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Ostbayerische Technische Hochschule
Amberg-Weiden

Course Catalogue

Modulhandbuch

Artificial Intelligence for Industrial Applications

Künstliche Intelligenz für industrielle Anwendungen

Master of Science (M.Sc.)

Master of Science (M.Sc.)

Table of content

Inhaltsverzeichnis

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

Change History

Änderungshistorie

03.05.2024	Creation of document
19.12.2024	Updated Elective section
10.12.2025	Removed elective section, updated for new SPO
19.05.2026	Small changes

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	8	10	0	0	**8**	**10**	**11%**
1.1	Deep Learning (DPLE)			4	5			**4**	**5**	
1.2	Computer vision and AI (CVAE)			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 module(s)	4	5	8	10			**12**	**15**	
								0	**0**	
	Scientific training (winter/summer)	0	0	8	10	0	30	**8**	**40**	**44%**
4.1	AI conference (AICO)			4	5			**4**	**5**	
4.2	Scientific Research and Methods (SRM)			4	5			**4**	**5**	
4.3	Master thesis					0	30	**0**	**30**	
								0	**0**	
	Total:	24	30	24	30	0	30	**48**	**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)	8	10	0	0	0	0	**8**	**10**	**11%**
1.1	Deep Learning (DPLE)	4	5					**4**	**5**	
1.2	Computer vision and AI (CVAE)	4	5					**4**	**5**	
								0	**0**	
								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**	
	Optional module(s)	8	10	4	5			**12**	**15**	
								0	**0**	
	Scientific training (winter/summer)	8	10	0	0	0	30	**8**	**40**	**44%**
4.1	AI conference (AICO)	4	5					**4**	**5**	
4.2	Scientific Research and Methods (SRM)	4	5					**4**	**5**	
4.3	Master thesis					0	30	**0**	**30**	
								0	**0**	
	Total:	24	30	24	30	0	30	**48**	**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	0	0	0	0	**8**	**10**	**11%**
1.1	Deep Learning (DPLE)			4	5							**4**	**5**	
1.2	Computer vision and AI (CVAE)			4	5							**4**	**5**	
												0	**0**	
												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 module(s)	4	5			4	5	4	5			**12**	**15**	
0	0											**0**	**0**	
	Scientific training (winter/summer)	0	0	0	0	4	5	4	5	0	30	**8**	**40**	**44%**
4.1	AI conference (AICO)					4	5					**4**	**5**	
4.2	Scientific Research and Methods (SRM)							4	5			**4**	**5**	
4.3	Master thesis							0	0	0	30	**0**	**30**	
												0	**0**	
	Total:	12	15	12	15	12	15	12	15	0	30	**48**	**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	0	0	0	0	0	0	**8**	**10**	**11%**
1.1	Deep Learning (DPLE)	4	5									**4**	**5**	
1.2	Computer vision and AI (CVAE)	4	5									**4**	**5**	
												0	**0**	
												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**	
	Optional module(s)	4	5			4	5	4	5			**12**	**15**	
												0	**0**	
	Scientific training (winter/summer)	0	0	0	0	8	10	0	0	0	30	**8**	**40**	**44%**
4.1	AI conference (AICO)					4	5					**4**	**5**	
4.2	Scientific Research and Methods (SRM)					4	5					**4**	**5**	
4.3	Master thesis									0	30	**0**	**30**	
												0	**0**	
	Total:	12	15	12	15	12	15	12	15	0	30	**48**	**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

Prerequistes*
Voraussetzungen

- Programming skills in an object-oriented programming language (Python, Java, C++)
- Knowledge of linear algebra, multivariate calculus, and probability/statistics
- Preferably, familiarity with concepts and methods of classical machine learning (e.g., KNN, decision trees, linear regression, ensemble methods)
- Preferably, theoretical and practical knowledge of methodological steps in developing machine learning workflows (e.g., data preprocessing, feature engineering, feature selection, model selection, model training, model evaluation, model deployment, hyperparameter optimization, etc.)

***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

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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:

- **Professional Competence:**
  Students understand typical use cases for deploying Deep Learning in various application contexts and can distinguish Deep Learning from classical Machine Learning. Based on the expertise and practical skills they have acquired, they can assess for which application scenarios the use of Deep Learning is appropriate. They are familiar with common architectural types of artificial neural networks and have gained solid theoretical and practical knowledge of how they function. On this basis, they are able to classify and compare different model approaches and critically evaluate the results achieved with them. Furthermore, they are familiar with the challenges associated with their use, know various solution strategies, can select and implement them in practice, and measure their effectiveness.

- **Methodological Competence:**
  Students can select an appropriate deep learning architecture for given application scenarios, parameterize it, and implement it programmatically in an efficient and effective manner using software libraries. They are able to analyze the results, interpret them critically, and based on their theoretical understanding of how neural networks function appropriately adapt, extend, and optimize the methods used.

- **Personal Competence (Social Competence and Self-Competence):** Students are able to continuously expand their expertise in the field of deep learning by engaging with current scientific literature and to remain up to date in this dynamic area of research. They can communicate subject-specific positions and solutions to problems in dialogue with experts and defend them using sound arguments.

Course Content
Inhalte der Lehrveranstaltungen

- Chapter 1: Mathematical and Algorithmic Foundations for Deep Learning
- Chapter 2: Introduction to Neural Networks and Deep Learning: Model Function, Cost and Activation Functions, Vectorization
- Chapter 3: Model Training Part 1: Gradient Methods, Forward and Backpropagation
- Chapter 4: Model Training Part 2: Parameter Initialization, Variants of Gradient Methods, Batch Normalization, Hyperparameter Tuning, Regularization Techniques
- Chapter 5: Convolutional Neural Networks
  Chapter 6: Other Selected Architectures (e.g., Autoencoders, RNNs)

Teaching Material / Reading
Lehrmaterial / Literatur

C. Bishop: Pattern Recognition and Machine Learning, Springer, 2006.
F. Chollet: Deep Learning with Python, Manning, 2018. (deutsche Version bei mitp Professional, 2018)
A. Géron: Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFow, O'Reilly Media, 2019
I. Goodfellow, Y. Bengio, A. Courville: Deep Learning, 2017. Online: http://www.deeplearningbook.org
J.D. Prince: Understanding Deep Learning, The MIT Press, 2023. Online: https://udlbook.github.io/udlbook/
T. Rashid: Make Your Own Neuronal Network, CreateSpace, 2016.
A. Zhang, C. Lipton, M. Li, A. Smola: Dive into Deep Learning, 2023. Online: https://d2l.ai/

Foundational and current conference papers/preprints (to be specified in the course).

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Internationality
Internationalität (Inhaltlich)

Slides, Literature and Presentation in English

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
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

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 Self study: 60 h Project work: 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)
- Self-Attention and Vision Transformers
- Object Recognition with CNN & Transformers
- Image Classification & Segmentation with CNNs and Transformers
- Foundation models, Multimodal models, Self-supervised learning, contrastive learning

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	Project course work including project design and implementation (20%), documentation (10%) and presentation (70%). Every part must be passed to pass the course.	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.

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	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: 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:

- **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

- 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 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
Exam	Written exam, 90 minutes	Understand mathematical basics of machine learning, machine learning methods, data processing, analyze given problems and show possible solutions and be able to show solutions, apply basic methods/functions

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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
Prof. Dr. Gerald Pirkl	Prof. Dr. Gerald Pirkl

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 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 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

- 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

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

Prüfungsform		
ModA	Three Assignments during Semester	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.

Natural Language Processing 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

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 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 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		
ModA	Two written exercises during the semester (45 min. each)	Understand the basics of NLP methods, analyze given problems and show possible solutions.

*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
	AIPR	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. Christian Bergler	Prof. Dr. Christian Bergler

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 Project work: 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, 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
Inhalte der Lehrveranstaltungen

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 prepraration/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 adaptions/extensions in terms of already existing software frameworks.

Teaching Material / Reading
Lehrmaterial / Literatur

Provided and relevant literature depends on the respective project task

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 (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

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 Self study: 90h

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 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

- 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 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
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 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

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 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 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	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 Research and Methods

Wissenschaftliches Schreiben

Classification Zuordnung zum Curriculum	Module ID Modul-ID	Kind of Module Art des Moduls	Number of Credits Umfang in ECTS-Leistungspunkte
	SRM	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 or summer semester	

Module Convenor Modulverantwortliche/r	Professor / Lecturer Dozent/In
Prof. Dr. Christian Roth	Prof. Dr. Christian Roth

Prerequistes*
Voraussetzungen

completed scientific education (e.g. Bachelor of Science)
basic mathematic (stochastics, analytics)

***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	Seminar	Lecture: 60h Self-study, Preparation and follow-up, Examination preparation: 90h Total: 150 h

Learning Outcomes
Lernziele / Qualifikationen des Moduls

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

- The students know the basics of scientific research and apply them to their own delimited projects.
- They work out a research problem and formulate research questions and hypotheses.
- They differentiate possibilities of data collection and choose suitable methods depending on the research objective.
- The students use basic methods of data analysis and evaluation for qualitative and quantitative data.
- The students distinguish between qualitative and quantitative research and understand the possibilities of increasing the gain of knowledge through mixed methods and triangulation.
- They understand quality criteria of research and assess the quality of different methodological approaches criteria-based and based on theory.
- They collaboratively design small research projects and apply concrete methods of data collection exemplarily.
- The students formulate essential aspects of their approach in an "extended abstract" and present the essential contents by means of a scientific poster.

Course Content
Inhalte der Lehrveranstaltungen

The content of the course comprises research logic processes that are addressed across disciplines. Further emphasis is on quantitative and qualitative empirical methods. In addition, the focus is on the application in research. In the sense of research-based learning, students become familiar with the research logic of empirical investigations as well as with methods of data collection and data analysis. Technical tools for data analysis for both qualitative and quantitative research are addressed.

The contents of the course can be taught in presence and/or in virtual form.

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	Type/scope including weighting *2)	Learning objectives/competencies to be assessed

examination [*1)] Prüfungsform	Art/Umfang inkl. Gewichtung	Zu prüfende Lernziele/Kompetenzen
ModA	Project work / 100%	Professional competence, methodological competence, social and personal competence

[*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	30 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

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		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-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 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
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.