Moshe Klein · Oded Maimon

Foundations of Soft Logic

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Preface

Dear reader, we present to you our original research from the past seven years. It is a groundbreaking new mathematical paradigm and system (which includes the invention of a new number) that enables a new approach to advancing the foundations of science and technology.

We develop new approaches to connecting subjective and objective points of view that do not rely solely on the classical deductive approach. There is no need to fear paradoxical situations because it is precisely in them that lies the key to a new understanding that is more connected to life itself.

We wrote this book with the understanding that, in our times, there is a great need to develop a new approach for advancing science in the face of new challenges, including consciousness research. Our experience in the fields of robotics, computer science, and artificial intelligence has led us to the conclusion that the real challenge today is not only to make machines intelligent but also to develop and refine intelligence in human beings.

We would like to acknowledge and thank our friends who were involved in the research and assisted us in bringing it to the state of a complete book: to Yale Landsberg for the conversations that helped develop the Soft coordinate system (Chap. 5), to Prof. Kevin Vixie for the important contribution in linking the Soft numbers to the Möbius strip, to Prof. Alla Shmukler for the significant assistance in developing Soft analysis (Chaps. 9 and 10), to Oren Fivel for the significant contribution in developing Soft probability and Soft analysis (Chaps. 12 and 14), and to Dr. Ron Hirschprung for developing the research and implementation in the field of privacy paradox (Chaps. 13 and 14). Thanks also to Avishay Galili for the connection of Soft logic to Salomon Maimon and the Theory of Infinitesimals (Chap. 2), to Omer Cantor for his contribution to the understanding of the connection between Soft Möbius function and the Riemann hypothesis (Chap. 11), to Sigal Kordova for the correlation to System thinking (Chap. 14), John Torday for the connection to biology and the origin of life (Chap. 14), and to Idan Sagiv for his professional editing.

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Tel Aviv, Israel

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List of Symbols, Signs, and Terms of Soft Logic

Symbol/Sign/Term	Definition
$\bar{\mathbf{0}}$	The special object of the infinitesimal type with the fundamental property $\bar{0}^2 = 0$, the generator of the zero axis
$a\bar{\mathbf{0}}$ $(a \in \mathbb{R})$	A zero axis number, a Soft zero
$-\bar{\mathbf{0}} = -1\bar{\mathbf{0}}$	The negative zero
$+\bar{\mathbf{0}} = 1\bar{\mathbf{0}}$	The positive zero
$\mathbf{0} = 0\bar{\mathbf{0}}$	The absolute zero
$\bar{\mathbf{0}}$-axis, a zero axis, a zero line	A vertical line presenting a continuum of Soft zeros
$\bar{\mathbf{1}}$	The number 1 when it is used to present a real number as a multiple of 1
$b\bar{\mathbf{1}}$ $(b \in \mathbb{R})$	A real number b presented as a multiple of 1
$\bar{\mathbf{1}}$ –axis, a real axis, a real line	A vertical line presenting a continuum of real numbers
$\perp$	The bridge sign
$a\bar{\mathbf{0}}\perp b\bar{\mathbf{1}}$ $(a, b \in \mathbb{R})$	A bridge number of the right type (a real number is to the right of the bridge sign)
$b\bar{\mathbf{1}}\perp a\bar{\mathbf{0}}$ $(a, b \in \mathbb{R})$	A bridge number of the left type (a real number is to the left of the bridge sign). We tend to omit writing the one axis, so the regular notation of soft numbers is of the form $a\bar{0}\dot{+}b$
BN	The set of all bridge numbers. $\{ a\bar{\mathbf{0}}\perp b\bar{\mathbf{1}}, b\bar{\mathbf{1}}\perp a\bar{\mathbf{0}} \;:\; a, b \in \mathbb{R} \}$
$a + b\varepsilon$ $(a, b \in \mathbb{R}, \varepsilon^2 = 0)$	A dual number
$\dot{+}$	Soft number sign
$a\bar{\mathbf{0}} \dot{+} b$ $(a, b \in \mathbb{R})$	A Soft number in the right appearance (a real number is on the right side of the Soft number sign)
$b \dot{+} a\bar{\mathbf{0}}$ $(a, b \in \mathbb{R})$	A Soft number in the left appearance (a real number is on the left side of the Soft number sign)
SN	The set of all Soft numbers $\{ a\bar{\mathbf{0}}\dot{+}b \;:\; a, b \in \mathbb{R} \}$
$c = X\bar{\mathbf{0}}\perp Y$	A bridge number of the right type in the pair of bridge numbers defining a Soft number $X\bar{0}\dot{+}Y$

(continued)

Symbol/Sign/Term	Definition
$\boldsymbol{c}' = \boldsymbol{Y} \perp \boldsymbol{X}\bar{\mathbf{0}}$	A bridge number of the left type in the pair of bridge numbers defining a Soft number $X\bar{0} \dotplus Y$
SNS	A Soft number strip with a central zero axis and two bounding, real axes
$\boldsymbol{A}\ (-\infty < \boldsymbol{A} < \infty)$	The height of a point on an SNS
$\boldsymbol{B}\ (\mathbf{0} \leq \boldsymbol{B} \leq \mathbf{1})$	The width of a point on an SNS
$\boldsymbol{c} = (\mathbf{1} - \boldsymbol{B})\boldsymbol{A}\bar{\mathbf{0}} \perp \boldsymbol{B}\boldsymbol{A}\bar{\mathbf{1}}$	A bridge number of the right type corresponds to a point C that is located in the right part of an SNS with a height A and a width B
$\boldsymbol{c}' = \boldsymbol{B}\boldsymbol{A}\bar{\mathbf{1}} \perp (\mathbf{1} - \boldsymbol{B})\boldsymbol{A}\bar{\mathbf{0}}$	A bridge number of the left type corresponds to a point C' that is located in the left part of an SNS with a height A and a width B
$\mathbf{S}\boldsymbol{N}(+)$	The group of Soft numbers under addition
$\mathbf{S}\boldsymbol{N}(+, *)$	The ring of Soft numbers under the operations of addition and multiplication
$\mathbf{SN}^*(\neg\mathbf{0})$	The set of invertible Soft numbers
$\mathbf{SN}^*(\mathbf{1})$	The set $\{a\bar{0} \dotplus (\pm 1) : a \text{ is any real number}\}$
$\mathbf{SQ}^*(\neg\mathbf{0})$	The set $\{q\bar{0} \dotplus r : q, r \text{ are rational numbers}, r \neq 0\}$
$\bar{f} : \mathbf{SN} \rightarrow \mathbf{SN}$	The Soft function of a Soft variable, an extension of a differentiable real function $f(x)$
$\widehat{f} : \mathbf{R} \rightarrow \mathbf{SN}$	The Soft function of a real variable, enabling a graphic presentation by a curve on an SNS

About the Authors

Moshe Klein is a researcher in the Consciousness and Soft Logic research lab at Tel Aviv University headed by Oded Maimon. He is the founder of the Gan Adam project for the development of mathematical and scientific thinking among preschoolers, and has since instructed hundreds of kindergarten teachers throughout Israel. He is a lecturer at Tel Hai College.

Oded Maimon is the Oracle chair professor at Tel Aviv University, previously at MIT. Oded's research focuses on exploring and modeling natural and artificial intelligence, Soft logic, and consciousness. He has spent sabbaticals at BU (Boston) and BHU (Varanasi, India), and was invited to lecture and help direct leading universities around the world (including Stanford in the United States, Tsinghua in China, IIT in India, Waseda in Japan, Paris 6 in France, and UNAD in Columbia). Oded has published over 100 refereed papers in leading academic journals and 20 research books, and has made over 200 research presentations at international scientific conferences with many invited and keynote presentations.

Chapter 1
Introduction

Soft logic is a mathematical language that facilitates richer and more diverse situations than the regular logical distinction between right and wrong. For this purpose, we have developed a rigorous mathematical theory that includes the invention of a new type of number called a "Soft number." This theory will be the foundation for scientific development and inventions in various new directions.

1.1 The Essence of Soft Logic

Our times fundamentally require a new mathematical language that is Soft and dialogical, a language that is based on the interaction between human beings and the world. The ability of Soft logic to contain contradictory and opposing situations may assist in situations of human conflict and dispute. This language enables each party to the conflict to develop a new point of view that sees and contains the point of view of the other party. This will make it possible to discover the common denominator between the two parties and resolve the conflict or disagreement.

Life is richer and more varied and colorful than the two extremities of right and wrong. To use the color analogy, one can say that this mathematical language is more colorful; it has more colors and shades than just black and white. Regular mathematics avoids paradoxical situations that contain internal contradictions. On the other hand, Soft logic by definition combines logical and linear thinking with a type of thinking based on the mathematical exercise of dividing zero by itself, an exercise with infinitely correct results, or, in other words, the type of thinking in which a thing and its opposite can be simultaneously correct.

Soft logic is based on a new perspective on the number zero, which was invented in India in the seventh century. This invention is relatively modern, compared to the invention of all the natural numbers tens of thousands of years ago. The invention of the zero was revolutionary since it gave a special sign to an amount that is nothing at all. This invention enabled the development of the decimal system of writing

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numbers, which was then used to write large numbers with a relatively small amount of digits. Soft logic expands the effect of the location of the number zero as it assumes a continuum of zeros rather than a discrete location of zeroes.

The mathematician Leibnitz developed the binary system based on two numbers only: one and zero; later it became the mathematical infrastructure for the development of the computer. Leibnitz himself strove to develop a new mathematical language that would be at the same time rational and softer than the dichotomy of right and wrong; the term “Soft logic” was inspired by him.

The novel distinction of Soft logic is that zero is not, in fact, nothing. To describe nothing, a blank sheet of paper would suffice. The very act of writing down the number zero shows that there is something that can be distinguished. This leads to the possibility that zero is both negative and positive. A similar distinction already exists in differential and integral calculus, which refers to the direction in which a series of points tends to zero. Contrary to this, Soft logic distinguishes between the various multiples of the number zero (Klein and Maimon 2021; Fivel et al. 2023; Hirschprung et al. 2023).

Soft logic has a zero axis, upon which lie the various multiples of the number zero. Soft logic offers a new set of coordinates that is non-Cartesian. This system has a zero axis facing the axis of real numbers. The Soft system of coordinates includes a twist and therefore constitutes a simple model for an infinite Möbius strip. Locally, a Möbius strip has two sides, but globally, it has only one side. This paradox is demonstrated and realized geometrically with Soft logic.

Using the zero axis, we define a new type of number called “Soft numbers.” The following operations can be applied to them: addition, subtraction, multiplication, division, exponentiation, and extraction of roots. Soft numbers have an algebraic structure very similar to the structure of an algebraic field.

Complex numbers, which include the root of minus one ($i = \sqrt{-1}$), were invented 500 years ago by the Italian mathematician, Gerolamo Cardano. The mathematicians of his time found it very difficult to accept this concept, but after 400 years, it was put into extensive use in the mathematical development of the theory of electricity and alternate current.

Without the invention of complex numbers, the Internet could not have been invented. Complex numbers are also useful for the description of periodic waves in optical physics as well as quantum theory. In Soft logic, instead of the imaginary number i, we use the number $\overline{0}$. The laws of addition for Soft numbers are similar to those for complex numbers, but the laws of multiplication are different. Eventually, a use was found for complex numbers; similarly, we aim to develop and discover scientific and technological applications for Soft logic.

The relationship between mathematics and physics is one of the most challenging issues facing science today. It is one of the open problems (Problem no. 6) posed by the mathematician David Hilbert at the International Conference of Mathematics that took place in Paris in the year 1900. In 1905, Albert Einstein published the special theory of relativity, whose main idea is the constancy of the speed of light in a vacuum. Two sources of light that are moving toward each other do so at the relative