Time Traveling by Simuverses

Essay written for the FQXi contest on the Nature of Time
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Abstract

As a reader fond of the Science-Fiction histories and beginning writer in this subject matter, I've been often involved with the idea of time travel and how they might be focused. Usually, we try to imagine how to do these trips in the real time, be it with the help of a time machine or through a "singularity portal [1]". All those methods have a basic problem: they elude one or several physical laws, what leads to the appearance of paradoxes, which indicates its unfeasibility.

Recently, I've written a tale named Simuversia [2] where a different approach is applied: instead of trying to travel in the physical time, my characters discover how to do it "virtually" by developing a Generator of Simuverses (GoS): a computer program capable of duplicating any place of the Universe by calculating what happens there without matters how far it is, or if it is located in the past, the present or the future; even, though its location is beyond Hubble radius[3] or the events are taking place outside our light cone[4].

Just, imagine!: No more time paradoxes[5], since everything is happening in a parallel universe; it is so comfortable and safe as a videogame; and, especially, it is usable at home, without troublesome stays in remote event horizons, waiting for the corresponding wormhole to open.

In this essay, I am going to analyze what would suppose to develop this logical machine and what could be done with it. At the end, it will result on that, speaking about time travels, the virtual ones are more possible, more "real", than the physical ones.

In addition, to explain the nature of time, I apply the concept of that the matter-energy evolutions generate the space-time waves. Might this be a way towards Quantum Gravity?

Introduction

To bring in the theory that is behind the GoS, I had chosen the hypothesis postulating that *the course of the time is based on the occurrence of events at different levels: quantum, microscopic, macroscopic, and others*.

While I was checking concepts about Quantum Mechanics(QM)[6], General Theory of Relativity(GRT)[7] and Big Bang[8] in order to argue my reasoning, I discovered a fact that we come overlooking for long time in spite of it has been always in front of our noses: all these theories points to that *"matter and energy evolutions are generating and defining the space-time in each region of the universe", as suggested by* GRT and Big Bang; and also that *"matter and energy contained in every physical system are generating and defining its particular space-time"*, as suggested by QM.

This idea, which started by being a personal appraisal, was increasing in consistency when I verified that it was able to explain very well such phenomena as Quantum Superposition[9], Quantum Entanglement[10] or the above mentioned relation between QM and GRT.

Not having found studies contemplating these hypothesis that have rejected them, I've taken them as probable ones and I'll try to develop my reasoning, up to a point, in the paragraph "1-The nature of time in the architecture of the Universe", with two aims: to mention it towards its possible usefulness, and to base the GoS, on which I treat in the rest of the points.

Then, I'll divide this essay in the following parts:

1—The nature of time in the architecture of the Universe. The physical foundation of the study will consist in that the basic substratum of the cosmos is formed by matter and energy wherefrom is derived everything else; among others, the time which is the result of the state changes in the above mentioned matter and energy set. This is not new at all; the Big Bang model already postulates that matter and energy, in its inflation process [11], gave place to the space-time of the Universe.

2—Developing a Time Machine. If someone were asking you for a map of certain area to travel through, you might adopt two totally opposite attitudes.

You might say: "That's impossible; to do it, I would need a surface as big as the same represented zone. In addition, it would be a madness to try to duplicate all the details."

Or, you might take a chunk of paper and a pencil, draw a few outlines, and say: "Look. This is an approximate sketch of the area you want to go across, you must follow these indications. In addition, if you return tomorrow, I will have a much more detailed map prepared to you".

There is a great difference between a way of proceeding and the other one; probably the first one is more exact; but, definitively, to the traveller the second one will turn out to be more useful.

The history of the cartography is very ancient; it should have begun when our forefather, hardly different from an ape, did a simple outline on the ground with a stick or a finger to indicate a way to his fellows. And nowadays this skill has reached high degrees of sophistication.

It is possible that with our first machine we make only the equivalent to draw an outline on the ground, but it already would be a beginning. Raising a first prototype of such a device should not be very complicated; in fact, nowadays there are already simuverses in its more elementary level, though they have other names such as Astronomic Simulator, Weather Forecaster, Civilization Simulators, book of history...

Once obtained the initial prototype, the time travel trouble will consist on: up to what degree of simulation might we come?

3—Usefulness of simuverses. All right. Just imagine, for a moment, that we have already managed the construction of GoS with enough sophistication to simulate a trip over time or one faster than speed of light with enough credibility, what might we do with it?

4—Virtual travel versus real travel. Yes, with this invention many things can be done but you can opine that it is not the same than its real counterpart. Perhaps, you would have liked to be able of change real past events, and recover dear missing beings. Also you would have liked to experience the inventions of the future, and not only have them "virtually". Let me explain something to you.

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1— The nature of time in the architecture of the Universe.

A Theory of Everything (ToE) [12] is neither possible nor necessary to explain the mechanic of the Universe; it is enough to have the Standard Model and GRT. Two theories, since the fundamental particles constituting the matter are located in two different types of systems: quantum systems and classic systems, with different laws and behaviours, but interrelated by an evolutionary bridge, Quantum Decoherence [13].

On the other hand, the Big Bang model shows that space and time were generated in an initial instant from the original matter and energy, and that space continues expanding.

From this very well known base: Standard Model, GRT and Big Bang, I will postulate the following:

P1—In any physical system, the matter contained in it, and state changes produced in that matter by some type of energy, generate an space-time chunk attached to that system.

P2—If the state change produced in P1 *can be undone in a coherent way,* so that the system returns to its previous condition, as much materially as energetically, we will say that the *used energy has not degenerated* and so that *the entropy*[1] [14] *of the system has not changed*.

Since the state change is the decisive factor in the advance of the Arrow of Time [15] (and the entropy increase, its indicator), if it can be undone we will say that the time of the system does not advance in a stable manner, or that sometimes it advances and others it moves back, or that the system has a particular time that it can traverse of independent form to the rest of the universe.

To an exterior observer, the state changes seems to being done and undone randomly, since he looks at them from a different space-time; because of this, its states seems to be superposed; as if the system was oscillating between conditions, as a wave. We will name it as "Quantum System", where only quantum interactions are given.

P3—If the state change produced in P1 cannot be undone coherently, we will say that the energy that provoked the change has degenerated; the entropy has increased; the time has advanced; decoherence has been produced in the system; the wave function has collapsed[16]; and its final state has been reached. We will name it as "classic system"; any interaction can occurs.

P4—Any change produced in a system by the interaction of a degenerating energy, introduces an entropy increase that provokes the definition of its state and internal clock, thus giving place to the creation of the space-time associated with that system.

P5—We will name "Observer System" to that one interacting with an observed system; and "Quantum Observer System" will be that one not introducing entropy in the observed system (for example, in the quantum entanglement experience, when the initial interaction is produced, both particles are mutual quantum observers). That way, "Classic Observer System" is an introducing entropy observer. Thus, it is not the mere fact of observing, but the introduction on the part of the observer of an entropy factor what collapses the wave function of the observed system.

This way, quantum system, classic system and observer has been redefined at least with the scope of this essay. Let's see some consequences:

[1] In this essay, with "entropy" I always mean "thermodynamic entropy" [14].

C1—From P5 we can understand why sometimes the intervention of a classic observer does not produce decoherence; it is because sometimes it does not introduce entropy.

C2—The entropy measurement in a classic system should give an idea of the "time speed" in that system. The entropy difference between two systems should be equivalent to the speed difference between their virtual clocks; and *vice versa*.

C3—Quantum entanglement. Let's suppose a system with two particles. Between them an initial interaction is produced that provokes a not decoherent change in mutual properties of both particles. If these properties are interdependent (example: particle spines that due to the interaction have to take opposite directions), it is said that both particles have become entangled. This is produced because, as stated in P2, on being a quantum interaction, the produced modification has to be available to be undone at any time. And, since the internal space-time of the system depends on this state change and the affected particles, even if the particles are very remote in the external observer space-time, in the internal one they are together and if no other interaction have been done with particles, its internal time have elapsed only one "reversible tic".

If an external system interacts with one of the particles, and it is a quantum observer that does not introduce entropy, the wave function of the system will not collapse. The external quantum observer might also become entangled.

If the one that interacts is a classic observer, it can produce decoherence in the observed system. If so, there takes place a kind of private Big Bang: a new space-time is born from it. It is not important that particles seemed to be far separated for the external observer, since up to that moment, they had internally a very near private space-time, generated upon the reversible state change and, thus, undefined space-time.

It seems as if an inter-dimensional crossing had taken place between two universes. Mathematically speaking, the system has passed of being defined in a Hilbert's space of infinite dimensions, to be it in a Euclidean space of four dimensions.

C4—General Relativity Theory. From P1 it is deduced that every zone of the Universe defines its own area of space-time, conforming a global space-time that is curved or deformed depending on the different concentrations of matter and energy. This is, precisely, the postulate of the GRT.

This universal space-time topography can have soft differences, when the conditions of adjacent micro-systems are similar; or abrupt ones, as it does happen in the case of a black hole. Its transmission way does not need of any quantum particle (~~graviton~~), since it is performed across the generated space-time; it is like saying that the gravitational waves acts across the space that is filled with itself. The attraction force could then be due to the phenomenon described by Einstein, the space-time deformation.

C5—The Big Bang. Let's suppose that before the creation of our Universe there was a Quantum Universe where neither space nor time existed; only a strange soup of elementary particles, doing and undoing private and ephemeral space-time chunks.

In a certain moment, a strange kind of energy produces undoable transitions in several of the particles what causes they emits more degenerative energy, extending the effect to a vast number of them. Their space-times become then overlapped, building a space-time sea crossed by gravity waves.

C6—Time and space are also quantized, due to the fact that its origin is a quantum phenomenon. That is to say, if the time is a consequence of the evolutions of the matter, which state changes are produced by the interaction of forces that are transmitted in quantum packets, it is logical to say that time is also quantized; also, the space.

Conclusions of this paragraph applicable to the essay:

CA1—In quantum systems, the states are overlapped. Past, present or future doesn't exist for them. Its states behaviour is wave liked.

CA2—In classic systems the entropy grows and the arrow of the time always advances from the past towards the future. The future is not fixed, though it is possible to suppose composed by the events that have a certain probability of happening; it is like a multiverse of time lines waiting for its opportunity to happen. This probability increases or diminishes as there approaches the present, moment in which they reach its maximum or minimal probability (they happen or not) and become immutable. Therefore, the past of the classic systems cannot change; forever, there will be in them a past line that happened really and a multiverse of uchronian[17] pasts belonging to the world of what could have been but wasn't.

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2—Developing a time machine

With Galileo, Huygens, Laplace, Descartes and Newton, among others, in the 17th century, the Determinism [18] and the Mechanistic Paradigm [19] made thinking to the world that the universe could be compared to a clock in which everything was synchronized; that, even, would be feasible to foresee the future or to calculate what happened in the past if the suitable machine were available.

These reasoning began to weaken in the 19th century and they came definitively down at the beginning of the 20th with the advent of such theories as the Heisenberg Uncertainty Principle [20], the Einstein Relativity Theory, the Quantum Mechanics or the Mandelbrot fractal mathematics [21].

But at the end of the 20th century and beginning of the 21st, a new tendency arises that recovers some of the ideas of the Mechanism, I mean the Neomechanism[22]. This new current is different enough of, for example, that of Descartes, so that the mechanisms already are not only mechanical facts, but they include also physical, chemical, biological, psychological, or social origins.

Also it relegates to the oblivion the mechanist reductionism [23] approximation, giving way to phenomena that are not the result of the set of the parts but they explain its origin as proceeding from a superior level typical phenomenon, such as the intelligence or the conduct of the individual owed to the social environment.

In addition, to support this neomechanistic tendency, nowadays we can take advantage of the machines to which our ancestors dreamed. I am referring, naturally, to the computers. Its essence leads them to our intention, since they are, in its conception, devices that manage information and that can perform complex calculations with it to generate more information. That's what we are looking for, to extrapolate the information contained in the interactions of the matter and the energy, in all levels, in a way that allows us to handle it to our whim.

We might say that, if matter and energy generates space-time in the real universe, the information managed by the computers can generate a kind of space-time in the virtual universe.

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2.1—Idea analysis

We would not begin with a perfect machine. The intention would be to develop something feasible with the current technology to have a prototype, and to improve it as new ways of applying theories of simulations and calculation of predictions of futures, remote places and past unknown events are discovered.

Then, a very basic approach to the challenge of generating a Simuverse would be to raise it as the accomplishment of a map of the Universe space-time. Certainly, to do it we will have to contemplate much more dimensions than in a usual map. Let's see how many might they be:

A—Regions with quantum states: where space-time distributions are given by a function of probability. Past, present and future do not exist as such. The states are superposed. You may represent such a quantum systems with mathematical approximations like Hilbert spaces [24] and Gelfand-Naimark-Segal constructions [25].

B—Singular Regions: Inside my conjecture, they are regions where the singularity has made unviable the state changes; overlapped space-time has disappeared and the matter-energy has returned to its original quantum state. It's a situation similar to that of the A case.

C—Neither quantum nor singular regions: In them we must bear in mind that the time does not evolve in the same way everywhere, so we always will have to indicate as parameter of the program (initial condition) the reference system in which we will place the simulator as observer of the universe.

In these neither quantum nor singular regions:

C1—The future is composed by events that have probabilities different from zero and one. The GoS should calculate the above mentioned probabilities and concatenate some events with others to obtain several time lines. The probable events are located in regions of three spatial dimensions and the temporary one.

C2—In the present, the probability of the events becomes 0 (they do not happen) or 1 (they happen).

C3—The real past line will be unique and will be composed by all the events that happened. Also we might reproduce uchronian pasts, with the same method of probabilities used to calculate the possible time lines in the futures. The past is the easiest to manage to simulate with loyalty since, in many cases, it is contrastable with the historical known reality.

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2.2—Software

We will not restrict our analysis to the utilization of a determined programming language. To begin, any compiler with a minimum of sophistication might suit our needs. The same concept can be applied to the operating system; any one having a simulator of any type in its software baggage will be surely valid.

As prototype base application an astronomic simulator would serve very well. In it we already could meet some of the basic elements to our project, as are: a representation of several bodies manoeuvring in a space and evolving in time. The calculations of the orbits of the different heavenly bodies might suit as initial functions for the calculation of the cloud of future events to this level. We may add interference factors in the functions and the associated calculation of probabilities.

Once established the initial model from an astronomic simulator, it can be extended by the addition of such improvements as a major detail or a major extension in

the representation, or a more optimized calculation system. If initially it only was including the Solar System, it might be extended with the calculation of positions of stars or with the internal composition of the planets, in a first approximation.

Examples of extensions of the contained information might be: the calculation of planets in remote stars from the effects observed in their orbit or surface, the addition of the atmospheric composition and the climatology of some planets, introduction of the Earth geography and history, and similar data and calculations.

As an example of predictive theory to include might be the Chaos Theory [26], used for predictions in fluids. Some expert systems could help us to improve the development of the embedded artificial intelligence.

Certainly, it would be an extraordinary work. But, unlike some other projects of time travel, proposed in the reality or imagined in science fiction histories, it seems to be a more possible beginning to approach.

On the other hand, once the calculated data has been obtained, with them you could represent a simulated copy in a metaverse, concept largely know and developed with very advanced software and hardware technologies, due to its wide utilization in video games and virtual worlds.

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2.3—Hardware

Could you imagine having a time machine in your portable computer?

Possibly, at certain stages you will not need any more than a portable to have it, be due to the simulators are not developed to a great level of detail, or because the machines have increased very much its power, and part of the storage of information and the calculations develop in other places; as is happening, for example, with the in network computation systems of BOINC [27], the storage of the information in seekers such as Google, or in the Google Earth program; it is enough to have the computer connected to Internet and the precise program.

To work with more powerful machines it would be necessary waiting to see if significant advances are reached in quantum computation, the generalization of the use of many processors in the same computer system, or the utilization of cells of memory with systems of numeration more complexes that the binary one.

If what we want is to experience a more immersive simulation than a 2D representation on a screen, we should use hulls of virtual reality, or wait until 3D environments have been developed.

Already there is a whole plethora of processors specializing in the simulation of physical effects; they are the PPU (Physics Processing Unit) [28], used mainly in the video games, to calculate physical processes similar to the real ones such as the rigid body dynamics, soft body dynamics, collision detection, fluid dynamics, hair and clothing simulation, finite element analysis, and fracturing of objects.

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3—Usefulness of simuverses

Now imagine that we have reached the physical limits of what we can to explore due to the vast enormity of the universe. At same time, we have managed to be some great connoisseurs of the cosmos functioning; with so level of knowledge that we are able to reproduce at laboratory most of physical phenomena. Suppose that, among other calculation tools, we have enough advanced GoS to be able to perform time trips or to go everywhere in the cosmos in a virtual manner. What would we able to do with such a device?

Among others, we would have a way of knowing in advance about the inventions and discoveries of the future, to copy and reproduce them in current time. This could be a way of reach the Technological Singularity [30], suggested by the statistical analyst I.J.Good and popularized by Vernor Vinge [31], one of my preferred science fiction authors. (Note of interest: Demonstrating the ownership of inventions, discoveries and works of art, copied from the diverse futures, would not be a problem, since the World Department of Patents might discover, with the help of some simuverses, who was the real author, though he had not born.)

Imagine that in one of these trips to the future, we copy the way of constructing everything necessary to recover the information of the DNA [32] and the cerebral information of a virtual being, and how to make bodies to our taste, be they biological or bionic ones. Then, we construct those devices and travel to the virtual past with them (they are information recovery devices and we are travelling through an informational universe). There, we recover the necessary information to reproduce our wished beings or, even, human idols like Elvis, Mozart, Einstein, Charles Chaplin, Marilyn, Plato, etc. Also, we can visit them interactively in his time, by doing virtual time-tourism.

We might cross the cosmos, be it in the present, the past or future time; to attend in any way the Big Bang (though possibly it has not been a visible phenomenon, as we understand this term); the birth of the Earth or the first appearance of life; to visit inhabited worlds, even worlds with smart life, even if they are not contemporary with the human being and are in a million light years far from us.

It could be happening in a reverse manner; some more advanced specie, living in a world very far from ours, could be watching through their simuverses how the human specie evolves, even since before than over the Earth appeared the first life.

Wars would diminish notably, because it would be known in advance what might happen. The same thing would happen with crimes, which would not remain unpunished and many of them would be avoided. Simuverses might be applied as preventive measure of accidents; not because the future is completely certain, but to be oneself advertised on the possible problems of a trip or a job.

In addition, with the reproduction of uchronian pasts, we could recover all those moment that did not happen in real life: how it would have been the life in the 20th century if there had no been wars, what would have happened if certain facts were or were been take place, etc.

Finally, on having to our disposition all those scientific advances that would allow to us to lengthen our life to a nearly eternal time and with the possibility of recovering all the past, the men might manage to live in a kind of timeless world. We could say that GoS would have transformed the whole universe in a place of superposed states at macroscopic level, without past, present or future as such; only a Simuversia[2] era created at the men convenience.

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4—Virtual travel versus real travel

At a first glance, they would look as two totally different things to us; we might think, for example, that by doing a time travel in the real way it would be possible to change the past, whereas in the virtual one not; and that we would not "feel" alike these past or future worlds if we see them across a simulation that if we are physically in them.

But, as we would have at our scope all the technologies from all times and as we would be able of simulating any object and any sensation, the result would be the same. Already we have mentioned that we might extract the "soulware" of the person, reproduced in a virtual past, and then push it in another body in the real present.

Also we might reproduce in a metaverse a copy of the real past time in such a way that, from a certain moment on, it stops reproducing the above mentioned past and begins to follow an alternative line of time, an uchronian virtual past, in which we could insert our logical psyches in order to live another history, different from what really happened.

As for changing the past, and bearing in mind that wouldn't be possible to change it by travelling to the real past, as already I explained previously, we might wonder:

Why is it necessary to change physically the past?

The previous past would not disappear at all while some of we follow remembering it.

All the mistakes of the real past can be repaired in another way by using the virtual ones and the resurrection trick.

Everything what got lost can be recovered with a GoS.

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Linkography and Bibliography

[1] Wikipedia, “Gravitational singularity”, http://en.wikipedia.org/wiki/Gravitational_singularity
[2] V.Solís, *Simuversia (English: http://www.lulu.com/content/4749274 / Español: http://www.lulu.com/content/4737982 / http://www.sedice.com/portada/index.php?q=node/3038)*
[3] Wikipedia, “Hubble radius”, http://en.wikipedia.org/wiki/Hubble_radius
[4] Wikipedia, “Light cone”, http://en.wikipedia.org/wiki/Light_cone
[5] Wikipedia, “Time paradox”, http://en.wikipedia.org/wiki/Time_paradox
[6] Wikipedia, “Quantum Mechanics”, http://en.wikipedia.org/wiki/Quantum_mechanics
[7] Wikipedia, “General Relativity Theory”, http://en.wikipedia.org/wiki/General_relativity
[8] Wikipedia, “Big Bang”, http://en.wikipedia.org/wiki/Big_Bang
[9] Wikipedia, “Quantum Superposition”, http://en.wikipedia.org/wiki/Quantum_superposition
[10] Wikipedia, “Quantum Entanglement”, http://en.wikipedia.org/wiki/Quantum_entanglement
[11] Wikipedia, “Cosmic Inflation”, http://en.wikipedia.org/wiki/Cosmic_inflation
[12] Wikipedia, “Theory of Everything”, http://en.wikipedia.org/wiki/Theory_of_everything
[13] Wikipedia, “Quantum Decoherence”, http://en.wikipedia.org/wiki/Quantum_Decoherence
[14] Wikipedia, “Thermodynamic Entropy”, http://en.wikipedia.org/wiki/Entropy
[15] Wikipedia, “Arrow of Time”, http://en.wikipedia.org/wiki/Arrow_of_time
[16] Wikipedia, “Wave Function Collapse”, http://en.wikipedia.org/wiki/Wave_function_collapse
[17] Wikipedia, “Uchronia or Alternate history”, http://en.wikipedia.org/wiki/Alternate_history
[18] Wikipedia, “Determinism”, http://en.wikipedia.org/wiki/Determinism
[19] Wikipedia, “Mechanistic Paradigm”, http://en.wikipedia.org/wiki/Mechanism_(philosophy)
[20] Wikipedia, “Heisenberg Uncertainty Principle” http://en.wikipedia.org/wiki/Heisenberg_Uncertainty_Principle
[21] Wikipedia, “Mandelbrot fractal mathematics”, http://en.wikipedia.org/wiki/Mandelbrot_fractal
[22] **BECHTEL, W. & A. ABRAHAMSEN (2005)** “Explanation: a mechanist alternative”. *Studies in History and Philosophy of Biological and Biomedical Sciences* 36: 421-441; **BUNGE, M. (1977 y 1979)** *Treatise on Basic Philosophy*. Vols. 3 y 4, Ontology I y II. Dordrecht, Reidel; **BUNGE, M. (2004)** *Emergencia y convergencia. Novedad cualitativa y unidad del conocimiento*. Barcelona, Gedisa; **CRAVER, C. & L. DARDEN (2005)** Introduction. *Studies in the History and Philosophy of the Biological and Biomedical Sciencies* 36: 233–244; **GLENNAN, S. (2002)** Rethinking mechanistic explanation. *Philosophy of Science* 69: S342-S353; **SALMON W. S. (1989)** “Four Decades of Scientific Explanation”. En P. KITCHER & W. S. SALMON (eds.) *Minnesota Studies in the Philosophy of Science Vol. XIII. Scientific Explanation*. Minneapolis, University of Minnesota Press. Pp. 3-220
[23] Wikipedia, “Reductionism”, http://en.wikipedia.org/wiki/Reductionism
[24] Wikipedia, “Hilbert spaces”, http://en.wikipedia.org/wiki/Hilbert_spaces
[25] Wikipedia, “Gelfand-Naimark-Segal constructions”, http://en.wikipedia.org/wiki/Gelfand-Naimark-Segal_construction
[26] Wikipedia, “Chaos Theory”, http://en.wikipedia.org/wiki/Chaos_theory
[27] BOINC, Volunteer computing, http://boinc.berkeley.edu/
[28] Wikipedia, “PPU”, http://en.wikipedia.org/wiki/Physics_processing_unit
[30] Wikipedia, “Technological Singularity”, http://en.wikipedia.org/wiki/Technological_singularity
[31] Vernor Vinge, “Vernor Vinge on the singularity”, http://mindstalk.net/vinge/vinge-sing.html
[32] Wikipedia, “DNA”, http://es.wikipedia.org/wiki/DNA