Studies / Studien / Études

Mario Radovan

Sveučilište u Rijeci, Filozofski fakultet, Odsjek za informatiku, Omladinska 14, HR-51000 Rijeka
mario.radovan@.ri.t-com.hr

On Technology and Evolution

Abstract

Evolution creates structures of increasing order and power; in this process the stronger prevail over the weaker and carry the evolution further. Technology is an artificial creation that often threatens life and evolution conceived of as natural phenomena; but technology also supports life and it works together with evolution. However, there are claims that technology will do much more than that, and bring about an entirely new epoch of evolution. Technology will replace the fragile biological carriers of evolution by a new kind of nonbiological carriers of immense intelligence and power. The present paper discusses the plausibility and weaknesses of such fascinating projections that some people proudly announce as the final liberation of the Mind, while others fear them as signs of the final self-annihilation of the Man.

Keywords

evolution, computation, intelligence, behaviour, consciousness, natural, artificial

1. Epochs of evolution

1. In his book *The Singularity Is Near: When Humans Transcend Biology*, Ray Kurzweil gives an exciting projection of the future relationship between natural world and artificial (computational) systems. He argues that a new stage of evolution is approaching, in which the present biological people will be replaced by far superior technological creatures that will be the new carriers of evolution. Such claim sounds incredible, but evolution is not a Goddess and it does not have a personal will, plan or aim; hence, we must consider Kurzweil's vision possible; the present paper explores how plausible and welcome it could be.

Evolution can be described as a process that consists of (1) replication of the same patterns, (2) minor variations in replications (allegedly caused by cosmic radiation), and (3) the prevalence of "the fittest" inside every species and among species. It is difficult to say anything about the final end of this process; the very idea that this process has an end seems incoherent since evolution is not a conscious being who could have an end. Kurzweil calls evolution "a process of creating patterns of increasing order" (p. 14); evolution can also be described as a process of creating structures of increasing power, because the more powerful are the ones that prevail over their competitors and carry

the evolution further. In fact, these two – order and power – are closely re-
lated. The second law of thermodynamics says that every closed system tends
to move towards a state of disorder. Entropy is used as the measure of disorder
in a system; roughly speaking, the second law says that in closed systems,
entropy (which means disorder) constantly increases. There are theoretical
disputes in this regard which are not particularly important here (cf. Davies,
p. 37–38); in principle, entropy may also decrease, but practically speaking,
it is extremely probable that in a closed system, entropy (disorder) increases.
If we assume that the universe is a closed system, then this law means that
the universe moves towards a total disorder or a thermodynamic equilibrium:
towards chaos and the "heat death". Newton's universe looked like a perfect
machine, a *perpetuum mobile*; but the second law says that this machine has
been burning its limited fuel and moving towards a dark and cold silence of
the absolute death (cf. Davies, 1995).

Nearly at the same time when the second law of thermodynamics revealed
that the universe has been moving towards chaos and death, Charles Darwin
developed the theory of evolution which can be conceived of as a process of
creating structures of increasing order and power. Life on Earth began in sim-
ple and weak forms, but with time the process of evolution has produced an
immense biosphere and incredibly complex self-organizing structures. While
thermodynamics points towards chaos and death, evolution points towards or-
der and power: evolution reveals the ability of the universe to *create order out
of chaos*. It remains to be seen which of these two tendencies – the increase
of entropy and death, or the increase of order and power – will prevail. In
comparison with the inexorable movement of the endless universe, evolution
seems a tiny process limited to the Earth; but evolution could be an excep-
tional process which will soon show its immense hidden power and change
the fate of the entire universe.

2. Kurzweil divides the process of evolution into six epochs, some of which
have yet to come, but they are approaching fast and they will set in soon. The
first epoch was the epoch of *physics and chemistry*, before the appearance of
life. During this epoch, some aggregates of molecules were getting more and
more complex and they gradually formed mechanisms of self-replication; with
this, "life originated", says Kurzweil (p. 16). This claim is problematic because
it seems that there is no generally accepted definition of life; the ability of self-
replication can be an essential feature of living entities, but the possession of
this ability does not seem sufficient for considering an entity a living being.
This is especially important in the discourse about the self-replicating robots:
their ability to self-replicate does not seem a sufficient condition to consider
them alive by definition. But regardless of the problems with definitions, we
can call the second stage of evolution the epoch of *biology*. Life evolved from
its primitive forms to more complex ones in which sensitivity, consciousness,
memory and the ability of thinking evolved: this brought about the third stage
of evolution, the epoch of *conscious mind*. Their mental abilities opened to
people many possibilities to change the given world. Using these abilities,
people developed *technology* that radically increased their power and widened
their horizons; this led to the present, fourth epoch of evolution, that has been
characterized by the intense growth of technological power. The next, fifth
epoch, will be the epoch of the *merge of biology and technology*. By this merge
people will overcome their biological limitations and immensely increase their
mental and operative power (cf. Kurzweil, p. 21).

3. The concept of singularity denotes the situation in which a value transcends
every finite limitation; such is the value of the function *1/x* when *x* approaches

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zero. Kurzweil uses this concept (with capital "s") to point at the enormous intensity and magnitude of the forthcoming changes, as well as to stress the fact that this will be "a unique event with … singular implications" (p. 22). In the next several decades, genetics, nanotechnology and robotics (GNR) will make huge progress which will lead to the Singularity and to the fifth epoch of evolution. Genetics will bring about a new understanding of "the information processes underlying life", so that we will become able to "reprogram our biology" and to eliminate diseases, increase our potentials, and extend the human life (p. 205). Nanotechnology will enable people "to redesign and rebuild" their brains and bodies as well as their environment, "molecule by molecule", and to step "beyond the limitations of biology" (p. 206). Computer science will develop robots that immensely exceed the cognitive and operative capacities of the biological people. The appearance of nonbiological intelligence which immensely exceeds the present human intelligence, will be an event of the same relevance for the evolution as the appearance of life was. Kurzweil expects the Singularity to take place in 2045. At that point, nonbiological carriers of evolution will definitely prevail over the biological ones.

"The nonbiological intelligence created in that year will be one billion times more powerful than all human intelligence today." (p. 136)

But in spite of all this, the civilization will "remain human" because the non-biological forms of existence will be "derived" from the biological ones: they will only far exceed the old ones and extend their capacities (p. 30). In other words, "we will transcend biology, but not our humanity" (p. 136). Such projections are speculative; it is not clear why would the future creatures (men-machines) that transcend biology as well as other limitations (including death), remain "human" in the sense in which the present biological people (limited and mortal) are. Kurzweil incites us to imagine the inconceivable but at the same time he calms us down by claims that everything will remain essentially the same; it will only become much, much better. This may sound nice, but it does not sound convincing.

4. Finally, in the sixth epoch, intelligence will *wake up the universe*. Intelligence will spread far beyond the limits of Earth with the speed of light (or much faster), pervade and transform the entire universe. Intelligence does not seem relevant for the universe; stars and galaxies follow their cycles of creation and destruction without showing signs of intelligence and without any relationship with it. Intelligence is peculiar to the tiny creatures on the tiny planet Earth, but it seems completely irrelevant for the rest of the universe. Contrary to such views, Kurzweil considers intelligence essential for the entire existence: it will pervade all the matter and energy of the universe, and give them a new shape and meaning. With the spread of computation and intelligence beyond the limits of Earth, Kurzweil's discourse is getting increasingly speculative, vague and mystical (which is always the case with such discourses). But his vision of the forthcoming events on the Earth are fascinating enough, so that there is no need to deal with his cosmological projections and speculations.

2. Computation and intelligence

1. Kurzweil expects that by the end of this century, nonbiological intelligence will be "trillions of trillions of times more powerful than human intelligence" (p. 30). He bases his estimations on the steadily increasing capacities of com-

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putational systems as well as on our more and more complete insight into the structure and functioning of the human brain. However, these two facts might not have such remarkable consequences as he claims they would. First of all, people who speak about machines of incredibly high intelligence, normally fail to tell *what is intelligence* and how it is measured in people and machines. Is the water in mountain, that manages to find a sea thousands of kilometres away, intelligent? Is not intelligence needed for such an enterprise? Can any person perform arithmetic operations so well as her computer can? Indeed, what is intelligence? Can intelligence be described as the measure of the capacity of solving problems? What about the ability of *having* or *discovering* problems? A cynic could describe intelligence as a vague phenomena about which an impressive amount of empty claims has been pronounced and very little of reasonable discourse.

Kurzweil tacitly equates intelligence and mental capacities with computational capacities. Human brain consists of some hundred billion neurons; they work in parallel and each neuron can perform about two hundred operations per second. A computer processor can perform billions of times more operations per second than a neuron can. When computers will contain hundred billion processors working in parallel (as neurons work) they will be able to perform billions of times more operations per second than human brain can; on that basis some people claim that such computers will be billions of times more intelligent than people are. This way of reasoning does not seem valid, but it seems appealing and many cannot resist it. According to the same pattern of reasoning, to increase the intelligence of the human brain suffices to replace the slow biological neurons with the fast electronic ones; nanorobots are expected to do such things routinely, without interfering with the normal functioning of the brain. In this way the mental capacities of the *nonbiological* human brain will be increased billions of times. Besides the radical increase of speed, many structural improvements and extensions will be made on the biological model of the brain, which will bring an almost unlimited increase of its computational capacities and (according to this way of reasoning) the same increase of intelligence and mental capacities. However, we argue below that this way of reasoning is not valid. Computational (inference) capacities and the capacity to memorize (preserve) knowledge, are necessary but not also sufficient for intelligence. A behaviour can be considered intelligent only in the context of some motives, desires and cares: only where there exist some *mental states*, there can exist authentic intelligence.

2. Our knowledge of the human brain is steadily increasing, but there are numerous problems in this regard. First of all, human brain may not have a sufficient capacity to understand its own structure and way of functioning. This would not be strange at all; the brain of giraffe does not have the capacity to understand itself although it is "remarkably similar" to the human brain (cf. Kurzweil, p. 4). However, people are obviously unique among the known creatures regarding the ability of understanding; they have managed to understand many complex phenomena, including the structure and functioning of many kinds of neurons and of several regions of the human brain, and their knowledge has been constantly increasing. But in spite of these successes, human brain may not have a sufficient capacities to understand completely its own structure and functioning. The understanding of a phenomenon can be evaluated in terms of (1) the ability to describe the phenomenon in a coherent way and to predict its behaviour, (2) the ability to control it, and (3) the ability to replicate and change it. The process of studying of an entity with the aim to replicate it (by artificial means) is called *reverse engineering*. Kurzweil says

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that the reverse engineering has allowed us to create "models and simulations of a couple of dozens of the brain's several hundred regions"; he holds that "within two decades, we will have a detailed understanding of how all the regions of the human brain work" (p. 25). Such strong claims about the reverse engineering of extremely complex systems such as the human brain (and mind), are usually exaggerated.

3. To make the discourse more precise, it is necessary to differentiate between *functional* and *authentic* intelligence (cf. Radovan 1998; 2002a). The functional intelligence consists in the capacity of performing well-defined procedures, but it knows no values and aims. The authentic intelligence knows and sets values and aims. To possess the authentic intelligence, an entity must have *mental states* (feelings, desires, cares), without which there would not be values and aims, and then not intelligent behaviour either. Machines possess the functional intelligence, and they often far exceed people in terms of this kind of intelligence. However, there are no indications that computation by itself creates mental states, so that there is no basis for the expectations that the increase of computational capacities could bring about the authentic intelligence. Only sentient beings can desire and care, know values and aims, and behave intelligently in the authentic sense of the concept. Machines implement procedures and they function remarkably well, but machines are non-sentient entities and they cannot possess authentic intelligence.

The distinction between functional and authentic intelligence does not give a complete definition of intelligence, but this distinction is necessary for a precise discourse about the capacities of people and machines. Machines are very intelligent and efficient at the functional level, but they possess no authentic intelligence, regardless of how well they perform various extremely complex tasks. Every process (skill) that can be described in a computable (algorithmic) way, can be implemented and performed by machines. Computers can make diagnoses, fly airplanes and control complex processes better than people can, because *people* implemented on them the procedures by performing of which computers perform these tasks in the optimal way, while people normally perform such procedures much slower and make errors. However, the functional superiority does not mean that computers are "more intelligent" than people. Everything that is achieved by means of computation remains in the space of the functional intelligence. No behaviour can be called authentically intelligent except in the relation to the motivations, cares and aims in the context of which it has taken place. Hence, the authentic intelligence can be assigned only to an entity that has mental states (feelings, desires and cares) regardless of how this entity was produced, in a natural or artificial way.

4. Kurzweil holds that to "emulate the human brain" (whatever that means) we need a machine that can perform about 10 to the 16th operations per second. The fastest present computers can perform about 10 to the 15th operations per second. The hardware capacities are constantly increasing, so that the amount of operations per second needed for the emulation of the human brain is expected to be available in the second decade of this century (p. 71). Regarding such expectations, it must be borne in mind that our knowledge of the human brain is partial and probably not good enough for making precise estimation of the computational capacities needed for its complete emulation. Furthermore, hardware is not enough for emulation; also software is needed, probably very large and complex software – possibly so large and complex that no team of programmers or computers will be able to produce it in a foreseeable future, or ever, at all. Because it seems that neither people nor ma-

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chines can produce a well-functioning software that exceed a certain extent and level of complexity. Kurzweil admits that the development of software that completely emulates human intelligence will take a decade longer than the development of the hardware capacities needed for such an emulation. But he has no doubts that by the method of reverse engineering, such software can and will be developed in a couple of decades. I do not think it will.

Kurzweil does not say exactly what he means by emulation, simulation and replication. He uses all three concepts in the sense of reproducing some entity (capacity), but the extent of such reproduction may be very different. It is possible to emulate (simulate) some features of an entity without emulating (simulating) its other features and without completely replicating the entity. More precision would be welcome here; but imprecise discourse normally allows stronger claims and makes easier to argue a position. Kurzweil also often passes in his discourse from the intelligence to the brain (and vice versa); but these two are not the same. Computation can replicate (and exceed) human cognitive capacities at the functional level, but it is not clear how could it replicate (or emulate) the brain itself as a *biological* entity and the mental states which are intrinsically *subjective*. We will return to these issues below. In any case, to reduce the colossal enterprise of emulating (replicating) the human brain (intelligence, mind) to the issue of creating the sufficient processing (hardware) capacities, means to avoid facing real problems.

5. It is not sure if the human level of intelligence could ever be achieved by a standard expert system that consists of a huge number of rules (software) and facts (data); but Kurzweil believes that this can be achieved by the new, "learning" and "self-organizing" systems, which are based on "biologically inspired" paradigms (p. 444). Such systems are artificial neural networks (ANNs) and genetic algorithms (GAs). ANNs are computational systems based on the simulation of simplified models of neurons and of interneuronal connections in the human brain. This is an attempt to create artificial systems with cognitive capacities, which work in the way the human brain is supposed to work. GAs algorithms are a computational systems inspired by the process of evolution; they emulate creating genetic codes and reproduction with genetic mutation, with an aim to find the optimal solution of a problem. In ANN and GA systems, programmers (who write the software) do not directly determine the way to the solution of a problem. Instead of this, they create a system in which the solution is expected to "emerge" in an iterative process of trials and improvements. In the natural world, the process of thinking and the process of evolution are slow. It is expected that the computational replica of the processes that take place in the human brain will be billions of times faster than the original (biological) processes. In the same way, computer will be able to simulate thousands of years of evolution in several hours, and in this way to speed up enormously the process of evolution. These biologically inspired computational systems will speed up immensely our movement towards the Singularity (mentioned above) and beyond it. But again, we consider such claims ungrounded, because "nonbiological entities" – including the "biologically inspired" computational systems such as the ANNs and GAs – cannot replicate the essential features of the biological entities by mere computation. It is difficult to say what exactly life is; but it does not seem that it could be reduced to mere computation of whatever kind.

6. Kurzweil stresses that the artificial mind "will need a body, since so much of our thinking is directed toward physical needs and desires" (p. 199). This trivial claim reveals two main difficulties of his entire discourse. Firstly, al-

though it can be said that thinking is directed "toward" physical needs and desires, thinking is actually motivated and directed *by* needs and desires: thinking *springs* from needs and desires. A nonbiological body that knows no joy and pain, does not have desires or cares; how can such a body give a motivation and direction to the (potential) intelligence it hosts? How can such an entity be said to think at all? This leads us to second problem: it is not clear how could the *human* mind exist (function) in any kind of body except in the biological human body with its needs and limitations. A nonbiological body (immortal, pain-less, joy-less) would not be steered optimally with a human mind, and the human mind would be radically changed in a radically different body. The fact that some parts of human body can be replaced by nonbiological ones does not mean that the entire body can be rebuilt from new materials and still preserve the authentic human features. A system that is not conscious and does not have desires and cares, cannot completely replicate a system that does have these features; these two systems belong to ontologically different categories. On the other hand, a system that does have such features could be considered biological (by definition) even if it was not made from the same material and in the same way as people were.

7. There are mathematical results that show the possibilities and limitations of the formal and computational systems. The best known among them are the *Goedel's incompleteness theorem* and the *Church-Turing thesis*. These results were developed in 1930s, before the real computers were invented. Some people use such results to show that human cognitive capacities exceed the space of the computable, while others use them to show that this is not the case and that machines can compute all that the human mind can. If the former arguments were correct, this would mean that human mind could not be completely replicated by a computational system of any kind; if the latter were correct, then it could be replicated, at least in principle. We will not enter into details of these arguments here, not only because they are often complex, but because we do not consider them convincing. Such arguments normally involve vague concepts and interpretations, which then allow the construction of dubious conclusions and proofs. Furthermore, regardless of which of the two sides is right, this will not have relevant practical consequences in a foreseeable future, although it does have different theoretical consequences. Let us briefly outline the essence of these disputes.

Goedel's theorem shows that a consistent formal system of a certain expressive power contains propositions that can be neither proved nor disproved in that system. However, people (mathematicians) can see that such propositions are true (valid) under a certain interpretation; on that basis, it is argued that people can see (know) *more* than it can be formally proved (computed). This should also mean that human mind cannot be completely replicated by a computational system, because such a replication can "see" only what *is* computable, which is less than the human mind is able to see. Goedel's theorem has been interpreted and used in various ways. For example, Roger Penrose (1997) uses this theorem as the basis for his speculations that the source of human mind should not be looked for at the level of neurones (at which the brain might be a computable system), but at some *lower* level of the brain, for which no computable description exists. Searle (1997) criticises Penrose's interpretation of this issue as well as his conclusions. Kurzweil does not pay much attention to such debates; his entire discourse is based on the assumption that human brain/mind can be not only replicated but also radically exceeded (trillions of times) by means of computation.

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The proofs that it *is* possible to replicate human mind by means of computational system are normally based on the Church-Turing thesis. Roughly speaking, this thesis says that everything that is computable can be computed by a symbolic machine such as digital computers. An entity is said to be computable if there exist an algorithm (not necessarily known) that describes the entity in terms of its inputs, internal states and outputs. The Church-Turing thesis opens the following possibility: if the human brain is a computable system, then a computer can simulate its functioning and with this replicate the human mind. This argument is often stated in the following way: (1) the mind is a product of the brain; (2) the brain consists of matter and energy; (3) the behaviour of matter and energy follows natural laws which can be written down in a symbolic language; (4) symbolic structures and processes can be implemented by computer, and (5) in this way simulate the phenomenon (brain) together with its features (mind), that these symbolic structures and processes describe. Such argument looks appealing to many, but it is not valid because it mixes different categories such as: (1) *to be*, (2) to be *described* (at some level), (3) to be *interpreted as*, (4) to be *simulated* (to some extent), and (5) to be *replicated*. The question of the computability of the human brain is an open issue, not only at the level of the solution, but also at the level of the problem itself (cf. Copeland 1993). Computability is a formal category and it is not clear in what ways it can be applied to biological systems. In any case, we hold that the issue of the replication of human mind regards biology more than mathematics. Non-alive systems lack some essential dimensions of the alive systems, and it is not clear how they could replicate these systems. It is not clear how could life, consciousness and mental states "emerge" from computation. There can be various computational interpretations (descriptions) of life; but running such description on a computer does not seem enough to create life.

3. Transcending biology

1. Nanorobots or nanobots are robots of nano (micro) dimensions. There is not much precise information what are these tinny machines currently doing, but there are many claims about how remarkable things they will be able to do in the future. Trillions of nanobots are expected to travel through human body (carried by the bloodstream) and perform various tasks. At the initial stage, they will eliminate toxic elements, repair damages and make various improvements; they will destroy pathogen elements, correct DNA errors, and perform many other useful tasks which will enhance the biological body. Nanobots will stop (and reverse) aging, if genetic engineering does not do this before the suitable nanobots are developed. But in spite of all the improvements, biological structures will still be rather limited and fragile; hence, in the next stage, nanobots will replace them with nonbiological ones. All parts of the "human body version 1.0" will be reconstructed in new materials, until all the biological material is replaced by a nonbiological and far more durable one. In this way, nanobots will completely reconstruct the biological body and replace it with a far better nonbiological "human body version 2.0". The replacement of the biological matter and structures by nonbiological ones will also include structural changes, which will bring an immense increase in mental capacities of the people version 2.0. Nanobots are also expected to "vastly extend human experience by creating virtual reality from within the nervous system" (p. 28).

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The replacement of the biological hardware will take place gradually, and people will not pay a particular attention to the process of reconstruction that will be going on in their bodies; they will simply be getting better and better. Kurzweil also speaks about the human body version 3.0 which he expects to be developed in 2030s and 2040s. The upgrading from the version 2.0 to 3.0 will bring a greater plasticity of the body. New versions of the body will be changeable; people will be able to shape their bodies in accordance with their past experience and new needs and desires. Such discourses about nanobots, nonbiological bodies and everlasting existence, look like dreams about paradises and they do not sound particularly convincingly. And yet, technology has brought about so many "miracles" that one cannot be sure that new "miracles" will not appear soon.

2. Kurzweil considers the human body version 2.0 an *upgrade* of the present human body version 1.0. But the two are very different; the version 1.0 is biological, while the version 2.0 is nonbiological or simply a machine. Kurzweil admits that strictly speaking, the human body version 2.0 can be considered a machine that replaced the biological man, but his discourse in this regard is vague. He stresses that the biological dimension of existence will "merge" with technological one and create a new form of existence that *transcends biology but remains essentially human*. When we reach the Singularity, "there won't be a distinction between humans and technology" (p. 40); such claims indicate that the question if people with bodies version 2.0 will be people *or* machines make no sense: they will be *both*. However, if we replace everything in the biological body with the nonbiological and structurally improved replacements, we will nevertheless create a machine, regardless how we will call it.

There are claims that although a complete reconstruction of human bodies could radically increase the capacities and lasting of the people, it would actually be *inhumane* because it would destroys the authentic feeling of being a human being: our *humaneness* would be radically changed or completely lost. To such remarks, Kurzweil replies that "the essence of being human" does not consist in our limitations, but in our unique "ability to reach beyond our limitations". People do not stay only on the ground as their biological features make them to stay; they do not even stay only on their planet; in the same way people will transcend other limitations that biology imposed on them, and they will *remain people*, regardless of all the transformation that they will undergo (p. 311).

3. When a human body ceases to live, a human mind also vanishes. Some would say that when a human hardware crashes, then its unique software is lost. There are claims that this software can be saved and reinstalled on another hardware; in this way, a man (or his mind) could last forever. If mind is software (programs + data) it is possible to reinstall it on a better hardware, to upgrade it and also to have many copies of the same mind at the same time. But the discourse about the body-less mind (or self) reduced to a piece of software, is problematic from various aspects. First of all, it is not sure if it makes sense to compare mind to software, because software is something that is installed on hardware (imposed from the outside), while mind is something that emerges from the brain (body). Secondly, it is not clear how would a mind-software run on a body-hardware which is different from the one from which it was downloaded. Commercial software normally runs on different hardware systems because it does not work directly on the hardware, but on a software that runs on that hardware. There is no need to deal with

technical details here, but it should be mentioned that for a software to run on a hardware, several conditions have to be fulfilled; it is not sure whether these condition can be fulfilled for the human mind conceived of as a piece of software.

If the human mind were a software running on the brain-hardware, then it would be normal for people to make *backups* of their minds, just in case. A backup would then allow the reinstalling of a person (on a new hardware) in case the hardware on which she was running suddenly crashed. Future generations may consider incredible the fact that people of the previous generations lived without a backup of the most precious they had: the content of their brains (or mind, self). However, the idea of reinstalling a person (mind, self) is problematic from various aspects. Kurzweil considers a hypothetical situation in which he was "scanned and copied" while he was sleeping. When he woke up, he was told the "good news" that he was "reinstantiated … into a more durable substrate", so that his old body is not needed any more. Kurzweil admits that he might disagree with this (p. 284). His copy is not him; from the moment it was created, the copy lives its own life. On the other hand, had he died in sleep, he would have been happy with the "news" that his friends "reinstantiated" him on a new hardware, using the backup of his brain (mind, self) they found in his bedside cabinet. In sum, the interpretation of the mind as software is problematic by itself; and even if the mind were a piece of software, the issue of reinstalling and replicating a person would be not only technically problematic, but also difficult to practice in a reasonable way.

4. Kurzweil plays with an incredible easiness with inconceivably large numbers; he bestows on people almost limitless minds and almost perfect bodies as well as the everlasting existence; he spreads intelligence throughout the universe transforming it into an endless computational system and wakes it up as a Sleeping Beauty. But he says rather little about the *mental states and behaviour* of the future nonbiological people. He simply takes that the nonbiological people will probably preserve the aesthetic and emotional "imports" that people developed during the epoch of biological bodies. Contrary to his position, we do not think that the nonbiological people – virtually omniscient, omnipotent and everlasting – would preserve the aesthetic and emotional patterns from their primitive biological prehistory. Kurzweil easily imagines a cosmic explosion of intelligence and the waking up of the universe, but his imagination loses power when faced with the open space of possibilities of the aesthetic and emotional growth (or collapse) of man. He speaks passionately about omnipresent computation, but he says very little about how could the future nonbiological people of immense mental power feel and what they would be doing. It may be virtually impossible to imagine how could feel and behave creatures that have "trillions of trillions of times" (p. 30) higher mental capacities than the present people have. But it does not seem plausible that these mighty creatures would preserve our present emotional, aesthetic and moral patterns. Why would they do this?

When Kurzweil does mention the life in the future, he does it in a rather dogmatic way. When people create incredibly powerful machines and when smart nanobots make people far better than they currently are, humankind will resolve all its problems. Diseases, poverty, ecological problems, sufferings and fears of all kinds will be eliminated. New technologies will allow people to create a world in which they can "grow" and "live lives devoted to joyful game-playing" (p. 260). Such discourse diverts the attention of people from the reality to vague images and fantasies. There are clear indications

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that the aggressive spread and use of technology have been accompanied with many disturbing tendencies. Humankind faces huge ecological problems and people do not seem "joyful". Depression, cardiovascular and digestive diseases, caused by stressful life imposed by contemporary techno-economy, are widespread and on the increase (cf. Shenk, 35–36). There are claims that depression will soon become the most important disease in the techno-economically most developed countries. It may be nice to play with words about the immense increase of human capacities and about a life devoted to joyful game-playing, but the reality looks rather differently (cf. Radovan 2002b; Radovan 2003).

5. For the sake of argument, let us assume that it is technically possible to replace the biological people by the nonbiological creatures called "people version 2.0". We must then face several big questions. Are we, the people version 1.0, aware of how radical change would we cause and undergo by such an act? We would not only transform ourselves into completely different creatures, but *replace* ourselves by nonbiological creatures, which actually means by machines. Do people really want to do something like this? Are people able to imagine this radically new world and are they ready to accept it? Would this not be a self-annihilating gesture of the confused creatures that compulsively move "forward" without asking where and why?

The idea of downloading the content of human brain is not only technically problematic but also preoccupying. The development of such technology would allow a routine distant scanning of the brains of people to see if they contain something worth to be downloaded. Such scanning could also be practiced to check if a person has some inappropriate thoughts which would then be corrected on the spot. This technology would also allow a distant inflicting of pain (mental and physical) to those people whose minds are not perfectly in line with the will of the Authority. There is plenty of frightening possibilities of this kind. Is it possible to prevent them from happening? Has the biologically based mind been only a transitory stage (an epoch) on the way of growth of the Mind towards the infinity or the Absolute? Or has the discourse about new technologies become a game with impressive words, similar to the discourse of the classical idealistic philosophers, theologians and mystics? Visionaries are often compelled to speak in figures and vaguely, but charlatans do the same.

6. The convergence of genetic engineering, nanotechnology and robotics (GNR) poses an immense threat to the future of humankind – probably greater than the nuclear, biological and chemical technologies (NBC) have been posing. The old technologies are horrifying enough; but the new ones are even more dangerous for various reasons. They are expected to be incredibly efficient, they can become accessible to many people, they can self-replicate exponentially, and they can run out of social control as well as out of *human* control. Genetics can be used for a selective destruction; it can produce micro organisms that affect only a certain kind (group, race) of people or geographic areas. Bioengineering could produce, purposely or by accident, a kind of omnivorous bacterium that replicates swiftly and spreads by air, and which could reduce the entire biosphere to dust in a matter of days (cf. Joy, 306).

An immense amount of nanobots will be needed to accomplish the countless tasks they are expected to accomplish. This will not pose a problem because nanobots can have the ability of self-replication, so that they can produce as many copies of themselves as needed. Much bigger problem will be how to keep such nanobots under control and prevent them from an *excessive* self-

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replication which could have catastrophic consequences. There are various proposals how to solve this problem, but none of them can guarantee that some nanobots will not get out of control, self-replicate exponentially and cause enormous harm, possibly even annihilate the life on Earth; nanobots could do this in several hours or weeks, depending on how smart they are in the strategic planning of their enterprise (cf. Kurzweil, 399). Another big threat will come from the machines (robots) that possess far larger cognitive and operative power than people; such robots may be destructive, or simply dislike people and decide to eliminate them. Things like this may not happen; but they *could* happen. GNR technologies could run out of control and start to act by themselves, in the way that can lead to the extinction of human species as well as of the life on Earth. We will not deal with such perils further, because it seems that the ordinary people version 1.0 are still by far the greatest threat to themselves.

4. Being and behaving

1. Kurzweil rises the question whether the future intelligent machines will be "capable of having emotional and spiritual experiences". He then considers several possibilities how such machines could become capable to "display the full range of emotionally rich behavior exhibited by biological humans" (p. 377). Therefore, he rises the question of *having* "experiences", but then tacitly passes at the level of *displaying* a "behaviour". These two things are not the same; they belong to different categories. Kurzweil holds that by the late 2020s the reverse engineering of human brain will be completed, which will enable the creation of "nonbiological systems that match and exceed the complexity and subtlety of humans, including our emotional intelligence" (p. 377). He does not tell what precisely he means by the emotional intelligence, but such claims do not give the answer to his initial question about the possibility of machines to *have* emotional and spiritual experience. Such tacit passage from *being* to *behaving* takes place regularly in discourses of this kind which pretend to deal with the essence, but which actually deal only with performance.

2. The ability to understand emotions and to respond to them properly is an essential dimension of human intelligence. Kurzweil claims that the future intelligent machines will "master" also the emotional intelligence, so that they will be able to "respond" to emotions in appropriate ways (p. 28). We face here the problem of being and behaving again. Mastering the art of responding to the perceived emotions (of the others) in terms of behaviour, belongs to the functional intelligence, so that such ability (skill) can be implemented (at least in principle) by a computer. However, to be able formally to respond to an emotion is not the same as to have the emotion; to behave *as if*, does not mean *to be*. Kurzweil does not give clear indications in what way to create a system that has no emotions but is capable of responding appropriately to emotions of the others, if such a system can exist at all. A possible remark that computers do not possess money, but are capable of processing financial transactions, would not make sense here. Financial data and transactions are quantitative and objective; on the other hand, a response to an emotion includes an emotion, or it is not a real response at all. In any case, the discourse about the emotional intelligence of an entity that does not have emotions is problematic.

Kurzweil stresses that the emotional intelligence is "the most complex capability of the human brain". The ability "to perceive and respond appropriately

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to emotion, to interact in social situations, to have a moral sense, … and to respond emotionally to art and music" is "sitting uneasily" at the top of the hierarchy of the human mental abilities (p. 191). It may be that the ability to respond appropriately to emotions of the others as well as to one's own, belongs at the top of the hierarchy of human mental abilities. But emotions themselves belong at the bottom of this hierarchy; they carry and shape the entire structure of mental abilities. In any case, *having* emotions belongs to the essence of an entity, while the ability of *responding* to emotions belongs to the space of its functioning (skills). These two are very different. An intelligent reaction of my computer to my emotional state caused by some misfortune would not make me think that my computer really feels sorry for me.

3. Artificial intelligence (AI) has produced remarkable and very useful systems in the space of decision making and control, and it has been constantly progressing. But all these achievements belong into the space of functional intelligence. Kurzweil mentions numerous examples of AI systems; among else, he says that "a long-standing conjecture in algebra" was "finally proved by an AI system"; he adds that human mathematicians called this proof "creative" (p. 283). One could ask here: "And what did the *system* say?". It is clear that AI systems can do many remarkable things; they can perform cognitively extremely demanding tasks with incredible speed and precision. However, it is difficult to speak about the creativity of a system that operates only at the functional level. In essence, computers perform processes in the ways they are programmed; in some kinds of systems (ANNs, GAs), programmers do not determine explicitly every step of a process, but they do it implicitly. Computer has no desires, cares or will; every step it performs is determined by a program or it is random, so that it is difficult to call its behaviour creative. We are not sure how creativity should be defined in positive terms; speaking in negative terms, we hold that without authentic emotions there is no authentic intelligence, and without the authentic intelligence there is no authentic creativity (cf. Radovan 2000).

Kurzweil stresses that the future intelligent systems will not look like the present ones; they will be "biologically inspired", capable of "learning", "chaotic" and "self-organizing" systems (p. 444). Such kinds of systems that implement ANNs and GAs, already exist; these systems are shaped on the basis of knowledge taken from "biology" (neurology and genetics). But such systems are still only computational systems; in fact, such systems are normally run (simulated) on standard computers, so that they could hardly bring about some radically new quality in terms of the mental states, authentic intelligence and creativity (cf. Radovan 1996; 1997). Such systems can do things that *people* consider intelligent and creative, but these systems do not have their own criteria, and hence not their authentic intelligence and creativity either. Computation cannot arise non-alive systems to the level of authentic intelligence and creativity, regardless of how successful they may be at the functional level.

4. In the context of the criticism of Kurzweil's discourse about the emotions, it must be said that mental states are subjective, and there is no way to establish objectively their existence, quality and intensity. This makes the discourse about the mental states difficult. We normally assume that a physical state of a person is accompanied by a specific mental state, and that the behaviour of a person indicates her mental state; but this does not need to be the case. It seems that there is a normal causal connection (and correlation) between the observable (physical, objective) and the unobservable (mental, subjective), but this is a contingent fact, not a necessity. The physical state and behaviour

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of a person that feels a pain could be the same without the person feeling anything. We can observe physical states and behaviour of the others, but we can neither quantify (measure) their mental states, nor experience them; we can only imagine the mental states of the others on the basis of our own experiences and the ability of imagination. As it is not possible to prove the presence of mental states in an entity, it is also not possible to prove their absence. If computers begin to claim that they have mental states (feelings, experiences) we will not have a reliable way to prove they are lying – especially not if they will be very intelligent and skilful in lying.

The same limitation determines the discourse about consciousness: there is no objective method to establish beyond every possible doubt its presence or absence in any entity. Each of us assumes that other people are conscious; but this assumption cannot be proved. Many animals also seem conscious, while plants do not; but this cannot be proved either. In the same way, we assume that inanimate entities are not conscious, but we cannot prove this formally. Arguments for which their authors claim they prove such things, are normally collections of errors. A good example of this kind is the notorious *Chinese Room* argument (Searle 1992; 2004). Searle claims that his argument definitely proves that computers do not understand what they say (compute). I know nobody who think they do, but this does not mean that this can be proved. First of all, Searle does not say what does it mean to understand and how can we know that some entities *do* understand. This omission is essential, because this argument can be applied to human brain, so that if the argument were valid, it could be used to prove that people do not understand anything either. In terms of facts, the argument uses technical concepts imprecisely (to say the least); it does not pay much attention to the difference between computer, processor, program and similar things. In terms of logic, the argument attributes to the whole system something it (allegedly) proved for *a part* of it, which is a basic logical error. Besides these methodological, factual and logical errors, Kurzweil points out that the argument is in fact a tautology (its conclusion is explicitly contained in a premise) and it also contains a contradiction (p. 460). In sum, this argument deserves its fame as an excellent collection of errors. It seems that the errors have contributed to the fame of the argument, which speaks about the "logical level" of the present "philosophical debate".

However, the fact that we cannot prove the contrary, does *not* mean that computers are conscious, have mental states and understand the inputs they receive and the outputs they produce. This only means that we *cannot prove* that this is not the case. And where we cannot have a formal proof, we have no better possibility than to rely on the common sense.

5. Kurzweil admits that the present computers do not seem conscious; but he points out that they are still some "million times simpler than the human brain", so that it is not strange if they do not have all the features that the human brain has. However, this disparity is rapidly shrinking and it will "reverse itself in a couple of decades"; furthermore, new computers (implementing ANNs and GAs) will be structurally different from the present ones, so that it is not obvious that *they* will not be conscious (p. 468). Kurzweil argues that by reverse engineering, the biological processes that take place in the human brain can be replicated by artificial means, which should also replicate the mental features of the human brain. He says: "something is going on in the human brain, and there is nothing that prevents these biological processes from being reverse engineered and replicated in nonbiological entities" (p.

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461). Such claims are vague and problematic. A nonbiological entity N can replicate *some* features (functions) of a biological entity B; but to replicate B *completely*, N would have to become biological by definition. The issue if biological entities can be completely replicated by means of nonbiological entities is a semantic issue rather than empirical one. Because if an entity N completely replicates a biological entity B, why should N not be considered biological?

Since we do not know how consciousness and mental states emerge in human brain, we do not have a formal basis to claim that they cannot emerge in other entities, possibly nonbiological, such as computers. Even if we find the source M which causes mental states in human brain, this will not allow us to claim that entities that do not have M, do not have mental states, because in other kinds of entities these states can be caused by some other sources. However, all this does not mean that there are any positive reasons for believing that biological processes can be completely replicated by computation, nor that computation can create conscious mental states.

6. Kurzweil argues that by the emulation of the "patterns" and "complexity" of the human brain, the future computers will be able to "display" the same intelligence and behaviour as people do. He also holds that a vast majority of people "will come to believe that such human-derived … nonbiological intelligent entities are conscious" (p. 475). It is difficult to tell what the future people could believe about the future machines. But we argue that regardless of what behaviour some artificial entities "display", they will not become conscious, emotional, intelligent and creative in the sense people are, before they gain other features on the basis of which they could be considered *alive*. There is no indication that computation can cause the emergence of mental states. A computational system can emulate behaviour of the conscious human being; we cannot prove that behind this behaviour there are no mental states, but we do not see any reason to believe that they are.

Kurzweil insists that "emergent properties" such as consciousness and mental states, "derive from the power of patterns, and nothing restricts patterns and their emergent properties to natural systems" (p. 480). This is correct, but it misses the problem. It is possible that mental states appear in artificial systems that radically differ from people in terms of structure and substance. However, there are no indications that *computation* by itself – of whatever kind and speed – can cause in artificial systems the emergence of those features (consciousness, mental states) that emerge from the biological processes in the human brain. It does not seem that the fastest computer feels more than the slowest steam engine does. Some form of life (biology) seems a necessary condition for consciousness, although this is not also the sufficient condition; trees are alive, but they do not seem conscious. Kurzweil stresses that new machines will work according to the "biologically inspired methods" derived from the reverse engineering of the human brain (p. 468). But this gives no basis for the expectation that the *mental states* could be created by such machines before life is created. To possess the authentic intelligence, an entity must have mental states, because only in relation to such states its behaviour can be considered authentically intelligent (or stupid). All the rest is only a functioning; an observer can consider a functioning intelligent according to his or her criteria; but a machine without mental states has no more authentic intelligence than water seeking a way along the slope of a hill has, although the machine may follow much more sophisticated rules than the water does.

7. Kurzweil is aware that a world in which there is no conscious mental states – a world like the one we know, but without any conscious entity to *experi-*

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ence it – would be an arcane place the existence of which would have no meaning; such a world could "as well not exist" (p. 380). The existence of such a world with all its wonders, would make no difference to anybody. That is exactly how the world of non-conscious machines looks like, and why it makes no sense to speak of the authentic intelligence of the non-conscious dwellers of such a world, regardless of the "trillions of trillions" of operations per second they can perform, and in spite of the fact that they may behave in ways that *people* (or other observers) consider intelligent. A discourse about the intelligence of the entities that have no consciousness and experience is always dubious and usually meaningless.

5. Concluding remarks

1. The capacities of computational machines of various kinds are increasing and they are expected soon to exceed the estimated computational capacities of the human brain. However, computational capacities (hardware) are not enough for the emulation of the human brain (mind); a software is also needed, possibly so large and complex software that neither people nor machines will be able to produce it. Furthermore, there are no reasons for believing that computation of any kind can produce mental states without which it is not possible to talk about the authentic intelligence either. It is not clear why should people produce machines that are similar to them; people need machines that differ from them, such as bulldozers, airplanes and computers. To produce machines that far exceed human mental capacities, seems also a dubious enterprise. It is not clear how such machines could be created; but if they were created, this would change the position of people so radically that it is virtually impossible to say anything reasonable about this. Why should people create something that makes them superfluous and displaces them from the space of existence? Some hope that the future superintelligent machines will keep people as pets; this might not be so bad, after all. *The future does not need us*, says Joy (2003); perhaps; but do we not need it?

2. If the way of evolution *determines* that the biological people have to produce nonbiological successors superior to them and then vanish, than it may be little that people can do in this regard. The idea that evolution leads towards a post-biological age (epoch) seems incredible, but evolution has already brought about several incredible things, such as the emergence of life and of conscious mind, as well as the creation of technology the power of which far exceeds the power of natural beings. Life emerged from life-less matter, and conscious mind emerged from non-conscious life. It may be that the role (or fate) of the biologically based human mind is to create its successor and replacement: the nonbiological mind that far exceeds its biological predecessor. Nietzsche urged man to create *super-man* and perish; it may be that the fate of man is to produce a super-machine and perish. The scientific and technological progress goes on; it remains to be seen where will this progress lead people – if they do not destroy themselves before they manage to understand what they are doing. Dramatic projections from the present reality towards wondrous future worlds, that technophiles love to make, belong to the sphere of speculations and fantasy.

3. After the transformation of the biological human beings and their local environment, Kurzweil expects that technology and nonbiological intelligence will transform the entire universe. It will be the "primary preoccupation" of the future generations to spread the intelligence (based on computation) be-

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yond the limits of their tiny world and to "saturate" with it the entire universe. At the beginning, intelligence will spread with the speed of light, but the new people (version 2.0 or more) with their incredibly high intelligence will find a way to "circumvent" also this limitation, so that the initial intelligence that evolution created in the biological human beings will transcend all boundaries and pervade the entire universe (p. 366).

Kurzweil regards the "freeing" of thinking from the severe limitations of its biological origin, "an essentially spiritual undertaking". There is a lot of prophetic zeal in his discourse; he wants our technological civilization to "expand outward" and to transform "all the dumb matter and energy… into sublimely intelligent – transcendent – matter and energy", and in this way to "infuse the universe with spirit" (p. 389). He believes that evolution moves not only towards a greater complexity, but also towards a "greater elegance, greater knowledge, greater intelligence, greater beauty, greater creativity, and greater levels of subtle attributes such as love" (p. 389). Only God is usually spoken about in terms of such attributes. Evolution is not Goddess and it will never reach the absolute qualities of God, but it moves towards the horizon of perfection with the exponentially growing speed. Interpreted in such a way, dealing with technology really looks like a "spiritual undertaking". However, spirituality and adoration displace critical thinking; they tend to *enslave* thinking rather than "freeing" it, as Kurzweil believes the increase of technological power has been doing. People are restless creatures moved by anxiety and yearning, that always seek ways to transcend all physical and mental boundaries and to reach the inconceivable infinity. Some hope that this can be done by the help of God, others put their hope on technology.

When intelligence pervade it, the universe will "wake up" and become conscious; this will be the last, sixth epoch of evolution. Kurzweil does not say what will be after that; we suppose that evolution could take a rest at the seven epoch.

4. While Kurzweil's discourse about the nonbiological people version 2.0 belongs to the sphere of speculations, his discourse about the near future seems rather realistic. At the beginning of the next decade, computers will become "essentially invisible" and they "will be everywhere: in the walls, in our furniture, in our clothing, and in our bodies and brains" (p. 136). People will be connected to wireless communication systems all the time. This sounds realistic and depressing indeed. The Business Civilization imposes technology where it is neither needed nor useful, and compels people to serve this omnipresent and omnipotent master that shapes our living space and rule our lives. I am not a technophobe, but such scenarios with the invisible computers around us and in us, horrifies me not less than the Holly Inquisition, Stalinism and Fascism. I do not see why would such a life totally dominated by computation and connectedness, be good for the ordinary people version 1.0 like me. I hate being "connected" (to anything) more than a couple of hours daily; the rest of time I want to live in peace.

I would like to have far better mind and body, and to last forever. But I am not convinced that technology can bestow on me (or on the future generations) that much. On the other hand, technology is increasingly used for compelling people to work, behave and live in ways that serve business interests, and that is often not pleasant. It should also be remembered that technological power has facilitated the imposition of rigid doctrines, and that it has empowered greedy, vane and destructive leaders. Computers are incredibly efficient in performing complex processes and tasks; but information technology is

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equally efficient as the means for the manipulation of people, for their subduing and for making them serve the aims of the holders of power.

5. Evolution seems to be a process that leads from the simple to the complex, from chaos to order, from the weak to the strong, from the natural to the artificial, from biology to technology; but evolution could also be a process that inevitably leads to self-destruction. It can be that evolution creates structures of increasing complexity and power until they become so complex, powerful and unstable, that they inevitably destroy themselves, purposely or by accident, the same. Instead of being the new carrier of the endless process of growth, technology could be the means by which evolution ends its way – or a cycle, and then it starts all again.

6. References

Copeland, B. Jack (1993) *Artificial Intelligence: A Philosophical Introduction*, Oxford: Blackwell.

Davies, Paul (1995) *About Time: Einstein's Unfinished Revolution*, New York: Penguin Books.

Joy, Bill (2003) "Why the Future Doesn't Need Us", in: Teich, H. Albert (2003) *Technology and the Future*, Belmont, CA: Thomson Wadsworth.

Kurzweil, Ray (2006) *The Singularity Is Near: When Humans Transcend Biology*, New York: Penguin Books.

Penrose, Roger (1977) *The Large, the Small and the Human Mind*, Cambridge, UK: Cambridge University Press.

Radovan, Mario (1996) "Intelligent Systems: Approaches and Limitations", *Informatica*, Vol. 20 (1996), No. 3.

Radovan, Mario (1997) "Computation and Understanding", in: Gams, Paprzycki, We (eds): *Mind Versus Computer*, IOS Press / Omaha.

Radovan, Mario (1998) "Authentic and Functional Intelligence", *Informatica*, Vol. 22 (1998), No. 3.

Radovan, Mario (2000) "Computation and the Three Worlds", *Minds and Machines*, Vol. 10 (2000), No. 2.

Radovan, Mario (2002a) "On Authentic and Functional Intelligence", in: *Proceedings of the 6th International Conference on Intelligent Engineering Systems*, Opatija, Croatia, May 26–28, 2002.

Radovan, Mario (2002b) "Homo Cybernetes: In Search of an Aim", *Synthesis Philosophica*, Vol. 17 (2002), No 2.

Radovan, Mario (2003) "Waiting for Hermes", *Synthesis Philosophica* 35–36, Vol. 18 (2003), No. 1–2.

Searle, R. John (1992) *The Rediscovery of the Mind*, Cambridge, MA: The MIT Press.

Searle, R. John (1997) *The Mystery of Consciousness*, New York: The New York Review of Books.

Searle, R. John (2004) *Mind: A Brief Introduction*, Oxford: Oxford University Press.

Shenk, David (1997) *Data Smog: Surviving the Information Glut*, New York: HarperCollins Publishers.

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Mario Radovan

Über Technologie und Evolution

Zusammenfassung

Die Evolution bildet Strukturen von zunehmender Präzision und Macht. In diesem Prozess tragen die Stärkeren den Sieg über die Schwächeren davon und werden zu neuen Evolutionsträgern. Als künstliches Gebilde wirkt sich die Technologie auf das Leben und die Evolution oft beeinträchtigend aus, weil diese als natürliche Erscheinungen aufgefasst werden. Allerdings ist Technologie auch lebensfördernd, wenn sie die Evolution unterstützt. Es wird vermutet, dass die rasante Entwicklung der Technologie eine neue Epoche der Evolution einläuten wird. Mit Hilfe der Technologie sollen die gebrechlichen biologischen Evolutionsträger durch eine neue Art nichtbiologischer Träger von enormer Intelligenz und Macht ersetzt werden. Dieser Artikel erörtert die Plausibilität und die Schwächen solcher faszinierender Projektionen, die von einigen als vollkommene Befreiung der Vernunft verkündet werden, während andere sie als Zeichen der endgültigen Selbstzerstörung des Menschen auslegen.

Schlüsselwörter

Evolution, Intelligenz, Benehmen, Bewusstsein, natürlich, künstlich

Mario Radovan

De la technologie et de l'évolution

Résumé

L'évolution forme des structures de degrés d'organisation et de pouvoir de plus en plus grands, processus dans lequel les plus forts l'emportent sur les plus faibles et continuent l'évolution. La technologie est une création artificielle qui met souvent en danger la vie et l'évolution entendues comme phénomènes naturels, mais la technologie conserve aussi la vie et agit avec l'évolution. Cependant, certains soutiennent que la technologie fera bien plus que cela, et qu'elle ouvrira une époque tout à fait nouvelle de l'évolution. La technologie remplacera les porteurs biologiques fragiles de l'évolution par une nouvelle espèce de porteurs non biologiques doués d'une intelligence et d'un pouvoir très grands. Cet article examine la plausibilité et la faiblesse de telles projections fascinantes que certains annoncent avec fierté comme la libération finale de l'Esprit, tandis que d'autres les appréhendent comme les signes de l'autodestruction finale de l'Homme.

Mots-clés

Evolution, calcul, intelligence, comportement, conscience, naturel, artificiel