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Guide to Teaching Data Science

An Interdisciplinary Approach

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To our families, students, and colleagues

Prologue

This *Guide to Teaching Data Science* can be used by all educators in all educational environments and settings: in formal education (from elementary schools through high schools to academia) and informal education, in industry, and in non-profit governmental and third sector organizations. Specifically, the guide can be used as a textbook for Methods of Teaching Data Science courses, in which prospective and in-service teachers learn the pedagogy of data science, which is currently emerging in parallel to the development of the discipline of data science. The guide can serve also other practitioners who are curious about data science, its main characteristics, the challenges it poses, and the opportunities it offers to a variety of populations.

To benefit all of its potential user populations, the guide is organized in a way that enables immediate application of its main ideas. This goal is achieved by presenting the rationale behind the inclusion of each topic presented in this guide, its background, development, and importance in the context of data science and data science education, as well as the details of the actual teaching process (including over 200 exercises, worksheets, topics for discussions, and more).

The writing of this guide is based on our five years of experience teaching and conducting research on data science education in a variety of frameworks (2018–2022 inclusive). Specifically, we have taught courses and facilitated workshops on data science and on data science education in different formats (from 2 h active-learning workshops to full, year-long academic courses) to a variety of populations: high school pupils, undergraduate and graduate students, practitioners in different sectors, researchers in a variety of domains, and pre-service and in-service data science teachers. In parallel, we researched a variety of data science education topics, such as teaching methods, learning processes, teacher preparation, and social and organizational aspects of data science education. We are also involved in various data science education initiatives and participate in national initiatives and policy-making committees. This guide enables us to share with the professional community of data science educators the professional knowledge that we have accumulated over the years. In addition, supplementary pedagogical material is available on our website at https://orithazzan.net.technion.ac.il/data-science-education/.

We would like to thank all those who have contributed to our understanding of the nature of data science education and who have fostered the interdisciplinary approach to data science presented in this guide: These include all of the students in the various courses we have taught and many prospective and in-service high school computer science and data science teachers, as well as colleagues, researchers, and instructors who have collaborated with us throughout the years in a variety of teaching, research, and development initiatives. Over the past five years, they have all shared with us their knowledge, professional experience, thoughts, and attitudes with respect to data science education. We have learned from them all.

In addition, we thank Tech.AI—Technion Artificial Intelligence Hub and The Bernard M. Gordon Center for Systems Engineering, also at the Technion, for their generous support of our research. Special thanks go to Ms. Susan Spira for her highly professional editing of many of our publications (including this guide).

Haifa, Israel Orit Hazzan
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