

AMLEA - Advanced Machine Learning in Energy Applications

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General information	
Module Code	AMLEA
Unique Identifier	AdvMachLearn-01-MA-M
Module Leader(s)	Prof. Dr. Hennig, Patrick (patrick.hennig@haw-kiel.de)
Lecturer(s)	Prof. Dr. Hennig, Patrick (patrick.hennig@haw-kiel.de)
Offered in Semester	Sommersemester 2024
Module duration	1 Semester
Occurrence frequency	Regular
Module occurrence	In der Regel im Sommersemester
Language	Englisch
Recommended for international students	Yes
Can be attended with different study programme	Yes

Curricular relevance (according to examination regulations)
Study Subject: M.Eng. - MET - Elektrische Technologien (PO 2017, V3) Module type: Wahlmodul Semester: 1, 2
Study Subject: M.Sc. - DS - Data Science Module type: Wahlmodul Semester: 2
Study Subject: M.Sc. - MCS - Computer Science (PO 2023, V1) Module type: Wahlmodul Semester: 1, 2
Study Subject: M.Sc. - MIE - Information Engineering (PO 2022, V3) Module type: Wahlmodul Semester: 1, 2, 3

Qualification outcome
<i>Areas of Competence: Knowledge and Understanding; Use, application and generation of knowledge; Communication and cooperation; Scientific self-understanding / professionalism.</i>

Students can specifically (in terms of content)...

- explain the concept of machine learning (ML) and classify it in the context of artificial intelligence (AI),
- name, differentiate, describe and explain the concepts, methods and models of supervised and unsupervised learning,
- understand the mathematical and statistical foundations as well as in-depth methods and models of machine learning,
- name and explain basic and advanced methods of data analysis and data pre-processing, in particular procurement, transformation, cleansing, partitioning, scaling, visualization and static description,
- describe the complete process of carrying out an ML project from the analysis and pre-processing of data to the application of methods and development of models through to the post-processing of data (e.g. model-based forecasting).

Students have/are generally able to...

- significantly deepened and expanded their knowledge,
- define and interpret the special features and limitations of the methods and models,
- develop, on the basis of existing knowledge, both research- and application-oriented develop and apply independent generalized and specialized ideas on the methods and models in a research and application-oriented manner,
- weigh up the correctness of their extended and, if necessary, independently modified knowledge, taking into account scientific-disciplinary (e.g. mathematics and statistics) and methodological considerations, and solve scientific and practical problems on this basis.

Students can specifically (in terms of content) ...

- identify and assess the application potential of AI or ML in different and possibly unknown application contexts,
- solve specific problems largely independently using Python.

Students can generally ...

- integrate new information into the existing knowledge network and/or further process and develop existing knowledge and thus acquire new knowledge independently,
- apply their knowledge, understanding and problem-solving skills in new, unfamiliar and unpredictable situations that are related to their field of study in a broader or multidisciplinary context by integrating existing and new knowledge in complex contexts,
- deal with a high degree of complexity and intricacy with regard to scientific and practical tasks,
- making scientifically sound decisions,
- designing research questions from a purely scientific point of view, selecting well-founded research methods and interpreting research results critically.

Students can generally ...

- engage in discussions with representatives of different academic and non-academic fields of activity as well as on alternative, theoretically justifiable solutions to problems,
- integrate participants into tasks in a goal-oriented manner, taking into account the respective group situation,
- recognize potential for conflict in cooperation with others and reflect on this against the background of cross-situational conditions,
- ensure the implementation of solution processes appropriate to the situation through constructive, conceptual action

Students can generally ...

- develop a professional self-image that is oriented towards goals and standards of professional action both in academia and in professional fields outside academia.
- justify their own professional actions with theoretical and methodological knowledge and reflect on alternative approaches.
- judge their own abilities, make autonomous use of relevant freedom of organization and decision-making and develop these further under guidance.
- recognize situation-appropriate and cross-situational framework conditions for professional action and reflect on decisions in an ethical and responsible manner.
- critically reflect on their professional actions in relation to social expectations and consequences and further develop their professional actions.

Content information

Content	<ul style="list-style-type: none"> - Advanced topics in machine learning with a strong application focus - Application examples are mainly, but not exclusively, from the energy sector e.g. <ul style="list-style-type: none"> - Determination of power degradation of PV systems based on operating data - Energy generation forecasts for wind power plants - Electricity price forecasts for the spot market - Problem areas: <ul style="list-style-type: none"> - Supervised learning: regression, classification - Unsupervised learning: clustering, dimension reduction - Reinforcement learning - Exploratory data analysis and pre-processing - Course draws on previous knowledge at Bachelor level and deepens the content - Content is taught and applied using practical examples and small projects
Literature	Literature will be announced during the course.

Teaching formats of the courses

Teaching format	SWS
Lehrvortrag	2
Übung	2

Workload

Number of SWS	4 SWS
Credits	5,00 Credits
Contact hours	48 Hours
Self study	102 Hours

Module Examination

Examination prerequisites according to exam regulations	None
AMLEA - Übung	Method of Examination: Übung Weighting: 0% wird angerechnet gem. § 11 Absatz 2 PVO: Yes Graded: No Remark: Regular participation and collaboration & short presentation

AMLEA - Hausarbeit	Method of Examination: Hausarbeit Weighting: 100% wird angerechnet gem. § 11 Absatz 2 PVO: No Graded: Yes
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Miscellaneous	
Recommended Prerequisites	<ul style="list-style-type: none"> - interest in machine learning and neural networks - basic knowledge in machine learning recommended - conceptual and analytical skills - mathematical skills (linear algebra, analysis, calculus) - programming skills (e.g. Python) - interest to work with software libraries (e.g. Python)