# BOOK REVIEWS

functions that are far beyond their current known roles.

On the whole, this volume of *ARN* offers extremely interesting information on areas of research that are likely to become prominent in the next few years.

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INDU MANI

Department of Nutrition,
St. John's Research Institute,
Koramangala,
Bengaluru 560 034, India
e-mail: indu2004@gmail.com
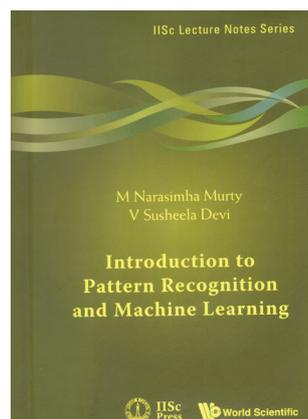
Introduction to Pattern Recognition and Machine Learning. M. Narasimha Murty and V Susheela Devi. IISc Press and World Scientific Publishing Co. Pte. Ltd, 5 Toh Tuck Link, Singapore 596224. 2015. 404 pages. Price: US$ 125.00

Over the last couple of decades there has been a phenomenal increase in the amount of data, documents and other information available in electronic form. This has naturally given rise to renewed interest in techniques for analysing data and terms like 'big data analytics' have become part of common vocabulary these days. Machine learning can be defined as a field that is concerned with techniques for analysing data, fitting models for data and for making useful predictions or inferences based on data. Thus, there is a lot of interest today in this field and many universities are offering both undergraduate and graduate courses in machine learning. Many industries are interested in professionals trained in machine learning and there are also special initiatives from Government agencies such as the Karnataka Knowledge Commission in promoting better training in machine learning in the engineering colleges. Hence, Indian textbooks in this area are very much needed. In this context, this book written by two prominent researchers from the Indian Institute of Science (IISc), Bengaluru is a welcome addition.

Machine learning is largely seen as a subfield of computer science. Pattern recognition, which essentially addresses similar issues, is an older term which has its origins in electrical and systems engineering in the 1960s. Today, the field of pattern recognition is seen to be mainly concerned with classification and regression problems, while the field of machine learning is seen to be somewhat wider in scope as it deals with many other data analysis problems as well. However, these two terms are now closely interlinked and this is reflected in the title of the book.

Writing a textbook on machine learning today is a challenging task. Due to the enormous amount of research work done in this area over the last three decades, there are now many principles and techniques that are useful in machine learning. Therefore, it is difficult to fit all the information into any modest-sized book. Also, there does not appear to be any consensus among the practitioners on what constitutes the core of machine learning, or what is a good logical sequence for presenting the material. One can see this difference in viewpoints by comparing some of the recent and popular books in the field[1,2]. The field of pattern recognition is more or less defined by the very influential textbook by Duda and Hart[3] published in 1973. These authors brought out a new version of this book in 2001 (ref. 4) and comparing this with the two books mentioned earlier[1,2], would make this difference of viewpoints even more clear. Having taught a course on this subject for many years at IISc, this reviewer has first-hand experience of the difficulty in selecting a coherent set of topics that can fit in a one-semester course for students with limited mathematics background. Incidentally, the book by Bishop has about 800 pages and the one by Murphy has over 1000 pages.

Given the above, the authors of this book have done a commendable job in bringing out a volume of about 350 pages that introduces the reader to most of the essential topics of machine learning in an easily understandable manner. The book contains a good overview of many issues in machine learning in the first chapter. In the next few chapters, it discusses most of the standard topics such as Bayes classifier, maximum likelihood and Bayesian estimation of density models, classification techniques such as k-NN, SVM, logistic regression, random forests, artificial neural networks, etc. It also discusses semi-supervised classification techniques and multi-label classification. The book assumes that the reader has some knowledge of the field and hence it may not be suitable as an undergraduate textbook though the style of writing is such that most students would easily follow the material. In any effort of this kind, there are bound to be different opinions on what subset of topics should be included. Thus, personally, I think the authors should have included, in some detail, topics such as

learning regression models, probabilistic graphical models, the EM algorithm for estimating latent variable models and some of the recent developments in deep neural networks. However, even with these omissions, this book has many special positive features. It contains a chapter on feature extraction and feature selection techniques, which are useful in applications but are not generally discussed in machine learning books in any detail. The book also has a chapter on clustering techniques, which is not surprising considering that one of the authors is a well-known expert in this field. Another special feature of the book is that it contains two chapters on soft computing techniques for classification and clustering. These chapters present both fuzzy and rough set-based methods for classification and clustering as well as methods based on genetic algorithms. This is also an area that is not covered in standard books on this subject. As an example of soft clustering, the book discusses various techniques for learning of topic models such as LSA, PLSA and LDA.

The final chapter on using machine learning techniques for the analysis of social networks is well written and provides the reader with a good background in this important application area.

Another interesting aspect of the book is the inclusion of what the authors call research ideas at the end of each chapter. Each of these is posed as a specific question to be investigated and the reader is provided with three to four seed references. It is useful for research students interested in exploring more advanced topics. Some questions listed under this can serve as Master's thesis topics and some of them are good starting points for Ph D thesis topics too. This is indeed a special feature which enhances the value of the book. However, except for the references listed for the research ideas, the book does not provide any references to the literature for the topics discussed in it. It would have been nice if the authors had provided some historical and bibliographic remarks at the end of each chapter for the concepts discussed in them.

Overall, I think this is a good book and it would be useful to students as well as working professionals interested in this area. It can be used as additional reading for undergraduate courses on pattern recognition and machine learning. It can also be used as a textbook for a graduate course though it may have to be supplemented with some extra material, depending on the preferences of the instructor for the topics to be covered in the course.

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P. S. SASTRY

Department of Electrical Engineering,
Indian Institute of Science,
Bengaluru 560 012, India
e-mail: sastry@ee.iisc.ernet.in