

Machine Learning

Benno Stein

Theo Lettmann

Michael Völske

Martin Potthast

Contents

I. Introduction

II. Machine Learning Basics

I. | III. Linear Models

II. | IV. Neural Networks

V. Support Vector Machines

VI. Decision Trees

VII. Bayesian Learning

VIII. Learning Theory

III. | IX. Deep Learning

X. Ensemble Methods and Meta Learning

XI. Reinforcement Learning

Objectives

- ❑ understand and explain basic concepts of machine learning
- ❑ understand formalized concepts and methods
- ❑ be able to implement concepts and methods in the form of algorithms
- ❑ be able to sensibly select, adapt, and apply relevant methods
- ❑ be able to educate oneself

Related Fields

1. Statistics

[paradigms, models]

2. Mathematics

3. Artificial Intelligence

[methods, algorithms]

4. Heuristic Search

5. Information Retrieval

6. Knowledge Processing

7. Natural Language Processing

8. Decision Support Systems

[applications]

9. Medical Systems

10. Search Engines

11. Self-driving cars

12. Writing Support Systems

Literature

Machine Learning:

- ❑ T. Mitchell.
Machine Learning
1st edition, McGraw-Hill, 1997.
www.cs.cmu.edu/~tom/mlbook.html
- ❑ C.M. Bishop. [[Interview 2018 @ MS Research](#)]
Pattern Recognition and Machine Learning
2nd edition, Springer 2006.
www.microsoft.com/en-us/research/people/cmbishop/prml-book/
- ❑ T. Hastie, R. Tibshirani, J. Friedman.
The Elements of Statistical Learning
2nd edition, Springer, 2009.
statweb.stanford.edu/~hastie/ElemStatLearn/ (2017)
- ❑ I. Goodfellow, Y. Bengio, A. Courville.
Deep Learning
MIT Press, 2016.
deeplearningbook.org

Literature

Machine Learning: (continued)

- ❑ N. Cristianini, J. Shawe-Taylor.
An Introduction to Support Vector Machines and Other Kernel-based Learning Methods
Cambridge University Press, 2000.
- ❑ L. Breiman, J.H. Friedman, R.A. Olshen, C.J. Stone.
Classification and Regression Trees
CRC Press reprint, 1998.
- ❑ V. Vapnik.
The Nature of Statistical Learning Theory
2nd edition, Springer 2000.

Software

Programming:

- ❑ The Jupyter Project.
JupyterHub
Version 4.0.
jupyter.org
- ❑ Microsoft Corporation.
Visual Studio Code
Version 1.83.
code.visualstudio.com
- ❑ JetBrains, Inc.
PyCharm IDE
Version 2023.2.2.
www.jetbrains.com/pycharm

Software

Machine Learning:

- ❑ *NumPy*
Version 1.26.
numpy.org
- ❑ *scikit-learn: Machine Learning in Python*
Version 1.3.
scikit-learn.org

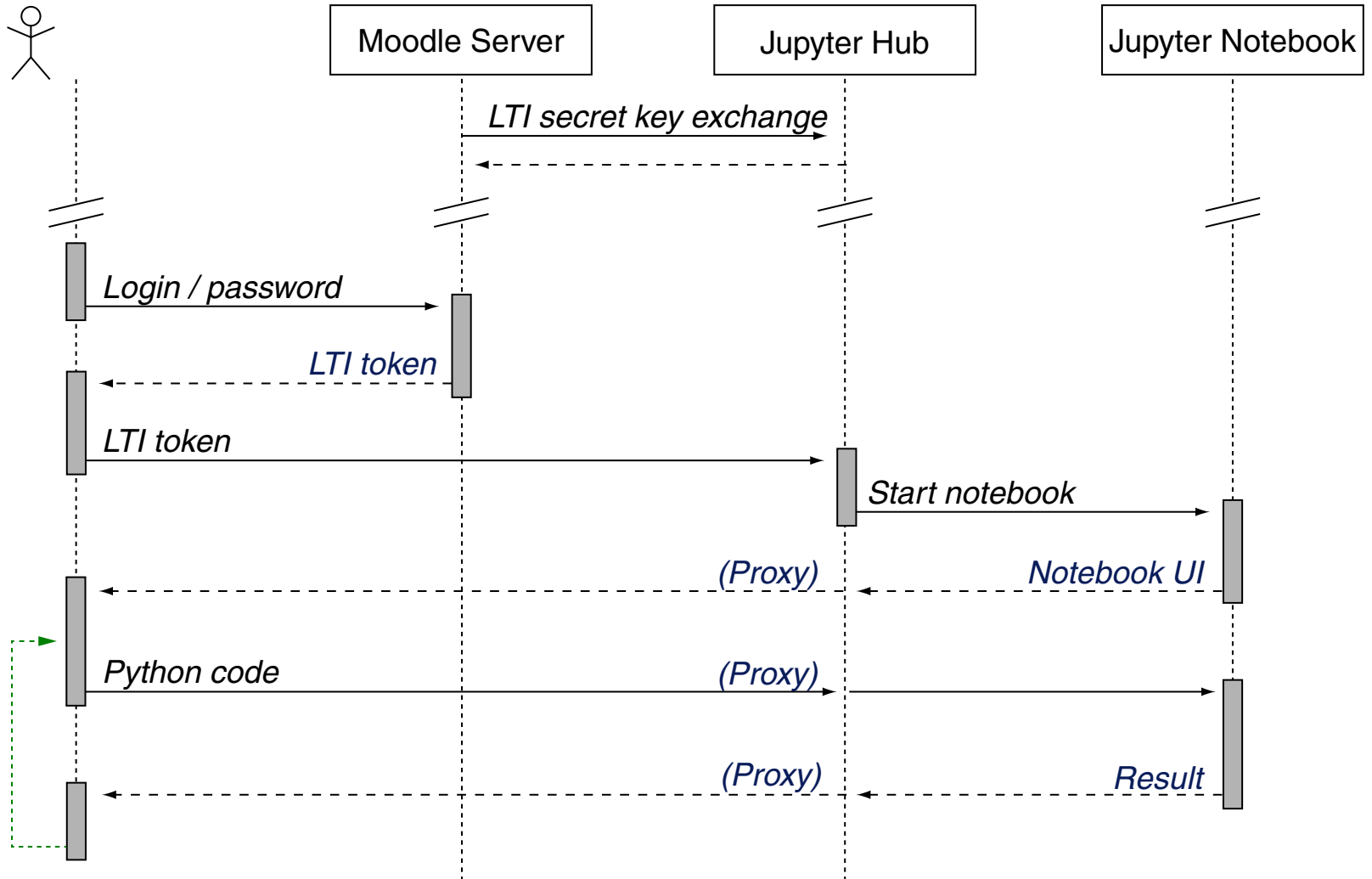
Software

Statistics:

- ❑ R Development Core Team.
R
Version 4.3.
www.r-project.org
- ❑ E. Jones, T. Oliphant, P. Peterson and others.
SciPy
Version 1.11.
www.scipy.org
- ❑ J. W. Eaton.
GNU Octave
Version 8.3.
www.gnu.org/software/octave

Software

Lab Class Setup



Software

Lab Class Setup (continued)

