Book Reviews

Semi-Supervised Learning—O. Chapelle, B. Schölkopf, and A. Zien, Eds. (London, U.K.: MIT Press, 2006, pp. 508, ISBN: 978-0-262-03358-9). *Reviewed by Philippe Thomas*

This book addresses some theoretical aspects of semisupervised learning (SSL). SSL is particularly devoted to application domains in which unlabeled data are plentiful, such as images processing, information retrieval, and bioinformatics.

SSL is halfway between supervised and unsupervised learning and so, the data set is divided into labeled and unlabeled data sets.

The book is organized as a collection of different contributions of authors who are experts on this topic. After an introductory chapter, the book is divided into six main parts. Each part is subdivided into 3–5 chapters. The objectives of this book are to present a large overview of the SSL methods and to classify these methods into four classes that correspond to the first four main parts of the book. The last two parts are devoted, respectively, to applications and perspectives of SSL.

The introduction describes the two fundamentally different types of tasks in machine learning, the supervised and unsupervised learning, and introduces SSL. In a second step, after a brief history of SSL, a discussion on the utility of SSL in function of the application cases is performed. In a third step, the different classes of algorithms are presented.

Part 1 is composed of four chapters (Chapters 2–5) and deals with generative models. Generative models can be seen as classification with additional information on the marginal density or as clustering with additional information. Chapter 2 presents a simple taxonomy of probabilistic graphical models for SSL. Chapter 3 deals with text classification application by comparing SSL to iterative expectation–maximization methods. Chapter 4 presents traps that need to be avoided in such approaches. In fact, unlabeled data can degrade performance of generative classifiers. This chapter focuses on the effects of modeling errors in SSL. Chapter 5 discusses clustering with additional information where this information is provided as constraints. This chapter presents a method based on hidden Markov random fields.

The second part (Chapters 6–10) is dedicated to the low-density separation methods. Chapters 6 and 7 are devoted to the most common low-density separation method—the transductive support vector machine (TSVM). Two alternatives to the TSVM are then presented in the next three chapters. Binary Gaussian process classification is presented in Chapter 8 and Chapters 9 and 10 are devoted to the entropy minimization approach.

The graph-based methods are the topics of Part 3, which is constituted by Chapters 11–14. The common denominator of these methods is that data are represented by nodes of a graph and edges are labeled with the pairwise distances of the incident nodes. Chapter 11 shows how different graph-based SSL algorithms can be cast into a common framework of label propagation and quadratic criterion optimization when Chapter 13 takes a more theoretical point of view and transfers notions of smoothness from the continuous case onto graphs. Usually, these kinds of methods are intrinsically transductive. However, Chapters 12 and 14 try to extend graph-based methods to produce inductive solutions.

Part 4 (Chapters 15–17) is devoted to algorithms that are not intrinsically semisupervised but perform two-step learning: 1) an unsupervised learning on all data and 2) a supervised learning using just labeled data. These methods are closely related to graph-based methods and Chapters 15 and 16 are dedicated to spectral transforms of such a graph when Chapter 17 deals with the metrics derived from graphs.

The last two parts deal with the practice of SSL and the perspectives, respectively. Chapters 18 and 19, which start Part 5, present two approaches to dealing with large number of points. Chapters 19 and 20 apply the SSL algorithms to the classification of protein sequences. The last chapter of the part presents, in a first step, seven benchmarks in order to evaluate and compare SSL algorithms. In a second step, several variations of the algorithms presented in the preceding chapters are tested and compared on these benchmarks.

The last part of the book (Chapters 22–25) is devoted to some of the most interesting directions of ongoing research in SSL. Chapter 22 presents an extension of the probably approximately correct (PAC) learning model.

As the main part of the state-of-the-art field, the first five parts of the book focus on the classification aspects whereas Chapter 23 considers both classification and regression by using metric-based approaches. The last two chapters discuss the difference between the inductive SSL and transduction.

This book was created collectively by over 50 researchers who are recognized as experts in the field, so the book covers the main knowledge in a given area. It provides a deep treatment of the subject. However, introductions in each part of the book would be helpful for the unification of the views of this book.

The theoretical aspects are well introduced. Benchmarks are provided in Chapters 5, 20, and 21. They are also available on the indicated websites. Some chapters (19 and 21) give websites including Matlab programs of the concerned algorithms. This fact helps in the understanding the different methods. One may regret that there are some missed algorithms, which could be provided as was done in these two chapters and it would be helpful if the websites associated with the book gathered all programs.

However, this book responds to its major objectives, which are to perform a complete overview of its subject and to be very comprehensive in order to serve as a basis for an intermediate level graduate course on SSL. This book may also serve as a useful self study and reference source for practicing engineers.

The reviewer is with the Centre de Recherche en Automatique de Nancy (CRAN-UMR 7039), Nancy University, CNRS, Vandoeuvre-les-Nancy 54506, France (e-mail: philippe.thomas@cran.uhp-nancy.fr).

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Challenges for Computational Intelligence—W. Duch and J. Mańdziuk, Eds. (New York: Springer-Verlag, 2007, Series on Studies in Computational Intelligence, Vol. 63, pp. 488, ISBN: 978-3-540-71983-0). *Reviewed by Vladimir G. Red'ko*

The book discusses very interesting problems: What is Computational Intelligence (CI)? What are goals of CI researches? Is it possible

The reviewer is with the Scientific Research Institute for System Analysis, Russian Academy of Sciences, Moscow 119333, Russia (e-mail: vgredko@gmail.com).

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