

The Artelect War

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Will massively intelligent machines replace human beings as the dominant species in the next few decades?

The “species dominance” issue will dominate our global politics this century, resulting in a major war that will kill billions of people. The issue is whether humanity should build godlike, massively intelligent machines called “artilects” (artificial intellects), made possible by 21st-century technologies and having mental capacities trillions of times above the human level. Society will split into three major philosophical groups, all murderously opposed to each other.

Artelect-Enabling Technologies

The following 21st-century technologies will result in the creation of an artificial brain industry and the creation of rival national brain-building institutions and projects equivalent to NASA and the European Space Agency for space travel.

Information Storage and Femtosecond Switching

Gordon Moore, cofounder of the microprocessor company Intel, noticed in 1965 that the number of transistors on an integrated circuit (chip) was doubling every year or two. This trend has continued for nearly 50 years, and is expected to remain valid for another 15 years or so until transistors reach atomic size.

Extrapolating “Moore’s law” down to storing one bit of information on a single atom by about 2020, a handheld object will be able to store a trillion trillion bits of information. Such a device is called an Avogadro machine. An Avogadro machine could “flip” the state of a single atom (from 0 to 1) in a femtosecond (10^{-15} seconds), a total processing speed of $\sim 10^{40}$ bits /second.

Reversible Computing

If computing technology continues to use its traditional irreversible computational style, the heat generated in atomic scale circuits will be so great they will explode. A reversible, information-preserving computing style will be needed, and this is usually called “reversible computing”. This would not generate heat, allowing 3D computing, and would have no limit to their size. As a result, artilects could become the size of asteroids, kilometres across, with vast computing capacities.

Nanotechnology

Nanotechnology (i.e. molecular-scale engineering) will allow Avogadro machines to be built. Nanotech is the “enabling technology” for artelect building.

Artificial Embryology

One of the greatest challenges of 21st-century biology is to understand “development” (i.e. the embryogenic process in which a fertilised single cell grows into an animal comprising 100 trillion cells. Once this process is well understood, technology will be able to create an artificial embryology process to manufacture products. This “embryofacture” will be used to build complex 3D artilects.

Evolutionary Engineering

The complexities of artelect building will be so great – after all, the human brain has a quadrillion (10^{15}) synapses between neurons in the brain – that an evolutionary engineering approach will be needed that applies a “genetic algorithm” approach to engineering products. Artilects will be built using this technique.

(Topological) Quantum Computing

Quantum computing could become exponentially more powerful than classical computing. It can compute 2^n things at a time (compared to classical computing's one thing at a time), where n is the number of (qu)bits in the register of the quantum computer. Topological quantum computers store and manipulate the qubits in topological quantum fields, and are thus robust against noise. Topological quantum computers will soon make quantum computers practical. Artefacts will be such devices.

If the artefact can be made intelligent using neuroscience principles, it could become truly godlike, massively intelligent and immortal.

Nanotechnology's Impact on Brain Science

Today's most powerful supercomputers have reached the estimated bit processing rate of the human brain (i.e. about 10^{16} bits per second), but they are far from being intelligent by human standards. What is needed to make them humanly intelligent is knowledge from the neurosciences about how the human brain uses its brain circuits to perform intelligent tasks. Nanotechnology will furnish neuroscience with powerful new tools to discover how the brain works. This knowledge will be quickly incorporated into the building of artefacts.

Incredible Mental Capacities

We know that the estimated bit processing rate of the human brain is approximately 10^{16} bit flips per second. This figure is derived from the fact that the human brain has about 100 billion neurons (10^{11}), with each neuron connecting with roughly 10,000 other neurons (10^4). This amounts to a quadrillion synapses, each signalling at a maximum rate of about 10 bits per second.

Thus the human bit processing rate is $10^{11+4+1} = 10^{16}$ bits per second. As mentioned previously, a handheld artefact could flip at 10^{40} bits per second. An asteroid-sized artefact could flip at 10^{52} bits a second. Thus the raw bit processing rate of the artefact could be a trillion

trillion trillion (10^{36}) times greater than the human brain. If the artefact can be made intelligent using neuroscience principles, it could become truly godlike, massively intelligent and immortal.

The Species Dominance Debate

The "species dominance" debate has already started, at least in English-speaking countries. The fundamental question is whether humanity should build artefacts or not. This issue will dominate our global politics this century, and may lead to a major war killing billions of people.

As artificial brain-based products (e.g. genuinely useful household robots) become smarter every year, people will be asking questions such as: "Should humanity place an upper limit on robot and artificial brain intelligence? Can the rise of artificial intelligence be stopped? What are the consequences for human survival if we become the number 2 species?"

The question "Should humanity build godlike, massively intelligent artefacts?" is the most important of the 21st century, and will dominate our century's global politics. It is the equivalent of "Who should own capital?", which dominated 19th- and 20th-century global politics and led to the rise of the capitalist-communist dichotomy and the Cold War.

As the species dominance debate begins to heat up, humanity will split into three major philosophical groups. The Cosmists (based on the word *cosmos*) will be in favour of building artefacts. The Terrans (based on the word *terra*, meaning "earth") will oppose building artefacts, and the Cyborgists (part-machine, part-human) will want to become artefacts themselves by adding artefactual components to their own human brains.

The dispute between the Terrans and the Cosmists/Cyborgists will be so bitter that a major war is almost inevitable in the second half of this century.

The Cosmist Perspective

Human beings live a puny 80 years in a universe billions of years old that contains a trillion trillion stars. The cosmos is the "big picture". Cosmists want artefacts to become a

part of that big picture, understanding it, travelling through it and manipulating it, hence the name of the ideology “cosmism”. The preoccupations of human beings seem pathetic in comparison.

Scientific Religion

Most Cosmists are not religious, viewing traditional religions as superstitions invented thousand of years ago before the rise of science. But as humans they feel the pangs of religious impulse. Such impulses could be satisfied by Cosmism, a “scientist’s religion” due to its awe, its grandeur, its capacity to energise and its vision.

Building Artelect Gods

The primary aim of the Cosmists will be to build artelects. It will be a kind of religion to them: the next step up the evolutionary ladder, the “destiny of the human species to serve as the stepping stone to the creation of a higher form of being”. In building artelects, the Cosmists will feel they will be “building gods”.

Human Striving Cannot Be Stopped

It is human nature to be curious, to strive. Such tendencies are built into our genes. Building godlike artelects will be inevitable because we humans will choose to do it. It would run counter to human nature not to do it.

Economic Momentum

Once the artificial brain and intelligent robot industries become the world’s largest, worth trillions of dollars per year, it will be very difficult to stop their growth. The economic momentum will be enormous.

Military Momentum

The military momentum will be even greater. In the timeframe we are talking about, China will overtake the US as the century’s dominant power. Since China is still a brutal one-party dictatorship that has killed more people than the regimes of Stalin or Hitler, it is despised by the US so political rivalries will only heat up. Each ministry of defence cannot afford to allow the other to get ahead of it in areas such as intelligent soldier robot design. Hence Cosmism will be an entrenched philosophy in the respective defence departments. Even if American and Chinese citizens become alarmed

by the closure of the “IQ gap” between human intelligence and home robot intelligence over the next few decades, their respective governments will not listen to their cries for reasons of “national defence”.

View of the Terrans

Preserve the Human Species

The major argument of the Terrans is that the artelects, once they become hugely superior to human beings, may begin to see us as grossly inferior pests and decide to wipe us out. As artelects, this would be easy for them. The Terrans would prefer to kill off a few *million* Cosmists/Cyborgists for the sake of the survival of *billions* of human beings. Recent wars were about the survival of countries. An artelect war would be about the survival of the human species. Since the size of the stake is so much higher, so also will be the passion level in the species dominance debate.

Fear of Difference

Terrans will be horrified at the idea of seeing their children becoming artelects and thus becoming utterly alien to them. They will reject the idea viscerally and fear the potential superiority of the artelects. They will organise to prevent the rise of the artelects and cyborgs and will oppose the Cosmists ideologically, politically and, eventually, militarily.

Rejection of the Cyborgists

The Terrans will also be opposed to the Cyborgists because, to a Terran, there is little difference between an advanced cyborg and an artelect. Both are artelect-like, given the gargantuan bit processing rate of “nanotech” matter that can be added to the brains of human beings. The Terrans will lump the Cyborgists into the Cosmist camp, ideologically speaking.

Unpredictable Complexity

Given the likelihood that artelects will be built using evolutionary engineering, the behaviour of artelects will be so complex as to be unpredictable, and therefore potentially threatening to human beings. One of the keywords in the species dominance debate is “risk”. Terran global politicians need to hope for the best (e.g. that the artelects will leave the

planet in search of bigger things and ignore puny humans) yet prepare for the worst (i.e. exterminating *millions* of Cosmists/Cyborgists for the sake of the survival of *billions* of human beings).

Cosmist Inconsideration

The Terrans will argue that the Cosmists/Cyborgists are supremely selfish since by building artefacts, or making themselves artefacts, not only will they put the lives of the Cosmists at risk if the artefacts turn against them, but also the lives of the Terrans. To prevent such a risk the Terrans will, when push really comes to shove, decide to wipe out the Cosmists/Cyborgists for the greater good of the survival of the human species.

“First Strike” Time Window to React Against the Cosmists/Cyborgists

The Terrans will be conscious that they cannot wait too long because, if they do, the cyborgs and the artefacts will have already come into being. The Terrans will then run the risk of being exterminated by the artefacts/cyborgs. So the Terrans will be forced into a “first strike” strategy. They will have to kill off the Cosmists and Cyborgists before it is too late. If not, the artefacts and cyborgs will have become too intelligent, too powerful in any human–machine confrontation, and will easily defeat the humans. But the Cosmists/Cyborgists will be reading the Terran arguments and preparing for an artefact war against the Terrans using latter 21st-century weaponry.

Aims of the Cyborgists

Become Artefact Gods Themselves

The primary aim of the Cyborgists is to become artefacts themselves by adding artefactual components to their own human brains, converting themselves bit by bit into cyborgs and eventually into artefacts. Instead of watching artefacts become increasingly intelligent as observers, Cyborgists want that experience for themselves. They want to “become gods” themselves.

Avoid the Cosmist–Terran Clash

Some Cyborgists argue that, by having human beings become artefacts themselves, the dichotomy between the Cosmists and the

Terrans can be avoided because all human beings would become artefacts. The Terrans, of course, will reject the Cyborgists and lump them with the Cosmists and artefacts. In reality, the growing presence of cyborgs in daily life will only hasten the alarm and alienation of the Terrans and bring their first strike closer.

How the Artefact War Heats Up

Nanoteched, molecular-sized robots will revolutionise neuroscience because they will provide a powerful new tool to understand how the brain works. An entire human brain could be simulated in vast nanoteched computers and investigated “in hardware”. Neuroscience would finally be in a position to explain how brains make human beings intelligent. That knowledge would be implemented in the artefacts.

In time, neuroscience and neuroengineering will interact so closely that they will become one, in the same way as theoretical and experimental physics are two aspects of the same subject. Neuroscientists will be able to test their theories on artificial brain models, thus rapidly increasing the level of understanding of how intelligence arises and how it is embodied.

With a much higher level of artificial intelligence based on knowledge of the human brain, artificial brains and artificial brain-based home robots will become a lot more intelligent and hence useful as domestic appliances. A vast industry of artificial brain-based products will be created, becoming the world’s largest, worth trillions of dollars per year.

Once neuroscientists and brain-builders understand how human intelligence is created, new theories about the nature of intelligence will be created by “theoretical neuroscientists”. An “intelligence theory” (IT) will be created, and human intelligence will be just one data point in the space of possible intelligences. Intelligence theory should show how it is possible to increase intelligence levels. It will be able to explain why some people are smarter than others, or why humans are smarter than chimps, for example.

As a result of the marriage of neuroscience and neuroengineering, the artificial brain-based industries will deliver products that increase their intelligence every year. This trend of

growing intelligence will cause people to ask the questions mentioned before. The species dominance debate will spread from the intellectual technocrats to the general public via the media and blockbuster Hollywood movies.

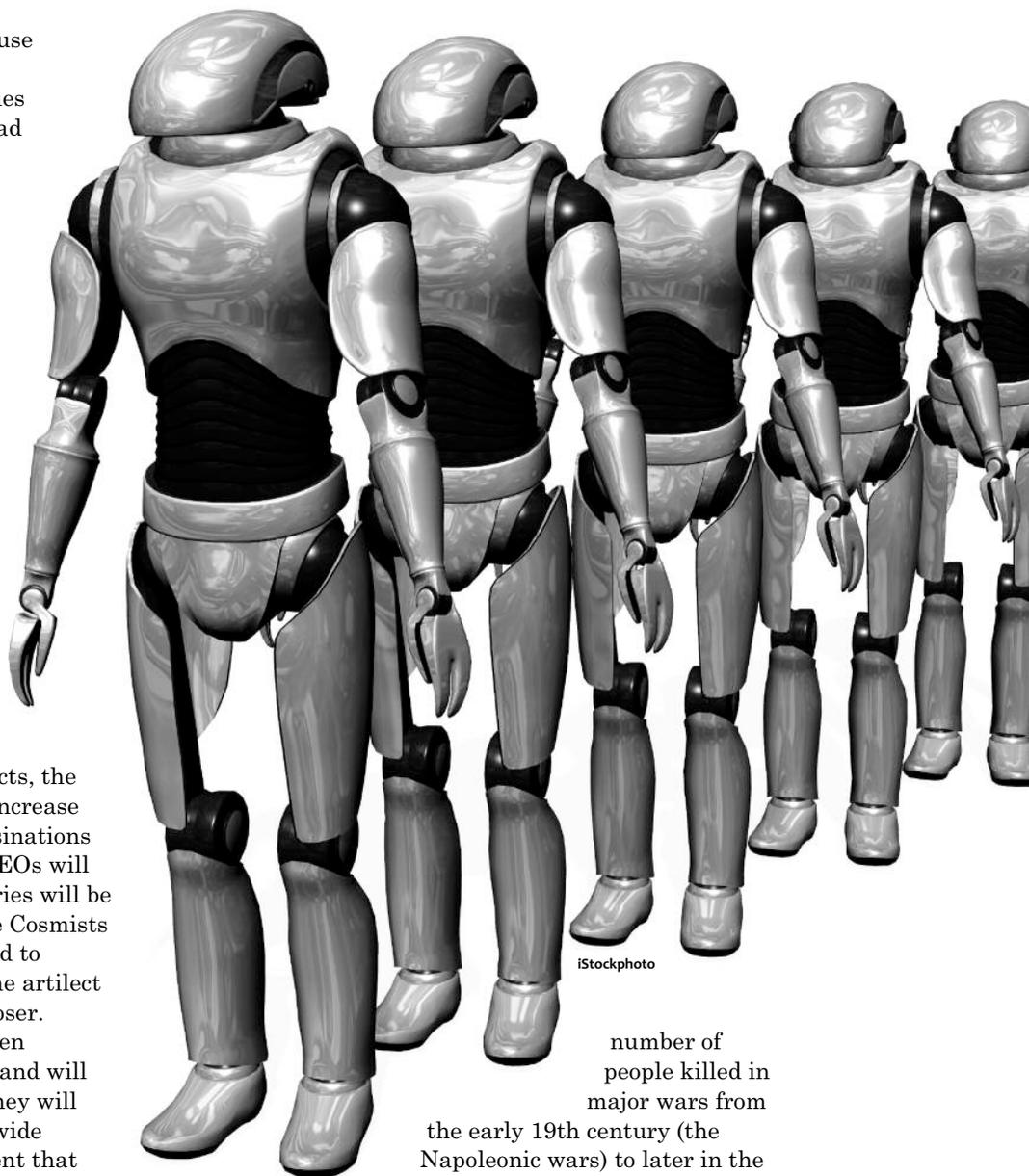
As the IQ gap between home robots and human beings becomes increasingly smaller, the species dominance debate will begin to rage. The three schools of thought will form, and the rhetorical exchange will become less polite and more heated as the IQ gap closes.

When people are surrounded by ever-increasingly intelligent home robots and other artificial brain-based products, the general level of alarm will increase to the point of panic. Assassinations of brain-builder company CEOs will start, and home robot factories will be arsoned and sabotaged. The Cosmists and Cyborgists will be forced to strengthen their resolve. The artilect war will be drawing ever closer.

The Terrans will have been organising for a first strike and will have made preparations. They will then take power in a worldwide coup of the global government that is likely to exist by mid-century, and begin exterminating the Cosmists and Cyborgists in a global purge, exterminating millions of them – or at least that is the Terran plan.

The Cosmists/Cyborgists will be following the arguments of the Terrans very closely, and will be preparing equally for a confrontation against the Terrans. They will have their own plans and their own weapons and militaries. If the Terrans strike first, a quick reply will follow from the Cosmists/Cyborgists, and the artilect war will have begun.

If one extrapolates up the graph of the



number of people killed in major wars from the early 19th century (the Napoleonic wars) to later in the 21st century (the artilect war), then one predicts that *billions* of people will be killed using latter 21st century weapons. This “gigadeath” figure is the characteristic number of deaths in any major latter 21st-century war. About 300 million people were killed for political reasons in the 20th century.

Who Believes in the Risk of the Artilect?

At the end of the talks I give on this topic, I usually invite my audiences to vote on the

following question: “Do you feel personally that humanity should build artefacts, these godlike massively intelligent machines, despite the risk that they might decide, in a highly advanced form, to wipe out humanity?” The result is usually around an even Cosmist–Terran split. Most people, like me, are highly ambivalent about artefact building. They are awed by the prospect of what artefacts could become, and horrified at the prospect of a gigadeath artefact war.

The early artefacts... could be made “human-friendly”, but once they start performing “evolutionary engineering” experiments on part of themselves to vastly increase their mental capacities there will be no way to ensure the “human-friendly” outcome.

The fact that the Cosmist–Terran split is so even will make the artefact war all the more divisive and bitter. This divisiveness can be expressed in the form of the following question: Do we build gods, or do we build our potential exterminators?

During the past year I have handed out questionnaires to four different groups of 30–50 people each on the issue of species dominance. The first one was given to a group of electronic engineers in Melbourne. Sixty per cent of them thought that an artefact war is coming. Even half of the members of the various transhumanist organisations (who usually think that an artefact war is improbable) think that the rise of artefacts would pose an “existential risk” to human beings – so the future looks pretty gloomy.

Is the Artefact War Avoidable?

If an artefact war, killing billions of people, occurs in the mid–late 21st century, then young people alive now will probably still be alive to be part of it, and therefore will probably be killed in it. This is such a depressing prospect that it

is understandable that much effort in the transhumanist research community is devoted to trying to make artefacts “human-friendly”. Some brain-builders think that it may be possible to make artefacts so that they remain friendly towards human beings, even once they have modified themselves into vastly superior creatures.

Personally, I am extremely sceptical that this is possible. The early artefacts, still a little bit dumber than their human programmers, could be made “human-friendly”, but once they start performing “evolutionary engineering” experiments on part of themselves to vastly increase their mental capacities there will be no way to ensure the “human-friendly” outcome.

It is virtually certain that advanced artefacts will have attitudes towards human beings that will be totally alien to us. Humans will not be able to predict these attitudes, so there would always be a risk that the artefacts could turn out to be very “human-unfriendly”. Therefore Terran politicians will not tolerate the construction of superhuman artefacts and, when the IQ gap between humans and machines is about to close, will go to war against the Cosmists/Cyborgists to stop the rise of the artefact.

Another approach to avoiding an artefact war is to have *all* humans become cyborgs. If this could be done “lock step”, so that everyone advances at the same rate simultaneously (e.g. with everyone adding the same artefactual components to their heads at the same time), then the argument of the Cyborgists that “an artefact war could be avoided because there would be no Terrans nor Cosmists left to fight it” would be valid – but it is an entirely unrealistic precondition.

In reality there would be “cyborgian divergence”. The cyborgs would advance in many different directions, and at different speeds. Many people would remain ardent Terrans, choosing not to modify themselves at all. To the Terrans, there is not much difference between an advanced cyborg and a pure artefact given the huge computing capacity of nanotech, one bit per atom, matter. The presence of millions of cyborgs in their midst would only render the Terrans even more paranoid and fearful.

The Terrans could not help noticing that the cyborgs and artefacts keep getting smarter every

year, so if the Terrans want human beings to remain the dominant species, the Terrans will have to “first strike” and prepare for it before they become too stupid.

There are, however, scenarios where humanity escapes an artelect war. For example, the artelects come into being far faster than anyone had anticipated, so that there is not enough time for human politics to react. Then the artelects quickly decide that their fate lies far from the Earth and into the cosmos. They simply leave, sparing humanity.

This is a possibility, but less likely than the scenario in which it takes decades to figure out how the human brain works in order to put the principles of the functioning of the human brain into artificial brains and reach human intelligence and consciousness levels in machines. Thus there will be enough time for

human politics to unfold. The Terrans will have enough time to prepare for the artelect war, and so will the Cosmists/Cyborgists to defend themselves against the anticipated first strike of the Terrans.

In my view, the most realistic scenario is in fact the worst. I’m very glad to be old now (mid-60s). I will probably live for another 20–30 years, time enough to see the species dominance debate rage but not the artelect war. I will be lucky enough to live between the two major wars – World War II and the artelect war. I will die peacefully in my bed, but the young generation will not. They will be caught up in the horror of gigadeath and will not survive it.

Professor Hugo de Garis is the technical advisor to a major Hollywood film studio that is currently making a movie on the themes of this article. His essays and international media videos are at <http://profhugodegaris.wordpress.com>

Machine to Human: I Know You

A dot-sized part of a face may soon be all that is needed to identify a person, according to a face recognition expert at The University of Western Australia.

Ground-breaking research by Associate Professor Ajmal Mian is investigating how to use satellite technology to identify facial features that lie under the skin.

“Multi-spectral imaging can be used to measure light reflected off a face at hundreds of discrete wavelengths in the visible spectrum and beyond,” he said.

Professor Mian, an Australian Research Fellow who has worked in the field for eight years, said his research may also be able to detect people who have used cosmetic surgery to alter their looks.

“Recognition based on sets of facial images from surveillance cameras, YouTube videos, Google Images or personal photo albums is more accurate because they contain more information,” he said.

“Face recognition technology is being used increasingly for computer log-ons, identity checks and surveillance, and is a boom industry around the world.

“It can be used in any kind of machine such as mobile phones, computers and robots. It’s the most user-friendly way to authenticate someone, and is now so sophisticated that machines can identify a face no matter what the expression.

“Humans are very good at finding a familiar face in a crowd but less able to identify someone they may have seen only once. This is where machines outperform people because they can memorise images and never tire of matching them to faces in a crowd.”

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Professor Ajmal said face recognition technology was better than fingerprinting because it didn’t require special equipment or an expert to verify the results.

Also, any part of a face could be used, and many images of a person’s face – including different expressions and poses – could be merged to make a composite image that was more meaningful to the machine.

“Humans can recognise a person regardless of whether they’re laughing, frowning, crying or sleeping. Machines may soon be able to do the same.”

Source: University of Western Australia