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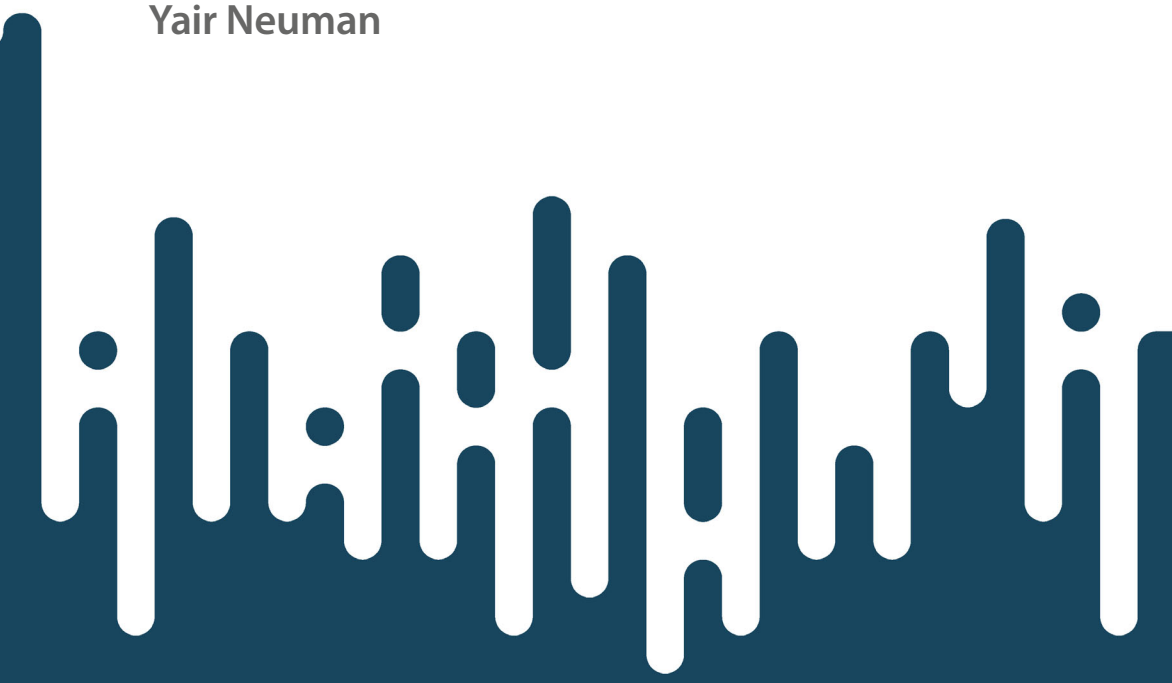
Yair Neuman



AI for Understanding Context

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Preface

Context is necessary for understanding human behavior. The etymology of the word context shows us that it emerged from the Latin word *contextus* "a joining together." Without understanding how pieces of information join together, it is impossible to understand human behavior. The current book aims to explain how to use AI to understand context better. It aims at a wide readership, from computer and data scientists to those involved in digital humanities and computational psychology. The interested reader should not, therefore, be surprised if some parts of the text seem trivial, while others beyond their scope of expertise are more challenging.

The first five chapters (1–5) present the theoretical foundations. Chapters 6–8 discuss three case studies in which I elaborate on the ideas and show how to prompt ChatGPT to identify the relevant contextual dimensions and use them better to understand human behavior in all its challenging complexity.

As the book aims to address a broad audience, it combines a scientific style with lively examples and case studies. My case studies are presented as worked examples. Many years ago, I learned from John Sweller's research that there are significant benefits to learning through worked examples. In contrast with some of my academic publications, where I address a scientifically oriented audience to communicate new technologies, here, my focus is on teaching and learning. Therefore, focusing on case studies and worked examples seems fully justified. The reader is invited to a fascinating journey in which I hope to show how AI can help us in "joining together."

Be'er Sheva, Israel — Yair Neuman

Acknowledgments My understanding of context and the complexity of human behavior might have looked different if I had not met Zvi Bekerman as a young student. A quarter of a century later, his teachings still echo in my research. I also thank Yochai Cohen, the software engineer in my DARPA project, for materializing my algorithms in silico. Finally, I thank Springer's editor, Alexandru Ciolan, for his friendly approach to bringing this manuscript into print.

About This Book

Context is necessary for understanding human behavior. However, so far, the concept of context has mostly been treated in a way that lacks any clear relevance for using, developing, and engineering intelligent systems. In this short manuscript, Prof. Neuman explains the importance of context for understanding human behavior, presents a theory of context, and shows how AI, specifically Large Language Models such as GPT, can support our understanding of context when analyzing human behavior as expressed in texts ranging from conversations to short stories. Drawing on years of R&D and academic publications in top-rated journals, Prof. Neuman provides the reader with a deep understanding of context and its modeling for specific challenges, from identifying social norm violations to understanding conversations going awry and stories by great authors. The book may interest a wide variety of readers seeking to incorporate AI into their understanding of human behavior.

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About the Author

Yair Neuman (b. 1968) is a polymath drawing on diverse disciplines to address real-world and academic challenges. He published numerous papers and academic books and was a visiting Professor at M.I.T., University of Toronto, University of Oxford, and Weizmann Institute of Science. Beyond his academic work, he developed state-of-the-art social and cognitive computing algorithms, such as those he developed for IARPA and DARPA.

Chapter 1
The Importance of Context

Abstract We cannot understand human behavior without taking context into account. However, too many projects miss this point either from naïve ignorance, or because they apply an engineering-biased approach, or for the sake of simplicity. In this chapter, I explain why context is important and relevant for computational projects, such as the automatic identification of social norms and their violations and the automatic analysis of human personality.

1.1 Context Is Necessary for Understanding Behavior

It is impossible to understand human behavior without considering the contextual/situational[1] dimensions in which it occurs. This argument can be illustrated through two simple examples presented long ago.

The first example was given in the 1920s by one of the most important language theorists, Valentine Voloshinov. Voloshinov [1] describes a couple sitting in silence in a room when one suddenly says, "Well!", while the other does not reply. For us, as outsiders, the meaning of this act of communication, the utterance "Well!", is incomprehensible. We learn from this lack of understanding that the meaning of "Well!" is not contained in the word itself. Like a particle residing in a physical space, the meaning of a word emerges only through the semantic field in which it is located.

What do we need to understand the meaning of "Well!"? What we need, suggests Voloshinov, is the non-verbal context. This includes three components:

1. the spatial purview the speakers share,
2. the couple's "common knowledge and understanding of the circumstances," and
3. the couple's "common evaluation" of the circumstances (ibid., p. 11).

Voloshinov provides these contextual dimensions to show how the single word "Well!" may be loaded with meaning. He explains that the couple are glancing out

[1]Here, I use the terms "context" and "situation" interchangeably.

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the window and see snow falling, and yet it is May. They are both sick of the winter and anxious it will end; therefore, the one word "Well!" expresses a mental state of anticipation they both share and understand.

The example is appealing in its simplicity and illustrates an important point: we must consider contextual/situational dimensions to understand human verbal or non-verbal behavior. Knowing nothing about the situational dimensions, we cannot understand the meaning of "Well!". Without these contextual dimensions, even this relatively simple act of communication is meaningless. The situation (or context) describes the circumstances in which the utterance occurs. Therefore, any act of communication is contextual in that it cannot be understood without considering certain dimensions outside the behavior which is the focus of our attention.

Here is a second example given by the anthropologist and polymath Gregory Bateson in a book published during the 1970s [2]. Bateson describes a mother who habitually rewards her child with ice cream when he eats his spinach. At that time, spinach was not considered an attractive food for children, despite its nutritional benefits. If you recall the animation heroes of that time, *Popeye the Sailor Man* should immediately come to mind. Popeye gained strength by opening a can of spinach and swallowing it in one gulp. Swallowing the spinach, he immediately became superhuman, saving his loved one and beating his ultimate opponent. The mother in Bateson's story does not have Popeye to help her convince her son to eat spinach. Therefore, she rewards the behavior of eating spinach by doling out ice cream.

Here, Bateson is challenging us with an interesting question. What additional information, asks Bateson, do we need to be able to predict whether in the future the child will:

1. come to love or hate spinach,
2. love or hate ice cream, or
3. love or hate Mother?

Notice that the simple situation of a mother rewarding her son for eating spinach may lead to *diametrically opposing* behaviors. For example, the son may come to *love* or *hate* spinach. He may associate the spinach with the caring mother and the rewarding ice cream and, therefore, may come to love the taste of spinach. In contrast, he may associate spinach with its unpleasant and bitter taste and with a mother forcing him to eat something he despises. Therefore, he may hate spinach (and his mother …).

It is important to realize that these two *opposing* behaviors (i.e., love or hate) are both reasonable trajectories for the *same* behavior, the behavior which is the focus of our attention. At the micro level of analysis, this same behavior can potentially lead in totally different directions. In a profound sense, the entropy or the uncertainty associated with this particular behavior is maximal. The outcomes seem theoretically similar to the outcomes of tossing an unbiased coin.

We must focus on additional aspects of the mother–son interaction to predict the child's behavior and reduce the entropy. Bateson shows us, similarly to Voloshinov,