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Data Science Education Across Academic Disciplines: A Comprehensive Approach to Campus-wide Integration

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Data Science—encompassing data collection, storage, analysis, visualization, and interpretation—has become a foundational pillar of modern research, decision-making, and innovation. Its influence extends across scientific, social, industrial, and governmental domains, transforming both methods and outcomes. This contribution discusses the importance of integrating Data Science education across all academic disciplines, recognizing its multidisciplinary nature and universal relevance. While core Data Science programs remain essential, a broader educational approach is needed to equip all students—of every academic discipline—with basic data literacy, data search and retrieval, analytical skills, and ethical awareness. The Israeli National Academy of Sciences and Humanities has established a committee to evaluate and promote this vision, in coordination with national academic policy bodies. Central to this initiative is the "data cycle"model, a generic framework for data-informed inquiry and decision-making, applicable across disciplines. The report proposes differentiated teaching objectives for three student groups: Data Science majors, students in data-adjacent fields, and the broader student body (where, in addition to a fundamental section of Data Science course, a discipline-oriented section will be offered). This framework aims to foster informed citizenship, critical thinking, and workforce readiness in an increasingly data-driven world. Our findings and recommendations contribute to global discussions on embedding Data Science into higher education systems.

The National Academy report suggests a universal approach to data handling entitled The Data Cycle. The data cycle offers a structured framework for addressing data-driven questions, spanning six key stages: problem definition, data collection, cleaning and integration, analysis, visualization, and drawing conclusions. Each stage requires distinct computational and ethical competencies, from sourcing and validating data to applying statistical, AI, and machine learning methods. Technological tools—from qualitative design software to advanced programming environments—support this process, with differentiated access for students based on background and field. The cycle's iterative nature reinforces the evolving relationship between data, knowledge, and decision-making. Ethical and legal considerations, including privacy, bias, transparency, and replicability, are integrated throughout, emphasizing critical thinking as a core component of data education. This presentation outlines a pedagogical model designed to equip all students—not only Data Science majors—with the skills and sensitivity needed for responsible and effective data use across academic and professional domains in an immersive information world.

This initiative outlines a modular and interdisciplinary framework for integrating Data Science education across all academic disciplines. Recognizing the varying needs of fields such as humanities, law, engineering, exact sciences, and life sciences, the proposed model begins with a universal core course introducing the data cycle, ethical considerations, basic tools, and types of digital data. This is followed by discipline-specific modules that align Data Science concepts and tools with the methodologies and priorities of each field. Content delivery can take the form of standalone introductory courses, enriched existing courses, or a hybrid of both. Emphasis is placed on experiential learning through real-world data, collaborative team projects, and critical thinking. Partnerships with university Data Science centers and academic libraries are central to the program's success, as they provide both technical expertise and infrastructure, including access to domain-specific datasets. Furthermore, the initiative recommends developing national data resources and supporting pre-university education to instill data literacy from an early age. (In fact, the Ministry of Education has established a three-year program entitled Data and Information in high schools to precede the academic studies in Data Science). This comprehensive approach not only equips students with essential skills for research and employment but also fosters cross-disciplinary communication and data-informed thinking—crucial for

addressing today's complex societal challenges.

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