

Dear brothers Nicola and Michele,

I writes you this letter on the new essay contest in FQXi: It from Bit, or Bit from It.

This condenses an idea of Wheeler: every description of the physical world can be described by a computer program (the digital world).

I hate publish article, because they are a straitjacket that constrain the article shape, the language style and the free words of a researcher; and I lose too time to try to publish article in journals: so I decide to write unpublishable articles, and ideas, in free blogs sharing them along equals.

So, I don't know if I participate to this essay, can be that I submit it!

I write here a simple idea: Galileo start the Physics writing a differential equation that describes the reality; I start writing a numerical method that permit to write a differential equation from the experimental data; then I write a relaxation iterative method to solve the differential equation or other iterated function; then each iterated function contain a numerical flow between contiguous cells: this is a exchange of bit values between cells; then the cells contains an entropy of density function; then each differential equation have an entropy evolution with the time: there is a entropy for each differential equation that is a time functional.

I give a general theory, and a numerical example, using the more simple theoretical description, a metallic layer (or a more complex meteorological layer): in my previous essay I demonstrate that each system is Hamiltonian, so that a general differential equation can be Hamiltonianized and it is true the Liouville theorem (the trajectories flow in contiguous cells is null).

Each dynamic of a real system can be write (Galileo data-physics traduction):

$$0 = F(y, \dot{y}, \ddot{y}, \dots)$$

this is true for each infinitely differentiable function $y(t)$; the function F can be approximated by a polynomial of some order and degree (I use, to simplify, degree two and order one):

$$0 = a_0 + a_1y + a_2\dot{y} + a_3y^2 + a_4y\dot{y} + a_5\dot{y}^2$$

the differential equation can be write in a standard form:

$$0 = a_0y^{(0)}y^{(0)} + a_1y^{(0)}y^{(1)} + a_2y^{(0)}y^{(2)} + a_3y^{(1)}y^{(1)} + a_4y^{(1)}y^{(2)} + a_5y^{(2)}y^{(2)}$$

it is possible to derivate the optimal differential equation:

$$0 = a_1\dot{y} + a_2\ddot{y} + 2a_3y\dot{y} + a_4\dot{y}^2 + a_4y\ddot{y} + 2a_5\dot{y}\ddot{y}$$

this is a trick to have a maximum order derivative of degree one, and it is possible to solve the differential equation in a simple way (there are some numerical approximations that are not important now).

It is necessary an error function to minimize this differential equation:

$$E = \sum_n \left[\frac{\sum_{i_1 \geq i_2 \geq \dots \geq i_D} b_{i_1 \dots i_D} y_n^{(i_1)} \dots y_n^{(i_D)}}{\sum_{i_1 \geq i_2 \geq \dots \geq i_D} |b_{i_1 \dots i_D}|} \right]^{1/D} = \sum_n F_n^{[D]}$$

we have for this error function that $F_n^{[N]}$ and $F_n^{[2N]}$ have the same value; there are some methods to choose the optimal differential equation, but these are not important now, because each differential equation (of high degree and order) work.

These differential equation approximate each real experimental data with a differential equation of increasing order and degree (f.e Galileo law of free fall, Newton's law of universal gravitation and Einstein's equation).

Each differential equation is Hamiltonizable if we doubling the variable of the system; in this case we must use $(y, \dot{y}, \ddot{y}, \dots)$ and the new momentum variable (p_0, p_1, p_2, \dots) .

The Liouville's theorem is true for each Hamiltonian, so that the flow of trajectory in the space have a solenoidal flow (so that in the extended space is a probability space and we can use the entropy in the extended space): if the system have an attraction point, the momentum range is infinite.

The entropy functional is:

$$S[V, F(y, \dot{y}, \ddot{y})] = - \int \int_V dx dp \rho(x, p) \ln \rho(x, p)$$

only for some differential equation happen that the entropy is constant: we can use, to simplify, a grid calculus in a three-dimensional space:

$$\begin{aligned} S(0) &= -\rho_{00} \ln \rho_{00} - \sum_{ij} \rho_{ij} \ln \rho_{ij} \\ S(dt) &= -(\rho_{00} + \Delta\rho_{00}) \ln(\rho_{00} + \Delta\rho_{00}) - \sum_{ij} (\rho_{ij} + \epsilon_{ij}) \ln(\rho_{ij} + \epsilon_{ij}) \\ \Delta S &\simeq -\Delta_{00} \ln \rho_{00} - \sum_{ij} \epsilon_{ij} \ln \rho_{ij} \\ \Delta S &\simeq -\Delta_{00} \ln \rho_{00} - \sum_{ij} \epsilon_{ij} \ln(\rho_{00} + \rho_{ij} - \rho_{00}) \\ \Delta S &\simeq -\Delta_{00} \ln \rho_{00} - \sum_{ij} \epsilon_{ij} \ln(\rho_{00}) - \sum_{ij} \epsilon_{ij} \frac{\rho_{ij} - \rho_{00}}{\rho_{00}} \\ 0 &= \sum_{ij} \epsilon_{ij} (\rho_{ij} - \rho_{00}) \\ 0 &= \sum_{ij} \epsilon_{ij} \rho_{ij} - \rho_{00} \sum_{ij} \epsilon_{ij} \\ 0 &= \sum_{ij} \epsilon_{ij} \rho_{ij} + \rho_{00} \Delta\rho_{00} \end{aligned}$$

Each differential equation is a local game-theory (three-dimensional Conway's game of life), where the flow ϵ_{ij} in the grid are the bits exchanged between contiguous cells.

Some solution of the isoentropic solution are simple: a system with cells that have constant, and null, density and a flow that preserve the form (game of life of a single organism, or multiple organism without intersections); this is the connection between entropy, computer and biological life.

An other simple solution is the stationary isoentropic solution: cell value is constant, then $\Delta_{00} = 0$, and there are only flow between contiguous cell; the solution is a knot path (open or closed) with an arbitrary solenoidal flow (the density distribution don't change).

We consider a simply connected initial volume in $2N$ -dimensional Hamiltonian space, then the dynamic of the inner space can be studied with a $2N$ -dimensional tessellation (with constant density for each tessell): the inner tessell have invariant density (because of the dynamic is solenoidal), then the change of the entropy is only a surface effect that propagates in the inner cells: if the flow is a closed path, then the entropy can be constant.

If the cell dimension tend to zero, then it is possible to write the derivative equation for isoentropic flow:

$$\frac{\partial \rho}{\partial t} + \nabla \cdot (\rho \vec{v}) = 0$$

the constant flow along an open, or close, knot transport each density (the game of life: we see only the movement, and the flow is transparent). Each constant rotation flow transport isoentropically the density.

A simple example is a bidimensional metallic plate where there is a temperature constant frontier, and a thermal flow (that can be measured with a infrared camera): the real thermic equation (a Fourier's law with non-linear terms) can be obtained with a minimization of the differential equation error, so it is possible the entropy calculus measuring the entropy in the derivative space: the stationary solution is isoentropic in the plate because of the border constraint.

The metallic plate is an interesting system (if the irradiation is low) because permit to evaluate the entropy diffusion using the real Fourier's law.

An other meaning of the "It form bit" can be "Life from Bit".

I think that the life is each self-reproducing system, and that make some other elementary action; so that an elementary living being can be obtained in a super-computer, using a simulation of chemical compounds interaction.

I am not interested to this, because is only a great technological work without a foundational meaning (can be useful for virus destruction but I think that exist more simple way to attack they); but, and this is interesting, we can start a real new life in a supercomputer in a simple way: a self-reproducing program (the Bits) that write itself in a random position, with an error rate, in a quick solid state memory.

This is a method to write an Artificial Intelligence with an bottom-down approach, obtaining some million of year of evolution in some year of supercomputers life (it is important the code-containment), that permit to obtain virus organism with software (like genetic programming), but the only purpose is the self-reproduction and the survival in an hostile environment: it is necessary to use low-level programming language (the Bits) because it is simple the change of the instructions.

If this work, then we have an evolution that lead to consciousness; it is possible an interaction with the real environment with advanced sensor (optical, acoustic, tactile) to built consciousness in robots, but it is not possible the blocked-sensor evolution and it is necessary an hostile real world (the movements are slow): this step can be accelerated with a virtual reality (with the possibility to change the sensor, and mechanics), this can be useful to obtain robots for extreme environment (there is an equivalence between life and robot in virtual reality).

I have had a ethical problem to print these ideas, but I think that we are not alone in the Universe: I think that life happen thousands (or millions?) of times in the Universe, with natural chemical processes; so this heretical idea is one of thousands natural method to obtain life: this is only an other high level process.

An other ethical problem is the possibility of military application: I would not that my research may be used by military, and I limit my thoughts to pure research; if I see that the right application exceed the bad application, then I publish they: there is ever the possibility to contrast the bad knowledge with the ethical knowledge.

This is a six day work, so it is a little raw, and indistinct, but I send you because I think that there are some interesting thoughts.

Saluti

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