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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: summer term 2024
Sommersemester 2024

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Preliminary Notes

Vorbemerkungen

- **Note:**

Please take special note of the Program and Examination Regulations of this degree program 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 – General 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
	<hr/>
	= 150 h

- **Accreditation of course achievements:**

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

- **vhb**

vhb (German: virtuelle Hochschule Bayern / English: virtual university Bavaria) is an online learning platform with online courses from 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



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 (DPLE)			4	5			4	5	
1.2	Computer vision and AI (CVAE)			4	5			4	5	
1.3	Autonomous robots (AURE)			4	5			4	5	
								0	0	
	AI basics data & language (winter)	12	15	0	0	0	0	12	15	17%
2.1	Machine Learning (MALE)	4	5					4	5	
2.2	Modern Databases and NoSQL (MDNE)	4	5					4	5	
2.3	NLP and Information retrieval (NLPE)	4	5					4	5	
								0	0	
	AI Applications (winter/summer)	12	15	8	10	0	0	20	25	28%
3.1	AI project (AIPR)	4	5					4	5	
3.2	Interdisciplinary topic (INTP)	4	5					4	5	
	Optional modules "Basic"	4	5					4	5	
	Optional modules "Advanced"			8	10			8	10	
	Scientific training (winter/summer)	0	0	4	5	2	30	6	35	39%
4.1	AI conference (AICO)			4	5			4	5	
4.2	Scientific writing (SCWR)					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



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 (DPLE)	4	5					4	5	
1.2	Computer vision and AI (CVAE)	4	5					4	5	
1.3	Autonomous robots (AURE)	4	5					4	5	
								0	0	
	AI basics data & language (winter)	0	0	12	15	0	0	12	15	17%
2.1	Machine Learning (MALE)			4	5			4	5	
2.2	Modern Databases and NoSQL (MDNE)			4	5			4	5	
2.3	NLP and Information retrieval (NLPE)			4	5			4	5	
								0	0	
	AI Applications (winter/summer)	8	10	12	15	0	0	20	25	28%
3.1	AI project (AIPR)			4	5			4	5	
3.2	Interdisciplinary topic (INTP)	4	5					4	5	
0	Optional modules "Basic"	4	5					4	5	
0	Optional modules "Advanced"			8	10			8	10	
	Scientific training (winter/summer)	4	5	0	0	2	30	6	35	39%
4.1	AI conference (AICO)	4	5					4	5	
4.2	Scientific writing (SCWR)					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



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 (DPLE)			4	5							4	5		
1.2	Computer vision and AI (CVAE)			4	5							4	5		
1.3	Autonomous robots (AURE)							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 (MALE)	4	5									4	5		
2.2	Modern Databases and NoSQL (MDNE)	4	5									4	5		
2.3	NLP and Information retrieval (NLPE)					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 (AIPR)							4	5			4	5		
3.2	Interdisciplinary topic (INTP)			4	5							4	5		
0	Optional modules "Basic"	4	5									4	5		
0	Optional modules "Advanced"					4	5	4	5			8	10		
	Scientific training (winter/summer)	0	0	0	0	4	5	2	2	0	28	6	35	39%	
4.1	AI conference (AICO)					4	5					4	5		
4.2	Scientific writing (SCWR)							2	2			2	2		
4.3	Master thesis							0	0	0	28	0	28		
												0	0		
	Total:	12	15	12	15	12	15	14	17	0	28	50	90	100%	

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



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 (DPLE)	4	5									4	5		
1.2	Computer vision and AI (CVAE)	4	5									4	5		
1.3	Autonomous robots (AURE)					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 (MALE)			4	5							4	5		
2.2	Modern Databases and NoSQL (MDNE)			4	5							4	5		
2.3	NLP and Information retrieval (NLPE)							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 (AIPR)							4	5			4	5		
3.2	Interdisciplinary topic (INTP)			4	5							4	5		
0	Optional modules "Basic"	4	5									4	5		
0	Optional modules "Advanced"					4	5	4	5			8	10		
	Scientific training (winter/summer)	0	0	0	0	4	5	0	2	2	28	6	35	39%	
4.1	AI conference (AICO)					4	5					4	5		
4.2	Scientific writing (SCWR)									2	2	2	2		
4.3	Master thesis							0	2	0	26	0	28		
												0	0		
	Total:	12	15	12	15	12	15	12	17	2	28	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
	DPLE	Required module	5 ECTS

Location Ort	Language Sprache	Duration 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. Christian Bergler			Prof. Dr. Christian Bergler	
Prerequisites* Voraussetzungen				
advanced competences in computer science and mathematics				
*Note: please also observe the prerequisites according to examinations 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 Self study: 90h

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Learning Outcomes Lernziele / Qualifikationen des Moduls
After completing this module successfully, students will have the following professional, methodological and personal competences:
<ul style="list-style-type: none"> Professional competence: Students learn and understand the functionality and basics of neural networks and deep learning methods. Methodological competence: Students can implement chosen deep learning methods based on given and existing software libraries, apply them to given data sets and select and optimize the appropriate functions and parameters. <p>Personal competence (social competence and self-competence): Students can solve complex problems in the field of deep learning on their own, while also learning from the views and approaches of others to further deepen their understanding. Overall, it helps students to learn not only how to self-organize, but also how to manage their time and exchange ideas with other colleagues, which contributes to their personal, professional, and social growth</p>
Course Content Inhalte der Lehrveranstaltungen
<ul style="list-style-type: none"> Mathematical and algorithmic foundations for deep learning Introduction to neural networks and deep learning: model function, cost and activation functions, vectorization Model training: Gradient-based methods, forward- and backward- propagation Model training: Parameter initialization, variants of the gradient-based methods, batch normalization, hyperparameter tuning, regularization techniques Convolutional Neural Networks
Teaching Material / Reading Lehrmaterial / Literatur
<ul style="list-style-type: none"> C. Bishop: Pattern Recognition and Machine Learning, Springer, 2006. F. Chollet: Deep Learning with Python, Manning, 2018. (deutsche Version bei mitp Professional, 2018) Géron: Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, O'Reilly Media, 2019 Goodfellow, Y. Bengio, A. Courville: Deep Learning, 2017, online: http://www.deeplearningbook.org T. Rashid: Make Your Own Neuronal Network, CreateSpace, 2016. (German Version: Neuronale Netze selbst programmieren: Ein verständlicher Einstieg mit Python, Oreilly, 2017) Zhang, C. Lipton, M. Li, A. Smola: Dive into Deep Learning, 2023, online: https://d2l.ai/ current research papers
Internationality Internationalität (Inhaltlich)
Module is offered in English. Students work in international teams.

English literature is used.

Method of Assessment (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
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
	CVAE	Required module	5 ECTS

Location Ort	Language Sprache	Duration 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	
Prerequisites* 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 Self study: 60 h Project work: 30 h

Learning Outcomes Lernziele / Qualifikationen des Moduls		
<p>After completing this module successfully, students will have the following professional, methodological and personal competences:</p> <ul style="list-style-type: none"> • 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		
<ul style="list-style-type: none"> • 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 Assessment (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 report	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
	AURE	Required module	5 ECTS

Location Ort	Language Sprache	Duration 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	

Prerequisites* Voraussetzungen

advanced competences in computer science and mathematics

***Note: please also observe the prerequisites according to examinations 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 Self study: 40h Project work: 50h

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):** Students can solve complex problems by their own

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 Assessment (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	Short presentation and project report (10-15 pages)	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
	MALE	Required module	5 ECTS
Location Ort	Language Sprache	Duration of Module Dauer des Moduls	Frequency of Module Vorlesungsrythmus
Amberg	English	one semester	winter semester
Module Convenor Modulverantwortliche/r		Professor / Lecturer Dozent/In	
Prof. Dr. Patrick Levi		Prof. Dr. Patrick Levi	
Prerequisites* Voraussetzungen			
advanced competences in computer science and mathematics *Note: please also observe the prerequisites according to examinations 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 Self study: 30h Project work: 50h	
Learning Outcomes Lernziele / Qualifikationen des Moduls			
After completing this module successfully, students will have the following professional, methodological and personal competences:			
<ul style="list-style-type: none"> • 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			
<ul style="list-style-type: none"> • Clarification of terms and applications of Machine Learning • Mathematical basics (e.g. gradient descent methods) • Regression and Classification (Linear Regression, Binary Classification, Multiclass Classification, Goodness Measures for the Evaluation of regression and classification models, cross validation, hyperparameter optimization, regularization) • Basic methods of supervised learning • Basic methods of unsupervised learning • Data Preprocessing • Machine Learning in Python 			
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 Assessment (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 report (10-15 pages)	Conception and prototypical implementation of a machine learning use case
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*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
	MDNE	Required module	5 ECTS

Location Ort	Language Sprache	Duration 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.	
Prerequisites* Voraussetzungen				
advanced competences in computer science and mathematics				
*Note: please also observe the prerequisites according to examinations 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 Self study: 90 h

Learning Outcomes Lernziele / Qualifikationen des Moduls		
<p>After completing this module successfully, students will have the following professional, methodological and personal competences:</p> <ul style="list-style-type: none"> • Professional competence: The students know the basics of relational database systems and can understand and compare them with other forms of data organisation. 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		
<ul style="list-style-type: none"> • Database theory and practice: data organisation, 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		
<p>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.</p> <p>Course-specific material on the Moodle learning platform.</p>		
Internationality Internationalität (Inhaltlich)		
<p>Module is offered in English. Students work in international teams. English literature is used.</p>		
Method of Assessment (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 report (10-15 pages)	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
	NLPE	Required module	5 ECTS

Location Ort	Language Sprache	Duration 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	
Prerequisites* Voraussetzungen				
advanced competences in computer science and mathematics *Note: please also observe the prerequisites according to examinations 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 Self study: 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:** 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 Assessment (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 report (10-15 pages)	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 <small>Zuordnung zum Curriculum</small>	Module ID <small>Modul-ID</small>	Kind of Module <small>Art des Moduls</small>	Number of Credits <small>Umfang in ECTS-Leistungspunkte</small>
	AIPR	Required module	5 ECTS

Location <small>Ort</small>	Language <small>Sprache</small>	Duration of Module <small>Dauer des Moduls</small>	Frequency of Module <small>Vorlesungsrythmus</small>	Max. Number of Participants <small>Max. Teilnehmerzahl</small>
Amberg	English	one semester	winter/summer semester	
Module Convenor <small>Modulverantwortliche/r</small>			Professor / Lecturer <small>Dozent/In</small>	
Prof. Dr. Christian Bergler			Prof. Dr. Christian Bergler	
Prerequisites* <small>Voraussetzungen</small>				
advanced competences in computer science and mathematics				
*Note: please also observe the prerequisites according to examinations regulations law in the current version of the SPO.				
Usability <small>Verwendbarkeit</small>		Teaching Methods <small>Lehrformen</small>		Workload
Master study programmes with focus on AI		Seminars with exercises		Contact time: 60 h Project work: 90 h

Learning Outcomes <small>Lernziele / Qualifikationen des Moduls</small>		
After completing this module successfully, students will have the following professional, methodological and personal competences:		
<ul style="list-style-type: none"> • Professional competence: The students derive and deepen professional, solid, as well as fundamental skills, with respect to an individual project-specific topic in the field of artificial intelligence. • Methodological competence: Students will learn and derive an overall understanding about the given AI-related project task, identify and internalize important underlying theoretical concepts, while the level of competence is further intensified through practical programming work. • Personal competence (social competence and self-competence): Independent project and task-specific literature research as well as downstream software implementations and integrations reflect the traditional scientific approach and lead not only to improvements regarding professional attributes, but also personal skills. 		
Course Content <small>Inhalte der Lehrveranstaltungen</small>		
The contextual parts which are covered in this course, are essentially determined and defined by the individually assigned project topics. In general, a wide range of application-related research questions and challenges are covered, all of them addressing topics in the field of artificial intelligence, such as data-related project tasks (data preparation/pre-processing/enhancement), next to the design, training and evaluation of domain- and task-specific ML/DL frameworks (computer vision-, acoustic-, and text-based research questions), in addition to software engineering topics with the development of own software, but also adaptations/extensions in terms of already existing software frameworks.		
Teaching Material / Reading <small>Lehrmaterial / Literatur</small>		
Provided and relevant literature depends on the respective project task		
Internationality <small>Internationalität (Inhaltlich)</small>		
Students work in international teams. English literature is used.		
Method of Assessment (ggf. Hinweis zu Multiple Choice - APO §9a) <small>Modulprüfungen</small>		
Type of examination *1) <small>Prüfungsform</small>	Type/scope including weighting *2) <small>Art/Umfang inkl. Gewichtung</small>	Learning objectives/competencies to be assessed <small>Zu prüfende Lernziele/Kompetenzen</small>
PrA	Presentation in the team (15 minutes), project documentation (7 pages)	Realization of an individual domain- and task-specific AI-project, including a theoretical part (literature review) and practical part (software programming).

*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
	INTP	Required module	5 ECTS

Location Ort	Language Sprache	Duration 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. Michael Wiehl			selected lecturers	
Prerequisites* 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 Self study: 90h

Learning Outcomes Lernziele / Qualifikationen des Moduls		
After completing this module successfully, students will have the following professional, methodological and personal competences:		
<ul style="list-style-type: none"> • Professional competence: Leadership, change management, decision making and organisation in teams • Methodological competence: Students are able to apply the methods 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		
<ul style="list-style-type: none"> • Organisational 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 Assessment (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
Präs	Presentation (10 minutes per student)	Self- and team organization, presentational skills

*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	Duration of Module Dauer des Moduls	Frequency of Module Vorlesungsrhythmus	Max. Number of Participants Max. Teilnehmerzahl
Amberg	English	one semester	summer semester	
Module Convenor Modulverantwortliche/r			Professor / Lecturer Dozent/In	
Prof. Dr. Christian Bergler			Prof. Dr. Christian Bergler	
Prerequisites* Voraussetzungen				
completed scientific education (e.g. Bachelor of Science)				
*Note: please also observe the prerequisites according to examinations regulations law in the current version of the SPO.				
Usability Verwendbarkeit		Teaching Methods Lehrformen		Workload
Master study programmes		Seminars		Contact time: 60 h Self study: 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 derive and deepen professional, solid, as well as fundamental skills, by investigating, summarizing, and presenting an individual, domain-, and topic-specific scientific publication in the field of artificial intelligence.
- **Methodological competence:** Students will learn and derive skills how to properly read, analyze, understand, and present domain-/task-related scientific contributions (conference and/or journal papers) in the field of artificial intelligence, through summarizing all the important and essential contextual parts as part of a scientific presentation.
- **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 Assessment (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	Report and scientific presentation (20 minutes)	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
	SCWR	Required module	2 ECTS

Location Ort	Language Sprache	Duration 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.	
Prerequisites* Voraussetzungen				
completed scientific education (e.g. Bachelor of Science)				
*Note: please also observe the prerequisites according to examinations 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: 15 h Self study: 15 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 Assessment (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
Präs	Scientific presentation 15 minutes	Quality of slides and presentation quality and style of writing, style of citation

*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
	MSCT	Required module	28 ECTS

Location Ort	Language Sprache	Duration 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	
Prerequisites* 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				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:		
<ul style="list-style-type: none"> • 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-organisation, 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 Assesment (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
Master thesis	Master's thesis according to the SPO	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)

Available electives are listed here. All modules can be taken as "Advanced" or "Basic" module.

Elective module	SWS contact time	ECTS	Rhythm
Deep Reinforcement Learning	4	5	WiSe
Selected Topics in AR/VR	4	5	WiSe
Energy Management with AI Methods	4	5	WiSe
Advanced Topics in Machine Learning	4	5	WiSe
Symbolic AI & Rule Based Agents	4	5	SoSe
AI Security and Privacy	4	5	SoSe
Embedded Intelligence	4	5	SoSe

WiSe = winter semester

SoSe = summer semester