Preface

Support vector machines (SVMs), introduced by Vapnik in 1998, have proven very effective computational tool in Machine Learning. SVMs have already outperformed most other computational intelligence methodologies mainly because they are based on sound mathematical principles of statistical learning theory and optimization theory. SVMs have been applied successfully to a wide spectrum of areas, ranging from pattern recognition, text categorization, biomedicine, bioinformatics and brain–computer interface to financial time series forecasting.

In 2007, Jayadeva, Khemchandani and Chandra have proposed a novel classifier called twin support vector machine (TWSVM) for binary data classification. TWSVM generates two non-parallel hyperplanes by solving a pair of smaller-sized quadratic programming problems (QPPs) such that each hyperplane is closer to one class and as far as possible from the other class. The strategy of solving a pair of smaller-sized QPPs, rather than a single large one, makes the learning speed of TWSVM approximately four times faster than the standard SVM.

Over the years, TWSVM has become a popular machine learning tool because of its low computational complexity. Not only TWSVM has been applied to a wide spectrum of areas, many researchers have proposed new variants of TWSVM, for classification, clustering (TWSVC) and regression (TWSVR) scenarios.

This monograph presents a systematic and focused study of the various aspects of TWSVM and related developments for classification, clustering and regression. Apart from presenting most of the basic models of TWSVM, TWSVC and TWSVR available in the literature, a special effort has been made to include important and challenging applications of the tool. A chapter on "Some Additional Topics" has been included to discuss topics of kernel optimization and support tensor machines which are comparatively new, but have great potential in applications.

After presenting an overview of support vector machines in Chap. 1 and devoting an introductory Chapter (Chap. 2) on generalized eigenvalue proximal support vector machines (GEPSVM), the main contents related with TWSVMs are presented in Chaps. 3–8. Here Chap. 8 is fully devoted to "applications".

This monograph is primarily addressed to graduate students and researchers in the area of machine learning and related topics in computer science, mathematics

and electrical engineering. Senior undergraduate students having reasonable mathematical maturity will also benefit from this monograph. In writing a monograph of this kind, there is always a difficulty in identifying what to include, or rather what not to include. We have tried our best to include all major variants of the basic TWSVM formulation but still some may have been left out. We hope that the readers will appreciate that a monograph can never be made exhaustive and some such omissions are bound to happen. Although every care has been taken to make the presentation error free, some errors may still remain and we hold ourselves responsible for that and request that errors, if any, be intimated by e-mailing at chandras@maths.iitd.ac.in (e-mail address of S. Chandra).

In the long process of writing this monograph, we have been encouraged and helped by many individuals. We would first and foremost like to thank Prof. Janusz Kacprzyk for accepting our proposal and encouraging us to write this monograph.

We would specially like to thank Prof. O.L. Mangasarian whose research work has been the starting point of our interest in the area of machine learning. In an era when we had no access to the Internet, he has been very kind in sending his reprints/preprints and clarifying many subtle points. In our research, we have been mostly following the work of Prof. Mangasarian and in that sense we have always regarded him as our mentor.

We are highly grateful to Profs. X.J. Peng, Y. Tian and Y.H. Shao and their research collaborators for sending their reprints/preprints and answering to our queries at the earliest. We would also like to thank and acknowledge the editors and the publishers of the journals IEEE Transactions on Pattern Analysis and Machine Intelligence, Neurocomputing, Neural Networks, International Journal of Machine Learning and Cybernetics, Expert System with Applications, Optimization Letters, Information Sciences, European Journal of Operational Research, Neural Computing and its Applications, Applied Intelligence, and Applied Soft Computing for publishing our papers on TWSVM-related work which constitutes the core of this monograph.

Our special thanks are to the authorities of Indian Institute of Technology, Delhi, and South Asian University, New Delhi, for their encouragement and providing all facilities for the preparation of this monograph.

We would like to thank our friends and colleagues Profs. Aparna Mehra, B. Chandra, K.K. Biswas, R.K Sharma, S. Dharmaraja and Shantanu Chaudhary at IIT Delhi, and Danish Lohani, Pranab Muhuri and R.K. Mohanty at South Asian University (SAU) for their interest and encouragement. Professors Amit Bhaya, C.A. Murthy, C.R. Bector, Jeyakumar, Pankaj Gupta, Ravi Kothari, M. Arun Kumar, S. Balasundaram and S.K. Neogy have always encouraged us and took keen interest in the preparation of this monograph.

We appreciate our students Anuj Karpatne, Keshav Goel and Sumit Soman of IIT Delhi, and Pooja Saigal, Aman Pal, Sweta Sharma and Pritam Anand of SAU for their help in the preparation of this manuscript in LATEX and reading the manuscript from a student point of view. Dr. Abha Aggarwal took a major responsibility of organizing the material and her efforts are duly acknowledged.

We are obliged to Dr. Thomas Ditzinger of International Engineering Department, Springer Verlag, for all his help, cooperation and understanding in the publication of this monograph.

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http://www.springer.com/978-3-319-46184-7

Twin Support Vector Machines
Models, Extensions and Applications
Jayadeva; Khemchandani, R.; Chandra, S.
2017, XIV, 211 p. 21 illus., 20 illus. in color., Hardcover
ISBN: 978-3-319-46184-7