

Oleg Okun and Giorgio Valentini (Eds.)

Applications of Supervised and Unsupervised Ensemble Methods

Studies in Computational Intelligence, Volume 245

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To Raisa, Gregory, and Antoshka

– Oleg Okun

A Vito di Gesù, grande ricercatore

dall'animo nobile, ma soprattutto un amico

– Giorgio Valentini

Preface

This book contains the extended papers presented at the 2nd Workshop on Supervised and Unsupervised Ensemble Methods and their Applications (SUEMA) held on 21–22 July, 2008 in Patras, Greece, in conjunction with the 18th European Conference on Artificial Intelligence (ECAI 2008). This workshop was a successor of the smaller event held in 2007 in conjunction with 3rd Iberian Conference on Pattern Recognition and Image Analysis, Girona, Spain. The success of that event as well as the publication of workshop papers in the edited book “Supervised and Unsupervised Ensemble Methods and their Applications”, published by Springer-Verlag in Studies in Computational Intelligence Series in volume 126, encouraged us to continue a good tradition.

The scope of both SUEMA workshops (hence, the book as well) is the application of theoretical ideas in the field of ensembles of classification and clustering algorithms to real/life problems in science and industry. Ensembles, which represent a number of algorithms whose class or cluster membership predictions are combined together to produce a single outcome value, have already proved to be a viable alternative to a single best algorithm in various practical tasks under different scenarios, from bioinformatics to biometrics, from medicine to network security. The ensemble approach is caused to life by the famous “no free lunch” theorem, stating that there is no absolutely best algorithm to solve all problems. Although ensembles cannot be considered as absolute remedy of a single algorithm deficiency, it is widely believed that ensembles provide a better answer to “no free lunch” theorem than a single best algorithm. Statistical, algorithmical, representational, computational and practical reasons can explain the success of ensemble methods.

The purpose of this book is to encourage practitioners in various branches of science and technology to adopt the ensemble approach for their daily research work. We hope that fourteen chapters composing the book will be a good guide in the sea of numerous opportunities for ensemble methods.

The book has the following organization. Chapter 1 serves as a tutorial introduction into ensemble pruning (selection) methods. Chapters 2 and 3

concern classifier ensemble applications to email spam filtering. Chapter 4 describes facial expression recognition using ensembles of neural networks and error/correcting output coding. Chapter 5 deals with gene function prediction based on ensembles of support vector machines. Classification employing is the concept of partitioner trees introduced in Chapter 6. Chapter 7 proposes a new nearest neighbor-like technique to increase the diversity for ensembles of decision trees. Semi-supervised ensemble clustering of remote sensing data is considered in Chapter 8. Chapter 9 applies tensor voting theory to image classification and inpainting. Chapter 10 focuses on clustering ensembles and semisupervised clustering under active constraints. Multi-class classification when misclassification costs vary from class to class is presented in Chapter 11. Ensemble selection for weather forecasting and air pollution dispersion prediction is explored in Chapter 12. Chapter 13 concentrates on embedding feature selection into classifier ensemble training. Chapter 14 reports a classifier ensemble application to decision support for intensive medical care.

The book is intended to be primarily a reference work. Hence, it could be a good complement to two excellent books on the general ensemble methodology – “*Combining pattern classifiers: methods and algorithms*” by Ludmila Kuncheva (John Wiley & Sons, 2004) and “*Decomposition methodology for knowledge discovery and data mining: theory and applications*” by Oded Maimon and Lior Rokach (World Scientific, 2005). Extra primal sources of information are proceedings of the biannual international workshop on Multiple Classifier Systems (MCS) published by Springer-Verlag, and proceedings of the International Conference on Information Fusion (FUSION) organized by the International Society of Information Fusion (<http://www.isif.org/>). Among other conferences of interest are International Conference on Machine Learning (ICML), European Conference on Machine Learning (ECML), International Joint Conference on Artificial Intelligence (IJCAI), European Conference on Artificial Intelligence (ECAI), and International Conference on Machine Learning and Data Mining (MLDM) (proceedings of ECML and MLDM are published by Springer-Verlag). Two international journals are largely devoted to the topic of our book are Information Fusion published by Elsevier and Journal of Advances in Information Fusion published by The International Society of Information Fusion, but most machine learning journals such as Machine Learning, the Journal of Machine Learning Research and the IEEE Transactions on Pattern Analysis and Machine Intelligence dedicate large room to papers on ensemble methods. This list, though comprehensive, but is certainly incomplete.

We would like to express our gratitude to several people and organizations who helped this book to appear. PASCAL 2 (Pattern Analysis, Statistical Modelling and Computational Learning) European Network of Excellence sponsorship of SUEMA’2008 is gratefully acknowledged.

We are thankful to Prof. Boi Faltings, Prof. Ioannis Vlahavas, and Prof. Pavlos Peppas for the opportunity to hold SUEMA’2008 in the ancient Patras.

The contributions of SUEMA'2008 participants to this book made it to be born and we are grateful to all authors for their time, efforts, and warm support of our undertaking.

Prof. Janusz Kacprzyk and Dr. Thomas Ditzinger from Springer-Verlag deserved our special acknowledgment for warm welcome to our book and their support and a great deal of encouragement. Finally, we thank all other people in Springer who participated in the publication process.

Malmö (Sweden) and Genoa (Italy),
June 2009

Oleg Okun
Giorgio Valentini

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