Course Outline: Generalized Linear Models / Machine learning (21 hours)

September 5, 2025

1 Introductory Examples

1.1 Simple linear regression

1.2 Multiple linear regression

1.3 Parametric non-linear regression

1.4 Polynomial regression

1.5 Non-parametric regression

1.6 Piecewise linear regression

1.7 Logistic regression (Generalized Linear Model)

2 Multiple Linear Regression

2.1 Homoscedastic models

2.2 Heteroscedastic models

3 Overparameterization in Regression

3.1 Context

3.2 Ridge regression

3.3 LASSO method

3.4 Dimensionality reduction by creating new regressors

4 Generalized Linear Models

4.1 Why generalized linear models?

4.2 Scalar exponential families

4.3 Exponential families with a nuisance parameter

4.4 Classic examples

4.5 Definition of generalized linear models

5 Logistic Model

5.1 Definition and examples

5.2 Parameter estimation and precisions

5.3 Model quality

6 Random Forests

6.1 Background

6.2 Trees

6.3 Bagging predictors

6.4 Random Forests algorithm

7 Introduction to neural networks

7.1 Perceptron and its limitations

7.2 Multilayer Networks

7.3 Backpropagation algorithm

7.4 Overfitting and Regularization

7.5 Tools

7.6 The need of GPU

Bibliographie

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