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Machine Learning and Statistical Modeling Approaches to Image Retrieval

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To our parents

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Preface

The real voyage of discovery consists not in seeking new landscapes, but in having new eyes.

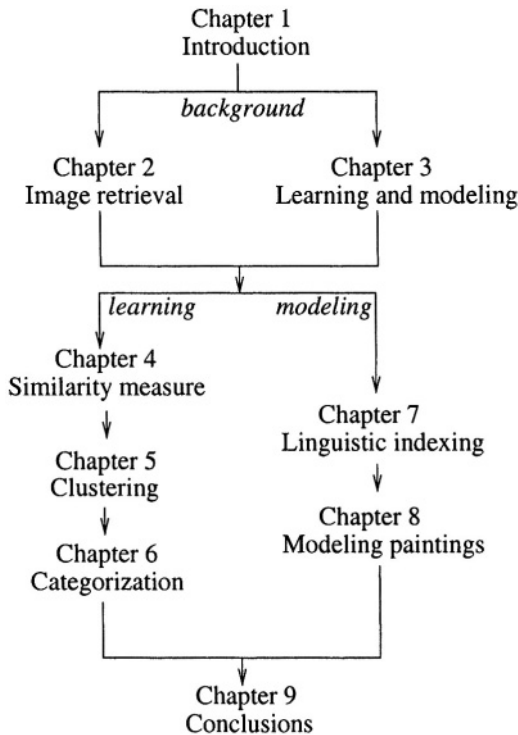
—— Marcel Proust (1871-1922)

In the early 1990s, the establishment of the Internet brought forth a revolutionary viewpoint of information storage, distribution, and processing: the World-Wide Web is becoming an enormous and expanding distributed digital library. Along with the development of the Web, image indexing and retrieval have grown into research areas sharing a vision of intelligent agents: computer programs capable of making “meaningful interpretations” of images based on automatically extracted imagery features. Far beyond Web searching, image indexing and retrieval can potentially be applied to many other areas, including biomedicine, space science, biometric identification, digital libraries, the military, education, commerce, cultural, and entertainment.

Although much research effort has been put into image indexing and retrieval, we are still very far from having computer programs with even the modest level of human intelligence. Decades of research have shown that designing a generic computer algorithm for object recognition, scene understanding, and automatically translating the content of images to linguistic terms is a highly challenging task. However, a series of successes have been achieved in recognizing a relatively small set of objects or concepts within specific domains based on learning and statistical modeling techniques. This motivates many researchers to use recently-developed machine learning and statistical modeling methods for image indexing and retrieval. Some results are quite promising.

The topics of this book reflect our personal biases and experiences of machine learning and statistical modeling based image indexing and

retrieval. A significant portion of the book is built upon material from articles we have written, our unpublished reports, and talks we have presented at several conferences and workshops. In particular, the book presents five different techniques of integrating machine learning and statistical modeling into image indexing and retrieval systems: an similarity measure defined over region-based image features (Chapter 4); an image clustering and retrieval scheme based on dynamic graph partitioning (Chapter 5); an image categorization method based on the information of regions contained in the images (Chapter 6); modeling semantic concepts of photographic images by stochastic processes (Chapter 7); and the characterization of ancient paintings using a mixture of stochastic models (Chapter 8). The first two techniques are within the scope of image retrieval. The remaining three techniques are closely related to automatic linguistic image indexing. The dependence of chapters on earlier chapters is shown in the following chart.



The book will be of value to faculty seeking a textbook that covers some of the most recent advances in the areas of automated image indexing, retrieval, and annotation. Researchers and graduate students interested in exploring state-of-the-art research in the related areas will find

in-depth treatments of the covered topics. Demonstrations of some of the techniques presented in the book are available at `riemann.ist.psu.edu`.

YIXIN CHEN, JIA LI, AND JAMES Z. WANG

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