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Bridging the Gap: Unfolding and Quantification Learning for Physics Research

The resolution of any detector is finite, leading to distortions in the measured distributions. Within physics research, the indispensable correction of these distortions is know as *Unfolding*. Machine learning research uses a different term for this very task: *Quantification Learning*. For the past two decades, this difference in terminology (and some differences in notation) have prevented physicists and computer scientists from acknowledging the fact that Unfolding and Quantification Learning cover indeed the same mathematical problem.

In this talk, I will bridge the gap between these two branches of research and I will provide an overview of the many key results that Quantification Learning has produced over the past two decades, covering statistical consistency, the anatomy of reconstruction errors, improved optimization techniques, more informative data representations, and arbitrary numbers of observable quantities. Each of these results has immediate and compelling implications on the practice of Unfolding, tackling questions like: Which algorithms are trustworthy? How can we increase their performance and how should we implement them? How much data do we need? Which of the current limits are inherent and which can be lifted? I will discuss these questions from an interdisciplinary perspective, taking into account recent developments from both physics and machine learning research.

AI keywords

quantification learning; learning theory; label shift; classification; constrained optimization

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