None can live for a million years, memorize all of Wikipedia, understand all known science or enjoy spaceflight without a spacecraft. None can transform our largely lifeless cosmos into a diverse biosphere that will flourish for billions or trillions of years, enabling our universe to finally fulfill its potential and wake up fully. All this requires life to undergo a final upgrade, to Life 3.0, which can design not only its software but also its hardware. In other words, Life 3.0 is the master of its own

destiny, finally fully free from its evolutionary shackles. The boundaries between the three stages of life are slightly fuzzy. If bacteria are Life 1.0 and humans are Life 2.0, then you might classify mice as 1.1: they can learn many things, but not enough to develop language or invent the internet. Moreover, because they lack language, what they learn gets largely lost when they die, not passed on to the next generation. Similarly, you might argue that today's humans should count as Life 2.1: we can perform minor hardware upgrades such as implanting artificial teeth, knees and pacemakers, but nothing as dramatic as getting ten times taller or getting a thousand times bigger brains. In summary, we can divide the development of life into three stages, distinguished by life's ability to design itself: · Life 1.0 (biological stage): evolves its hardware and software · Life 2.0 (cultural stage): evolves its hardware, designs much of its software · Life 3.0 (technological stage): designs its hardware and software After 13.8 billion years of cosmic evolution, development has accelerated dramatically here on Earth: Life 1.0 arrived about 4 billion years ago, Life 2.0 (we humans) arrived about a hundred millennia ago, and many artificial AI researchers think that Life 3.0 may arrive during the coming century, perhaps even during our lifetime, spawned by progress in AI. What will happen, and what will this mean for us? That's the topic of this book.

Customer Reviews Most helpful customer reviews 59 of 61 people found the following review helpful. A brilliant guide to the massive AI revolution headed our way By Anthony Aguirre The first chapter of Tegmark's new book is called "Welcome to the most important conversation of our time," and that's exactly what this book is. Before diving into the book, a few words about why this conversation is so important and why Tegmark is a central agent helping make it happen and, through the book, the perfect guide. Have you notice how you don't "solve" CAPTCHAs (Completely Automated Public Turing test to tell Computers and Humans Apart) anymore? That's because computers now can. Artificial Intelligence, from being a fairly niche area of mostly academic study a decade ago has exploded in the last five years. Much more quickly than many anticipated, machine learning (a subset of AI) systems have defeated the best human Go players, are piloting self-driving cars, usefully if imperfectly translating documents, labeling your photos, understanding your speech, and so on. This has led to huge investment in AI by companies and governments, with every sign that progress will continue. This book is about what happens if and when it does. But why hear about it from Tegmark, an accomplished MIT physicists and cosmologist, rather than (say) an AI researcher? First, Tegmark has over the past few years *become* an AI researcher, with 5 published technical papers in the past two years. But he's also got a lifetime of experience thinking carefully, rigorously, generally (and entertainingly to boot) about the "big picture" of what is possible, and what is not, over long timescales and cosmic distances (see his last book!) – which most AI researchers do not. Finally, he's played an active and very key role (as you can read about in the book's epilogue) in actually creating conversation and research about the impacts and safety of AI in the long-term. I don't think anyone is more comprehensively aware of the full spectrum of important aspects of the issue. So now the book. Chapter 1 lays out why AI is suddenly on everyone's radar, and very likely to be extremely important over the coming decades, situating present-day as a crucial point within the wider sweep of human and evolutionary history on Earth. Chapter 2 takes the question of "what is intelligence?" and abstracts it from its customary human application, to "what is intelligence *in general*?" How can we define it in a useful way to cover both biological and artificial forms, and how do these tie to a basic understanding of the physical world? This lays the groundwork for the question of what happens as artificial intelligences grow ever more powerful. Chapter 3 addresses this question in the near future: what happens as more and more human jobs can be done by AIs? What about AI weapons replacing human-directed ones? How will be cope when more and more decision are made by AIs what may be flawed or biased? This is a about a lot of important changes occurring *right now* to which society is, for the most part, asleep at the wheel. Chapter 4 gets into what is exciting – and terrifying – about AI: as a designed intelligence, it can in principle *re*design itself to get better and better, potentially on a relatively short timescale. This raises a lot of rich, important, and extremely difficult questions that not that many people have

thought through carefully (another in-print example is the excellent book by Bostrom). Chapter 5 discusses where what happens to humans as a species after an “intelligence explosion” takes place. Here Tegmark is making a call to start thinking about where we want to be, as we may end up somewhere sooner than we think, and some of the possibilities are pretty awful. Chapter 6 exhibits Tegmark’s unique talent for tackling the big questions, looking at the *ultimate* limits and promise of intelligent life in the universe, and how stupefyingly high the stakes might be fore getting the next few decades right. It’s both a sobering and an exhilerating prospect. Chapters 7 and 8 then dig into some of the deep and interesting questions about AI: what does it mean for a machine to have “goals”? What are our goals as individuals and a society, and how can we best aim toward them in the long term? Can a machine we design have consciousness? What is the long-term future of consciousness? Is there a danger of relapsing into a universe *without* consciousness if we aren’t careful? Finally, an epilogue describes Tegmark’s own experience – which I’ve had the privilege to personally witness – as a key player in an effort to focus thought and effort on AI and its long-term implications, of which writing this book is a part. (And I should also mention the prologue, which gives an fictional but less *science*fictional depiction of an artificial superintelligence being used by a small group to seize control of human society. The book is written in a very lively and engaging style. The explanations are clear, and Tegmark develops a lot of material at a level that is understandable to a general audience, but rigorous enough to give readers a real understanding of the issues relevant to thinking about the future impact of AI. There are a lot of news ideas in the book, and although it is sometimes written in a breezy and engaging style, that belies a lot of careful thinking about the issues. It’s possible that real, general artificial intelligence (AGI) is 100 or more years away, a problem for the next generation, with large but manageable effects of “narrow” AI to deal with over a span of decades. But it’s also quite possible that it’s going to happen 10, 15, 20, or 30 years from now, in which case society is going to have to make a lot of very wise and very important (literally of cosmic import) decisions very quickly. It’s important to start the conversation now, and there’s no better way. 0 of 0 people found the following review helpful. Amazing Read on the Future of AI By Boniface N. Osonwanne This book is a thoughtful examination of where we are now in AI innovation and the need for AI safety as technology races to a future of Artificial General Intelligence and Superintelligence and why as homo sapiens we need to think of ourselves as homo sentient (consciousness) and the need to have meaning/conscious/sentient AI as humanity explores/expands to the rest of our universe in the future, Life 3.0 18 of 19 people found the following review helpful. An exciting look into one of the most important conversations we will ever have By Lucas Perry Tegmark brings a refreshing perspective to what likely is one of, if not the, most important conversation of our time. After setting the stage and clearing the field of common myths and misconceptions regarding AI, Tegmark methodically moves through the emergence of intelligence in our cosmos some 4 billion years ago to the implications of what he calls "Life 3.0," entities which can both redesign their hardware and software. Couching the emergence and development of both consciousness and intelligence within the more cosmological world view of a physicist offers a truly inspiring narrative. Moving through hundreds, thousands, and billions of years with Tegmark solidifies the development of intelligence as a cosmological phenomenon which you come to realize that you yourself are a part of. Learning how intelligence is an emergent expression of more basic physical laws feels, at least to me, thoroughly grounding and deeply reestablishing of a real connection between me and the world. Chapters 6, 7, and 8 are my favorite and cover territory seldom explored in similar literature. In 6, he explores the capacity of artificial superintelligence to colonize the universe and the implications for the about 10 billion galaxies he estimates might be able to be colonized by it. Chapter 7 explores the emergence and evolution of goals at different levels of reality, ranging from thermodynamics to wet and squishy intelligences like you and me. In chapter 8, Tegmark explores consciousness and the mysteries and questions surrounding it, a topic I believe deserves far more attention than it is currently getting. This book is aimed at a wider audience than Bostrom’s Superintelligence, but even if you are an avid reader of all that concerns technology, the deep future, and AI, I'm certain you'll find novel content and an

enjoyable recontextualization of AI from the perspective a physicist. On a less serious note, I really love that the author summarizes the most important points at the end of each chapter. It helps me remember everything. :p See all 35 customer reviews...

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