HAW Kiel
Hochschule für Angewandte Wissenschaften Kiel
Kiel University of Applied Sciences

# AMLEA - Advanced Machine Learning in Energy Applications


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| General information | |
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| **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) |
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| Study Subject: M.Eng. - MET - Elektrische Technologien (PO 2017, V3)<br>Module type: Wahlmodul<br>Semester: 1, 2 |
| Study Subject: M.Sc. - DS - Data Science<br>Module type: Wahlmodul<br>Semester: 2 |
| Study Subject: M.Sc. - MCS - Computer Science (PO 2023, V1)<br>Module type: Wahlmodul<br>Semester: 1, 2 |
| Study Subject: M.Sc. - MIE - Information Engineering (PO 2022, V3)<br>Module type: Wahlmodul<br>Semester: 1, 2, 3 |

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

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| Students can specifically (in terms of content)...<br>- explain the concept of machine learning (ML) and classify it in the context of artificial intelligence (AI),<br>- name, differentiate, describe and explain the concepts, methods and models of supervised and unsupervised learning,<br>- understand the mathematical and statistical foundations as well as in-depth methods and models of machine learning,<br>- 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,<br>- 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).<br>Students have/are generally able to...<br>- significantly deepened and expanded their knowledge,<br>- define and interpret the special features and limitations of the methods and models,<br>- 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,<br>- 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) ...<br>- identify and assess the application potential of AI or ML in different and possibly unknown application contexts,<br>- solve specific problems largely independently using Python.<br><br>Students can generally ...<br>- integrate new information into the existing knowledge network and/or further process and develop existing knowledge and thus acquire new knowledge independently,<br>- 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,<br>- deal with a high degree of complexity and intricacy with regard to scientific and practical tasks,<br>- making scientifically sound decisions,<br>- designing research questions from a purely scientific point of view, selecting well-founded research methods and interpreting research results critically. |
| Students can generally ...<br>- engage in discussions with representatives of different academic and non-academic fields of activity as well as on alternative, theoretically justifiable solutions to problems,<br>- integrate participants into tasks in a goal-oriented manner, taking into account the respective group situation,<br>- recognize potential for conflict in cooperation with others and reflect on this against the background of cross-situational conditions,<br>- 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** | |
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| **Content** | - Advanced topics in machine learning with a strong application focus<br>- Application examples are mainly, but not exclusively, from the energy sector e.g.<br>- Determination of power degradation of PV systems based on operating data<br>- Energy generation forecasts for wind power plants<br>- Electricity price forecasts for the spot market<br><br>- Problem areas:<br>- Supervised learning: regression, classification<br>- Unsupervised learning: clustering, dimension reduction<br>- Reinforcement learning<br><br>- Exploratory data analysis and pre-processing<br>- Course draws on previous knowledge at Bachelor level and deepens the content<br>- Content is taught and applied using practical examples and small projects |
| **Literature** | Literature will be announced during the course. |

| **Teaching formats of the courses** | |
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| **Teaching format** | **SWS** |
| Lehrvortrag | 2 |
| Übung | 2 |

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

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

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| **AMLEA - Hausarbeit** | Method of Examination: Hausarbeit<br>Weighting: 100%<br>wird angerechnet gem. § 11 Absatz 2 PVO: No<br>Graded: Yes |

| **Miscellaneous** | |
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| **Recommended Prerequisites** | - interest in machine learning and neural networks<br>- basic knowledge in machine learning recommended<br>- conceptual and analytical skills<br>- mathematical skills (linear algebra, analysis, calculus)<br>- programming skills (e.g. Python)<br>- interest to work with software libraries (e.g. Python) |