fördern • führen • inspirieren

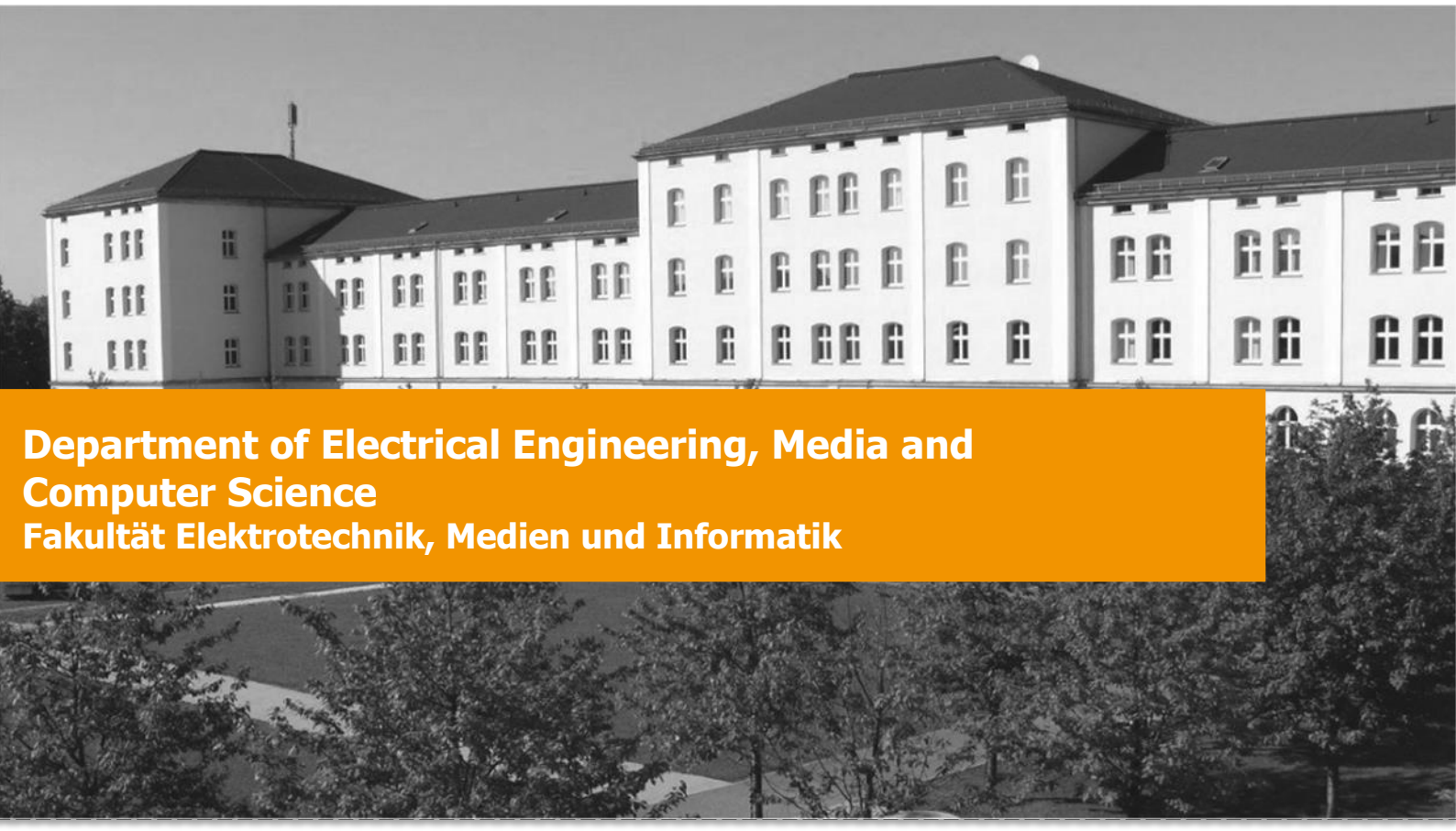
Ostbayerische Technische Hochschule
Amberg-Weiden

Course Catalogue

Modulhandbuch

Artificial Intelligence for Industrial Applications

Künstliche Intelligenz für industrielle Anwendungen



Department of Electrical Engineering, Media and Computer Science
Fakultät Elektrotechnik, Medien und Informatik

Master of Science (M.Sc.)

Master of Science (M.Sc.)

Artificial Intelligence for Industrial Applications - Master Künstliche Intelligenz für industrielle Anwendungen - Master	Updated: winter term 2023/2024 Wintersemester 2023/2024

Table of content

Inhaltsverzeichnis

Table of content 2
Preliminary Notes 3
Full time study programme 1
Part time study programme 2
Module Descriptions 3
Required modules: AI Basics Vision & Robotics (summer) 3
    Deep Learning 3
    Computer Vision and AI 5
    Autonomous robots 6
Required modules: AI basics data & language (winter) 7
    Machine Learning 7
    Modern Databases and NoSQL 9
    NLP and Information Retrieval 10
AI applications 11
    AI project 11
    Interdisciplinary topic 12
Scientific training 13
    AI conference 13
    Scientific writing 14
    Master thesis 15
Elective modules 1

Preliminary Notes

Vorbemerkungen

- **Note:**

Please take special note of the Program and Examination Regulations of this degree programm in their current version.

- **Study Structure**

The program comprises a standard duration of 3 semesters for full-time study and 5 semesters for part-time study.

- **Registration formalities:**

All examinations must be registered with the Students´Office through PRIMUSS. Additional formalities are listed in the module descriptions.

- **Abbreviations:**

ECTS = The European Credit Transfer and Accumulation System (ECTS) is a credit point system for accreditation of course achievements.
SWS = Semesterwochenstunden – Semester hours of week
SPO = Studien- und Prüfungsordnung = Program and Examination Regulations
ASPO = Allgemeine Studien- und Prüfungsordnung – Gerneral Program and Examination Regulations
APO = Allgemeine Prüfungsordnung = General Examination Regulations

- **Workload:**

According to the Bologna Process, a credit point is based on a workload of 25-30 hours. The number of hours includes contact time/presentation time at the university, time spent preparing for and following up on courses, time spent preparing papers or time spent preparing for exams.

Example calculation workload (course with 4 SWS, 5 ECTS points):

Workload:	5 ECTS x 30h/ECTS = 150 h
- Lecture	(4 SWS x 15 weeks) = 60 h
- Self-study	= 60 h
- Exam preparation	= 30 h
	= 150 h

- **Accreditation of course achievements:**

Please observe all relevant application procedures via the Students´Office.

- **vhb**

vhb (German: virtuelle Hochschule Bayern / English: virtual universitiy Bavaria) is an online learning platform with online courses form different universities in Bavaria. Further information can be found here: https://www.vhb.org/en

Full time study programme

Studium in Vollzeit

Curriculum for master´s degree program in full-time Artificial Intelligence for Industrial Applications

Ostbayerische Technische Hochschule Amberg-Weiden

Start of study: (please select) →	**winter term**								
No.	Modulegroups/Modules	**1. Semester**		**2. Semester**		**3. Semester**		**Total**		
		contact time (SWS)	ECTS	contact time (SWS)	ECTS	contact time (SWS)	ECTS	**contact time (SWS)**	**ECTS**	**%**
	AI basics vision & robotics (summer)	0	0	12	15	0	0	**12**	**15**	**17%**
1.1	Deep Learning			4	5			**4**	**5**	
1.2	Computer vision and AI			4	5			**4**	**5**	
1.3	Autonomous robots			4	5			**4**	**5**	
								0	**0**	
	AI basics data & language (winter)	12	15	0	0	0	0	**12**	**15**	**17%**
2.1	Machine Learning	4	5					**4**	**5**	
2.2	Modern Databases and NoSQL	4	5					**4**	**5**	
2.3	NLP and Information retrieval	4	5					**4**	**5**	
								0	**0**	
	AI Applications (winter/summer)	8	10	12	15	0	0	**20**	**25**	**28%**
3.1	AI project			4	5			**4**	**5**	
3.2	Interdisciplinary topic	4	5					**4**	**5**	
3.3	Optional modules "Basic"	4	5					**4**	**5**	
3.4	Optional modules "Advanced"			8	10			**8**	**10**	
	Scientific training (winter/summer)	4	5	0	0	2	30	**6**	**35**	**39%**
4.1	AI conference	4	5					**4**	**5**	
4.2	Scientific writing					2	2	**2**	**2**	
4.3	Master thesis					0	28	**0**	**28**	
								0	**0**	
	Total:	24	30	24	30	2	30	**50**	**90**	**100%**

Curriculum for master´s degree program in full-time Artificial Intelligence for Industrial Applications

Ostbayerische Technische Hochschule Amberg-Weiden

Start of study: (please select) →	**summer term**								
No.	Modulegroups/Modules	**1. Semester**		**2. Semester**		**3. Semester**		**Total**		
		contact time (SWS)	ECTS	contact time (SWS)	ECTS	contact time (SWS)	ECTS	**contact time (SWS)**	**ECTS**	**%**
	AI basics vision & robotics (summer)	12	15	0	0	0	0	**12**	**15**	**17%**
1.1	Deep Learning	4	5					**4**	**5**	
1.2	Computer vision and AI	4	5					**4**	**5**	
1.3	Autonomous robots	4	5					**4**	**5**	
								0	**0**	
	AI basics data & language (winter)	0	0	12	15	0	0	**12**	**15**	**17%**
2.1	Machine Learning			4	5			**4**	**5**	
2.2	Modern Databases and NoSQL			4	5			**4**	**5**	
2.3	NLP and Information retrieval			4	5			**4**	**5**	
								0	**0**	
	AI Applications (winter/summer)	8	10	12	15	0	0	**20**	**25**	**28%**
3.1	AI project			4	5			**4**	**5**	
3.2	Interdisciplinary topic	4	5					**4**	**5**	
3.3	Optional modules "Basic"	4	5					**4**	**5**	
3.4	Optional modules "Advanced"			8	10			**8**	**10**	
	Scientific training (winter/summer)	4	5	0	0	2	30	**6**	**35**	**39%**
4.1	AI conference	4	5					**4**	**5**	
4.2	Scientific writing					2	2	**2**	**2**	
4.3	Master thesis					0	28	**0**	**28**	
								0	**0**	
	Total:	24	30	24	30	2	30	**50**	**90**	**100%**

Part time study programme

Studium in Teilzeit

Curriculum for master´s degree program in part-time Artificial Intelligence for Industrial Applications

Ostbayerische Technische Hochschule Amberg-Weiden

Start of study: (please select) →	**winter term**												
No.	Modulegroups/Modules	**1. Semester**		**2. Semester**		**3. Semester**		**4. Semester**		**5. Semester**		**Total**		
		contact time (SWS)	ECTS	contact time (SWS)	ECTS	contact time (SWS)	ECTS	contact time (SWS)	ECTS	contact time (SWS)	ECTS	**contact time (SWS)**	**ECTS**	**%**
	AI basics vision & robotics (summer)	0	0	8	10	0	0	4	5	0	0	**12**	**15**	**17%**
1.1	Deep Learning			4	5							**4**	**5**	
1.2	Computer vision and AI			4	5							**4**	**5**	
1.3	Autonomous robots							4	5			**4**	**5**	
												0	**0**	
	AI basics data & language (winter)	8	10	0	0	4	5	0	0	0	0	**12**	**15**	**17%**
2.1	Machine Learning	4	5									**4**	**5**	
2.2	Modern Databases and NoSQL	4	5									**4**	**5**	
2.3	NLP and Information retrieval					4	5					**4**	**5**	
												0	**0**	
	AI Applications (winter/summer)	4	5	4	5	4	5	8	10	0	0	**20**	**25**	**28%**
3.1	AI project							4	5			**4**	**5**	
3.2	Interdisciplinary topic			4	5							**4**	**5**	
3.3	Optional modules "Basic"	4	5									**4**	**5**	
3.4	Optional modules "Advanced"					4	5	4	5			**8**	**10**	
	Scientific training (winter/summer)	0	0	0	0	4	5	0	0	2	30	**6**	**35**	**39%**
4.1	AI conference					4	5					**4**	**5**	
4.2	Scientific writing									2	2	**2**	**2**	
4.3	Master thesis									0	28	**0**	**28**	
												0	**0**	
	Total:	12	15	12	15	12	15	12	15	2	30	**50**	**90**	**100%**

Curriculum for master´s degree program in part-time Artificial Intelligence for Industrial Applications

Ostbayerische Technische Hochschule Amberg-Weiden

Start of study: (please select) →	**summer term**												
No.	Modulegroups/Modules	**1. Semester**		**2. Semester**		**3. Semester**		**4. Semester**		**5. Semester**		**Total**		
		contact time (SWS)	ECTS	contact time (SWS)	ECTS	contact time (SWS)	ECTS	contact time (SWS)	ECTS	contact time (SWS)	ECTS	**contact time (SWS)**	**ECTS**	**%**
	AI basics vision & robotics (summer)	8	10	0	0	4	5	0	0	0	0	**12**	**15**	**17%**
1.1	Deep Learning	4	5									**4**	**5**	
1.2	Computer vision and AI	4	5									**4**	**5**	
1.3	Autonomous robots					4	5					**4**	**5**	
												0	**0**	
	AI basics data & language (winter)	0	0	8	10	0	0	4	5	0	0	**12**	**15**	**17%**
2.1	Machine Learning			4	5							**4**	**5**	
2.2	Modern Databases and NoSQL			4	5							**4**	**5**	
2.3	NLP and Information retrieval							4	5			**4**	**5**	
												0	**0**	
	AI Applications (winter/summer)	4	5	4	5	4	5	8	10	0	0	**20**	**25**	**28%**
3.1	AI project							4	5			**4**	**5**	
3.2	Interdisciplinary topic			4	5							**4**	**5**	
3.3	Optional modules "Basic"	4	5									**4**	**5**	
3.4	Optional modules "Advanced"					4	5	4	5			**8**	**10**	
	Scientific training (winter/summer)	0	0	0	0	4	5	0	0	2	30	**6**	**35**	**39%**
4.1	AI conference					4	5					**4**	**5**	
4.2	Scientific writing									2	2	**2**	**2**	
4.3	Master thesis									0	28	**0**	**28**	
												0	**0**	
	Total:	12	15	12	15	12	15	12	15	2	30	**50**	**90**	**100%**

Module Descriptions
Modulbeschreibungen

Required modules: AI Basics Vision & Robotics (summer)

Deep Learning
Mehrschichtiges maschinelles Lernen

Classification Zuordnung zum Curriculum	Module ID Modul-ID	Kind of Module Art des Moduls	Number of Credits Umfang in ECTS-Leistungspunkte
	1.1	Required module	5 ECTS

Location Ort	Language Sprache	Duratrion of Module Dauer des Moduls	Frequency of Module Vorlesungsrythmus	Max. Number of Participants Max. Teilnehmerzahl
Amberg	English	one semester	summer semester	

Module Convenor Modulverantwortliche/r	Professor / Lecturer Dozent/In
Prof. Dr. Patrick Levi	Prof. Dr. Walter

Prerequistes*
Voraussetzungen

advanced competences in computer science and mathematics

***Note: please also observe the preperquisites according to eximinations regulations law in the current version of the SPO.**

Usability Verwendbarkeit	Teaching Methods Lehrformen	Workload
Master study programmes with focus on AI	Seminars with exercises	Contact time: 60h Pre- and post-processing: 60h Exam preparation: 30h

Learning Outcomes
Lernziele / Qualifikationen des Moduls

After completing this module successfully, students will have the following professional, methodological and personal competences:

- **Professional competence:** The students know and understand the functionality and basics of neural networks and deep learning methods.
- **Methodological competence:** Students will be able to implement selected deep learning methods based on software libraries, apply them to given data sets, and select and optimize the appropriate functions and parameters.
- **Personal competence (social competence and self-competence):** Working in international project teams, analytical-scientific methodology

Course Content
Inhalte der Lehrveranstaltungen

- Crash course Machine Learning (introduction neural networks; vectorization, cost, activation functions, computational graphs, random initialization).
- Introduction to Deep Learning; forward, backpropagation, training, development, test sets
- Advanced methods; hyperparameter tuning, regularization, normalization, optimization, minibatch gradient descent
- Convolutional Neural Networks; Pooling Layer, Residual Networks, Error Analysis, Transfer Learning, Data Augmentation
- Sequence Models; RNNs, LSTMs, Language Models, Word Embeddings, Attention, Pre-training

Teaching Material / Reading
Lehrmaterial / Literatur

François Chollet: Deep Learning with Python, Manning, 2018. (deutsche Version bei mitp Professional, 2018)
Ian Goodfellow, Yoshua Bengio, Aaron Courville: Deep Learning, 2017, online: http://www.deeplearningbook.org
D2L.ai
Current scientific research papers

Internationality
Internationalität (Inhaltlich)

Module is offered in English.
Students work in international teams.
English literature is used.

Method of Assenssment (ggf. Hinweis zu Multiple Choice - APO §9a)
Modulprüfungen

Type of examination *1)	Type/scope including weighting *2) Art/Umfang inkl. Gewichtung	Learning objectives/competencies to be assessed Zu prüfende Lernziele/Kompetenzen

Prüfungsform		
written exam	Written exam, 90 min.	Understand the basics of deep learning methods, analyze given problems and show possible solutions be able to show solutions, apply basic methods/functions

*1) Please refer to the applicable overview of the forms of examination at the OTH Amberg-Weiden
*2) Please additionally provide information on the weighting (in % share) and, if applicable, also a reference to a bonus system.

Computer Vision and AI

Maschinelles Sehen und KI

Classification Zuordnung zum Curriculum	**Module ID** Modul-ID	**Kind of Module** Art des Moduls	**Number of Credits** Umfang in ECTS-Leistungspunkte
	1.2	Required module	5 ECTS

Location Ort	**Language** Sprache	**Duratrion of Module** Dauer des Moduls	**Frequency of Module** Vorlesungsrythmus	**Max. Number of Participants** Max. Teilnehmerzahl
Amberg	English	one semester	summer semester	

Module Convenor Modulverantwortliche/r	**Professor / Lecturer** Dozent/In
Prof. Dr. Tatyana Ivanovska	Prof. Dr. Tatyana Ivanovska

Prerequistes* Voraussetzungen

advanced competences in computer science and mathematics

***Note: please also observe the preperquisites according to eximinations regulations law in the current version of the SPO.**

Usability Verwendbarkeit	**Teaching Methods** Lehrformen	**Workload**
Master study programmes with focus on AI	Seminars with exercises	Contact time: 60 h Pre- and post-processing: 60 h Exam preparation: 30 h

Learning Outcomes
Lernziele / Qualifikationen des Moduls

After completing this module successfully, students will have the following professional, methodological and personal competences:

- **Professional competence:** The students know and understand how artificial neural networks work. They are familiar with different architectures (e.g. CNNs, RNNs) and their suitability for problems of image recognition and understanding.
- **Methodological competence:** Students will be able to select suitable deep learning methods and architectures for given application scenarios from the field of computer vision and implement them on the basis of software libraries. They are familiar with techniques and methods of feature generation from image data as well as model optimization and can apply them practically.
- **Personal competence (social competence and self-competence):** Teamwork, professional exchange with team members

Course Content
Inhalte der Lehrveranstaltungen

- Introduction to Computer Vision and Deep Learning
- Feature extraction methods for images
- Data augmentation for image data
- Convolutional Neural Networks (CNN)
- Object Recognition with CNN
- Image Segmentation with CNN
- autoencoders
- Recurrent Neural Networks (RNN)

Teaching Material / Reading
Lehrmaterial / Literatur

Ian Goodfellow, Yoshua Bengio, Aaron Courville: Deep Learning, 2017, online: http://www.deeplearningbook.org
Jason Brownlee: Deep Learning for Computer Vision, 2020
Aktuelle Forschungsarbeiten aus den Bereichen Computer Vision und Deep Learning (werden in der Lehrveranstaltung angegeben)

Internationality
Internationalität (Inhaltlich)

Module is offered in English.
Students work in international teams.
English literature is used.

Method of Assenssment (ggf. Hinweis zu Multiple Choice - APO §9a)
Modulprüfungen

Type of examination [*1)] Prüfungsform	**Type/scope including weighting** [*2)] Art/Umfang inkl. Gewichtung	**Learning objectives/competencies to be assessed** Zu prüfende Lernziele/Kompetenzen
PrA	Approx. 30h; project work in a small team	Design and implementation of a sample application using Deep Learning.

[*1)] Please refer to the applicable overview of the forms of examination at the OTH Amberg-Weiden

[*2)] Please additionally provide information on the weighting (in % share) and, if applicable, also a reference to a bonus system.

Autonomous robots

Autonome Roboter

Classification Zuordnung zum Curriculum	Module ID Modul-ID	Kind of Module Art des Moduls	Number of Credits Umfang in ECTS-Leistungspunkte
	1.3	Required module	5 ECTS

Location Ort	Language Sprache	Duratrion of Module Dauer des Moduls	Frequency of Module Vorlesungsrythmus	Max. Number of Participants Max. Teilnehmerzahl
Amberg	English	one semester	summer semester	

Module Convenor Modulverantwortliche/r	Professor / Lecturer Dozent/In
Prof. Dr. Thomas Nierhoff	Prof. Dr. Thomas Nierhoff

Prerequistes*
Voraussetzungen

advanced competences in computer science and mathematics

***Note: please also observe the preperquisites according to eximinations regulations law in the current version of the SPO.**

Usability Verwendbarkeit	Teaching Methods Lehrformen	Workload
Master study programmes with focus on AI	Seminars with exercises	Contact time: Pre- and post-processing: Exam preparation:

Learning Outcomes
Lernziele / Qualifikationen des Moduls

After completing this module successfully, students will have the following professional, methodological and personal competences:

- **Professional competence:** Students know basic procedures in the field of sensor processing, data fusion, localization and behavior control of autonomous robots.
- **Methodological competence:** Upon completion of the module, students will be able to solve a variety of tasks for autonomous robots using a unified framework.
- **Personal competence (social competence and self-competence):** Die Studierenden können im Team komplexe Aufgaben der Robotik eigenständig lösen.

Course Content
Inhalte der Lehrveranstaltungen

- Structure of autonomous robots
- environment perception
- sensor data fusion
- self-localization
- behavior control
- Bayesian optimization
- Gaussian processes

Teaching Material / Reading
Lehrmaterial / Literatur

B. Siciliano, O. Khatib: Handbook of Robotics, Springer, 2008
X. Gao, T. Zhang: Introduction to Visual SLAM: From Theory to Practice, Springer, 2021
C. E. Rasmussen, C. Williams: Gaussian Processes for Machine Learning, MIT Press, 2006
R. Garnett: Bayesian Optimization, Cambridge University Press, 2023

Internationality
Internationalität (Inhaltlich)

Module is offered in English.
Students work in international teams.
English literature is used.

Method of Assenssment (ggf. Hinweis zu Multiple Choice - APO §9a)
Modulprüfungen

Type of examination *1) Prüfungsform	Type/scope including weighting *2) Art/Umfang inkl. Gewichtung	Learning objectives/competencies to be assessed Zu prüfende Lernziele/Kompetenzen
PrA	Approx. 50h; project work in small teams	Design and implementation of a selected application

*1) Please refer to the applicable overview of the forms of examination at the OTH Amberg-Weiden

*2) Please additionally provide information on the weighting (in % share) and, if applicable, also a reference to a bonus system.

Required modules: AI basics data & language (winter)

Machine Learning

Maschinelles Lernen

Classification Zuordnung zum Curriculum	Module ID Modul-ID	Kind of Module Art des Moduls	Number of Credits Umfang in ECTS-Leistungspunkte
	2.1	Required module	5 ECTS

Location Ort	Language Sprache	Duratrion of Module Dauer des Moduls	Frequency of Module Vorlesungsrythmus	Max. Number of Participants Max. Teilnehmerzahl
Amberg	English	one semester	winter semester	

Module Convenor Modulverantwortliche/r	Professor / Lecturer Dozent/In
Prof. Dr. Patrick Levi	Prof. Dr. Patrick Levi

Prerequistes*
Voraussetzungen

advanced competences in computer science and mathematics

***Note: please also observe the preperquisites according to eximinations regulations law in the current version of the SPO.**

Usability Verwendbarkeit	Teaching Methods Lehrformen	Workload
Master study programmes with focus on AI	Seminars with exercises	Contact time: Pre- and post-processing: Exam preparation:

Learning Outcomes
Lernziele / Qualifikationen des Moduls

After completing this module successfully, students will have the following professional, methodological and personal competences:

- **Professional competence:** Students know typical use cases for the application of machine learning in different areas such as industry, media, marketing, etc.. They are familiar with common methods of supervised and unsupervised learning, have a conceptual understanding of how they work, and can evaluate them in terms of their strengths and weaknesses. They are familiar with the challenges associated with their use and know approaches and strategies to address them.
- **Methodological competence:** Students will be able to select suitable ML methods for various application scenarios and implement them programmatically on the basis of software libraries. They are able to evaluate and interpret the results and can assess the methods with regard to their quality and performance. They know different techniques for model optimization and can apply them practically.
- **Personal competence (social competence and self-competence):** Working in international teams, scientific and analytical approach and problem solving as a team member

Course Content
Inhalte der Lehrveranstaltungen

- structure of autonomous robots
- modelling of uncertainties
- localization and mapping
- sensor fusion
- path planning and path following
- machine learning for robotics

Teaching Material / Reading
Lehrmaterial / Literatur

I. H. Witten, E. Frank, M. A. Hall, C. J. Pal: Data mining: practical machine learning tools and techniques, Morgan Kaufmann, 2018.
A. Géron: Hands-on Machine Learning with Scikit-Learn, Keras and Tensor Flow, O'Reilly, 2018.
Raschka: Machine Learning with Python: the practical handbook for Data Science, Predictive Analytics and Deep Learning, mitp-Verlag, 2016.
C. M. Bishop: Pattern Recognition and Machine Learning, Springer Verlag, 2016.
T. Hastie, R. Tibshirani, J. Friedman, The Elements of Statistical Learning, Springer, 2nd ed. (2009)
Sklearn User Guide (https://scikit-learn.org/stable/user_guide.html)
Conference and Journal Papers (handed out in the course).

Internationality
Internationalität (Inhaltlich)

Module is offered in English.
Students work in international teams.
English literature is used.

Method of Assenssment (ggf. Hinweis zu Multiple Choice - APO §9a)
Modulprüfungen

Type of examination *1) Prüfungsform	Type/scope including weighting *2) Art/Umfang inkl. Gewichtung	Learning objectives/competencies to be assessed Zu prüfende Lernziele/Kompetenzen

PrA	Project work, approx. 50h	Conception and prototypical implementation of a machine learning use case

*1) Please refer to the applicable overview of the forms of examination at the OTH Amberg-Weiden

*2) Please additionally provide information on the weighting (in % share) and, if applicable, also a reference to a bonus system.

Modern Databases and NoSQL

Moderne Datenbanken und NoSQL

Classification Zuordnung zum Curriculum	**Module ID** Modul-ID	**Kind of Module** Art des Moduls	**Number of Credits** Umfang in ECTS-Leistungspunkte
	2.2	Required module	5 ECTS

Location Ort	**Language** Sprache	**Duratrion of Module** Dauer des Moduls	**Frequency of Module** Vorlesungsrythmus	**Max. Number of Participants** Max. Teilnehmerzahl
Amberg	English	one semester	winter semester	

Module Convenor Modulverantwortliche/r	**Professor / Lecturer** Dozent/In
N. N.	N. N.

Prerequistes*
Voraussetzungen

advanced competences in computer science and mathematics

***Note: please also observe the preperquisites according to eximinations regulations law in the current version of the SPO.**

Usability Verwendbarkeit	**Teaching Methods** Lehrformen	**Workload**
Master study programmes with focus on AI	Seminars with exercises	Contact time: 60 h Pre- and post-processing: 90 h

Learning Outcomes
Lernziele / Qualifikationen des Moduls

After completing this module successfully, students will have the following professional, methodological and personal competences:

- **Professional competence:** The students know the basics of relational database systems and can understand and compare them with other forms of data organization. They can name examples of the use of relational database systems and list the possibilities of linking databases to application programs. They know the syntax of a common access language and can apply it. The students learn about distributed data models as well as platforms and frameworks for distributed data, such as NoSQL databases.
- **Methodological competence:** Students will be able to independently design, create, and query databases. Students refine their knowledge of modern databases, including distributed data models. By designing and building complex infrastructures, students deepen their ability to abstract. Students learn a confident approach to modern database applications and infrastructures.
- **Personal competence (social competence and self-competence):** Students will be able to model, discuss, and present modern databases to a larger audience in small groups. Through independent learning, students will acquire time management skills.

Course Content
Inhalte der Lehrveranstaltungen

- Database theory and practice: data organization, types of databases, relational database design, transactions.
- Syntax of a database language like SQL
- Practical work with a relational database, such as DB setup and DB connection of application programs
- Distributed data models and platforms and frameworks for distributed data, such as NoSQL databases

Teaching Material / Reading
Lehrmaterial / Literatur

R. Elmasri and S. Navathe: Fundamentals of Database Systems, 7th Edition, Pearson (2017). ISBN 9789332582705.
P. Sadalage and M. Fowler: NoSQL Distilled, Addison-Wesley (2009). ISBN 0321826620.
Lena Wiese: Advanced Data Management, De Gruyter (2015). ISBN 9783110441406.

Course-specific material on the Moodle learning platform.

Internationality
Internationalität (Inhaltlich)

Module is offered in English.
Students work in international teams.
English literature is used.

Method of Assenssment (ggf. Hinweis zu Multiple Choice - APO §9a)
Modulprüfungen

Type of examination [*1)] Prüfungsform	**Type/scope including weighting** [*2)] Art/Umfang inkl. Gewichtung	**Learning objectives/competencies to be assessed** Zu prüfende Lernziele/Kompetenzen
PrA	Approx. 50h; project work in small teams	Design and implementation of a selected application

[*1)] Please refer to the applicable overview of the forms of examination at the OTH Amberg-Weiden

[*2)] Please additionally provide information on the weighting (in % share) and, if applicable, also a reference to a bonus system.

NLP and Information Retrieval

Sprachverarbeitung und Informationsgewinnung

Classification Zuordnung zum Curriculum	**Module ID** Modul-ID	**Kind of Module** Art des Moduls	**Number of Credits** Umfang in ECTS-Leistungspunkte
	2.3	Required module	5 ECTS

Location Ort	**Language** Sprache	**Duratrion of Module** Dauer des Moduls	**Frequency of Module** Vorlesungsrythmus	**Max. Number of Participants** Max. Teilnehmerzahl
Amberg	English	one semester	winter semester	

Module Convenor Modulverantwortliche/r	**Professor / Lecturer** Dozent/In
Prof. Dr. Patrick Levi	Prof. Dr. Patrick Levi

Prerequistes*
Voraussetzungen

advanced competences in computer science and mathematics

***Note: please also observe the preperquisites according to eximinations regulations law in the current version of the SPO.**

Usability Verwendbarkeit	**Teaching Methods** Lehrformen	**Workload**
Master study programmes with focus on AI	Seminars with exercises	Contact time: 60 h Pre- and post-processing: 60 h Exam preparation: 30 h

Learning Outcomes
Lernziele / Qualifikationen des Moduls

After completing this module successfully, students will have the following professional, methodological and personal competences:

- **Professional competence:** Students know the modalities of natural language and typical use cases for Natural Language Processing. Depending on the application scenario, they can select rule-based, statistical and (deep) neural network-based analysis or clustering methods, use them on the basis of common core algorithms and software libraries, and combine them into functional applications. Students are familiar with annotation methods for machine learning and can use them for supervised learning algorithms (incl. Deep Learning), for example for proper name recognition, character recognition or for dependency parsing.
- **Methodological competence:** Students will be able to select adequate analysis or generation procedures, create or annotate linguistic resources (lingware), apply and programmatically combine important algorithms and procedures, and evaluate the performance of NLP procedures and systems.
- **Personal competence (social competence and self-competence):** intercultural exchange on languages, analytical-scientific approach

Course Content
Inhalte der Lehrveranstaltungen

- Modalities of natural language
- Levels of language: Phonetics/phonology, morphology, syntax, semantics, pragmatics.
- Basic procedures: Tokenization, lemmatization, proper name recognition, chunking, parsing, logical-semantic analysis, generation
- Selection from several of the following topics (combinations are possible): Annotation tools, Information Retrieval, Semantic Search, Logic and Inference, Automatic question answering, Speech recognition, synthesis of spoken language (text-to-speech), Speech dialog systems, Text analysis, document analysis, OCR, Clustering/Classification. Neural networks and deep learning

Teaching Material / Reading
Lehrmaterial / Literatur

François Chollet: Deep Learning with Python, Manning, 2018.
Bird, Klein, Loper: Natural Language Processing with Python, 2015.
Christopher D. Manning, Prabhakar Raghavan and Hinrich Schütze, Introduction to Information Retrieval, Cambridge University Press. 2008.
Current scientific research papers

Internationality
Internationalität (Inhaltlich)

Module is offered in English.
Students work in international teams.
English literature is used.

Method of Assenssment (ggf. Hinweis zu Multiple Choice - APO §9a)
Modulprüfungen

Type of examination *1) Prüfungsform	**Type/scope including weighting** *2) Art/Umfang inkl. Gewichtung	**Learning objectives/competencies to be assessed** Zu prüfende Lernziele/Kompetenzen
PrA	Software/lingware and written elaboration	Create or use NLP resources independently and work with software libraries to functional NLP applications.

*1) Please refer to the applicable overview of the forms of examination at the OTH Amberg-Weiden

*2) Please additionally provide information on the weighting (in % share) and, if applicable, also a reference to a bonus system.

AI applications

AI project
KI-Projekt

Classification Zuordnung zum Curriculum	Module ID Modul-ID	Kind of Module Art des Moduls	Number of Credits Umfang in ECTS-Leistungspunkte
	3.1	Required module	5 ECTS

Location Ort	Language Sprache	Duratrion of Module Dauer des Moduls	Frequency of Module Vorlesungsrythmus	Max. Number of Participants Max. Teilnehmerzahl
Amberg	English	one semester	winter/summer semester	

Module Convenor Modulverantwortliche/r	Professor / Lecturer Dozent/In
Prof. Dr. Michael Wiehl	professors the faculty

Prerequistes*
Voraussetzungen

advanced competences in computer science and mathematics

***Note: please also observe the preperquisites according to eximinations regulations law in the current version of the SPO.**

Usability Verwendbarkeit	Teaching Methods Lehrformen	Workload
Master study programmes with focus on AI	Seminars with exercises	Contact time: 20 h Project work: 130 h

Learning Outcomes
Lernziele / Qualifikationen des Moduls

After completing this module successfully, students will have the following professional, methodological and personal competences:

- **Professional competence:** Students deepen professional competencies in the selected project.
- **Methodological competence:** Students learn to apply learned algorithms to problems in science and industry.
- **Personal competence (social competence and self-competence):** Work in a team together with task managers from science and industry, distribution of roles in the team depending on the task, improvement of language skills in direct exchange with fellow students.

Course Content
Inhalte der Lehrveranstaltungen

Depending on the project

Teaching Material / Reading
Lehrmaterial / Literatur

Researched by students or provided to assignment writers.

Internationality
Internationalität (Inhaltlich)

Students work in international teams.
English literature is used.

Method of Assenssment (ggf. Hinweis zu Multiple Choice - APO §9a)
Modulprüfungen

Type of examination [*1)] Prüfungsform	Type/scope including weighting [*2)] Art/Umfang inkl. Gewichtung	Learning objectives/competencies to be assessed Zu prüfende Lernziele/Kompetenzen
PrA	Presentation in the team, project documentation	Developed technical knowledge independently and in a team, meaningfulness of the approach to solving the problem, processing of the results as a technical report and/or technical presentation.

[*1)] Please refer to the applicable overview of the forms of examination at the OTH Amberg-Weiden

[*2)] Please additionally provide information on the weighting (in % share) and, if applicable, also a reference to a bonus system.

Interdisciplinary topic

Interdisziplinäres Fach

Classification Zuordnung zum Curriculum	**Module ID** Modul-ID	**Kind of Module** Art des Moduls	**Number of Credits** Umfang in ECTS-Leistungspunkte
	3.2	Required module	5 ECTS

Location Ort	**Language** Sprache	**Duratrion of Module** Dauer des Moduls	**Frequency of Module** Vorlesungsrythmus	**Max. Number of Participants** Max. Teilnehmerzahl
Amberg	English	one semester	winter/summer semester	

Module Convenor Modulverantwortliche/r	**Professor / Lecturer** Dozent/In
Prof. Dr. Michael Wiehl	Fabian Herding

Prerequistes*
Voraussetzungen

advanced competences in computer science and mathematics

***Note: please also observe the preperquisites according to eximinations regulations law in the current version of the SPO.**

Usability Verwendbarkeit	**Teaching Methods** Lehrformen	**Workload**
Master study programmes with focus on AI	Seminars with exercises	Contact time: Pre- and post-processing: Exam preparation:

Learning Outcomes
Lernziele / Qualifikationen des Moduls

After completing this module successfully, students will have the following professional, methodological and personal competences:

- **Professional competence:** Leadership, change management, decision making and organization in teams
- **Methodological competence:** Students are able to apply the methods of XY they have learned in a way that is appropriate to the situation.
- **Personal competence (social competence and self-competence):** Intercultural exchange, communication techniques, presentation techniques

Course Content
Inhalte der Lehrveranstaltungen

- Organizational Development
- Leadership and management
- change
- decision theory
- Team

Teaching Material / Reading
Lehrmaterial / Literatur

Recommended by the respective lecturer

Internationality
Internationalität (Inhaltlich)

Module is offered in English or bilingual
English literature is used.

Method of Assenssment (ggf. Hinweis zu Multiple Choice - APO §9a)
Modulprüfungen

Type of examination [*1)] Prüfungsform	**Type/scope including weighting** [*2)] Art/Umfang inkl. Gewichtung	**Learning objectives/competencies to be assessed** Zu prüfende Lernziele/Kompetenzen
Kl 90 or PrA or Präs or SemA or LPor		

[*1)] Please refer to the applicable overview of the forms of examination at the OTH Amberg-Weiden

[*2)] Please additionally provide information on the weighting (in % share) and, if applicable, also a reference to a bonus system.

Scientific training

AI conference
KI Konferenz

Classification Zuordnung zum Curriculum	Module ID Modul-ID	Kind of Module Art des Moduls	Number of Credits Umfang in ECTS-Leistungspunkte
	4.1	Required module	5 ECTS

Location Ort	Language Sprache	Duratrion of Module Dauer des Moduls	Frequency of Module Vorlesungsrythmus	Max. Number of Participants Max. Teilnehmerzahl
Amberg	English	one semester	winter/summer semester	

Module Convenor Modulverantwortliche/r	Professor / Lecturer Dozent/In
Prof. Dr. Michael Wiehl	Prof. Dr. Florian Walter

Prerequistes*
Voraussetzungen

completed scientific education (e.g. Bachelor of Science)

***Note: please also observe the preperquisites according to eximinations regulations law in the current version of the SPO.**

Usability Verwendbarkeit	Teaching Methods Lehrformen	Workload
Master study programmes	Seminars	Contact time: 60 h Pre- and post-processing: 0 h Exam preparation: 90 h

Learning Outcomes
Lernziele / Qualifikationen des Moduls

After completing this module successfully, students will have the following professional, methodological and personal competences:

- **Professional competence:** Incorporation, preparation and presentation of relevant close subject-related topics
- **Methodological competence:** Presentation of scientific results with the help of presentations or posters
- **Personal competence (social competence and self-competence):** Reflective and critical discussion and examination of presented contents, exchange in international groups, improvement of language skills in the English language

Course Content
Inhalte der Lehrveranstaltungen

The students should actively deal with current research results and prepare them in the form of a presentation and explain them to the other students. They present and explain them to the other course participants. The students should be able to put new knowledge into the context of teaching. They will also learn about the state of the art in selected areas of artificial intelligence and, based on this, will be able to better delineate their own contribution to existing knowledge in a master's thesis.

Teaching Material / Reading
Lehrmaterial / Literatur

Material researched by students

Internationality
Internationalität (Inhaltlich)

Students work in English to prepare for international conferences.
English literature is used.

Method of Assenssment (ggf. Hinweis zu Multiple Choice - APO §9a)
Modulprüfungen

Type of examination *1) Prüfungsform	Type/scope including weighting *2) Art/Umfang inkl. Gewichtung	Learning objectives/competencies to be assessed Zu prüfende Lernziele/Kompetenzen
Sem	Lecture and elaboration	Quality and content of the presentation

*1) Please refer to the applicable overview of the forms of examination at the OTH Amberg-Weiden

*2) Please additionally provide information on the weighting (in % share) and, if applicable, also a reference to a bonus system.

Scientific writing

Wissenschaftliches Schreiben

Classification Zuordnung zum Curriculum	Module ID Modul-ID	Kind of Module Art des Moduls	Number of Credits Umfang in ECTS-Leistungspunkte
	4.2	Required module	2 ECTS

Location Ort	Language Sprache	Duratrion of Module Dauer des Moduls	Frequency of Module Vorlesungsrythmus	Max. Number of Participants Max. Teilnehmerzahl
Amberg	English	one semester	winter/summer semester	

Module Convenor Modulverantwortliche/r	Professor / Lecturer Dozent/In
Prof. Dr. Michael Wiehl	N.N.

Prerequistes*
Voraussetzungen

completed scientific education (e.g. Bachelor of Science)

***Note: please also observe the preperquisites according to eximinations regulations law in the current version of the SPO.**

Usability Verwendbarkeit	Teaching Methods Lehrformen	Workload
Master study programmes with focus on AI	Seminars with exercises	Contact time: 60 h Pre- and post-processing: 50 h Exam preparation: 40 h

Learning Outcomes
Lernziele / Qualifikationen des Moduls

After completing this module successfully, students will have the following professional, methodological and personal competences:

- **Professional competence:** The students are able to work on topics scientifically. This includes the classification of the self-determined results in the scientific context. If the module accompanies a research activity in industry or university, the research contents and results of the students are the basis of the exercises in this module.
- **Methodological competence:** Students will learn proper citation styles, be able to correctly interpret and assess the quality of professional articles, and present scientific results in a variety of ways.
- **Personal competence (social competence and self-competence):** The students are able to independently grasp and work on larger topics, they are able to structure their results in written form in the master's thesis and to place them there in the scientific context. They also improve their ability to express themselves in written form in English.

Course Content
Inhalte der Lehrveranstaltungen

- Scientific methodology
- Presentation and evaluation of results
- Scientific analysis
- Preparation of a written report, poster and presentation

Teaching Material / Reading
Lehrmaterial / Literatur

APA (2020). Publication Manual of the American Psychological Association. The Official Guide to APA Style (7th Ed.) Washington.
Carlson, K. A. & Winquist, J. R. (2017). An Introduction to Statistics. An Active Learning Approach. SAGE.
Creswell, J. W. & Plano Clark, V. L. (). Designing and Conducting Mixed Methods Research (3rd. Ed.). SAGE.
Denzin, N. K. (2012). Triangulation 2.0. Journal of Mixed Methods Research, 6(2), 80–88.
Field, A. (2017). Discovering Statistics Using IBM SPSS Statistics. SAGE.
IEEE (2020). IEEE Editorial Style Manual for Authors. IEE Publishing Operations. Piscataway.
Krippendorff, K. H. (2018). Content Analysis. An Introduction to Its Methodology (4th Ed.). SAGE.

Internationality
Internationalität (Inhaltlich)

Module is offered in English.
English literature is used.

Method of Assenssment (ggf. Hinweis zu Multiple Choice - APO §9a)
Modulprüfungen

Type of examination *1) Prüfungsform	Type/scope including weighting *2) Art/Umfang inkl. Gewichtung	Learning objectives/competencies to be assessed Zu prüfende Lernziele/Kompetenzen
LPort	3-5 elements, scope per element approx. 10h	Research independently, determine state of science on own MA topic, present results as presentation/poster/paper.

*1) Please refer to the applicable overview of the forms of examination at the OTH Amberg-Weiden

*2) Please additionally provide information on the weighting (in % share) and, if applicable, also a reference to a bonus system.

Master thesis

Masterarbeit

Classification Zuordnung zum Curriculum	Module ID Modul-ID	Kind of Module Art des Moduls	Number of Credits Umfang in ECTS-Leistungspunkte
	4.3	Required module	28 ECTS

Location Ort	Language Sprache	Duratrion of Module Dauer des Moduls	Frequency of Module Vorlesungsrythmus	Max. Number of Participants Max. Teilnehmerzahl
Amberg	English	one semester	winter/summer semester	

Module Convenor Modulverantwortliche/r	Professor / Lecturer Dozent/In
Prof. Dr. Michael Wiehl	selected first and second reviewers

Prerequistes*
Voraussetzungen

At least 45 ECTS achieved (see examination regulations)

***Note: please also observe the preperquisites according to eximinations regulations law in the current version of the SPO.**

Usability Verwendbarkeit	Teaching Methods Lehrformen	Workload
Master study programmes	Tutoring	Planning: 90 h Realization: 450 h Creation of report: 300 h

Learning Outcomes
Lernziele / Qualifikationen des Moduls

After completing this module successfully, students will have the following professional, methodological and personal competences:

- **Professional competence:** familiarization with selected subject area on the basis of scientific reports
- **Methodological competence:** Students are able to work independently on a practice-relevant, definable project in a study program-related environment in a scientific manner. Students will be able to document the steps in a written document and put their activity into a scientific context.
- **Personal competence (social competence and self-competence):** Time management, self-organization, critical examination of self-determined results and works (such as software or algorithm), improvement of English writing language

Course Content
Inhalte der Lehrveranstaltungen

Depending on supervisor
Topic with AI reference

Teaching Material / Reading
Lehrmaterial / Literatur

English language and internationally available literature is set.
Scientific reports from international research teams will be researched and studied.

Internationality
Internationalität (Inhaltlich)

Module is offered in English.
Students work in international teams.
English literature is used.

Method of Assenssment (ggf. Hinweis zu Multiple Choice - APO §9a)
Modulprüfungen

Type of examination *1) Prüfungsform	Type/scope including weighting *2) Art/Umfang inkl. Gewichtung	Learning objectives/competencies to be assessed Zu prüfende Lernziele/Kompetenzen
Sem	Master's thesis according to the SPO, in detail depending on the taskmaster	Independent work, penetration of a new subject area subject area, classification in the scientific context, development context, elaboration or application of subject-specific methods and approaches

*1) Please refer to the applicable overview of the forms of examination at the OTH Amberg-Weiden

*2) Please additionally provide information on the weighting (in % share) and, if applicable, also a reference to a bonus system.

Elective modules

(Wahlpflichtmodule)

Modules from the group "Basic" (Module ID 3.3) can be selected at the beginning of the Master's program to achieve 210 ECTS or within the first semester according to SPO §5 para. 2.

Modules from the group "Advanced" (Module ID 3.4) can be selected after completing required modules within the study programme.

elective module	SWS contact time	ECTS	Rhythm
Elective modules "Basic"			
Reinforcement Learning	4	5	WiSe
Intercultural Competence	4	5	WiSe
Energy Management with AI Methods	4	5	WiSe
AI and security	4	5	WiSe
AR/VR	4	5	WiSe
AI research project	4	5	WiSe/SoSe
Practical training in industry (6 week internship)		10	WiSe/SoSe
Symbolic AI & Logic & Semantic Web	4	5	SoSe
Elective modules "Advanced"			
AI privacy and security	4	5	SoSe

WiSe = winter semester
SoSe = summer semester