

The project of JINR-2024 Program of Egyptian students
Machine Learning Fundamentals: From Theory to Practice
Meshcheryakov Laboratory of Information Technologies (MLIT)

Introduction

This course provides a comprehensive knowledge to the field of machine learning, equipping students with both theoretical knowledge and practical skills. The course will dive into the fundamental concepts of machine learning, exploring various algorithms and techniques. Students will gain hands-on experience by working on real-world projects, applying their learning to solve practical problems. It allows to understand the core principles and concepts of machine learning with learn about the different types of machine learning algorithms (supervised, unsupervised, reinforcement learning). The students will develop proficiency in programming machine learning models using popular libraries like Python's scikit-learn. They can apply machine learning techniques to solve real-world problems in various domains and gain experience in evaluating and interpreting machine learning models. They can understand the ethical implications of machine learning and its potential impact on society. The obtained knowledge will allow using different programming environments with the aiding of most common generative models such ChatGPT and Gemini for contents creation. The practical side will base on facilities of the JINR "HybriLIT" heterogeneous platform (<http://hybrilit.jinr.ru>). In addition, the usage of Colab which is a hosted Jupyter Notebook service to provide free access to computing resources, including GPUs and TPUs

Project aims

1. Introduce students to the fundamental concepts and techniques of machine learning.
2. Equip students with practical skills to build and deploy machine learning models.
3. Develop students' ability to analyze and interpret machine learning models.
4. Enhance critical thinking and problem-solving skills in the context of machine learning.

Entry requirements

Expected:

- Strong foundation in linear algebra, calculus, and probability theory.

Recommended:

- Basic programming skills (e.g., Python).

Course Assessment

- **Assignments:** Regular programming assignments to reinforce theoretical concepts and practical skills.
- **Project presentations:** Students will present their final projects to the class, demonstrating their ability to apply machine learning techniques.

Course Resources

Textbooks and Tutorials:

"Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow" by Aurélien Géron: This book offers practical examples and code snippets

"Machine Learning: A Probabilistic Perspective" by Kevin P. Murphy: A more theoretical approach with detailed explanations and examples

Online tutorials and blogs: Numerous online resources offer tutorials, blog posts, and presentations on various machine learning topics.

Oneshot learning with triplet loss for vegetation classification tasks. Uzhinskiy A., Ososkov G., Goncharov P., Nechaevskiy A., Smetanin A., Computer Optics 2021; 45(4): 608-614. DOI: 10.18287/2412-6179-CO-856.

- **Python libraries:**
 - NumPy, Pandas, PyTorch, Matplotlib, Scikit-learn
- **Datasets:**
 - UCI Machine Learning Repository
 - Kaggle

Course Projects

Students will be required to complete one or more projects throughout the course to apply their learning to real-world problems. Possible project ideas include:

- **Car Price Prediction:** using regression analysis
- **Chronic Kidney Disease:** using classification analysis
- **Churn Prediction:** for a specific domain (e.g., communications company)
- **Bank Marketing:** as a good example for using machine learning in finance
- **Heart Diseases:** using different classification algorithms
- **Plant disease detection:** image classification tasks.

By following this comprehensive course outline and incorporating practical assignments and projects, students can gain a strong foundation in machine learning and develop the skills necessary to succeed in this rapidly growing field. Students will gain a strong foundation in machine learning and be well-prepared to pursue further studies or careers in the field.

Number of project participants: up to 10

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