Course Descriptions International Computer Science

Summer Semester 2026

12 February 2026

German (different course levels)

Course title	see schedule Language Centre
ECTS	4
Course type	Seminar
SWS	4
Semester	Winter and summer
Workload in hours	60 hrs
Assessment method	Written examination, 90 min.
Language of instruction	German

Please find here the course descriptions for German language courses at all course levels:
https://th-deg.de/en/students/language-electives#german

English in Technical Contexts B2

Course title	English in Technical Contexts B2
ECTS	2
Course type	Language training course
SWS	2
Semester	Winter and summer
Course level	B2 • Can understand the main ideas of complex text on both concrete and abstract topics, including technical discussions in his/her field of specialization • Can interact with a degree of fluency and spontaneity that makes regular interaction with native speakers quite possible without strain for either party • Can produce clear, detailed text on a wide range of subjects and explain a viewpoint on a topical issue giving the advantages and disadvantages of various options
Lecturer	Neal O'Donoghue, MA
Course objectives	This course aims to deepen students' encounter with the English language in a technical context by giving practical training in specialized vocabulary, grammar and language usage. The four cardinal language skills – listening, speaking, reading, and writing – will play an integral role in this training. The course is designed to be relevant and interesting for engineering students and will be adapted to their learning needs and study areas.

	By the end of the course, participants should have a more comprehensive understanding of, and enhanced fluency in, the English language in an engineering context.
Course contents	*Obligatory topics (60 %):* • Numbers and mathematical operations • Shapes and dimensions • August 2017 • Basic physics and the scientific worldview • Materials and their properties • Case study on an area related to technology • /physics/engineering • Grammar/ communication skills *Variable content (40 %):* Variable content will be determined on the basis of a student survey conducted in the first session. Current world events (including news events and popular culture) and recent technological innovations may be used as a basis for discussions.
Teaching methods	Teaching methods focus on improving the four cardinal language skills and include group discussions and group projects; individual work; mini-presentations; role-plays; close reading and listening activities; dictation; grammar games; and various follow-up viewing and writing activities. Work not completed in class should be done at home. Self-study assignments will be set on a weekly basis.
Assessment method	Written exam (60 min) No dictionaries are allowed. Exam structure: • Part 1: Listening comprehension(s) • Part 2: Reading comprehension(s)

	• Part 3: Vocabulary and technical content • Part 4: Grammar (maximum 10% of total exam points, excluding writing exercise) • Part 5: Writing composition (150-200 words) The exam will be based on topics covered during the semester. The exam will be based on topics covered during the semester.
Recommended Literature	Astley, Peter, and Lewis Lansford. Engineering 1: Student's Book. Oxford: Oxford UP, 2013. Print. Bauer, Hans-Jürgen. English for Technical Purposes. Berlin: Cornelsen, 2000. Print. Bonamy, David. Technical English 4. Harlow, England: Pearson Education, 2011. Print. Bonamy, David, and Christopher Jacques. Technical English 3. Harlow: Pearson Longman, 2011. Print. Brieger, Nick, and Alison Pohl. Technical English: Vocabulary and Grammar. Oxford: Summertown, 2002. Print. Dummett, Paul. Energy English: For the Gas and Electricity Industries. Hampshire: Heinle, Cengage Learning, 2010. Print. Dunn, Marian, David Howey, and Amanda Ilic. English for Mechanical Engineering in Higher Education Studies Coursebook. Reading: Garnet Education, 2010. Print. engine: Englisch für Ingenieure. <www.engine-magazin.de> (Darmstadt). Various issues. Print. Foley, Mark, and Diane Hall. MyGrammarLab. Harlow: Pearson, 2012. Print. Glendinning, Eric H., and Norman Glendinning. Oxford English for Electrical and Mechanical Engineering. Oxford: Oxford UP, 1995. Print.

	Glendinning, Eric H., and Alison Pohl. Technology 2. Oxford: Oxford UP, 2008. Print. Heidenreich, Sharon. English for Architects and Civil Engineers. Wiesbaden: Vieweg + Teubner Verlag, 2008. Print. Ibbotson, Mark. Cambridge English for Engineering. Cambridge: Cambridge UP, 2008. Print. Ibbotson, Mark. Professional English in Use. Engineering: Technical English for Professionals. Cambridge: Cambridge UP, 2009. Print. Markner-Jäger, Brigitte. Technical English: Civil Engineering and Construction. Haan-Gruiten: Verl. Europa-Lehrmittel, 2013. Print. Murphy, Raymond. English Grammar in Use. Cambridge: Cambridge UP, 2004. Print. Schäfer, Wolfgang. Construction Milestones: Englisch Für Bau-, Holz- Und Anlagenberufe. Stuttgart: Klett, 2013. Print. Wagner, Georg, and Maureen Lloyd. Zörner. Technical Grammar and Vocabulary: A Practice Book for Foreign Students. Berlin: Cornelsen, 1998. Print.
Language of instruction	English
Prerequisites	B1 / Abitur (A-levels/ school leaving certificate giving right of entry to higher education) / 7-9 years of English

Intercultural Training for Germany and Bavaria

Course title	Intercultural Training for Germany and Bavaria
ECTS	1
Course type	Elective
SWS	1
Semester	Winter and summer
Workload in hours	30 hours
Name of Instructor	Lisa Werner
Course objectives	Participants get an understanding of the different theories of "culture" and learn about stereotypes and traditions in Bavaria. Furthermore, the participants get information on Germany and Bavaria as well as the Deggendorf Institute of Technology.
Course contents	I. Culture (theroies) II. Customs and Rituals in Germany/Bavaria III. Information on Germany and Bavaria and the DIT IV. Quiz and Presentation V. Culture Shock
Recommended literature	Bolten J. und Ehrhardt C., Interkulturelle Kommunikation, Verlag Wissenschaft & Praxis 2003; Bolten J, Einführung in die interkulturelle Wirtschaftskommunikation, Vandenhoeck & Ruprecht 2007
Teaching methods	The course is organized according to four pillars:

	1. Culture 2. Customs and Rituals 3. Information on Germany/Bavaria 4. Culture Shock Whereas hard facts are taught in a classical lecture style, students will do lots of role-plays, critical incidents, short movies and do a quiz.
Assessment method	Paper
Language of instruction	English/German
Prerequisites	None

Business and Society in China & Emerging Asia

Course title	Business and Society in China & Emerging Asia
ECTS	2
Course type	Elective
SWS	2
Semester	Summer
Workload in hours	Total: 60 / In-class: 30 / Self-study: 30
Lecturer	Prof. Dr. Wei Manske-Wang
Course objectives	• Awareness of foreign cultures and understanding their causes • Think out of the box and establish global horizons • Preparing for the challenges of future professional life in a global environment • Doing business in China/Asia successfully requires a holistic view on China/Asia and a thorough understanding how business is done there! This course aims at providing students with the necessary knowledge about contextual determinants of business practice (culture, politics, economy, society, history) and introduces exemplary reference cases.
Course contents	• The historical roots of China: What are structural legacies of the past? How do Chinese perceptions of history influence the present society? • The institutional setting of the Chinese economy: What are the main actors in the Chinese economy (state-owned enterprises, private-owned businesses)?

- The political system and its ramifications in the domain of economic policy and business: What is the role of the Communist Party? What are the principal decision makers on different levels of government? How does this affect central aspects of business environment such as corporate governance?
- What is behind Chinese long-term strategy "Belt and road initiative"?
- Culture and societal values: China represents an amazing mix of global metropolitan life and a resurgence of tradition, deeply enmeshed in her high-speed urbanization process that continue shaping the country in the last decades.
- What do you know about Chinese philosophies in the past? What do you know about Chinese values today?
- What are implications for business, such as regarding consumer demand of young generation?
- Behavioural aspects of business practice: The Chinese are famous for networking. We look at the 'Chinese way' in establishing social relations in the business domain. Further, we explore Chinese organizational behaviour in companies.
- What are 'mega-trends' of the future affecting the outlook for Chinese business? We touch on issues such as demographic change, looming environmental crises, digitalization and the question of political stability.
- Institutions and strategic arrangements in Asia: ASEAN, APEC, BRICS, BRI, RCEP etc.
- More countries in Asia: Japan, India, Vietnam, Indonesia etc.
- Is an Asian Century dawning?

Recommended literature	Hofstede, G.; Hofstede G.J. (2009): Lokales Denken, globales Handeln: Interkulturelle Zusammenarbeit und globales Management. 4. Auflage. München: Deutscher Taschenbuch Verlag Thomas, A.; Kammhuber S.; Schroll-Machl, S. (Hg.) (2007): Handbuch Interkulturelle Kommunikation und Kooperation Band 2: Länder, Kulturen und interkulturelle Berufstätigkeit. 2. Auflage. Göttingen: Vandenhoeck & Ruprecht
Teaching methods	Lecture, Press Monitoring, Case Studies, Discussions, Group Work, Q&A
Assessment method	Group works – Written Assignment (50%) & Final Presentation (50%)
Language of instruction	English

Social Responsibility and Initiative in a University Context

Course title	Social Responsibility and Initiative in a University Context
Course ID	344
ECTS	2
Course type	Elective
SWS	2
Semester	Winter and summer
Lecturer	Matthias Koeppen
Course objectives	Students who take an active role in university association, committee, or similar, or assume social responsibility within the university context can earn ECTS points for their outstanding contributions. Developing a deeper understanding of the importance of social engagement and responsibility in society, particularly in the university environment. Acquisition of practical skills in organising and implementing projects within student associations, committees, etc. Personal development through the promotion of responsibility, teamwork, communication, and leadership skills via active participation in association activities, meetings, committees, etc. Reflection on personal and professional development through engagement during studies and the application of theoretical concepts in practice.

Course contents	Students explore the topic of social responsibility and engagement within the university context. The course offers a unique opportunity to gain practical experience through active participation in student associations, committees, etc., and to achieve outstanding accomplishments, which will be rewarded with ECTS points. • Introduction to the concepts of social responsibility and civic engagement. • Analysis of successful projects and initiatives both within and beyond the university walls. • Planning and implementation of individual projects within the university context. • - Regular reflection and discussion of experiences and their significance for personal and professional development.
Recommended literature	Bierhoff, H.-W., & Rohmann, E. (2020). Soziale Verantwortung im Organisationskontext. In A. Seibert-Fohr (Hrsg.), Springer VS. Hochschulrecht – Satzungen und Verordnungen der THD (zu finden auf der Webseite der THD: https://th-deg.de/de/studierende/antraege-und-organisatorisches#hochschulrecht) Genenger-Stricker, M. (Hrsg.). (2019). Hochschule und soziale Heterogenität: Anforderungen und Impulse für eine diversitätssensible und -gerechte Hochschulentwicklung. Springer VS. Hans-Böckler-Stiftung. (2009). Hochschule in gesellschaftlicher Verantwortung: Unser Vorschlag für das Leitbild Demokratische und Soziale Hochschule. Hans-Böckler-Stiftung. Springer, C., & Struß, B. (2018). Hochschule mit Verantwortung: Engagementförderung durch universitäre Lehre. Newsletter des Bundesnetzwerks Bürgerschaftliches Engagement (BBE), Nr. 15, 26. Juli 2018.

Teaching methods	Projects, group work, active involvement
Assessment method	Written assignment (German or English)
Language of instruction	English
Prerequisites	For further information, please get in contact with the International Office.

AI Project

Course title	AI Project
ECTS	5
Course type	Project
SWS	2
Semester	Summer
Workload in hours	150 hours
Lecturer	Prof. Dr. Patrick Glauner
Course objectives	The aim of this class is to provide students with hands-on and real-world AI development experience. They will have the opportunity to work on real data sets in order to solve real-world problems. As these projects are completed in groups, students will also have the opportunity to use professional software development tools for collaboration.
Course contents	• Implementing high-tech projects in the fields of artificial intelligence, machine learning, computer vision, natural language processing and others. • Projects can be chosen for example from Kaggle, from other sources or be done in collaboration with an industrial partner. • Using modern high-end hardware, such as GPU clusters and cloud services. • Utilizing an agile process framework such as Scrum. • Understanding and using modern industrial software development tools such as work package trackers, code revision systems, debuggers, profilers and others.

	• Presenting R&D outcomes to stakeholders at different levels, such as fellow students, faculty members, practitioners and executives.
Recommended literature	1. S. Chacon and B. Straub, "Pro Git", Apress, second edition, 2014. 2. I. Goodfellow, Y. Bengio and A. Courville, "Deep Learning", MIT Press, 2016. 3. C. Larman, "Applying UML and Patterns: An Introduction to Object-Oriented Analysis and Design and Iterative Development", Prentice Hall, third edition, 2004.
Teaching methods	Project
Assessment method	Project
Language of instruction	English
Prerequisite	Foundations of AI and machine learning

Algorithms and Data Structures

Course title	Algorithms and Data Structures
ECTS	5
Course type	Lecture and lab
SWS	4
Semester	Summer
Workload in hours	150 hours
Lecturer	Prof. Dr. Patrick Glauner
Course objectives	The aim of this class is to provide an introduction to one of the most important foundations of a computer science degree: algorithms and data structures. A data structure enables a programmer to structure data into conceptually manageable relationships. An algorithm is a finite sequence of well-defined, computer-implementable instructions to solve a class of problems or to perform a computation. Algorithms often operate on data structures. This course provides a journey through computer science. Students will acquire a solid foundation in how the most important algorithms and data structures work. They will also learn how to design efficient algorithms and data structures.
Course contents	• Introduction: algorithm definition, classification of algorithms • Graphs: graph definitions, applications in computer science, shortest path, lowest cost, A* • Complexity analysis: time complexity, O, Omega, Theta, o and O tilde notations, space complexity

	• Lists: arrays, dynamic arrays/lists, amortization, fundamental operations, stacks, queues, linked lists • Recursion: search, divide and conquer, recurrence relations, master theorem, backtracking, dynamic programming • Sorting: bubble sort, selection sort, insertion sort, merge sort, quicksort, lower bounds • Trees: binary trees, traversing, advanced types of trees, decision trees Maps and hash tables: key-value stores, hashing, collision handling • Selected algorithms: fast matrix multiplication, random number generation, fast inverse square root, prime numbers, Bloom filter, union-find, median of medians, string matching • Quantum computing: qubits, quantum logic gates, quantum computers, quantum algorithms
Recommended literature	1. M. Goodrich et al., "Data Structures and Algorithms in Python", John Wiley & Sons, 2013. 2. R. Sedgewick, "Algorithms", Addison Wesley, fourth edition, 2011. 3. M. Sipser, "Introduction to the Theory of Computation", Cengage Learning, third edition, 2012.
Teaching methods	Lecture and lab
Assessment method	Written examination 90 min.
Language of instruction	English
Prerequisite	Programming foundations

Computer Vision

Course title	Computer Vision
ECTS	5
Course type	Lecture and lab
SWS	4
Semester	Summer
Workload in hours	150 hours
Lecturer	Prof. Dr. Patrick Glauner
Course objectives	The aim of this class is to discuss Computer Vision (CV), which allows computers to process visual inputs. We deal every day dozens of times with CV, such as facial recognition, real-time translating camera input or auto-tagging friends in photos. Modern CV algorithms are strongly based on machine learning methods, in particular deep neural networks. Students will acquire knowledge in CV and be able to elaborate it further in the future, for example in projects or further studies. Overall, CV is a cutting-edge field, with many high-pay opportunities for graduates.
Course contents	• Introduction: applications, computational models for vision, perception and prior knowledge, levels of vision, how humans see • Pixels and filters: digital cameras, image representations, noise, filters, edge detection • Regions of images: segmentation, perceptual grouping, Gestalt theory, segmentation approaches, image compression

	• Feature detection: RANSAC, Hough transform, Harris corner detector • Object recognition: challenges, template matching, histograms, machine learning • Convolutional neural networks: neural networks, loss functions and optimization, backpropagation, convolutions and pooling, hyperparameters, AutoML, efficient training, selected architectures • Image sequence processing: motion, tracking image sequences, Kalman filter, correspondence problem, optical flow • Foundations of mobile robotics: robot motion, sensors, probabilistic robotics, particle filters, SLAM • Outreach: 3D vision, generative adversarial networks, self-supervised learning
Recommended literature	1. R. C. Gonzalez and R. Woods, "Digital Image Processing", Pearson, 3rd edition, 2018. 2. I. Goodfellow, Y. Bengio and A. Courville, "Deep Learning", MIT Press, 2016.
Teaching methods	Lecture and lab
Assessment method	Project
Language of instruction	English
Prerequisite	Programming foundations, multivariate calculus

Deep Learning/Big Data

Course title	Deep Learning/Big Data
ECTS	5
Course type	Lecture and seminar
SWS	4
Semester	Summer
Workload in hours	150 hours
Lecturer	Prof. Dr. rer. nat. Isabel Hübener
Course objectives	The aim of this class is to provide students with an introduction to the fields of deep learning and big data. Students will acquire a solid foundation in how to design and implement big data systems and how to use big data sets for training deep learning models. They will also learn hands-on how to use industrial tools for deep learning and big data. Furthermore, they will understand the limitations of big data-driven approaches and how they can recognize and solve typical issues in big data, such as data quality and biases. As an outcome, they will be able to work on real-world problems that not only require knowledge in AI, but also an expertise in how to use infrastructures, frameworks, libraries and tools for deep learning and big data. Specifically, students will have achieved the following learning outcomes upon completion of the module: Subject competency Students will understand the concepts of the most common methods in big data and deep learning. (2 - Understanding)

	Students understand all the components of a feed-forward network (2 - Understand) and can implement them in Python. (3 - Apply) Methodological competency Students will have the ability to develop high-quality programs using big data and deep learning technologies. (3 - Apply) Students are able to compare different architectures of neural networks (4 - Analyze) and decide which architecture is suitable for a problem. (5 - Evaluate) Personal competency Students will be able to implement their own algorithms and defend them against competing approaches. (6 - Create) Social competency Programming exercises take place as part of the course. Students are thus able to understand, critique, and complement programs of other students. (5 - Assess)
Course contents	Deep Learning part: • Feed-forward neural networks • Tensorflow • Convolutional neural networks • Recurrent neural networks • Sequence-to-sequence learning • Deep reinforcement learning • Unsupervised neural network models Big Data part: • Introduction: 3 Vs, history of big data, selected big data use cases • Parallelism: parallelism and concurrency, creating threads, global interpreter lock (GIL) • Big data architectures: distributed systems, MapReduce, CAP theorem, speedup through GPUs and FPGAs

	• Big data, small data, all data: data quality, biases in data sets, small sample size problems • Uncertainty in learning: confidence intervals and statistical tests, Gaussian processes, conformal prediction, model calibration • MLOps: project lifecycle, challenges, operations, principal components, pipelines, best practices • Big data for NLP: embeddings, recent advances in NLP, transformers • Quantum computing: qubits, quantum logic gates, quantum computers, quantum algorithms • Selected big data infrastructures, frameworks, libraries and tools
Recommended literature	• E. Charniak, "Introduction to Deep Learning", MIT Press, 2018. • F. Chollet, "Deep learning with Python", Simon and Schuster, 2021. • H. Kinsley and D. Kukieła, "Neural Networks from Scratch in Python", NNFS.io, 2020. • C. Bishop and H. Bishop, "Deep Learning: Foundations and Concepts", Springer, 2024. • Petrov, "Database Internals: A Deep Dive into How Distributed Data Systems Work", O'Reilly Media, 2019. • E. Raj, "Engineering MLOps: Rapidly build, test, and manage production-ready machine learning life cycles at scale", Packt, 2021. • S. Sakr and A. Zomaya (Eds.), "Encyclopedia of Big Data Technologies", Springer, 2019.
Teaching methods	Lectures Seminars Discussion of research papers and recent news Coursework and case studies, including laboratory problems
Assessment method	Paper

Language of instruction	English
Prerequisite	Foundations of AI programming, mathematics

Datacenter Network Programming

Course title	Datacenter Network Programming
ECTS	5
Course type	Lecture + Lab + Project
SWS	4
Course level	Postgraduate
Semester	Summer
Workload in hours	Total: 150 / In-class: 60 / Self-study: 90
Lecturer	Prof. Dr. Andreas Kassler
Course objectives	Students acquire understanding and hands-on experience of how the data plane of modern datacenter networking equipment can be programmed using the high-level and popular programming language P4 (see http://p4.org). They learn the basic concepts of the P4 language and understand, how offloading simple computational tasks to the data plane of programmable networking devices (such as datacenter routers or network cards) can be used to speed up the performance of Deep Learning, Big Data Analytics use-cases within modern datacenters. They understand, how the data plane can be used to accelerate distributed high-performance computing (HPC) building blocks including distributed key-value stores, where load-balancing and network monitoring of the datacenter networking fabric is important for achieving high speed and low latency. They setup their own development environment in the network emulator Mininet and implement simple data plane programs in the P4 language. They know how to use P4 to parse packet

	headers, apply different actions and modify packets before forwarding them. They know basic P4 constructs, how to store stateful information (e.g. parts of a neural network) and how to perform simple computational tasks in the data plane. Based on this knowledge and understanding, students implement a small-scale project in a team. They use their acquired knowledge on P4 and programmable datacenter networking. They evaluate the results of other project groups and get evaluated by other groups. For this project work, they have used standard tools (Mininet, P4 toolchain, command line interface) for programming the data plane of an (emulated) datacenter router. After finishing this module, students can design, implement and evaluate their own P4 programs using the network emulator Mininet.
Course contents	The Course is decomposed into two parts: Part I: "Introduction to Datacenter Network Programming" and Part II "Project in Datacenter Network Programming" Content Part I: (1) Introduction to Programming the Data Plane of a Datacenter networking device: - Difference between Data and Control Plane - Introduction to P4 language - P4 programming model - Compiling and deploying P4 programs - P4 Targets: Behavioral Model (BMv2), Programmable Switching ASIC Intel Tofino, Mellanox Bluefield DPU, Netronome SmartNIC - Basic P4 concepts: header parsing, applying tables and actions, header rewriting. - Workshop: Setup Development environment with Mininet and Command Line Interface (CLI), implement, test and debug simple P4 language constructs and programs using the Mininet network emulator (2) Datacenter Networking and Load Balancing:

	- Datacenter networking fundamentals, routing and forwarding within the datacenter networking fabric - Workshop: Advanced P4 concepts: stateful information, register arrays, counters and meters. - Loadbalancing in Datacenter networks, Equal Cost Multipath Routing, Conga, Hula - Workshop: Implementing ECMP in P4 (3) In Network support for Monitoring and Caching: - Active and passive network monitoring - Inband Network Telemetry (INT) for fine-granular network monitoring - Accelerating Distributed Key-value stores in the data plane of the data center - Using telemetry for fine-grained loadbalancing - Workshop: Implementing Hula and INT in P4 (4) In Network support for Distributed Machine Learning: - Role of the datacenter network for distributed training and inference - In network support for Distributed Machine Learning Inference for in-switch traffic classification - Mapping trained machine learning models (decision trees, SVMs, neural networks) to programmable data plane devices - In network support for distributed training within a datacenter network Content Part II: Project: Implementation of your own small dataplane program in P4 and testing it in the Mininet network emulator.
Recommended literature	Recommended Literature will be provided at the start of the course by a set of research and practical oriented articles that are available online.
Teaching methods	Lecture with exercises and Labs followed by a small scale project

Assessment method	Written examination, 90 min.
Language of instruction	English
Prerequisites	Students should have basic understanding of Network Technologies and/or Communication Networks. Basic knowledge of Programming and basic knowledge in Python helps in the Project Part of the course.

Applications of Artificial Intelligence and Machine Learning for Wireless Networks

Course title	Applications of Artificial Intelligence and Machine Learning for Wireless Networks
ECTS	5
Course type	Lecture
SWS	4
Semester	Summer
Workload in hours	Total: 150
Lecturer	Prof. Dr. Andreas Kassler
Course objectives	Upon completion of the course, students should be able to: - explain the principles and limitations of wireless communication, - explain important technical aspects of current wireless communication systems, - compare and contrast different wireless communication systems based on an understanding of shared challenges (such as mobility management), - understand what are the different ML use cases in different layers of the protocol stack from the physical layer to the application layer - perform a literature review on the application of machine learning in wireless networks.
Course contents	The course is separated into two parts. The first part gives an introduction to the principles of mobile and wireless, including the function and operation of modern mobile and wireless communication systems and networks related to architecture, protocol, security, and algorithms. Current wireless systems, such as cellular systems (2G, 3G, 4G, 5G) and

mobile Internet, including the WLAN standard IEEE 802.11, are used as examples to explain these principles. The set of introductory lectures cover the following:
- Radio signals
- Coding, modulation, and multiplexing
- Medium access
- The basic principles of cellular systems (e.g. 2G, 3G, 4G, 5G) and wireless networks including WLAN (e.g. WiFi) and WPAN (e.g. Bluetooth)

In the second part, the students perform an individual literature review on the application of machine learning in wireless networks on a relevant topic. The steps to accomplish the literature review project are as follows:

A. Select a topic relevant to the application of ML in wireless networks and register it by email
B. Search for the relevant papers and make a list of papers
C. Study the papers and prepare a summary
D. Present the outcomes in a seminar style presentation (between 30 and 45 minutes)

Each student should present her/his research study in an intermediate and a final presentation. A summary paper should be written following the survey papers guideline using IEEE format.

Exemplary topics can be:
- ML use cases in physical layer of cellular networks
- ML use cases in MAC of cellular networks
- ML use cases in higher layer of cellular networks
- ML use cases in vehicular networks, 5G-V2X
- Intelligent wireless networks
- Cognitive radio networks
- ML use case in wireless networks
- Standardization activities on AI-enabled wireless networks
- ML use-cases for network slicing
- ML use-cases for OpenRAN
- ML use-cases for Software-Defined Networks

Recommended literature	Dahlman, Erik, Stefan Parkvall, and Johan Skold. 5G NR: The next generation wireless access technology. Academic Press, 2020. Sun, Yaohua, et al. "Application of machine learning in wireless networks: Key techniques and open issues." IEEE Communications Surveys & Tutorials 21.4 (2019): 3072-3108. Harounabadi, Mehdi, et al. "V2X in 3GPP Standardization: NR Sidelink in Release-16 and Beyond." IEEE Communications Standards Magazine 5.1 (2021): 12-21. Xie, Junfeng, et al. "A survey of machine learning techniques applied to software defined networking (SDN): Research issues and challenges." IEEE Communications Surveys & Tutorials 21.1 (2018): 393-430.
Teaching methods	
Assessment method	Portfolio: The grade will be composed of different components: • 30% written exam for the lecture part • 30% final presentation • 40% survey paper
Language of instruction	English
Prerequisites	Students should have basic understanding of computer networks.

Database Engineering

Course title	Database Engineering
ECTS	5
SWS	4
Course type	Undergraduate
Semester	Winter and summer
Workload in hours	In-class: 60 hrs. / Self-study: 90 hrs / Total: 150 hrs
Lecturer	Prof. Dr. Michael Scholz
Course objectives	After this module students should • be able to describe the database design process, • know the elements of the Entity-Relationship-Model, • can build an Entity Relationship Model for a specific case, • can normalize a database design, • be able to manage a database through a database management system, • be able to query a database using SQL, • know the core components and functionalities of a database management system.
Recommended literature	Conolly, Thomas M.; Begg, Carolyn E.: Database Solutions - A step-by-step guide to building databases. 2nd Edition. Harlow, Essex: Pearson Education Limited, 2004 Conolly, Thomas M.; Begg, Carolyn E.: Database systems - A practical approach to design, implementation, and management. 4th edition. Addison-Wesley, an imprint of Pearson Education, 2005

Teaching methods	Classes with exercises and practical training Course and document management through E-Learning System iLearn
Assessment method	Written examination, 90 min.
Language of Instruction	English
Prerequisites	Basics in Computer Science

Advanced Topics in AI

Course title	Advanced Topics in AI
ECTS	5
Course type	Lecture
SWS	4
Course level	Postgraduate
Semester	Summer
Workload in hours	Time of attendance: 60 hours Self-study: 90 hours Total: 150 hours
Lecturer	Prof. Dr. Andreas Fischer
Course objectives	The purpose of this course is to provide students with hands-on and real-world development experience. They will have the opportunity to review some cutting-edge research papers and to then turn them in concrete software/hardware outcomes. As these projects are completed in teams, students will also have the opportunity to elaborate on their social and language skills. At the end of the term, students will present their projects at an in-house R&D fair which will be open to the public.
Course contents	– Implementing contemporary research papers from the fields of artificial intelligence, machine learning, computer vision, natural language processing and others. – Using modern high-end hardware, such as GPUs clusters and cloud services. – Utilizing an agile process framework such as Scrum.

	– Understanding and using modern industrial software development tools such as work package trackers, code revision systems, debuggers, profilers and others. – Presenting R&D outcomes to stakeholders at different levels, such as fellow students, faculty members and practitioners and executives.
Recommended literature	Basic: - C. Bishop, Pattern Recognition and Machine Learning, Springer, 2006. - I. Goodfellow, Y. Bengio and A. Courville, Deep Learning, MIT Press, 2016. Study aids: - High-end GPUs - Cloud services - Development boards - Mobile robots and drones - Hardware manuals
Teaching methods	project and seminars
Assessment method	written student research project
Language of instruction	English
Prerequisites	None

ChatGPT et al.: Generative AI with Transformers

Course title	ChatGPT et al.: Generative AI with Transformers
ECTS	5
Course type	Lecture
SWS	4
Semester	Summer
Workload in hours	Total: 150 / In-class: 60 / Self-study: 90
Lecturer	Prof. Dr. Andreas Fischer
Course objectives	The module will give an introduction to the transformer technology which drives modern large language models, such as ChatGPT.
Course contents	Covered topics are in particular: • Foundations of Language Models • Word Embeddings • Attention Mechanism • Architectures of Transformer Models • Popular Open Source Transformer Models • Limitations of Large Language Models • Applications of Transformers in and beyond NLP • Optimization of Transformer Models

Recommended literature	Vaswani, Ashish, et al. "Attention is all you need." Advances in neural information processing systems 30 (2017). Devlin, Jacob, et al. "Bert: Pre-training of deep bidirectional transformers for language understanding." arXiv preprint arXiv:1810.04805 (2018). Mikolov, Tomas, et al. "Efficient estimation of word representations in vector space." arXiv preprint arXiv:1301.3781 (2013).
Teaching methods	Seminaristic education
Assessment method	Project work (paper)
Language of instruction	English
Prerequisites	Substantial background in artificial intelligence

Machine Learning

Course title	Machine Learning
ECTS	5
Course type	Lecture / Exercises / Project
SWS	4
Semester	Summer
Workload in hours	Total: 150 / In-class: 60 / Self-study and project work: 90
Lecturer	Prof. Dr.-Ing. Markus Mayer
Course objectives	• The students understand how to analyse a given dataset for its predictive quality and know how to motivate a classification or regression problem. They can perform the computation of statistics and programming of visualizations and can select the appropriate methods for given datasets. • The students can present a problem of supervised learning with remarks on predictive quality and the motivation. • The students understand the basic methods of feature engineering and the construction of machine learning evaluations in a scientific, rigid way. They can apply this knowledge and implement the methods in code. • The students understand the basic classification methods and their advantages and disadvantages. For a given problem, they can decide which to include in an evaluation and appropriatly parameterize library methods. • The students know unsupervised learning and some of its usages. They understand an exemplary algorithm from this field and can do the implementation.

Course contents	• Machine Learning Introduction • Machine Learning Overview: Exemplary problems and solution classes • Supervised learning experiment: Motivation • Error and quality measures • Bayes classifier, kNN classifier • Training and test data selection • Bayesian type classifiers • Linear regression • Feature engineering (Creation, Lifting, Selection) • Outliers, Cross validation, Resampling • Unsupervised Learning, K-Means clustering • Gradient descent • Support vector machines • Decision tree classifiers The main body of the lecture is supervised learning. Undsupervised learning is motivated and only exemplary shown.
Recommended literature	• An Introduction to Statistical Learning, James, Witten, Hastie, Rob Tishirani, 2nd Edition, 2021, available online: https://www.statlearning.com • MIT Open learning library: Introduction to machine learning. Online course, available at https://openlearninglibrary.mit.edu/courses/course-v1:MITx+6.036+1T2019/about
Teaching methods	• Lecture with PowerPoint slides • Exercises in the lecture and for self study • Presentation of the exercises by students with discussion • Online course material for self study • Project work with mandatory lecturer meetings as exam
Assessment method	Project work, ongoing over the semester
Language of instruction	English

Prerequisites	Analysis, Linear Algebra, Statistics

Project Management

Course title	Project Management
ECTS	5
Course type	Lecture
SWS	4
Semester	Summer
Workload in hours	Total: 150 / In-class: 60 / Self-study: 90
Lecturer	Prof. Dr. Christina Bauer
Course objectives	The students get to know the most important content of (IT) project management. After the course the students are able to plan and carry out a project with appropriate methods.
Course contents	Contents include but are not limited to: ▪ Phases of a project and documentation ▪ Requirements engineering ▪ Project controlling ▪ Static and agile methods
Recommended literature	▪ Cleland, D. I., & Ireland, L. R. (2008). Project manager's handbook: Apply best practices across Global industries. McGraw-Hill. ▪ Additional literature will be announced in the course
Teaching methods	Combination of lecture, presentation and case studies
Assessment method	Written examination, 90 min. and presentation

Language of instruction	English
Prerequisite	none