A simple digital consciousness toy model (DCTM) applicable to all multicellular life forms and based on a multi-level competitive hierarchical organization of biological cells in general (including neurons)

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Wiki-like transdisciplinary article (Open development interval: 2018 - ?)
- working paper preprint[1] -
Version 1.0 (19.05.2018)

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1st Motto: „We are the cosmos made conscious and life is the means by which the universe understands itself." (Brian Edward Cox, English physicist) (URL)

2nd Motto: „How can a three-pound mass of jelly that you can hold in your palm imagine angels, contemplate the meaning of infinity, and even question its own place in the cosmos? Especially awe inspiring is the fact that any single brain, including yours, is made up of atoms that were forged in the hearts of countless, far-flung stars billions of years ago. These particles drifted for eons and light-years until gravity and change brought them together here, now. These atoms now form a conglomerate- your brain- that can not only ponder the very stars that gave it birth but can also think about its own ability to think and wonder about its own ability to wonder. With the arrival of humans, it has been said, the universe has suddenly become conscious of itself. This, truly, it the greatest mystery of all." (Vilayanur Subramanian Ramachandran, American neuroscientist of Indian origin, cited tom his book „The Tell-Tale Brain: A Neuroscientist's Quest for What Makes Us Human") (URL)

3rd Motto: „World is a multi-dimensional reality. At lower level it is full with unconsciousness and competitiveness. At higher level it is full with beauty, bliss and divinity. Focus on higher dimensions." (Dr. Amit Ray, Indian author in his book „Walking the Path of Compassion") (URL)

4th Motto: „<<To be or/and not to be?>> that is consciousness, if to be defined in a single... question." (Andrei-Lucian Drăgoi, pediatrician specialist and independent researcher)

[1] Online paper preprint DOI: 10.13140/RG.2.2.26902.45125
[2] Andrei-Lucian Dragoi research pages on: ResearchGate, Academia.edu, ViXra, GSJournal;

Abstract

This paper presents a simple **digital consciousness toy model** (**DCTM**) applicable to all multicellular life forms and based on a multi-level competitive hierarchical organization of biological cells in general (including neurons). Consciousness (**CON**) is defined by Merriam-Webster dictionary as "the state or quality of awareness, or, of being aware of an external object or something within oneself". DCTM is a small set of (re)definitions and principles (statements/assumptions of the model) offering relatively many potential explanations and predictions that are testable in the future.

Keywords: a digital consciousness toy model (**DCTM**); biological cells; neurons;

Important note (1). This atypical URL-rich paper (which maximally exploits the layer of hyperlinks in this document), chooses to use Wikipedia links for all the important terms used. The main motivation for this approach was that each Wikipedia web-article contains all the main reference (included as endnotes) on the most important terms used in this paper: it's simply the most practical way to cite entire collections of important articles/books without using an overwhelming list of footnote/endnote references. The secondary motivation (for using Wikipedia hyperlinks directly included in keywords) was to assure a "click-away" distance to short encyclopedic monographs on all the (important) terms used in this paper, so that the flow of reading to be minimally interrupted.
Important note (2). This paper also exploits the advantages of the hierarchic tree-like model of presenting informational content which is very easy to be kept updated and well organized.

I. The main definitions and principles of DCTM

1) **"Self" and "non-self" definitions in DCTM**. DCTM uses the term "**self**" in the specific sense of "**all potentially detectable physical objects and phenomena (containing or implying both physical energy-mass and physical information quantities and transfers) at any conceivable length scale, that (may) exist or take place INSIDE the variable spatiotemporal borders of any physical body of any unicellular life form (ucLF) or multicellular life form (mcLF)**": DVTM also uses the term "internal reality" as synonymous to "self".
   a. "Non-self" is specifically redefined as analogous and complementary to the "self" redefinition, as strictly referring to the "**physical objects or phenomena from OUTSIDE the spatiotemporal borders of any ucLF or mcLF**": DVTM also uses the term "external reality" as synonymous to "non-self".

2) **CON redefinition in DCTM**. CON is redefined by DCTM as "**a simultaneous unified sense of self (internal reality) and non-self (external reality)**". **DCTM considers two major types of CON**: (**1**) CON generated in the awake state of that mcLF (**aCON**) and (**2**) CON generated in the sleep state of that mcLF (**sCON**) (applicable to those mcLF that were demonstrated to have sleep states). When speaking of CON in its global sense, DCTM also uses the term "whole CON" (**wCON**). Both aCON and sCON **develop as (1D) temporal successions of separate states (S) of "self&non-self sense" indexed as: S(1), S(2), …S(n), with integer index n predefined as finite**.

3) **Definitions**. The cells of mcLFs are stated to be organized in biological cells groups (**CGs**), each CG being defined as "**a group of one or more cells/neurons having a large set of biological functions/roles, but also relatively overspecialized for at least one specific biological information(BI) synthesis/integration role. CGs aren't necessarily composed from adjacent cells in direct cellular contact, but from cells that interchange BI (by direct and indirect cellular contact or from distance, by any other known/unknown ways of intercellular communication) for a specific type/level of BI synthesis.**"
   a. **Additional statement**. **BI generated by LFs is also stated to be of three major types** (as detailed in two of author's past papers [**1,2**] in which LFs are theorized to be software-like entities): (**1**) rational BI (based on rational meta-logic and logics); (2) emotional BI (based on emotional meta-logic and logics) and (**3**) volitional BI (based on volitional meta-logic and logics) (see reference for each term definition in part)
   b. **Additional definitions and notations**. Each synthesis level of BI (**slBI**) is indexed with an integer i starting from 1 and noted as: **slBI(1), slBI(2), slBI(3),...slBI(i),... slBI(i_{max}),...**, with **i_{max}** being the maximum level of BI synthesis achievable by a specific LF, which may differ from one type of LF to another and from one individual LF to another: **i_{max} is predefined as a finite integer in DCTM.**
      i. **The output BI generated by various CGs** after each slBI(i) is also indexed as: **BI(1), BI(2), BI(3), ...BI(i),...BI(i_{max})**.
      ii. **Each CG is stated to produce/generate a specific slBI(i)**, so that it is assigned that specific slBI(i): as there are usually at least two (and possibly very many) CGs **competing** in producing the same slBI(i) in any LF (by BI parallel processing[URL2]/computing), **CGs are also indexed in a 2D matrix CG(i,j)**, with a primary index i indicating their produced slBI(i) and secondary index j indicating the j-th CG generating that same slBI(i): the secondary index j may have a maximum value j_{max} (which is also predefined as a finite integer in DCTM) which may differ between two distinct CG(i_1,$j_{max(1)}$) and CG (i_2,$j_{max(2)}$) (depending on the type of LF and the individual LF).
      iii. **A generic CG(i,j) producing a slBI(i)** is also named as an "**i-th rank CG**" or shortly a **CG(i)**, no matter its secondary index j.
      iv. **Additional statement. The same cell can be part of one or more CGs of the same or distinct rank(s).**

v. **Additional statement. The BI flow between any two CGs (of the same or distinct ranks) is stated as bidirectional.**

vi. **Definition**. As any biological cell can convert both physical energy (**PE**) and physical information (**PI**) to BI (by "sampling"/filtering, with specific and variable excitation thresholds, any physical stimulus from inside or outside reality), **the "gross"/"raw" BI** produced (from the initial input PE/PI sets) by any biological receptor (or any other elementary particle/atom/molecule that can capture and retransmit BI inside a biological cell or inside any mcLF) **is indexed as BI(0) and is defined as the product of slBI(0) generated by any biological receptor (in the largest sense previously defined).**

vii. **Note**. The "sampling"/filtering that CGs apply on any PE/PI set from the inside/outside reality (generating finite "resolution" copies of those PE/PI sets as finite BI quantities) and the indexing of all slBI(i), BI(i) and CGs (i,j) are the main arguments for calling this DCTM a "digital consciousness toy model".

4) **Definition (and statement)**. Neurons groups (**NGs**) are stated include not just neurons, but also various types of glial cells (**neuroglia**) which "help" neurons (from any distinct NG) to perform highly specific tasks/functions, including BI analysis and synthesis. In DCTM, NGs are defined **as high-rank CGs(i) (assigned high indexes slBI(i)), which compute and generate high index BI(i)**. Each NG in part is also indexed in a 2D matrix as NG(i,j) (with predefined finite integers i_{max} and j_{max}) and a generic i-th rank NG is also abbreviated as NG(i).

5) **Pivotal statement**. Each NG(i) is stated to produce multiple copies of BI(i) (which can be regarded as "puzzle pieces" sets) and send them to the NGs(i+1) for further synthesis (which can be regarded as "puzzle solvers"): NGs(i+1) produce multiple copies of BI(i+1) and send them further to NGs(i+2) and so on until BI(n-1) copies reach the highest rank NGs(i_{max}) and are finally synthesized in two or more competing BI(i_{max}) packs (which can be regarded as final "models"/"theories"/"puzzles" on the initial "gross" BI(0)). The final product is a CON state S(x) (from a generic x-th time frame), which is a superposition of multiple BI(i_{max}) variants that compete to each other (each with an estimated probability to be "true") and can be further verified and clarified (filtered) by those NGs(i_{max}) that control each mcLF and can further extract additional BI(0) from the internal and external realities (using any possible self/non-self "tool"). Each distinct NG(i_{max}) can compare itself to the other NGs(i_{max}) (and their competing BI(i_{max})) and produces a specific BI(i_{max}) which is defined as a CON sub-state: the final CON state S(x) (from that specific chosen x-th time frame) is thus predicted to be in fact a mixture of superposed sub-states, each sub-state being represented by a distinct BI(i_{max}) produced by a distinct NG(i_{max}) which observes and competes with all the other distinct NGs(i_{max}) and their produced BI(i_{max})).

a. **Classification**. Two major types of NGs can be distinguished: (**1**) NGs which produce self BI(i) syntheses (starting from BI(0) extracted from the internal reality of that LF) and (**2**) NGs which produce non-self BI(i) syntheses (starting from BI(0) extracted from the external reality of that LF). **Statement**. The final rank NGs(i_{max}) are stated to always integrate self and non-self BI(n-1) from all NGs(n-1).

b. **Additional statement**. As any BI(x) synthesis also (and always) implies a BI(x-1) pre-analysis (followed by BI(x-1) synthesis), the synthesis between present BI(i) and past (rational/emotional/volitional) experience (past BI(i)) is regarded by DCTM as an essential process in LFs (with great importance in the survival of that LF) and it is accomplished in two major ways: (**1**) by interaction between BI(i-1) with any NG(i) (which NG(i) already has morphological and physiological modifications/"imprints" due to past BI(i-1) input and BI(i) synthesis); (**2**) by active comparison (in which NG(i) can also access past BI(i) stored in other NGs) of present BI(i-1) input and BI(i) synthesis with past BI(i-1) inputs and past BI(i) syntheses: based on these types of comparisons, a new present BI(i) is generated by that NG(i).

c. **Checkpoint conclusion**. Each state generic state S(x) of CON (either aCON or sCON) is a superposition of multiple BI(i_{max}) variants (produced by highest rank NGs(i_{max})) that compete to each other and generate the "sense of self&non-self" in that specific chosen x-th time frame of CON. **Note**. This process described and predicted by DCTM is similar to the evolution of science in time, in which science history retains a small set containing the most probable scientific models, each capable of "covering" and coherently synthesizing a relatively high percent of observations at that specific historical time frame.

d. **Explanation**. In this way, DCTM explains why each "memory event/object" appears to be stored in multiples places in the brain, as each BI(i) variant is produced in multiple copies that are further sent to (and used by) NGs(i+1) for processing, up to (the final rank) NGs(i_{max}) which may also store an "archived"/"compressed" copy of each generic BI(x) used in the final slBI(i_{max}) (a synthesis made by each competing NG(i_{max}) in part). This multiple copying in multiple storage places is also

analyzed in detail by the notorious holonomic brain theory initially developed by Karl Pribram in collaboration with David Bohm and then further developed by Pribram only.

e. **Explanation**. In this way, DCTM also explains why CON ("self&non-self sense") is perceived as a mixture of superposed states (which are actually inter-competing BI(i_{max}) variants produced by inter-competing NGs(i_{max})). **Additional explanation**. This composite structure of each generic S(x) (which is regarded as a superposition of sub-states) may also explain the similitudes between CON mechanisms and some quantum mechanical phenomena/principles (like the quantum superposition principle).

f. **Explanation**. By this pivotal statement, DCTM explains the latency between perception and final decision making, but also the time latency (experimentally determined to be of about 0.5 seconds) between the moment in which a healthy human subject takes a decision unconconsciously and the moment in which that same person becomes aware/"conscious" of that decision (previously "prepared" in his "unconscious").

g. **Explanation**. DCTM defines and explains dreams as "simulations"/"tests" of BI(0) generation, BI(i) synthesis and bidirectional BI flows (between any two possible CGs or NGs): in this view, **nervous systems** (**NSs**) in general act both like "fabrics" of cells and "testers" of cells (including neurons and glial cells) by direct interactions with internal or external realities OR by simulations of such interactions. **Prediction**. As all NSs perform tests on their own cells, DCTM predicts that all mcLF may have "dreams" or equivalents of "dreams" largely defined in DCTM as "**BI generation, synthesis and bidirectional flow simulations**". **Explanation**. DCTM also explains the necessity of two major "epochs" in the growth and development of any NS: (**1**) the first phase in which NGs(x) (with $0 \leq x \leq n$) are created and (**2**) the second phase of testing and remodeling those NGs(x), as a "natural" selection with multiple criteria and phases and based on the permanent verification of BI(x) generated by those NGs(x).

h. **Pivotal prediction**. As all mcLFs (plants and animals) are stated to use specific slBI(i)-based hierarchies, DCTM predicts that all mcLFs implicitly have ultimate rank CGs(i_{max}) and/or NGs(i_{max}) that produce "final" BI synthesis and generate LF-specific CON forms.

6) **Final conclusion**. The nervous systems (**NSs**) of mcLFs (where it is the case) may be thus regarded as very competitive "democratic" and "meritocratic" systems in which the "fastest" and the "smartest" NGs/"teams" (proving the validity of their syntheses and their usefulness for LFs as wholes, with also great impact in the survival of LFs) generate the final combined (self&non-self) CON state (for each time frame in part) and get the largest rewards and share of nutrients (by blood flow control in specific areas/regions of those NSs at specific time frames) to build themselves more robust in time.

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II. References

[1] Drăgoi Andrei-Lucian (2017). "(**BIDUM 3.2 full - Part A - 18 pages - last update on: 23.02.2017**) A Bio-Info-Digital Universe (toy-)Model – towards a transdisciplinary TOE centered on life phenomenon – **Part A**". **DOI 10.13140/RG.2.2.23869.26082**. URL(ResearchGate), URL(Academia.edu)

[2] Drăgoi Andrei-Lucian (2017). "(**BIDUM 3.2 full - Part B - 20 pages - last update on: 23.02.2017**) A Bio-Info-Digital Universe (toy-)Model – towards a transdisciplinary TOE centered on life phenomenon – **Part B**". **DOI: 10.13140/RG.2.2.35013.65760/1**. URL(ResearchGate), URL(Academia.edu)