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Bruno Apolloni

A Few Things I Know About Her

A Personally Machine Learning Inspired Approach to Understand Surrounding Nature

Springer

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Acknowledgements

After having read, either fully or in part, this book, the reader may understand my stumble with this section.

In concrete, I gratefully thank all colleagues with whom I shared thoughts and work during my many university years. In a certain sense, a scientific collaboration may prove more demanding than other kinds of partnership, as a person reveals his inner mindset and puts it in the hands of these partners, ever ready to receive any form of criticism since he knows it is honestly mutual. Formally, I'm much more cautious since I don't take for granted that some or all statements claimed in the book comply with those of my colleagues. Thus, I avoid mentioning anyone in particular, apart from Prof. Lakhmi Jain who kindly solicited me to write this book, even though I know he disagrees with some of the general ideas presented in it. That's the bliss of open-minded people.

What also embarrasses me is the fear I may have put bad mistakes somewhere in this long text. While that's a normal source of anxiety for writers of scientific texts, it is amplified for me by the wide scope of the book and, above all, by its leitmotif "issue your sentences after deep study, not simply as opinions", which, while may involuntarily sound conceited, could be cruelly contradicted by those mistakes.

So, encouraged also by friends with whom I shared my ideas, I decided to put my head in the mouth of one of my personal lions (hoping it to be tame).

Thanks for feedback.[1]

Bruno Apolloni

[1] $\alpha\&\omega$ is not a Cabala formula, it is just to note that we started the book with a lion matter and end with a lion matter as well.

Executive Summary

For starters: *the soul does not exist*. With this affirmation I no doubt lose 70% of my prospective readers—including: fundamentalists, flat-earthists, respectable people, pious types, and so forth. However, rather than seeking to provoke, I need this *incipit* to clarify that my perspective lies in bypassing the convenient soul-body dichotomy, and focus expressly on its second horn. Let's start from our brain, i.e., that huge jumble of neural cells, as the main responsible of our interaction with the surrounding Nature, and see how it may perceive, understand, and react to external stimuli. As such, this may seem to be a rather ambitious, if not unrealistic, task. Yet it is a task we face and solve in practice every day of our lives, always profiting from the experience cumulated on our body. My contribution consists simply in some strongholds that I would share with readers. Hence, I will tackle the following topics that will be the titles of as many chapters:

1. Genome + synapses, as the database and the operational root of all our actions.
2. My own personal physics, what I can know (from Sir Isaac Newton on) in search of a compatible world.
3. My favorite approach to exploiting observed data.
4. How to deal with hard-to-understand phenomena, by stressing intertwined functionalities of computation, communication, and memory activities.
5. Benefits and drawbacks of out-of-the-box solutions versus standard answers we get for free.

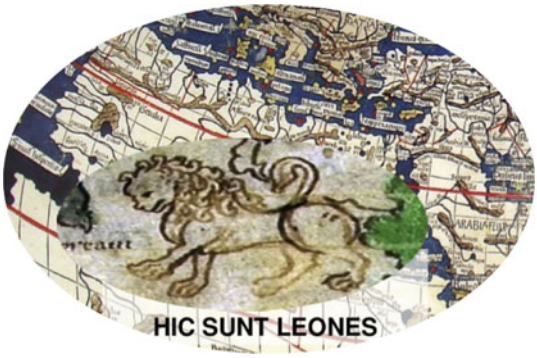
This short book will not represent a *Summa Teologica*, i.e., a comprehensive text where authors unveil to readers the Truth about the world (and the heavens). Rather, I will try to interpret two bases of our mental activities:*description* and *explanation*, in terms of elementary operations that take place according to a common model of our brain: namely, the weighted sum *net* and the broadcast communication through *synapses* (and their iterated application), within a diffuse broadcasting environment supported by long-term memory facilities. In my view, this leads people to navigate every day among compatible worlds instead of sticking to *the true one* (if any), where *compatibility* is another key issue of the book.

Hic sunt leones (here are lions). Folklore says ancient cartographers used these words in delimiting areas of the world they didn't visit, where lions embody the causes hindering the continuation of their explorations. Personally, I feel an analogous condition, where I know something, a few things about Her, yet touch with my hands the limits of my knowledge, and my urge to go beyond them, too, even by venturing some not-well-founded conjectures. But my mother always warned me to do not trust know-it-all people. Currently they are a plague fostered by the quick WEB search engines and the simplification conspiracy. So, in the book I will manage some professedly border-line statements, beyond which I must claim there are my personal lions.

Since the ideas so gathered concern basic issues, they should be sharable with the general reader. That's why I made every effort to write a reader-friendly text. To this aim, I did limit the amount of formulas to a minimum, and whenever possible avoid numbering formulas as well as pictures. They are exactly located under the eyes of the reader and explained in the text. By contrast, where necessary I created boxes containing somehow harder mathematics that may be skipped at a certain level of reading. In any case, at the end of each chapter I suggest further readings and related bibliography. In additional support to the reader, the text is constantly accompanied by summary notes along the margins. However, I warn the reader that the attention to be paid to the text increases chapter by chapter, where each is linked to what was discussed in the previous ones.

As an academician, I must doubly apologize: to readers for using a narrative style that is new to me; to colleagues for oversimplifying my subject matter and lacking in rigor here and there.

Thanks for reading.



Milan, Italy
October 2021

Bruno Apolloni

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Symbols

[]	delimiters of close intervals (those which do comprise the extremes).
()	delimiters of open intervals (those which do not comprise the extremes). They are the default delimiters when the membership of the extremes is immaterial.
{}	delimiters of a set of elements.
$\in$	denotes the membership of the left item to the right set.
$\sum_{i=1}^{n} x_i$	denotes a sum of all items in the set $\{x_1, \ldots, x_n\}$; when obvious, the extremes of the addend index are omitted.
$\prod_{i=1}^{n} x_i$	denotes a product of all items in the set $\{x_1, \ldots, x_n\}$; when obvious, the extremes of the factor index are omitted.
$\lim_{x \to x_l} f(x)$	denotes the value that $f(x)$ approaches when its argument approaches the value x_l.
∞	denotes a virtual value which is higher than any other one we can establish (it is a possible x_l in the lim notation).
dx	is an infinitely small increment of the variable x. (We may imagine it as the result of a never-ending halving of a segment whose length is whatever value of x.)
$\int_a^b f(x)dx$	denotes the integral of the function f when its argument ranges between a and b.
x's	denotes many values of x (by some notation abuse).
$\cdot$	denotes the dot product between two arrays. For $a = (a_1, \ldots, a_n)$ and $b = (b_1, \ldots, b_n)$, $a \cdot b = a_1 b_1 + \ldots, a_n b_n$

Note: For notation simplicity's sake, unless explicitly indicated I will not use different typefaces to distinguish single values from arrays and sets.