The Evolutionary 'Anthropic' Semantic Principle

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Abstract. We present the scientific foundation for a new Evolutionary 'Anthropic' Semantic Principle, with a discussion of previous work which now seems to support this conclusion.

The 'Anthropic' Semantic Principle

Diaz and Rowlands' paper 'A Computational path to the Nilpotent Dirac Equation' [2003] unveils a remarkable new discovery. There exists a nilpotent universal computational rewrite system (NUCRS) with an infinite universal alphabet. It defines the semantics of quantum mechanics in terms of a universal grammar, such that the nipotent generalization of Dirac's famous quantum mechanical equation is the computational machine order code. A nilpotent rewrite system differs from traditional rewrite systems (of computational semantic language description with a fixed or finite alphabet) in that the rewrite rules allow new symbols to be added to the initial alphabet. In fact Diaz and Rowlands start with just one symbol representing 'nothing' and two fundamental rules; *create* a process which adds new symbols and *conserve* a process that examines the effect of any new symbol on those that currently exist to ensure 'a zero sum' again. In this way at each step a new sub-alphabet of an infinite universal alphabet is created. However the system may also be implemented in an iterative way, so that a sequence of mathematical properties is required of the emerging sub-alphabets. They show that one such sequential iterative path proceeds from nothing (corresponding to the mathematical condition nilpotent) through conjugation, complexification, and dimensionalization to a stage in which no fundamentally new symbol is needed. At this point the alphabet is congruent with the Nilpotent generalization of Dirac's famous quantum mechanical Equation showing that it defines the quantum mechanical 'machine order code' for all further (universal) computation corresponding to the infinite universal alphabet. (Since a new symbol can stand for itself, a sub-alphabet or the infinite universal alphabet, the universal nilpotent rewrite system may thus rewrite itself, ontologically at

a higher (hierarchical) level of quantum physical structure.) This rewrite system with its nilpotent bootstrap methodology from 'nothing/the empty set' thus defines the requirement for universal quantum computation to constitute a semantic model of computation with a universal grammar.

Further, in a companion CASYS03 paper, 'Symmetry Breaking and the Nilpotent Dirac Equation', Rowlands [2003, see also Rowlands, 2001, Rowlands and Cullerne, 1999, 2001] shows that the symmetry breaking of this nilpotent Dirac equation, describes the spontaneous emergence of both 3+1 relativistic space time and the experimentally validated strong, weak and electromagnetic quantizations (including spin) of Standard Model elementary particle physics, from their empty set. That is to say, these fundamental physical quantum mechanical structures not only define level one of the ontological hierarchy corresponding to the NUCRS semantics, but are those from which all subsequent levels of this hierarchy will be reconstituted in 3+1 space-time due to the action of the strong, weak, electromagnetic and gravitational forces.

This discovery of the NUCRS thus provides a sound scientific basis, able to turn the conceptual Premise and Mission Statement of the British Computer Society Cybernetic Specialist Group (see below) into an actual Evolutionary 'Anthropic' Semantic Principle, by means of which the Group's search for the fundamental physical foundations of computing, as used in brains, can be realized [http://www.bcs.org.uk/cybergroup.htm]. For there can be little doubt, in view of natural language, i) that the human brain is a universal computational semantic machine, and ii) that the NUCRS would provide a natural model and modes by means of which human speech, writing and the hearing of natural language could actually be realized (through a neural NUCRS semantic ontology) so as to allow the human race, as is actually happening in science, to comprehend the evolutionary cosmos in which it exists.

Premise and Mission Statement

In science, Nature sets the rules, but it must never be forgotten, that it is only because life has exploited these rules successfully for billions of years to our evolutionary advantage, that human brains are able to understand them. The mission, at the physical foundations of computing/information processing if one accepts the premise, is therefore to identify how these rules were exploited to achieve this end.

In particular the above hypothesis immediately raises the question 'Is the DNA/RNA genetic code itself, a NUCRS?', for this would explain all living systems (including, of course, the biological human brain) as the

product of further intermediate levels of the NUCRS hierarchical semantic ontology. It would also answer the grand unsolved problem of the genetic code, as to how the 3+1 space-time structure of its organisms is encoded within it.

That is to say, the concept of computational rewrite systems and this remarkable quantum mechanical discovery defines Nature's rules, in the Premise and Mission Statement quoted, as those of the Nilpotent Dirac Equation so as to provide the desired scientific foundation, so that it now becomes the Evolutionary 'Anthropic' Semantic Principle.

Previous research in support of this conclusion

Previous research in support of this conclusion, comes from several different quarters. (1) Anticipatory Computation is the subject of a series of six international conferences on Computing Anticipatory Systems organized by CHAOS asbl under the direction of Professor Daniel Dubois, its founder (see www.ulg.ac.be/mathgen/CHAOS). This body of research publications [Dubois 1992-2005], can now be recognized with hindsight as applying the methodology of the computational rewrite process; a fact which says much for the prescience of Professor Dubois in 'anticipating' this new branch of the computer science which concerns semantic computation, which he has now championed for many years, through the concepts of chaotic computation, incursion, hyperincursion and of course computing anticipatory systems. And the concept of semantic computation would provide an alternative explanation of why Dubois's concepts above are so successful, as this body of publications demonstrates, in arriving rapidly at sound computational solutions to difficult problems, and as to why recursion in the form of ordinary digital computation may fail to do this.

(2) Other prescient work on semantic computation can also be recognized to concern the 'New Computing Principle' [Fatmi and Resconi, 1988] (in which the description of the optimal design for the physical machine already incorporates a description of a Lagrangian) and the 'Theory of the Cybernetic and Intelligent Machine based Lie Commutators' [Resconi and Marcer, 1987, Fatmi *et al.*, 1990] (in which computer input/output is represented by a categorical arrow, so as to describe formally such machines in terms of 'arrows of human mathematical thought'). Both follow from Dennis Gabor's paper 'A Universal Non-linear filter, Predictor and Simulator which optimizes itself by a Learning Process' [Gabor *et al.*, 1960], which is generalized by using the categorical formulation of 'General System Logical Theory' [Jessel and Resconi, 1986] based on Jessel's formalization of Huygens' principle of secondary sources [1954]. These might therefore be more appropriately

named respectively:- as the New Semantic Computing Principle, the Theory of the Semantic and Intelligent Machine …. , and General System Semantic Theory. All these ideas follow from the description by Mesarovic and Takahara [1975] of category theory in the form of arrows $\rightarrow$ where, as above, these concern a computational input and the subsequent computational output so that the arrow describes the computation.

In connection with General System Semantic Theory, Fatmi and Resconi's paper [1988] defines a new computing principle, in terms the topological structure:- i) where the G's, below, are topological Lie groups describing translation, rotation, Euclidian movement, affine, homographic, gauge and other topological transformations etc and require the equivalence relation between groups $G_k \equiv G_s$ that is represented in (3), where (2) G_k and G_s are the two equivalent continuous groups, G_j is the continuous reference group and f = (f_1 ,….., fm_1 ,…., fm_2 ,….., (n terms)) are the computer input and output signals of a vectorial field U where ∃ operators O_j (f(t)) constituting its Lie algebra of derivations.

(2) $$\cdot\ G_s G_j \prod_{i=1}^{p} f_{mi}(0) = G_k G_j \prod_{i=1}^{p} f_{mi}(0) + (G_j G_k - G_k G_j)\left(\prod_{i=1}^{p} f_{mi}(0)\right).$$

(3)
$$\begin{array}{ccc} \prod_{i=1}^{p} f_{mi}(0) & \xrightarrow{G_j} & G_j \prod_{i=1}^{p} f_{mi}(0) = \prod_{i=1}^{p} f_{mi}(t) \\ \Big| & & \Big| \\ G_k \downarrow & & \downarrow G_s \\ G_k \prod_{i=1}^{p} f_{mi}(0) & \xrightarrow{G_j} & G_s G_j \prod_{i=1}^{p} f_{mi}(0) \end{array}$$

ii) in which the optimal design of the machine for a physical system describable by a Lagrangian is already incorporated, as it can easily be shown that the continuous groups involved are functions of this type, and
iii) where the machine's underlying architecture is that of a unified, multiple ordered, parallel, non-linear analogue computer, able to utilized physio-chemical as well as electronic mechanisms, where no quantization of the input field is necessary.

(3) A third source supporting the main conclusion is Rowlands' latest paper 'Fermion Interactions and Mass Generation in the Nilpotent Formalism' [2005], which continues the theoretical exploration of the properties the nilpotent quantum formalism, so as to explain the existence of nonzero mass in relation to elementary particles of the Standard Model as predicted by the nilpotent Dirac equation. This is one of the Clay

Mathematical Institute's required criteria, for a sound model of elementary particle physics.

(4) Another Clay requirement is that of a solid mathematical foundation, which we hypothesize, Diaz and Rowlands' process of discovery [2003] of the universal computational rewrite system provides not only for the language descriptions of quantum physics, but also for mathematical language itself. The latter finds support from J. H. Conway's highly prescient 1976 generation of the Surreal Numbers [Conway, 1976]. For it provides a NUCRS foundation for mathematics, as an alternative to that of the more usual Zermelo-Fraenkel set theory, in the form of a non-standard mathematical analysis over the surreal number fields [Alling, 1988]. For the Conway 'process' definition of the surreals generates a restricted nilpotent infinite universal alphabet i.e. the numbers symbols themselves, where significantly the number symbol $i=\sqrt{-1}$ has to be added arbitrarily to ensure that this generation process is that of a universally embedding totally ordered (mathematical) field. We say 'significantly', because in another recent paper by Diaz and Rowlands entitled 'D: the infinite square roots of –1' [2005], these infinite roots of $i=\sqrt{-1}$ provide the universal infinite alphabet in relation to the nilpotent computational path to the nilpotent Dirac equation, and the universal grammar of the semantics of quantum physics. Another confirmation is Kilmister's use of Conway's methodology to provide an NUCRS foundation for the Combinatorial Hierarchy, a discrete model of elementary particle physics [Kilmister, 1984; Marcer, 1989, 1990, Clement et al., 1993].

Abstract Surreal numbers are shown to provide an appropriate classification of optimal extensions of Turing's definition of computability over the integers. These extensions exhibit many deep connections with the physical world as described by classical, relativistic and quantum mechanical theories; connections with biological control systems are also demonstrated. The connections confirm the Church-Turing Principle [Deutsch, 1985] that computability is primarily a physical property and only secondarily a mathematical one. These considerations suggest that this class of extensions can furnish a unified theory within which (extremal) conditions concerning a minimum number of computational steps can be seen to govern perception and cognition as generalized dynamical processes. They further provide explanations of the marked differences between control and information processing systems in living organisms and those employed in conventional (von Neumann/Turing) digital computers, and of how the combinatorial explosion has been avoided in natural systems subject to incremental evolution over time. However, the principal claim is that such a model of optimal computation

denoted herein as $C(0n_2)$ may furnish a theoretical basis for the genetic code in its contemporary evolved form.

(5) In 'A Remarkable Quantum Mechanical Discovery' Marcer and Rowlands [2005] rework their paper with Mitchell and Schempp, entitled 'Zenergy: The 'Phaseonium' of Dark Energy That Fuels the Natural Structures of the Universe' [Marcer *et al*., 2003], in terms of the concept of the nilpotent computational rewrite system:- i) to verify the previously reached conclusions, which is the case, and ii) because this new concept is a new and powerful means of presenting these conclusions so as to simplify and facilitate their understanding. [See also Scully, 2003, Leggett, 2005, and Pilbram, 1991.]

Of particular significance to the development of higher order 'Natural Structures', is the idea that the thermodynamic evolution of the universe is the expression of the way that the unique ordering (birthordering) of quantum events is managed, and that this ordering is what we mean by 'absolute (nonobservable QM) time' or 'causality'. The nilpotent universe is totally entangled in a QM sense, each nilpotent state requiring correlation with the rest of the universe to complete its description of energy-momentum conservation. There is no closed, isolated, system, and no true simultaneity at the quantum level, only an expression of irreversibility in terms of entropy or decoherence. It seems to be a 'law of thermodynamics' that an absolute sequencing of 'events' (involving information transfer) is only possible because entropy change is minimised in a universe structured as a Quantum Carnot Engine, as is implied in Marcer *et al*. [2003].

(6) The extensive research of Walter Schempp [1986, 1992, 1998, 2005, also Binz and Schempp, 2000], concerns the directly related Lie/boson partition of nilpotent quantum mechanical state space to that of the Nilpotent Dirac Equation which concerns its complementary Clifford/Fermion partition. In relation to Quantum Holography, with which some of Schempp's work is concerned, the authors of the present paper note that a holographic mechanism is specified directly in the nilpotent QM, where the nilpotent operator $(\pm i\mathbf{k}E \pm \mathbf{i}\mathbf{p} + \mathbf{j}m)$ has a Fourier transform $(\pm i\mathbf{k}t \pm \mathbf{i}\mathbf{r} + \mathbf{j}\tau)$. These operators, equivalent respectively to amplitude and phase, thus define the action of two sources of equivalent independent information, **p** or **r**, and E or t, relative respectively to the proper energy/rest mass (m) or equivalently the proper time (τ), either or both of which can be regarded as fixed/fixing a reference frame. And, of course, this nilpotent structure can exhibit 3-dimensionality, vector **r**, operating as a single unit, as well as other multi-dimensionalities (1-D, 3-D, 4-D, 5-D, 6-D, 8-D, 10-D and 11-D), depending on the perspective applied to the Clifford algebra.

However in one perspective they become 2-D, so that the minimum determining information, **r** and *t* in this rewrite language description, is in agreement with the holographic principle and thermodynamics through the concept of a bounding 'area' which determines the relation between a system and the rest of the universe as a unit of thermodynamic information, and realizes it within the nilpotent structure. The 'area' is that of the complex plane, involving **r** and *t*, which determines the nilpotent relation between the fermion state and the rest of the universe. It can be projected as a real area, because the fundamental dualities in the rewrite system allow one to exchange information about 2 spatial dimensions for 2 dimensions of space and time; and therefore because **r** can also be considered as a 3-D quantity in its own right, this nilpotent minimum rewrite description is that of a 4-D boundary to a 5-D universe.

(7) This new Principle is in line with J.A. Wheeler's hypothesis of 'Physical Law without Law' [1986, also Landauer, 1986], that the physical foundations of computation constitute 'a Meaning Circuit or 'bootstrap' able to determine physical law without any prior knowledge of what that law maybe. This bootstrap arises from the fact that, while such law must be describable in algorithmic form, any such description (of the law) can have no meaning unless there exist actual physical processes by means of which to execute it (the algorithm).

Wheeler's hypothesis maybe paraphrased as saying that such a semantic circuit describes not only that which can be said by words but that by means of which words are spoken (Or alternatively as is written/spelt out semantically by the DNA genetic code of a living system, but where DNA is also the quantum physical means ontologically by which this living system is actually physically brought into existence.)

(8) It is also possible to identify other examples of computational rewrite systems, namely:-

i) Spencer-Brown's controversial Laws of Form,

ii) the Alternative Natural Philosophy Association's discrete model of quantum physics, called the Combinatorial Hierarchy,

iii) the Dirac formalization of quantum mechanics in terms of bra and ket vectors, as set out in his famous and foundational book on quantum mechanics

iv) examples of conventional rewrite systems, to be found at http://algorithmicbotany.org/papers/#abop, where the more usual finite alphabet semantics corresponding to geometric rules is used to give very lifelike pictures matching those in botany, e.g. a sunflower.

v) A nilpotent computational system could loosely be thought of as computation using zero (i.e. topological computation) rather than bits in

the binary system 0,1 and it is more general than binary computation as Deutsch's theory of universal quantum computation [1985] shows. This raises the question 'Could semantic rather than digital computation be what we mean when we refer to the human brain as having 'commonsense'?' [Marcer, 1986].

REFERENCES

Alling, N. 1988, *Foundations of Analysis over the Surreal Number Fields North Holland*, Amsterdam.

Binz, E. and Schempp, W. 2000, Creating Magnetic Resonance Images, *International Journal of Computing Anticipatory Systems*, 7, 223-232; and A unitary parallel filterbank approach to Magnetic Resonance Tomography, *American Institute of Physics Proceedings*, 517.

Clement, B.E.P., Clement, P.V., Coveney, P. and Marcer, P.J. 1993, Surreal Numbers and Optimal Encodings for Universal Computations as a Physical Process Interpretation Of the Genetic Code, *CCAI the Journal for the Integrated Study of AI, Cognitive Science and Applied Epistemology*, 10, 1/2, 149-163.

Conway, J. H. 1976 *On Numbers and Games*, Academic Press, London.

Deutsch, D. 1985, The Church-Turing principle, and the universal quantum computer, *Proceedings of the Royal Society of London*, A400, 97-117.

Diaz, B. and Rowlands, P. 2003, *International Journal of Computing Anticipatory Systems*, 16, 203-218, 2004, presented CASYS, 2003; also at arXiv.cs.OH/0209026.

Diaz, B. and Rowlands, P. 2005 'D: the infinite square roots of –1', presented at CASYS, 2005, to appear in the *International Journal of Computing Anticipatory Systems*.

Dubois, D. 1992 *The Fractal Machine*, Presses Universitaires de Liège.

Dubois, D. & Resconi, G. 1992 *Hyperincursivity: A new mathematical theory*, Presses Universitaires de Liege. (This sets out a new generalization of the computational recursion called by Dubois 'incursivity' & 'hyperincursivity'.)

Dubois, D. (ed.) *American Institute of Physics Proceedings* and the *International Journal of Computing Anticipatory Systems*, Proceedings of the International HEC-ULg Conferences on CASYS 1997, 1998, 1999, 2000, 2001, 2003 and 2005 (in press), editor Dubois Daniel, University of Liege, Belgium.
See also http://www.ulg.ac.be/mathgen/CHAOS/CASYS.

Fatmi, H.A. and Resconi, G. 1988, A New Computing Principle, *Il Nuovo Cimento*, 101B, no.2, February, 239-242.

Fatmi, H.A, Jessel, M., Marcer, P.J. and Resconi, G. 1990, Theory of the Cybernetic and Intelligent Machine based on Lie Commutators, *International Journal of General Systems*, 16, 123-164.

Gabor, D. et al. 1960, A Universal Non-linear filter, Predictor and Simulator which optimizes itself by a Learning Process, *Proceedings IEE*, 108B, 422-438.

Jessel, M. 1954, *Comptes Rendus Acad. Sci. Paris*, 239, 1599-1601.

Jessel, M. and Resconi, G. 1986, General System' Logical Theory (GSLT) *International Journal of General Systems*, 12, 155-182.

Kilmister, C.W. 1984, 'Brouwerian Foundations for the Combinatorial Hierarchy', *Proc. 1st Annual Western Regional Meeting Discrete Approaches to Natural Philosophy*, November, Stanford University, USA. (See also 'Towards a Process Formalism in Quantum Physics', in *Microphysical Reality and the Quantum Formalism*, vol. 1, van der Merve, A., Selleri, F., Tarozzi, G., editors, Kluwer, Dordrecht, 1987.)

Landauer, R. 1986, Computation and Physics: Wheeler's Meaning Circuit?, *Foundations of Physics*, 16, 551-564.

Leggett, A.J. 2005, The Quantum Measurement Problem, *Science*, 307, 11 February 2005, 871-872.

Marcer, P.J. 1986, Commonsense, what is it?, presented at the British Theoretical Computer Science Colloquium, University of Warwick, March 24-26, 1986 (apply to author for details).

Marcer, P.J. 1989, ANPA has much to celebrate, *Proc. International ANPA89,* 44-55; A model for an Evolutionary Epistemology based on the axioms for the Universally Extending Continua, *ibid.*, 166-168.

Marcer, P.J. 1990, A Grand Unification for Wavefield Physics, *Proc. International ANPA90*, 136-163.

Marcer, P.J. and Rowlands, P. 2005, 'Remarkable Quantum Mechanical Discovery' to appear in the *International Journal of Computing Anticipatory Systems*.

Marcer, P.J., Mitchell, E., Rowlands P. and Schempp W. 2003, Zenergy: The 'Phaseonium' of Dark Energy That Fuels the Natural Structures of the Universe, *International Journal of Computing Anticipatory Systems*, 16, 2004, 189-202, presented at CASYs, 2003.

Mesarovic, M.D. and Takahara, D. 1975, *General System Theory*, Academic Press, New York.

Pribram, K.H. 1991, *Brain and Perception, Holonomy and Structure in Figural Processing*, Lawrence Erlbaum, Publishers, Hillsdale. N.J. and other published papers on quantum bio and neural computation cited at http://www.bcs.org.uk/cybergroup.htm.

Resconi, G., and Marcer, P.J. 1987 A Novel Representation of Quantum Cybernetics using Lie algebras, *Physics Letters* A, 125, no.6/7, 282-290

Rowlands, P. 2001, A foundational approach to physics, arXiv:physics/0106054.

Rowlands, P. 2003, *American Institute of Physics Proceedings*, 102-115, presented at CASYS, 2003.

Rowlands, P. 2004, On nothing, or an exploration of the vacuum, in *Against Bull*, Proceedings of the 26th ANPA Conference, editor K. Bowden, 2005, 18-55.

Rowlands, P. and Cullerne, J.P. 1999 A derivation of particle structures and the Dirac Equation from fundamental symmetries, 1999, in *Aspects II*, Proceedings of the 2oth ANPA Conference, editor K. Bowden, 155-191. contact via anpa-discussions-subscribe@yahoogroups.com.

Rowlands, P. and Cullerne, J.P. 2001, The Nilpotent Representation of the Dirac Algebra, in *Implications*, Proceedings of the 22nd ANPA Conference, editor K. Bowden, 99-106. See also arXiv:quant-ph/00010094; 0103036; 0106111; 0109069; arXiv:physics/0110092 (with Koberlein, B.D.).