

Corso di dottorato:

Introduction into Neural Networks and Deep Learning

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Aula D'Antoni (Dipartimento di Matematica)

Orario: 16:00-18:00

Calendario Lezioni:

I Lezione: Mercoledì 11 Maggio

II Lezione: Giovedì 12 Maggio

III Lezione: Giovedì 19 Maggio

IV Lezione: Giovedì 26 maggio

V Lezione: Mercoledì 1 Giugno

VI Lezione: Mercoledì 8 Giugno

VII Lezione: Giovedì 9 Giugno

VIII Lezione: Mercoledì 15 Giugno

IX Lezione: Giovedì 16 Giugno

X Lezione: Mercoledì 22 Giugno

XI Lezione: Giovedì 23 Giugno

XII Lezione: Giovedì 30 Giugno

Programma del corso:

Lecture 1. Neural networks. Theory

Neuron model, activation function. Direct distribution networks. Neural network architecture. Connectivism. Neural network training. Backpropagation of an error. The fastest descent method. How to recognize handwritten digits.

Lecture 2. Neural networks. General principles

Neural network training. Backpropagation of an error. Gradient descent method and its generalizations. Epochs and batches. Introduction to Keras and TensorFlow. Initialization of neural network weights. Data standardization prevents saturation. Training a feedforward neural network. Optimization (optimizers) in Keras. Formulas for weight corrections when training a neural network. An example of training a neural network.

Lecture 3. Training of neural networks in Keras. Part 1

An example of training a neural network. Quality criteria in Keras. Initialization of neural network weights in Keras.

Lecture 4. Training of neural networks in Keras. Part 2

Neural networks for forecasting. Reducing the forecasting problem to a regression problem. Forecasting series with a seasonal component.

Lecture 5. Deep Learning

Image recognition. Haar cascade to highlight the face in the picture. Convolutions. Convolution layers. Padding. Stride. Pooling. Dropout and decorrelation. Additional training of neural networks. Example: handwritten digit recognition, 1st solution.

Lecture 6. Deep learning. Regularization

Example: handwritten digit recognition, 2nd solution. Augmentation. VGG-16 neural network architecture. Regularization, its purpose. Regularization in linear regression analysis. Normal equations of linear regression analysis. Adding a regularization term to normal equations. The special role of a free member. Example: polynomial approximation of points. Sample validation. Variants of the regularization term (ridge regression, lasso, elastic net). Why Lasso allows you to reduce the number of predictors.

Lecture 7 XGboost

Theoretical substantiation of the method. An example of solving a problem in Python using XGboost. Unbalanced samples. Precision, Recall. Informativeness of variables (Importance). Selection of parameters in XGboost.

Lecture 8 XGBoost. Factor Analysis, Principal Component Analysis

Selection of parameters in XGboost. GridSearch for selection of parameters. Factor analysis. Problems solved with the help of factor analysis.

Lecture 9 Factor Analysis, Principal Component Analysis s (continued).

Mathematical models of principal component analysis and factor analysis. Interpretation of factors. Example of factor analysis in Python. Factor loads, factor labels, their interpretation. Rotation factors.

Lecture 10 Factor Analysis, Principal Component Analysis. SVD (Singular Value Decomposition)

Example of factor analysis in Python. Mathematical model of SVD decomposition. SVD decomposition and principal component analysis. SVD decomposition as a basis for latent semantic analysis (LSA). SVD decomposition of a data matrix containing gaps. Simon'a Funk's method. SVD decomposition when building a recommender system.

Lecture 11 Calibration of classifiers

Features of using SVD decomposition (Singular Value Decomposition) for data with a large number of gaps. Calibration of classifiers. Isotonic regression. Platt calibration.

Lecture 12 AUC, ROC curves. Logistic regression

Analysis of unbalanced samples. Accuracy, precision, recall, F1. ROC curve (ROC curve) to determine the threshold value. ROC curve for comparing classifiers. Area under curve (AUC). Logistic regression.