

Introduction

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Background

Researchers in many disciplines now face the formidable task of processing massive amounts of high-dimensional and highly-structured data. Advances in data collection and information technologies have coupled with innovations in computing to make commonplace the task of learning from complex data. As a result, fundamental statistical research is being undertaken in a variety of different fields. Driven by the difficulty of these new problems, and fueled by the explosion of available computer power, highly adaptive, non-linear procedures are now essential components of modern “data analysis,” a term that we liberally interpret to include speech and pattern recognition, classification, data compression and image processing. The development of new, flexible methods combines advances from many sources, including approximation theory, numerical analysis, machine learning, signal processing and statistics. This volume collects papers from a unique workshop designed to promote communication between these different disciplines.

History

In 1999, Hansen and Yu were both Members of the Technical Staff at Bell Laboratories in Murray Hill, New Jersey. They were exploring the connections between information theory and statistics. At that time, Denison and Mallick were faculty members at Imperial College, London, researching

Bayesian methods for function estimation; and Holmes was a graduate student at Imperial, studying with Mallick. In the summer of 1999, Denison, Holmes and Mallick (together with Robert Kohn at the University of New South Wales, and Martin Tanner at Northwestern University), began to think about a conference to explore Bayesian approaches to classification and regression. Holmes spent part that summer visiting Hansen and Yu at Bell Labs, and invited them to join the organizing committee of his conference. Very quickly, the focus of the meeting expanded to include a broad range of ideas relating to modern computing, information technologies, and large-scale data analysis. The event took on a strong interdisciplinary flavor, and soon we had a list of invited speakers from machine learning, artificial intelligence, applied mathematics, image analysis, signal processing, information theory, and optimization. Within each broad area, we tried to emphasize complex applications like environmental modeling, network analysis, and bioinformatics.

In the fall of 1999, the Mathematical Sciences Research Institute (MSRI) in Berkeley, California agreed to sponsor the workshop. Given the size of the problem area and the diversity of disciplines represented, we planned on a two week affair. In addition to the invited speakers mentioned above, the program also included a series of excellent contributed talks. This volume contains several of the papers given at the workshop, organized roughly around the sessions in which they were presented (the heading “Longer papers” refers to chapters written by invited participants; while the “Shorter papers” were submitted through the contributed track). The MSRI video taped all of the talks given during the workshop, and have graciously made them available in streaming format on their Web site, <http://www.msri.org>. In addition to videos, the MSRI also distributes electronic versions of each speaker’s talk materials, an invaluable resource for anyone interested in the areas represented in this volume.

In preparing these papers for publication, we are reminded of the excitement that came from the interplay between researchers in different fields. We hope that that spirit comes through in this book.

Thanks

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Next, we would like to thank Joe Buhler, (then) Deputy Director of MSRI, for his encouragement, guidance and seemingly tireless enthusiasm for this workshop. David Eisenbud, Director of MSRI was also instrumental in arranging funding and providing support for the event. Margaret Wright,

(then) head of the Scientific Advisory Committee (SAC) for MSRI helped us navigate the workshop approval process; and Wing Wong, (then) Statistics representative on the SAC helped sharpen our initial concept. Perhaps the most important practical contributions to this workshop were made by the Program Coordinator Loa Nowina-Sapinski who managed virtually every detail, from funding applications, to local arrangements, visas and travel reimbursements, to advertising and administrative support. Dave Zetland, Assistant to the Director of MSRI, and Rachelle Summers, Head of Computing at MSRI, were responsible for collecting presentation materials and organizing the streaming videos we mentioned above.

Finally, we are grateful to everyone who took the time to participate in this workshop, and are especially thankful for the impressive list of researchers who contributed to this volume.

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