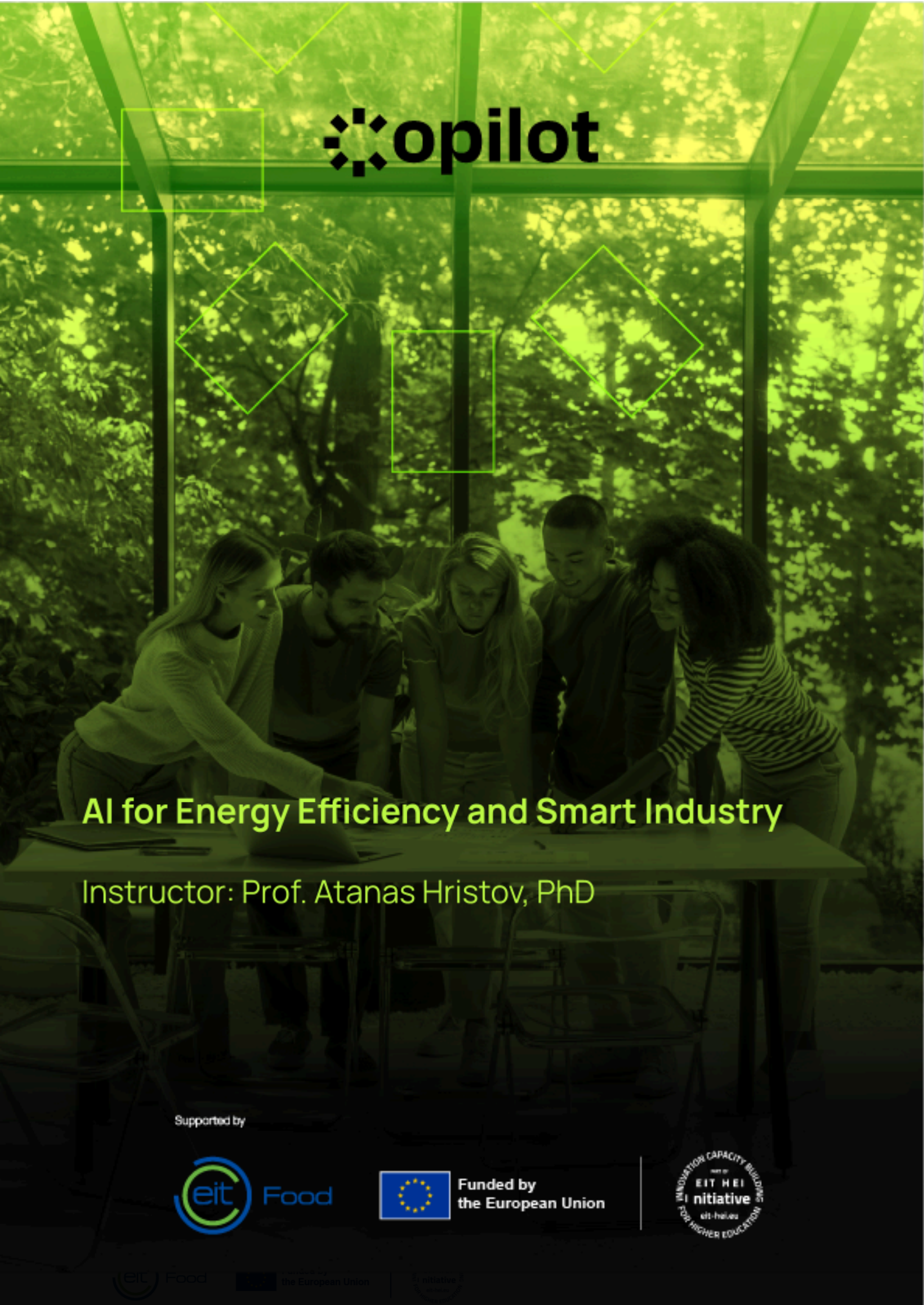

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AI for Energy Efficiency and Smart Industry
Instructor: Prof. Atanas Hristov, PhD
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Course Information

Title: ***AI for Energy Efficiency and Smart Industry***

Instructor: prof. Atanas Hristov, PhD

ECTS credits: 2

Course structure: *5 sessions, 2 lectures + 2 tutorials per session (intensive format)*

Mode of delivery: *online*

Course Summary

This course introduces the concepts, techniques, and practical applications of **Artificial Intelligence for Energy Efficiency and Smart Industry**. Participants will explore how AI and data analytics can support energy optimization, improve industrial efficiency, and enable smarter, more sustainable decision-making. By combining theoretical foundations with hands-on programming sessions, the course will focus on analyzing energy consumption data, developing machine learning models for energy forecasting, detecting anomalies, and identifying opportunities for improving industrial energy performance. Participants will work with Python and relevant data science and machine learning libraries to develop practical AI solutions addressing real-world industrial challenges.

During the course, participants will be able to:

- Understand the role of artificial intelligence and machine learning in energy efficiency and smart industry;
- Collect, preprocess, analyze, and visualize energy-related and industrial data;
- Develop and evaluate machine learning models for energy consumption forecasting;
- Apply anomaly detection techniques to identify unusual energy consumption patterns and potential inefficiencies;
- Interpret AI-generated insights and explore data-driven approaches to industrial energy optimization.

After completing the course, participants will be able to design, implement, and evaluate AI-based solutions for energy monitoring, forecasting, and efficiency improvement. Through practical exercises and a project-based approach, they will gain the skills to transform industrial data into actionable insights, supporting innovation, sustainable industrial practices, and informed decision-making.

Course Participants

This course is designed for a broad audience of **students, researchers, academic staff, industry professionals, and data scientists** interested in applying artificial intelligence to energy efficiency, industrial optimization, and sustainable technological development. The course is open to both **academic and non-academic staff**, encouraging interdisciplinary collaboration between industry and academia and promoting the practical application of AI-driven solutions to real-world challenges.

It is suitable for:

- **Undergraduate and graduate students** in computer science, engineering, energy systems, data science, and related disciplines who wish to develop practical skills in AI and its industrial applications.
- **Academic staff and researchers** interested in applying artificial intelligence, machine learning, and data analytics to energy-related research, industrial processes, and sustainable technologies.
- **Industry professionals and technical personnel** seeking to improve energy efficiency, analyze industrial data, predict energy consumption, and identify opportunities for process optimization through AI-based solutions.
- **Data scientists and software developers** interested in extending their knowledge of machine learning toward energy analytics, anomaly detection, predictive modeling, and smart industrial systems.

The course combines theoretical concepts with practical exercises, making it suitable for participants with a basic understanding of Python and data analysis who wish to explore how AI can contribute to more efficient, intelligent, and sustainable industrial operations.

Learning Outcomes

Upon completion of the course, participants will be able to:

1. Understand the fundamental concepts and applications of artificial intelligence and machine learning in energy efficiency and smart industry.
2. Prepare, preprocess, analyze, and visualize energy-related and industrial datasets using Python libraries.
3. Develop, implement, and evaluate machine learning models for energy consumption forecasting and energy performance analysis.
4. Apply anomaly detection techniques to identify unusual energy consumption patterns, potential inefficiencies, and opportunities for industrial optimization.

5. Interpret AI-generated insights and develop data-driven recommendations to support energy efficiency, industrial optimization, and sustainable decision-making.
6. Design and implement a practical AI-based solution for addressing a real-world energy efficiency or smart industry challenge.

Assessment

In order for each participant to successfully complete the course and be awarded the corresponding ECTS credits, they must successfully pass the course assessment. The assessment outcome will be either **Pass or Fail**, with a minimum passing threshold of **51%** of the total available points.

The assessment strategy combines conceptual understanding, practical data analysis and machine learning skills, and project-based learning. Participants will demonstrate their knowledge through a short quiz, a technical report, hands-on project development, a final project report, and an oral presentation. The assessment is designed to evaluate their ability to apply artificial intelligence techniques to energy efficiency and smart industry challenges.

Assessment methods

- Short quiz – 10%
- Technical report – 20%
- Hands-on project development – 30%
- Final project report – 25%
- Oral presentation – 15%

The link between learning objectives and assessment criteria can be seen below.

Learning outcomes	Assessment examples
• Understand the fundamental concepts and applications of artificial intelligence and machine learning in energy efficiency and smart industry, including their benefits and limitations.	Short quiz
• Prepare, preprocess, analyze, and visualize energy-related and industrial datasets using Python libraries.	Technical report
• Develop, implement, and evaluate machine learning models for energy consumption forecasting and energy performance analysis.	Hands-on project development

• Apply anomaly detection techniques to identify unusual energy consumption patterns, potential inefficiencies, and opportunities for industrial optimization.	Hands-on project development and final project report
• Interpret AI-generated insights and develop data-driven recommendations to support energy efficiency, industrial optimization, and sustainable decision-making.	Final project report and oral presentation
• Design and implement a practical AI-based solution addressing a real-world energy efficiency or smart industry challenge.	Hands-on project development, final project report, and oral presentation

Mentoring

In the context of this course, participants will receive personalized mentoring and guidance throughout the learning process. Mentoring will be provided through a combination of one-to-one consultations, small group sessions, and supervised project work.

Bibliography

1. *Géron, A. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow (3rd ed.). O'Reilly Media, 2022*
2. *Kelleher, J. D., Mac Namee, B., & D'Arcy, A. Fundamentals of Machine Learning for Predictive Data Analytics. MIT Press, 2020*
3. *Raschka, S., Liu, Y., & Mirjalili, V. Machine Learning with PyTorch and Scikit-Learn. Packt Publishing, 2022. Packt product page*
4. *Hyndman, R. J., & Athanasopoulos, G. Forecasting: Principles and Practice (3rd ed.). OTexts, 2021. Available at: https://otexts.com/fpp3/*
5. *Molnar, C. Interpretable Machine Learning (2nd ed.), 2022. Available at: https://christophm.github.io/interpretable-ml-book/*
6. *Scikit-learn developers. Scikit-learn: Machine Learning in Python — User Guide. Available at: https://scikit-learn.org/stable/user_guide.html*
7. *UCI Machine Learning Repository. Appliances Energy Prediction Dataset. Available at: https://archive.ics.uci.edu/dataset/374/appliances+energy+prediction*
8. *Open Power System Data. Time Series Data Package. Available at: https://data.open-power-system-data.org/time_series/*

Other Important Information

Course evaluation: Upon successful completion of the course, participants are required to fill in the course evaluation questionnaire.

Certificate: Upon successful completion of the course, participants will be issued a certificate of achievement provided by UIST and EIT Climate KIC.

Plagiarism: UIST has explicit rules concerning academic dishonesty including plagiarism. Course participants are reminded that all work submitted as part of the requirements for any examination (including coursework) of UIST must be expressed in their own words and incorporated in their own ideas and judgements.

Course Timetable

Session	Date and Time	Instructor	Venue
1st	04.11 2026 @ 17:00	Prof. Atanas Hristov	online
2nd	05.11 2026 @ 17:00	Prof. Atanas Hristov	online
3rd	12. 11 2026 @ 17:00	Prof. Atanas Hristov	online
4th	13.11 2026 @ 17:00	Prof. Atanas Hristov	online
5th	19.11 2026 @ 17:00	Prof. Atanas Hristov	online

Contact Details of Instructor(s)

Name	Email	Telephone number
Prof. Atanas Hristov	atanas.hristov@uist.edu.mk	+38975229463

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