Syllabus Information

Fall 2023
Oct 02, 2024

Syllabus Information
Machine Learning - 60964 - ECE 517 - 002

Associated Term: Fall 2023
Albuquerque/Main Campus
Lecture Schedule Type
Hybrid Instructional Method

Learning Objectives: This course covers topics in machine learning, including statistical learning theory, kernels, gaussian processes and deep learning. The course opens with an introduction to the basics of Statistical Learning Theory, that leads to the well known SVM. Here, the SVM principle is taken as an optimization criterion that can be applied virtually to any linear allgorithm. For Dimensionality Reduction, the SVM will be used as a particular technique for feature extraction or dimensionality reduction strategies. Block Reproducing Kernel Hilbert Spaces will be used to provide an introduction to kernel methods, and a view of kernels as a similarity measure tool that allows us to generalize any linear algorithm by extending them with nonlinear properties. In particular, some LS algorithms and SVMs will be extended to the nonlinear case. Also, we will go deeper in the concept of regularization already introduced in the first part of the course. In the section on Gaussian Process Networks, we will introduce an alternative criterion, based on ML particularly successful for regression, that will be generalized using kernels. Finally, Deep Learning Machines will be reviewed as a third major criterion for constructing ML algorithms. Introduction Topics covered• • • • • • • • • • • • • • • • • o o • Statistical learning theory. Estimation function and risk minimization. Definition of learning problems: classification, estimation, unsupervised learning. Empirical risk minimization. The generalization ability of a learning machine. Consistency of learning. VC dimension and the structural risk minimization. The Support Vector Machine approach. Detailed derivation. SVC, SVR, SVDD, variants. Optimization procedures. Reproducing Kernel Hilbert Spaces. Overview Positive definite kernels. Main theorems. The kernel trick. Kernel based learning machines. Some basic kernels and kernel properties Kernel development and special kernel classes. Gaussian Process Networks Basic concepts. Gaussian process networks for regression and classification. Kernel versions of the GPN. Dual formulation of the GPN. The idea of covariance matrices. Parameter optimization and model selection.
Required Materials: The Elements of Statistical Learning, T. Hastie et al. (Available online, free access) Gaussian Processes for Machine Learning, C. Rasmussen et al. (Available online, free access) Pattern Recognition, C. Bishop Kernel Methods for Pattern Analysis, J. Shawe-Taylor, N. Cristianini. A number of tutorials will be available online through UNM library access. Computer
Technical Requirements:

View Catalog Entry

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