Pattern Recognition

Index

Name

Pattern Recognition

Semester: 1

Number of credits: 4

Type: Optional Itinerario I4

Objectives

The main objective of this course is to give students some solid knowledge into the techniques of pattern recognition and optimization techniques, so will serve as support an application to a wide range of scientific disciplines and techniques.

More specifically, the skills aimed to develop among the students of the subject can be described as follows:

1. Apply the techniques of automatic classification and inference for decision making, information extraction and design of complex systems.

2. Draw conclusions from experimental data, whatever the field in which the researcher works.

3. Optimize classifiers, being of interest to highlight the relationship between the choice of component density functions, the number of parameters needed so as to estimate what impels that choice and the amount of data available for a task, relevant feature selection and dimension reduction of experimental vectors.

4. Critically assess the performance of systems and select the best method of classifica-tion and learning of their experimental data.

5. Apply optimization techniques based on stochastic, heuristic and evolutionary meth-ods.

6. Integrate the knowledge from different sources optimally into management according to the incomplete information available: system status, temporal context, multimodal and personal..

Program

The list of topics of the course deals mainly with contents related to machine learning, according to the following plan. Topic

Duration (hours)

Introduction and methodology.   6h

Bayes decision theory. 6h

Parametric estimation. 6h

Nonparametric estimation. 6h

Pre-processing and feature selection. 4h

Unsupervised Learning. 4h

SVM and CART. 2h

BN, ART and evolutionary methods. 6h

Optimization methods. 2h

Submission of papers. 2h

Bibliography

The textbook used is R.O. Duda, P. E. Hart, David G. Stork, Pattern Classification .. John Wiley & Sons, 2001. Additionally, for some issues we propose the following bibliography:

Additional General Bibliography

• Webb. Statistical Pattern Recognition. Second Ed Wiley. 2002.

• Schalkoff Robert, J.,. Pattern Recognition, Statistical, Structural and Neural Approa-ches. John Wiley & Sons, Inc., 1992.

• Statistical Pattern Recognition: A Review Anil K. Jain, Robert PW Duin, Mao Jianchang IEEE Transactions on Pattern Analysis and Machine Intelligence, vol 22 (1), 2000. pp. 4-37

Preprocessing and Parameter Selection

• An Introduction to Variable and Feature Selection Isabelle Guyon and André Elisseeff Journal of Machine Learning Research 3 (2003) p. 1157-1182

• Feature Selection for Classification M. Dash and H. Liu Intelligent Data Analysis, I (1997) p. 131-156 Elsevier

• Selection of Relevant Features and Examples in Machine Learning Avrim L. Blum Pat Langley and Artificial Intelligence, vol 97 (1-2) (1997) pp. 245. 271

• Wrappers for Feature Subset Selection Ron Kohavi, George H. John Artificial Intelli-gence, vol 97 (1-2) Special Issue on Relevance. 1997. pp. 273-324

• Feature Selection: Evaluation, Application and Small Sample Performance Anil Jain and Douglas Zongker IEEE Transactions on Pattern Analysis and Machine Intelligence, vol. 19 (2), 1997. pp. 153-158

Unsupervised Learning

• Machine Learning Online Courses Japkowicz Nathalie [Accessed September 2010] http://www.site.uottawa.ca/ ~ nat /

• Two-Dimensional Vector Quantization Online Animation [cited September 2010] http://www.data-compression.com/vqanim.shtml

• An Algorithm for Vector Quantizer Design Linde, Y., Buzo, A. and Gray, R. M. IEEE Tran-sactions on Communications, Vol.COM-28, No. 1, p. 84.95, January 1980.

• Kohonen Self Organizing Maps Tevuo Springer Verlag, 3rd edition. ISBN: 3540679219

Support Vector Machines

• A Tutorial on Support Vector Machines for Pattern Recognition, C. J. C. Burges, Data Mining and Knowledge Discovery 2, 121-167, 1998

Genetic Algorithms

• Goldberg, D. E. Genetic algorithms in Search, Optimization, and Machine Learning, Addison-Wesley, 1989.

• Melanie Mitchell. An Introduction to Genetic Algorithms. The MIT Press. Cambridge, MA, 1996.

• John R. Koza. Genetic Programming: On the Programming of Computers by Means of Natural Selection. Bradford Books, 1992.

• Michalewicz, Z. Genetic Algorithms + Data Structures = Evolution Programs, 3rd edi-tion, Springer, 1996.

Teachers

Coordinator: Javier Ferreiros López
Teachers: Javier Ferreiros López, Juan Manuel Montero Martínez y Luis Fernando D´Haro Enríquez

Teaching Methodology

Classes are using slides with explanations. At the end of the course, the students will present theirs works.

Evaluation

Students complete the course with a final individual character to be publicly submitted as part of efforts to acquire transferable skills of documentation, communication and publication.

The report must be in the typical format for IEEE conference papers (http://www.ieee.org/conferences_events/conferences/publishing/templates ....) to foster in students not only reading and interpretation of scientific and technical documents, but also the correct wording.

This final work must be eminently practical, and it should apply the techniques described in the course, preferably, to a problem that may be related to the activity of the student or professional researcher.

The final paper will constitute 70% of the final grade. There will be a written exam, which represents 30% of the final grade.

Contact

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Moodle http://moodle.upm.es/titulaciones/oficiales/course/view.php?id=2622