Module Handbook
for Artificial Intelligence

April 2026

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Introduction to Artificial Intelligence Majors

Module name	Introduction to Artificial Intelligence Majors		
Code	3080717270		
Semester	Fall, 1st Semester		
Contact person	Li Jinhua, AMEEN FADHL HASAN ALKASEM, Li Changlong		
Language	Chinese		
Relation to curriculum	Compulsory, Professional Foundational Course		
Type of teaching, contact hours	Lecture method, demonstration method, group discussion method, case analysis Teaching duration: 4 hours per week, for a total of 4 weeks, amounting to 16 hours.		
Work load	Total workload (estimated): 28 credit hours Total class hours: 16 hours Self-study duration: 12 hours, including: pre-class preparation, post-class review and consolidation, assignment completion, error identification and correction, advanced practice, summary, and gap identification and remediation.		
Credit points	1		
Recommended prerequisites	None		
Learning out-comes and their corresponding PLOs	Course Learning Outcomes (CLOs)	Description	Supported PLOs
	CLO1	Course Objective 1: To apply fundamental principles from mathematics, natural sciences, and engineering sciences to identify, articulate, and analyze complex engineering problems in artificial intelligence-related fields; to retrieve relevant information through literature review, organize, summarize, and analyze it to derive valid conclusions.	**R2**
	CLO2	Course Objective 2: When addressing complex engineering problems, students shall be able to analyze and evaluate the impacts of engineering practices on health, safety, the environment, legal considerations, and economic and social sustainability based on relevant engineering knowledge, while understanding their associated responsibilities.	**R6**
	CLO3	Course Objective 3: To cultivate a sound political stance, worldview, outlook on life, and values; to practice the core socialist values; to develop competencies in humanities and social sciences along with a strong sense of social responsibility; and to understand and adhere to engineering ethics and standards in artificial intelligence practice while fulfilling professional responsibilities.	**R7**

Content	This course is a foundational professional course that combines cognitive guidance with systematic framework development. Its theoretical instruction systematically introduces the disciplinary architecture, core research directions, knowledge system, and industry development landscape of artificial intelligence. These topics are highly comprehensive in scope; relying solely on classroom lectures makes it difficult for students to develop a holistic understanding of the field or clearly grasp the intrinsic connections and practical applications of individual knowledge modules. Therefore, the teaching approach consistently adheres to a principle that integrates systematic guidance, case-based empowerment, and cognitive enlightenment. For key areas such as core disciplines and knowledge frameworks, the course employs analyses of industry-specific cases and concrete examples of professional application scenarios to help students gain deep insights into the discipline's essence and developmental logic. More importantly, it aims to guide students in defining their academic focus and establishing a structured professional knowledge framework, thereby laying a solid foundation for subsequent specialized studies and career development. Knowledge Module 1: Overview of Artificial Intelligence (Weight: 2/16, Level: Understanding) Knowledge Module 2: BP Networks and Hopfield Networks (Weight: 4/16; Level: Applied) Knowledge Module 3: Convolutional Neural Networks (Weight: 4/16, Level: Application) Knowledge Module 4: Genetic Algorithm (Weight: 4/16, Level: Applied) Knowledge Module 5: Applications of Neural Networks (Weight: 2/16, Level: Application)
Forms of examination	The overall grade for this course consists of continuous assessment and the final examination grade. The grade is evaluated on a percentage scale, with 60 being the passing score for the course. The final examination is in the form of a course report, accounting for 60% of the overall grade. Students are required to submit a course report The continuous assessment component accounts for 40% of the overall grade and includes: (1) class participation 12%; (2) regular assignments 12%; and (3) interim tests 16%. Class participation is evaluated comprehensively based on students' contributions to class discussions, the quality of their questions and answers, their participation in group discussions, and their classroom discipline.
Study and examination requirements	Following the examination regulations, students must have selected and registered for the courses.
Reading list	[1] Fundamentals of Artificial Intelligence, edited by Yang Jie et al., Machinery Industry Press, 2020 [2] Principles and Methods of Artificial Intelligence, Wang Yongqing, Xi'an Jiaotong University Press, 2017 [3] Artificial Neural Networks, Yang Xingjun, Zheng Junli. Higher Education Press, 2019 [4] Advanced Artificial Intelligence, Shi Zhongzhi, Science Press, 2016 [5] A Milestone Year for New AI: A Review of Key Developments in Artificial Intelligence and Intelligent Technology [J], Shen Tianyu, Zhang Hui, Ye Peijun, Wang Feiyue, Pattern Recognition and Artificial Intelligence, 2025
Revision Date	V2024.1, September 2024. V2024.2, December 2025, Update: Credits and workload are calculated based on ECTS.

C Language Programming

Module name	C Language Programming		
Code	3080900242		
Semester	Fall, 1st Semester		
Contact person	Liu Yanfang, Li Mingyan, He Qin		
Language	Chinese		
Relation to curriculum	Compulsory，Professional Foundational Course		
Type of teaching, contact hours	Lecture method, demonstration method, group discussion method, laboratory experiment method, tool-assisted teaching, and personalized tutoring Teaching duration: 4 hours per week, totaling 12 weeks and 48 hours in total.		
Work load	Total workload (estimated): 84 credit hours Total class hours: 48 hours Self-study hours: 36 hours, including homework and exam preparation time		
Credit points	3		
Recommended prerequisites	None		
Learning out-comes and their corresponding PLOs	Course Learning Outcomes (CLOs)	Description	Supported PLOs
	CLO1	Course Objective 1: Through the study of C programming, students will acquire fundamental knowledge of computer languages, master essential programming methods and thinking frameworks, develop core programming concepts, learn basic debugging techniques, gain initial programming skills, and lay a solid foundation for advancing to other specialized courses and future careers in software development.	**R1**
	CLO2	Course Objective 2: Through this course, students will master the fundamental principles and programming methods of the C language, apply mathematical and software engineering fundamentals to identify and analyze complex programming problems, derive valid conclusions through programming and debugging, and develop problem analysis and solution skills.	**R2**
	CLO3	Course Objective 3: Master C programming techniques, capable of designing and implementing program modules and algorithmic flows that meet requirements to develop solutions for complex problems; integrate standardization awareness and innovative thinking into design processes while considering engineering factors such as security and compliance, thereby enhancing software design and development capabilities.	**R3**

	CLO4	Course Objective 4: Master the C programming development environment and debugging tools, and be capable of appropriately selecting programming techniques and tools to perform program analysis, design, implementation, and testing; understand the applicable scenarios and limitations of common development tools, and develop the fundamental ability to apply modern tools in solving software engineering problems.	**R5**
Content	Fundamentals of computer languages are essential skills for computer science students, playing a vital role in developing abstract thinking, enhancing computational literacy, and improving comprehension of subsequent courses. The C language, characterized by its platform independence and robust functionality, enables programming across various operating systems including Windows, Linux, and Unix, making it instrumental in cultivating students' programming capabilities. Through this course, students will acquire fundamental knowledge of computer languages, master essential programming methods and approaches, develop core programming concepts, learn basic debugging techniques, gain preliminary programming proficiency, and establish a solid foundation for advancing to specialized courses and future careers in software development. Knowledge Module 1: Programming and C Language (Weight: 2/48; Level: Memory + Understanding) Knowledge Module 2: Algorithms – The Soul of Programming (Weight: 4/48; Level: Understanding + Analysis + Evaluation) Knowledge Module 3: Basic C Programming – Sequential Programming (Weight: 4/48; Level: Memory + Understanding + Application) Knowledge Module 4: Selection Structure Programming (Weight: 6/48; Level: Memory + Understanding + Application) Knowledge Module 5: Loop Structure Programming (Weight: 6/48; Level: Memory + Understanding + Application) Knowledge Module 6: Using Arrays to Process Batch Data (Weight: 6/48; Level: Memory + Understanding + Application) Knowledge Module 7: Implementing Modular Programming Using Functions (Weight: 6/48; Level: Understanding + Application + Analysis) Knowledge Module 8: Pointers (Weight: 8/48; Levels: Understanding + Application + Analysis) Knowledge Module 9: Structures and Shared Classes (Weight: 4/48; Level: Memory – Understanding – Application) Knowledge Module 10: File Operations (Weight: 2/48; Level: Memory-Applied)		
Forms of examination	The overall grade for this course consists of continuous assessment and the final examination. The grade is evaluated on a percentage scale, with 60 being the passing score for the course. The final examination is a closed-book exam with a duration of 100 minutes, accounting for 60% of the overall grade. It comprehensively assesses students' ability to learn, analyze, and solve complex problems. The continuous assessment component accounts for 40% of the overall grade and includes: (1) class participation 12%; (2) regular assignments 12%; and (3) interim tests 16%. Class participation is evaluated comprehensively based on students' contributions to class discussions, the quality of their questions and answers, their participation in group discussions, and their classroom discipline.		

Study and examination requirements	Following the examination regulations, students must have selected and registered for the courses.
Reading list	[1] C Programming, edited by Tan Haoqiang, Tsinghua University Press, 2023,5th edition. [2] *C Language Programming*, edited by Zhao Ji and Wang Caixia, Tsinghua University Press, 2023. [3] Niu Guofeng, Zhu Miaomiao, Li Xin. Process-oriented design and research of blended teaching for the C language course [J]. Journal of Suzhou Institute of Technology, 2026,40(02):118−124. DOI: 10.16101/j.cnki.cn32-1749/z.2026.02.013. [4] Liu Zhihai, Liu Ruijie, Wang Chenglong, et al. Teaching design of C language integrating ideological and political education with case-based instruction [J]. China Educational Technology Equipment, 2025. [5] [1] Liang Xiaojie. Design and Application of Micro-lectures Based on Knowledge Integration Teaching Theory in the C Programming Flipped Classroom at Secondary Vocational Schools [D]. Central China Normal University, 2025.
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Discrete Mathematics

Module name	Discrete Mathematics		
Code	3080900204		
Semester	Spring, 2nd Semester		
Contact person	Zhao Dandan, Diao Tianru, Guo Shaosheng		
Language	Chinese		
Relation to curriculum	Compulsory, Professional Foundational Course		
Type of teaching, contact hours	Lecture method, group discussion method, laboratory experiment method Teaching duration: 4 hours per week, totaling 8 weeks, for a cumulative period of 32 hours.		
Work load	Total workload (estimated): 56 credit hours Total class hours: 32 hours Self-study hours: 24 hours, including pre-class preparation, post-class assignments, and exam preparation time		
Credit points	2		
Recommended prerequisites	Advanced Mathematics		
Learning out-comes and their corresponding PLOs	Course Learning Outcomes (CLOs)	Description	Supported PLOs
	CLO1	Course Objective 1: To understand the fundamental concepts of mathematical logic, set theory, and graph theory in Discrete Mathematics, and to begin describing, abstracting, and representing discrete structures in discrete mathematical problems.	**R1**
	CLO2	Course Objective 2: To understand the fundamental approaches of mathematical logic, set theory, graph theory, and related concepts; analyze applications of Discrete Mathematics in computer science and related fields; and formulate specific problems as computationally recognizable data models.	**R2**
	CLO3	Course Objective 3: To be able to employ mathematical tools to derive and prove solutions for specific problems, design feasible approaches through abstract thinking, generalized analysis, and logical reasoning, and arrive at sound conclusions.	**R4**
	CLO4	Course Objective 4: By studying the historical development of mathematical logic and classic paradoxes in set theory (such as the "Barber's Paradox"), students will recognize the complex yet progressive trajectory of mathematics' evolution, develop a proper learning perspective, extend existing knowledge to new contexts, and thereby fully appreciate the importance of self-directed and lifelong learning.	**R11**

Content	This course serves as a foundational subject for the four-year undergraduate program in Software Engineering. Discrete Mathematics is a branch of modern mathematics that studies the structure and interrelationships of discrete quantities. The main content includes mathematical logic (propositional logic, first-order logic), set theory (sets, relations, functions), and graph theory (graphs, trees). Through this course, students will master the fundamental concepts and analytical methods of Discrete Mathematics, acquire essential descriptive tools and techniques for working with discrete structures, apply common discrete mathematical approaches to solving practical problems in computer science, and establish a solid mathematical foundation for subsequent courses in software engineering. Knowledge Module 1: Propositional Logic (Weight: 6/32; Levels: Understanding + Application + Analysis + Evaluation) Knowledge Module 2: First-Order Logic (Weight: 6/32; Levels: Understanding + Application + Analysis) Knowledge Module 3: Sets (Weight: 6/32; Level: Understanding + Application + Analysis) Knowledge Module 4: Binary Relations (Weight: 6/32; Levels: Understanding + Application + Analysis) Knowledge Module 5: Functions (Weight: 2/32; Level: Understanding + Application) Knowledge Module 6: Graph Theory (Weight: 6/32; Level: Understanding + Application)
Forms of examination	The overall grade for this course consists of continuous assessment and the final examination. The grade is evaluated on a percentage scale, with 60 being the passing score for the course. The final examination is a closed-book exam with a duration of 100 minutes, accounting for 50% of the overall grade. It comprehensively assesses students' ability to learn, analyze, and solve complex problems. The continuous assessment component accounts for 50% of the overall grade and includes: (1) class participation 15%; (2) regular assignments 15%; and (3) interim tests 20%. Class participation is evaluated comprehensively based on students' contributions to class discussions, the quality of their questions and answers, their participation in group discussions, and their classroom discipline.
Study and examination requirements	Following the examination regulations, students must have selected and registered for the courses.
Reading list	[1] Qu Wanling, Liu Tian, Geng Suyun, et al. Discrete Mathematics (4th Edition) [M]. Beijing: Tsinghua University Press, 2022. [2] Qu Wanling, Liu Tian, Geng Suyun, et al. Solutions and Learning Guide to Discrete Mathematics Problems (4th Edition) [M]. Beijing: Tsinghua University Press, 2022. [3] Wang Qingxian, Gu Xiaofeng, Wang Lijie. Discrete Mathematics (Micro-lecture Edition) [M]. Beijing: People's Post and Telecommunications Press, 2023. [4] Ma Dianfu. Discrete Mathematics and Its Applications: Modeling and Implementation in Python [M]. Beijing: Higher Education Press, 2021. [5] Aigner M.[5] Aigner M. Discrete Mathematics[M]. American Mathematical Society, 2023. [6] Chen Lijun, Cheng Li. Reform of blended teaching in Discrete Mathematics based on the OBE concept [J]. Journal of Chifeng University (Natural Sciences Edition), 2024,40(02):78–81. [7] Wu Nan. Reflections on the Development of Ideological and Political Education Systems for Discrete Mathematics Courses in Computer Science Majors [J]. Higher Education Journal, 2023,9(34):174–177.
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Analog Circuits and Digital Circuits

Module name	Analog Circuits and Digital Circuits		
Code	3080717271		
Semester	Fall, 3rd Semester		
Contact person	Zhang Liping, Li Qihua		
Language	Chinese		
Relation to curriculum	Compulsory, Professional Foundational Course		
Type of teaching, contact hours	Lecture method, demonstration method, group discussion method, case analysis, laboratory experiment method Teaching duration: 4 hours per week, totaling 12 weeks and 48 hours in total.		
Work load	Total workload (estimated): 84 credit hours Total class hours: 48 hours Self-study hours: 36 hours, including homework and exam preparation time		
Credit points	3		
Recommended prerequisites	Advanced Mathematics, Linear Algebra, Circuit Principles		
Learning out-comes and their corresponding PLOs	Course Learning Outcomes (CLOs)	Description	Supported PLOs
	CLO1	Course Objective 1: To master the working principles and analysis methods of semiconductor devices, basic amplification circuits, and operational amplifiers; to understand the fundamental operating mechanisms of analog circuits; and to develop foundational circuit analysis skills.	**R2**
	CLO2	Course Objective 2: To be capable of applying methods for analyzing and designing logical algebra, gate circuits, and combinational logic circuits to model and analyze digital systems, and to possess solid skills in logic circuit design.	**R4**
	CLO3	Course Objective 3: To comprehensively apply knowledge of analog and digital circuits to design simple electronic systems, verify the correctness of designs through experiments, and develop fundamental engineering practice skills.	**R6**

Content	This course serves as a fundamental professional course for the Artificial Intelligence major, featuring both a well-defined structure and strong practical relevance. Its primary objectives are to equip students with an understanding of the basic operating principles, analytical approaches, and design methodologies for analog and digital circuits, while enabling them to develop initial capabilities in designing simple electronic systems tailored to industrial requirements. Through this course, students will enhance their problem-solving skills, laying a solid foundation for advanced studies in specific areas of electronics technology and its professional applications. The teaching process should deliberately foster students' self-directed learning abilities and their capacity to analyze and resolve problems, integrating educational goals throughout instruction to cultivate patriotism, a sense of collectivism, a spirit of innovation, as well as a rigorous scientific attitude and a pragmatic approach to inquiry. Knowledge Module 1: Semiconductor Devices (Weight: 4/48; Level: Memory + Understanding) Knowledge Module 2: Fundamentals of Amplifier Circuits (Weight: 6/48; Level: Understanding + Application) Knowledge Module 3: Operational Amplifiers and Feedback (Weight: 6/48; Level: Understanding + Analysis) Knowledge Module 4: Analog Computing Circuits (Weight: 6/48; Level: Applied + Analytical) Knowledge Module 5: Fundamentals of Boolean Algebra (Weight: 6/48; Level: Understanding + Application) Knowledge Module 6: Gate Circuits (Weight: 6/48; Level: Understanding + Analysis) Knowledge Module 7: Combinational Logic Circuits (Weight: 8/48; Level: Analysis + Application) Knowledge Module 8: Sequential Logic Circuits (Weight: 6/48; Level: Analysis + Design)
Forms of examination	The overall grade for this course consists of continuous assessment and the final examination. The grade is evaluated on a percentage scale, with 60 being the passing score for the course. The final examination is a closed-book exam with a duration of 100 minutes, accounting for 70% of the overall grade. It comprehensively assesses students' ability to learn, analyze, and solve complex problems. The continuous assessment component accounts for 30% of the overall grade and includes: (1) class participation 10%; (2) regular assignments 10%; and (3) interim tests 10%. Class participation is evaluated comprehensively based on students' contributions to class discussions, the quality of their questions and answers, their participation in group discussions, and their classroom discipline.
Study and examination requirements	Following the examination regulations, students must have selected and registered for the courses.
Reading list	[1] Analog Circuits and Digital Circuits, edited by Kou Ge and Jiang Liping, Electronic Industry Press, 2019,4th edition. [2] A Concise Tutorial on Analog Electronics Technology, edited by Yang Suxing, Tsinghua University Press, 2022,4th edition. [3] Fundamentals of Electronic Technology, edited by Kang Huaguang, Higher Education Press, 2021,7th edition. [4] Digital Electronic Technology, edited by Jiang Xiao 'an, Xi' an University of Electronic Science and Technology Press, 2024,5th edition. [5] Review on High-Resolution Audio Σ-Δ Modulators [J]. Sun Aoyun, Wen Peixu, Shao Huaixian. Journal of Electronics and Information Science, 2024.
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Data Structures and Algorithms

Module name	Data Structures and Algorithms		
Code	3080900230		
Semester	Spring，2nd Semester		
Contact person	Liu Yanfang, Guo Ning, He Qin, Yan Lingling		
Language	Chinese		
Relation to curriculum	Compulsory, Professional Foundational Course		
Type of teaching, contact hours	Lecturing method；Demonstration method；Laboratory experimental method Teaching Hours: 4 hours per week for 16 weeks, totaling 64 hours		
Work load	Total Workload (Estimated): 112 hours Teaching hours: 64 hours Self-study hours: 48 hours, including after-class assignments, exam preparation time, etc.		
Credit points	4		
Recommended prerequisites	C Language Programming, Discrete Mathematics		
Learning out-comes and their corresponding PLOs	Course Learning Outcomes (CLOs)	Description	Supported PLOs
	CLO1	Course Objective 1: Understand the fundamental concepts of Data Structures and Algorithms; master the logical and storage structures as well as basic operations of common data structures; and be capable of applying mathematical and engineering fundamentals to perform abstract modeling for problems in software engineering.	**R1**
	CLO2	Course Objective 2: To analyze the time and space complexities of various data structures and algorithms for specific problems, identify and articulate core requirements in complex engineering challenges, and derive valid conclusions through literature review.	**R2**
	CLO3	Course Objective 3: To develop solutions for complex problems in software engineering, select or design appropriate data structures and algorithms (e.g., sorting, search, graph algorithms), demonstrate innovative thinking in the design process, and consider social and security factors.	**R3**
	CLO4	Course Objective 4: To apply data structures and algorithm theory, employ scientific methods to investigate complex engineering problems, design experimental schemes, validate algorithm performance through programming implementation and data analysis, and derive well-founded conclusions.	**R4**

Content	This course provides a systematic introduction to the fundamental theories and application methods of Data Structures and Algorithms, equipping students with the ability to select appropriate data structures and design efficient algorithms for practical problems. Key topics include linear structures (ordered lists, linked lists, stacks, queues), trees and binary trees, graph structures, search and sorting algorithms, and algorithm complexity analysis. By integrating theory with practice, the course enables students to master core techniques for data organization and processing in software engineering, enhance their programming skills and problem-solving abilities, and lay a solid foundation for subsequent software development and system design. Knowledge Module 1: Introduction (Weight: 2/64; Level: Understanding) Knowledge Module 2: Linear Lists (Weight: 8/64; Level: Understanding + Application) Knowledge Module 3: Stacks and Queues (Weight: 8/64; Level: Understanding + Application) Knowledge Module 4: Strings (Weight: 6/64; Level: Understanding + Application) Knowledge Module 5: Arrays and Generalized Lists (Weight: 6/64; Level: Understanding + Application) Knowledge Module 6: Trees and Binary Trees (Weight: 8/64; Level: Understanding + Application + Analysis) Knowledge Module 7: Diagram (Weight: 8/64, Level: Application + Analysis) Knowledge Module 8: Search (Weight: 8/64; Levels: Application + Analysis + Evaluation) Knowledge Module 9: Sorting (Weight: 10/64; Levels: Application + Analysis + Evaluation)
Forms of examination	The overall grade for this course consists of continuous assessment and the final examination. The grade is evaluated on a percentage scale, with 60 being the passing score for the course. The final examination is a closed-book exam with a duration of 100 minutes, accounting for 50% of the overall grade. It comprehensively assesses students' ability to learn, analyze, and solve complex problems. The continuous assessment component accounts for 50% of the overall grade and includes: (1) class participation 15%; (2) regular assignments 15%; and (3) interim tests 20%. Class participation is evaluated comprehensively based on students' contributions to class discussions, the quality of their questions and answers, their participation in group discussions, and their classroom discipline.
Study and examination requirements	Following the examination regulations, students must have selected and registered for the courses.
Reading list	[1] Data Structures (C Language Edition). Edited by Yan Weimin. Beijing: Tsinghua University Press. [2] Hello Algorithm, Jin Yudong, People's Post and Telecommunications Press, 2024. [3] Animation Algorithms and Data Structures, by Toshihiro Watanabe (Japan) and Nikolai Milyankov (Russia), translated by Zheng Mingzhi, People's Posts and Telecommunications Press, 2024. [4] Challenge Programming Contest (2nd Edition), Takuya Akiha, Yoichi Iwata, Yasutoshi Kitagawa, People's Posts and Telecommunications Press, 2013. [5] Wen Yankun. Research on Discreteness in Computer Algorithm Design and Data Structures [J]. Information and Computer (Theoretical Edition), 2024.
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Principles of Computer Composition

Module name	Principles of Computer Composition		
Code	3080900209		
Semester	Fall, 3rd Semester		
Contact person	Dong Ling, Gao Wei		
Language	Chinese		
Relation to curriculum	Compulsory, Professional Foundational Course		
Type of teaching, contact hours	Lecture method, demonstration method, group discussion method, case analysis, laboratory experiment method Teaching duration: 4 hours per week, totaling 12 weeks and 48 hours in total.		
Work load	Total workload (estimated): 84 credit hours Teaching hours: 48 hours Self-study hours: 36 hours, including homework and exam preparation time		
Credit points	3		
Recommended prerequisites	Circuit Principles, Data Structures and Algorithms		
Learning out-comes and their corresponding PLOs	Course Learning Outcomes (CLOs)	Description	Supported PLOs
	CLO1	Course Objective 1: To achieve a precise understanding of the overall architecture of computer systems and the composition and functions of core hardware components (CPU, memory, bus, I/O interfaces); to master the operating principles, key technical parameters, and interaction mechanisms of each component; to clearly distinguish between computer organization and computer architecture concepts; and to accurately describe fundamental concepts such as binary encoding, instruction sets, and addressing modes, thereby establishing a solid theoretical foundation for advanced studies.	**R1**
	CLO2	Course Objective 2: By applying core knowledge of computer architecture principles, analyze the hardware connectivity logic, instruction execution flow, and data transmission processes of simple computer systems; integrate prior knowledge in digital electronics and assembly language to interpret instruction formats, perform assembly coding and machine code conversion for simple instructions, develop preliminary skills in analyzing and solving fundamental computer hardware issues, and independently complete basic hardware logic analysis tasks.	**R2**

	CLO3	Course Objective 3: To comprehensively apply theoretical knowledge of computer architecture principles to analyze the design concepts and implementation methods of typical computer hardware modules (such as arithmetic units, controllers, and memory); to develop preliminary designs for simple hardware logic modules or optimize workflows of existing modules based on specified functional requirements; to acquire fundamental capabilities in hardware system analysis, design, and optimization; and to understand the collaborative relationship between hardware and software.	**R3**
	CLO4	Course Objective 4: To develop a holistic understanding of computer systems, establish the conceptual framework that "hardware forms the foundational support for software operation," and cultivate rigorous logical reasoning skills and engineering practice competence; to stay informed about trends in computer architecture technologies (such as multi-core architectures and advanced memory technologies), possess the ability for self-directed learning and continuous exploration of new hardware technologies, integrate acquired knowledge with practical engineering applications, and lay a solid foundation for subsequent studies in operating systems, embedded development, and related fields, as well as for careers in computer hardware-related work.	**R3**
Content	This course serves as a core foundational comprehensive course designed to enhance students' understanding of fundamental computer technologies and develop their hardware application skills. It enables students to comprehend the overall architecture and operational mechanisms of computer systems, master the composition principles, operating mechanisms, and design concepts of major hardware components, and become familiar with the structures and interconnection techniques of key hardware modules such as arithmetic units, memory, controllers, and input/output systems. Through case studies and practical applications, students will understand instruction execution processes, data storage methods, and bus interaction logic. The course aims to cultivate students' ability to apply theoretical knowledge in electronics and digital logic to analyze hardware operation mechanisms and solve practical hardware problems, while strengthening their logical analysis capabilities for hardware systems and architectural design thinking. It also enhances the integration of theoretical knowledge with engineering practice, laying a solid foundation for subsequent courses such as Operating Systems, Embedded Development, and Microcomputer Principles. Knowledge Module 1: Overview of Computer Systems and Number Systems and Encoding (Weight: 2/48; Level: Memory – Understanding) Knowledge Module 2: Operators and Fundamentals of Data Operations (Weight: 4/48; Level: Understanding – Application) Knowledge Module 3: Memory Architecture and Design Principles (Weight: 12/48; Level: Understanding – Analysis) Knowledge Module 4: Instruction Set and Central Processing Unit (CPU) (Weight: 16/48; Level: Application – Analysis) Knowledge Module 5: Bus Systems and Input/Output Interfaces (Weight: 14/48; Level: Understanding – Application)		

Forms of examination	The overall grade for this course consists of continuous assessment and the final examination. The grade is evaluated on a percentage scale, with 60 being the passing score for the course. The final examination is a closed-book exam with a duration of 100 minutes, accounting for 70% of the overall grade. It comprehensively assesses students' ability to learn, analyze, and solve complex problems. The continuous assessment component accounts for 30% of the overall grade and includes: (1) class participation 10%; (2) regular assignments 10%; and (3) interim tests 10%. Class participation is evaluated comprehensively based on students' contributions to class discussions, the quality of their questions and answers, their participation in group discussions, and their classroom discipline.
Study and examination requirements	Following the examination regulations, students must have selected and registered for the courses.
Reading list	[1] Feng Jianwen, Zhang Fujia, Zhao Jianyong, et al. Principles of Computer Organization and System Architecture [M]. 3rd ed. Beijing: Higher Education Press, 2024. [2] Tang Shuofei. Principles of Computer Organization [M]. 2nd ed. Beijing: Higher Education Press, 2013. [3] Von Neumann J. First draft of a report on the EDVAC [R]. Philadelphia: University of Pennsylvania, 1945. [4] Liu L. Innovation and Practice in Blended Teaching of Computer Organization Principles with AI Empowerment [J]. Journal of Computer Technology and Education, 2025,13(1):45–52. [5] Xu Weidong, Lou Mian, Li Li, et al. Bit-serial SRAM in-memory computation based on original complement encoding [J]. Journal of Beijing Institute of Technology, 2024,44(10):1095–1104.
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Principles of Operating Systems

Module name	Principles of Operating Systems		
Code	3080903255		
Semester	Fall, 3rd Semester		
Contact person	Cao Xiuping, Li Jinhua, Li Mingyan		
Language	Chinese		
Relation to curriculum	Compulsory, Professional Foundational Course		
Type of teaching, contact hours	Lecture method, demonstration method, group discussion method, case analysis method Teaching duration: 4 hours per week, totaling 12 weeks and 48 hours in total.		
Work load	Total workload (estimated): 84 credit hours Total class hours: 48 hours Self-study hours: 36 hours, including homework and exam preparation time.		
Credit points	3		
Recommended prerequisites	C Language Programming, Data Structures and Algorithms		
Learning out-comes and their corresponding PLOs	Course Learning Outcomes (CLOs)	Description	Supported PLOs
	CLO1	Course Objective 1: Through the study of "Principles of Operating Systems," students will master the fundamental components and operating principles of Operating Systems, essential methods for core algorithm design, and interface technologies; by introducing the historical development of Operating Systems and examining current challenges in China's independent OS development as well as foreign technological monopolies, this course aims to foster students' patriotic spirit and determination to contribute to the advancement of domestically developed, controllable Operating Systems, while solidifying their core engineering knowledge in software engineering.	**R1**
	CLO2	Course Objective 2: Through this course, students will master the structural composition and operational principles of operating system kernel resources, as well as methods for expanding system resources. This enables them to develop accurate design solutions for operating system-related functionalities based on practical engineering requirements, enhances their problem analysis and resolution skills, and cultivates systematic problem-solving capabilities and logical reasoning proficiency.	**R2**

	CLO3	Course Objective 3: By writing core algorithm code within an operating system environment, students will achieve a systematic and in-depth integration of operating system theory with software programming. They will be capable of designing appropriate operating system functional modules and developing programs tailored to practical engineering requirements, thereby acquiring the skills needed for designing and developing relevant operating system components and laying a solid foundation for advanced studies in complex system development.	**R3**
	CLO4	Course Objective 4: To enable students to communicate effectively, learn from each other's strengths during the design and debugging of operating system course projects, fully leverage individual capabilities, collaborate closely to complete operating system-related tasks (such as a simple process management system or memory allocation simulation program), develop practical skills, foster innovation awareness, enhance the ability to apply operating system knowledge comprehensively to solve real-world engineering problems, and promote overall personal development.	**R4**
Content	"Principles of Operating Systems" is a compulsory course for computer science majors, designed to provide a comprehensive and systematic introduction to the architecture, design principles, implementation methods, and technologies of operating systems. It covers topics such as system calls and interfaces, processor scheduling and thread management, synchronization and communication mechanisms, deadlock resolution, memory management based on partitioning, paging, and segmentation along with virtual storage, device management, and file systems. Through this course, students will systematically acquire a thorough understanding of operating system fundamentals—including core concepts, primary functions, operational mechanisms, essential techniques, and implementation approaches—developing both practical application skills and analytical capabilities in operating system design. This course lays a solid theoretical foundation and technical competence essential for advanced studies in the field, as well as for developing various application software and system applications on operating system platforms. Knowledge Module 1: Overview of Operating Systems (Weight: 2/48; Level: Memory + Understanding) Knowledge Module 2: User Interface (Weight: 2/48; Levels: Memory + Understanding + Evaluation) Knowledge Module 3: Process Management (Weight: 10/48; Level: Understanding-Evaluation) Knowledge Module 4: Processor Scheduling (Weight: 12/48; Level: Memory-Evaluation) Knowledge Module 5: Memory Management (Weight: 10/48; Level: Understanding – Creation) Knowledge Module 6: File Management (Weight: 6/48; Level: Memory-Analysis) Knowledge Module 7: Device Management (Weight: 6/48; Level: Understanding + Application)		

Forms of examination	The overall grade for this course consists of continuous assessment and the final examination. The grade is evaluated on a percentage scale, with 60 being the passing score for the course. The final examination is a closed-book exam with a duration of 100 minutes, accounting for 60% of the overall grade. It comprehensively assesses students' ability to learn, analyze, and solve complex problems. The continuous assessment component accounts for 40% of the overall grade and includes: (1) class participation 12%; (2) regular assignments 12%; and (3) interim tests 16%. Class participation is evaluated comprehensively based on students' contributions to class discussions, the quality of their questions and answers, their participation in group discussions, and their classroom discipline.
Study and examination requirements	Following the examination regulations, students must have selected and registered for the courses.
Reading list	[1] Tang Xiaodan, Liang Hongbing, Zhe Fengping, Tang Ziying. Computer Operating Systems (4th Edition) [M]. Xi 'an: Xi' an University of Electronic Science and Technology Press, 2021. [2] Pang Liping, Yang Fumin. Computer Operating Systems (3rd Edition) [M]. Beijing: People's Post and Telecommunications Press, 2017. [3] Wu Fan, Liu Gongshen, Wu Chentao. Principles and Implementation of Operating Systems [M]. Beijing: People's Post and Telecommunications Press, 2024. [4] Ge Yan, Liu Guozhu, Du Junwei, Cao Ling. Research on diversified teaching models for the "Principles of Operating Systems" course [J]. 2024. [5] Liu Qiang, Zhang Hua. Teaching reform and practical exploration of operating system principles [J]. Computer Education, 2022, (10):123−126. [6] Zhang Lei, Wang Xiaochun, Liu Zhiyong. Exploration and Practice of an Industry-Education Integrated Teaching Model for Operating System Courses [D]. Computer Education, 2023.
Revision Date	V2024.1, September 2024. V2024.2, December 2025, Update: Credits and workload are calculated based on ECTS.

Principles of Computer Networks

Module name	Principles of Computer Networks		
Code	3080900237		
Semester	Fall, 5th Semester		
Contact person	Fang Xiaoxue, Yu Xiaoyan		
Language	Chinese		
Relation to curriculum	Compulsory, Professional Foundational Course		
Type of teaching, contact hours	Lecture method, group discussion method, case analysis method, simulation experiment method, flipped classroom method Teaching Hours: 4 hours per week for 12 weeks, totaling 48 hours		
Work load	Total Workload (Estimated): 84 hours Teaching hours: 48 hours Self-study hours: 36 hours, including pre-class preparation, post-class review and consolidation, assignment completion, experiment preparation, exam preparation, etc.		
Credit points	3		
Recommended prerequisites	Principles of Computer Composition, C Language Programming, Data Structures and Algorithms		
Learning outcomes and their corresponding PLOs	Course Learning Outcomes (CLOs)	Description	Supported PLOs
	CLO1	Building on a solid understanding of computer network architecture, protocols, topology, network devices, and transmission media, one should be capable of using a hierarchical architecture to analyze resource subnets and communication subnets, as well as designing and implementing simple computer networks.	R1
	CLO2	Be capable of applying acquired knowledge to identify network-related faults or requirements from diverse phenomena, pinpoint the source of network issues while considering the network hierarchy, interactions among devices, and user behavior patterns, thereby conducting comprehensive and in-depth analysis and resolving problems effectively.	R2
	CLO3	Master network deployment standards; capable of analyzing and evaluating project design, construction, and operation plans, as well as assessing the impact of new technologies; possess a strong awareness of sustainable development and can apply these principles in practice by integrating sustainability concepts into network planning.	R6

Content	This course provides an introduction to the fundamental concepts, principles, technologies, and applications of computer networks. It covers topics such as network architecture, fundamentals of data communication, network protocols, local area network (LAN) and wide area network (WAN) technologies, network interconnection and routing, network operating systems, and network security and management. By completing this course, students will gain insight into the evolution and current state of computer networks, understand how TCP/IP protocols operate, become familiar with common network devices and their configuration methods, and learn how to plan and design simple computer networks. Knowledge Module 1: Overview of Computer Networks (Weight: 2/48; Level: Memory + Understanding) Knowledge Module 2: Network Architecture and Network Protocols (Weight: 8/48; Level: Understanding + Application + Analysis) Knowledge Module 3: Physical Layer (Weight: 8/48; Levels: Understanding + Application + Analysis) Knowledge Module 4: Data Link Layer (Weight: 8/48; Level: Understanding + Application + Analysis) Knowledge Module 5: Network Layer (Weight: 6/48; Level: Understanding + Application + Analysis) Knowledge Module 6: Transmission Layer (Weight: 6/48; Level: Understanding + Application + Analysis) Knowledge Module 7: Application Layer (Weight: 6/48; Level: Understanding + Application + Analysis) Knowledge Module 8: Cybersecurity (Weight: 4/48; Levels: Application + Evaluation + Creation)
Forms of examination	The overall grade for this course consists of continuous assessment and the final examination. The grade is evaluated on a percentage scale, with 60 being the passing score for the course. The final examination is a closed-book exam with a duration of 100 minutes, accounting for 60% of the overall grade. It comprehensively assesses students' ability to learn, analyze, and solve complex problems. The continuous assessment component accounts for 40% of the overall grade and includes: (1) class participation 12%; (2) regular assignments 12%; and (3) interim tests 16%. Class participation is evaluated comprehensively based on students' contributions to class discussions, the quality of their questions and answers, their participation in group discussions, and their classroom discipline.
Study and examination requirements	Following the examination regulations, students must have selected and registered for the courses.

Reading list	[1] Wu Gongyi, Wu Ying. Computer Networks (5th Edition). Tsinghua University Press, July 2022. [2] Xie Xiren, Computer Networks (8th Edition), Electronic Industry Press, 2019 [3] Chen Hong, Xiao Chenglong. Computer Networks. China Machine Press, 2022 [4] Zhou Ge. Fundamentals of Computational Network Technology. People's Post and Telecommunications Press, 2022 [5] Wang Cong, Yang Yu, Li Qi. A Review of Research on Network Abnormality Detection for Encrypted Traffic [J]. Journal of Communications, 2024.
Revision Date	V2024.1, September 2024. V2024.2, December 2025, Update: Credits and workload are calculated based on ECTS.

Python Programming

Module name	Python Programming		
Code	3080717219		
Semester	Spring, 2nd Semester		
Contact person	Li Qi, Ma Xueting		
Language	Chinese		
Relation to curriculum	Compulsory, Professional Core Course		
Type of teaching, contact hours	Lecture method, demonstration method, group discussion method, case analysis method, laboratory experiment method, tool-assisted teaching, personalized tutoring Teaching duration: 4 hours per week, totaling 12 weeks and 48 hours in total.		
Work load	Total workload (estimated): 84 credit hours Total class hours: 48 hours Self-study hours: 36 hours, including homework and exam preparation time		
Credit points	3		
Recommended prerequisites	C Language Programming, Data Structures and Algorithms, Principles of Operating Systems		
Learning out-comes and their corresponding PLOs	Course Learning Outcomes (CLOs)	Description	Supported PLOs
	CLO1	Course Objective 1: Through this course, students will master Python's syntax conventions, program flow control, data types, functions, file and data formatting, object-oriented programming, exception handling, as well as the Python computing ecosystem and essential libraries. They will develop proficiency in applying Python's programming mindset to solve real-world problems.	**R2**
	CLO2	Course Objective 2: To cultivate students' innovative abilities and their capacity to identify, analyze, and solve problems; to apply fundamental computer knowledge and programming skills in designing solutions, constructing theoretical models, conducting practical implementations, processing data, and addressing real-world application challenges.	**R3**
	CLO3	Course Objective 3: Become proficient in using common Python development environments such as PyCharm, Anaconda, and Visual Studio Code 2022; learn program debugging techniques, perform debugging operations on code, and carry out related tasks. Development of practical projects.	**R5**

Content	Python Programming is a core professional course that introduces the Python Programming language and its applications. This course employs a teaching approach that integrates theory with practical application, enabling students to comprehend Python's programming paradigms, verify, understand, and ultimately master the knowledge acquired in class. Students will become proficient in using the Python development environment, leveraging fundamental data types—including lists, tuples, dictionaries, and sets—as well as features like list derivations and slicing to solve real-world problems; mastering Python's branching structures, loop constructs, function design, and class creation and usage; skillfully handling text and binary file operations; understanding Python debugging techniques; writing object-oriented programs; and becoming familiar with the basic usage of Python extension modules across various domains, thereby preparing them for future careers and academic pursuits. Knowledge Module 1: Overview of Python (Weight: 4/48; Level: Understanding) Knowledge Module 2: Fundamentals of Python Programming (Weight: 6/48; Level: Memory + Understanding) Knowledge Module 3: Programming Control Structures (Weight: 6/48; Level: Memory + Understanding + Application) Knowledge Module 4: Common Data Structures (Weight: 8/48; Level: Memory + Understanding + Application) Knowledge Module 5: Functions (Weight: 8/48; Level: Memory + Understanding + Application) Knowledge Module 6: Object-Oriented Programming (Weight: 8/48; Level: Memory + Understanding + Application) Knowledge Module 7: Files and Exceptions (Weight: 6/48; Level: Memory + Understanding + Application) Knowledge Module 8: Function Extension Module (Weight: 2/48; Level: Understanding + Application)
Forms of examination	The overall grade for this course consists of continuous assessment and the final examination. The grade is evaluated on a percentage scale, with 60 being the passing score for the course. The final examination is a closed-book exam with a duration of 100 minutes, accounting for 50% of the overall grade. It comprehensively assesses students' ability to learn, analyze, and solve complex problems. The continuous assessment component accounts for 50% of the overall grade and includes: (1) daily performance 15%; (2) regular assignments 15%; and (3) computer-based laboratory exercises 20%. Class participation is evaluated comprehensively based on students' contributions to class discussions, the quality of their questions and answers, their participation in group discussions, and their classroom discipline.
Study and examination requirements	Following the examination regulations, students must have selected and registered for the courses.
Reading list	[1] Python Programming, edited by Chen Chunhui, Weng Kai, and Ji Jiangmin, Zhejiang University Press, 2021 [2] Introduction to Python Programming: Experimental Guide, edited by Zheng Jiangchao, Tsinghua University Press, 2021 [3] Task-Based Tutorial on Python Programming, edited by Zhang Yingxin, Tsinghua University Press, 2021 [4] Fundamentals and Applications of Python Programming, edited by Dong Fuguo, China Machine Press, 2019 [5] He Caixia, Lü Yanan, Cen Weifu. Practice and exploration of the PBL teaching model for "Python Programming" in the context of new engineering education [J]. Journal of Zunyi Normal University, 2025,27(05):144–149.

Revision Date	V2024.1, September 2024. V2024.2, December 2025, Update: Credits and workload are calculated based on ECTS.

Introduction to Artificial Intelligence

Module name	Introduction to Artificial Intelligence		
Code	3080717245		
Semester	Fall, 3rd Semester		
Contact person	Amjad Ali Amjad, DR. AITIZAZ ALI		
Language	Chinese		
Relation to curriculum	Compulsory, Professional Core Course		
Type of teaching, contact hours	Lecture method, demonstration method, group discussion method, case analysis, laboratory experiment method Teaching duration: 4 hours per week, totaling 12 weeks and 48 hours in total.		
Work load	Total workload (estimated): 84 credit hours Teaching hours: 48 hours Self-study hours: 36 hours, including homework and exam preparation time		
Credit points	3		
Recommended prerequisites	Linear Algebra, Advanced Mathematics		
Learning out-comes and their corresponding PLOs	Course Learning Outcomes (CLOs)	Description	Supported PLOs
	CLO1	Course Objective 1: To apply mathematics, natural sciences, fundamental engineering principles, and specialized knowledge to solve complex engineering problems in artificial intelligence-related fields.	**R1**
	CLO2	Course Objective 2: To apply fundamental principles from mathematics, natural sciences, and engineering sciences to identify, articulate, and analyze complex engineering problems in artificial intelligence-related fields; to retrieve relevant information through literature review, organize, summarize, and analyze it to derive valid conclusions.	**R2**
	CLO3	Course Objective 3: When addressing complex engineering problems, students shall be able to analyze and evaluate the impacts of engineering practices on health, safety, the environment, legal considerations, and economic and social sustainability based on relevant engineering background knowledge, while understanding their associated responsibilities.	**R6**
	CLO4	Course Objective 4: To cultivate a sound political stance, worldview, outlook on life, and values; to practice the core socialist values; to develop competencies in humanities and social sciences along with a strong sense of social responsibility; and to understand and adhere to engineering ethics and standards in Artificial Intelligence practice while fulfilling professional responsibilities.	**R7**

	CLO5	Course Objective 5: Understand and master engineering management principles and decision-making methods in artificial intelligence-related fields, comprehend project life cycles, and apply them across multidisciplinary and cross-intelligence environments.	**R10**
Content	This course is a discipline with strong theoretical and practical components. Its theoretical sessions cover a wide range of fundamental principles, methods, and techniques in artificial intelligence; however, these concepts can seem abstract to students when taught solely through classroom lectures and are difficult to relate to solving real-world problems. Therefore, the teaching approach must consistently adhere to the principle of integrating theory with practice and concrete case studies. Specifically, key concepts from the textbook should be thoroughly understood and mastered by addressing specific problems in laboratory sessions, with the primary goal being to apply what has been learned practically. Knowledge Module 1: Overview of Artificial Intelligence (Weight: 2/48, Level: Understanding) Knowledge Module 2: Knowledge Representation and Reasoning (Weight: 8/48, Level: Understanding) Knowledge Module 3: Search and Inference Techniques (Weight: 12/48; Level: Memory) Knowledge Module 4: Deep Learning (Weight: 12/48, Level: Memory) Knowledge Module 5: Machine Learning and Knowledge Discovery (Weight: 14/48; Level: Applied)		
Forms of examination	The overall grade for this course consists of continuous assessment and the final examination. The grade is evaluated on a percentage scale, with 60 being the passing score for the course. The final examination is a closed-book exam with a duration of 100 minutes, accounting for 60% of the overall grade. It comprehensively assesses students' ability to learn, analyze, and solve complex problems. The continuous assessment component accounts for 40% of the overall grade and includes: (1) class participation 12%; (2) regular assignments 12%; and (3) interim tests 16%. Class participation is evaluated comprehensively based on students' contributions to class discussions, the quality of their questions and answers, their participation in group discussions, and their classroom discipline.		
Study and examination requirements	Following the examination regulations, students must have selected and registered for the courses.		
Reading list	[1] Fundamentals of Artificial Intelligence, edited by Yang Jie et al., Machinery Industry Press, 2020 [2] Principles and Methods of Artificial Intelligence, Wang Yongqing, Xi'an Jiaotong University Press, 2017 [3] Introduction to Artificial Intelligence, by Ma Shaoping and Zhu Xiaoyan, Higher Education Press, 2022 [4] Artificial Intelligence, by Nils J. Nilsson (USA), translated by Zheng Kuogen and Zhuang Yueting, Machinery Industry Press, 2018 [5] New Developments in Artificial Intelligence: From Large Models to General Intelligence [J], Wang Feiyue, Pattern Recognition and Artificial Intelligence, 2024		
Revision Date	V2024.1, September 2024. V2024.2, December 2025, Update: Credits and workload are calculated based on ECTS.		

Pattern Recognition

Module name	Pattern Recognition		
Code	3080717246		
Semester	Spring, 4th Semester		
Contact person	Li Yao, Zhao Hui		
Language	Chinese		
Relation to curriculum	Compulsory, Professional core course		
Type of teaching, contact hours	Lecture method, demonstration method, group discussion method, case analysis, laboratory experiment method Teaching duration: 3 hours per week, totaling 16 weeks and 48 hours in total.		
Work load	Total workload (estimated): 84 credit hours Total class hours: 48 hours Self-study hours: 36 hours, including homework and exam preparation time		
Credit points	3		
Recommended prerequisites	Advanced Mathematics A Ⅱ, Linear Algebra, Introduction to Artificial Intelligence		
Learning out-comes and their corresponding PLOs	Course Learning Outcomes (CLOs)	Description	Supported PLOs
	CLO1	Course Objective 1: To gain a deep understanding and mastery of the fundamental principles of Pattern Recognition. Methods and algorithms. Develop students' ability to apply their acquired knowledge to solve practical problems, including effectively processing, analyzing, and interpreting complex data.	**R1**
	CLO2	Course Objective 2: To be able to analyze complex systems based on Artificial Intelligence theory and employ scientific methods. Conduct research on engineering problems, select appropriate research approaches, design feasible experiments, analyze and interpret experimental data, and derive sound conclusions through comprehensive information synthesis. Stimulate students' innovative thinking, encourage them to explore novel algorithms and application scenarios, and lay a solid foundation for future scientific research and engineering practice.	**R4**
	CLO3	Course Objective 3: Through experiments and project-based practice, students will develop the ability to write code. The code enables Pattern Recognition algorithms, such as data processing and model training using programming languages like Python. Students are encouraged to participate in group discussions and collaborative projects to develop teamwork and communication skills, thereby enhancing their overall competence.	**R5**

	CLO4	Course Objective 4: To enable students to develop self-confidence through continuous practice and challenges. Confidence in one's ability to solve complex problems. Emphasis is placed on professional ethics and responsibility in data science and Artificial Intelligence, guiding students to develop sound values and a proper career perspective.	**R7**
Content	This course is a mandatory core professional course for undergraduate students in universities, focusing on the fields of Artificial Intelligence and Machine Learning. This is a crucial course. Its main content covers the fundamental concepts and principles of Pattern Recognition, including feature extraction and selection; provides an in-depth exploration of essential statistical methods such as linear discriminant analysis, perceptrons, and support vector machines; and introduces the basic principles and models of Deep Learning. Through this course, students will gain a thorough understanding of the fundamental principles, methods, and applications of Pattern Recognition, and acquire the skills to extract features from data, construct classifiers, and perform Pattern Recognition. The course includes application cases across various fields—such as image recognition, speech recognition, and Natural Language Processing—and through practical projects and experiments, enables students to apply learned Pattern Recognition techniques to solve real-world problems, thereby enhancing their practical skills and innovative thinking. Knowledge Module 1: Overview of Pattern Recognition and Applications (Weight: 2/48; Level: Understanding) Knowledge Module 2: Linear Classification Model (Weight: 8/48; Level: Memory + Understanding) Knowledge Module 3: Nonlinear Classification Models (Weight: 10/48; Level: Memory + Understanding + Application) Knowledge Module 4: Cluster Analysis (Weight: 10/48; Level: Memory + Understanding + Application) Knowledge Module 5: Fuzzy Pattern Recognition (Weight: 4/48; Level: Memory + Understanding + Application) Knowledge Module 6: Neural Network Recognition Theory and Models (Weight: 10/48; Level: Memory + Understanding + Application) Knowledge Module 7: Feature Extraction and Selection (Weight: 4/48; Level: Memory + Understanding + Application)		
Forms of examination	The overall grade for this course consists of continuous assessment and the final examination. The grade is evaluated on a percentage scale, with 60 being the passing score for the course. The final examination is a closed-book exam with a duration of 100 minutes, accounting for 50% of the overall grade. It comprehensively assesses students' ability to learn, analyze, and solve complex problems. The continuous assessment component accounts for 50% of the overall grade and includes: (1) daily performance 15%; (2) regular assignments 15%; and (3) computer-based laboratory exercises 20%. Class participation is evaluated comprehensively based on students' contributions to class discussions, the quality of their questions and answers, their participation in group discussions, and their classroom discipline.		
Study and examination requirements	Following the examination regulations, students must have selected and registered for the courses.		

Reading list	[1] Pattern Recognition, edited by Liu Mingtang, Electronic Industry Press, 2021,5th edition. [2] Pattern Recognition, edited by Zhang Xuegong, Tsinghua University Press, 2021. [3] Pattern Recognition, edited by Wu Chen, Machinery Industry Press, 2023. [4] Pattern Recognition, edited by Cai Limei, Tsinghua University Press, 2022. [5] Ni Zihan, Wang Mou, Yu Xianxiang, et al. Multifunctional radar operational mode recognition based on an extended long-term and short-term memory network [J]. Modern Radar, 2026,27(05):144–149.
Revision Date	V2024.1, September 2024. V2024.2, December 2025, Update: Credits and workload are calculated based on ECTS.

Principles of Database Systems

Module name	Principles of Database Systems		
Code	3080900211		
Semester	Fall, 5th Semester		
Contact person	Zhao Yuxia, Li Qi		
Language	Chinese		
Relation to curriculum	Compulsory, Professional Foundational Course		
Type of teaching, contact hours	Lecture Method, Group Discussion Method, Case Analysis Method, Simulation Experiment Method Class hours: 4 hours per week, 12 weeks in total, totaling 48 hours		
Work load	Estimated Total Workload: 84 class hours Teaching Hours: 48 hours Independent Study Hours: 36 hours, including homework, exam preparation and other self-study tasks.		
Credit points	3		
Recommended prerequisites	C Language Programming, Data Structures and Algorithms		
Learning outcomes and their corresponding PLOs	Course Learning Outcomes (CLOs)	Description	Supported PLOs
	CLO1	Master the basic concepts, relevant principles, and usage methods of relational databases; grasp the core functionalities of SQL language; understand the usage of commonly used database objects; and be proficient in commonly used database design methods.	**R1**
	CLO2	Able to create databases and their objects, and perform CRUD (Create, Read, Update, Delete) operations; capable of selecting tools based on requirements to model databases and conduct normalized database design.	**R2**
	CLO3	Through database experiments and database application system design, students' professional ethics and craftsmanship spirit are cultivated; through discussions on database security technologies, students' patriotism and sense of mission to contribute to the country through science and technology are inspired.	**R3**

Content	This course introduces and elaborates on the basic theories, fundamental techniques and methodologies of database systems. It requires students to master knowledge of relational data theory, database protection, database design and database management systems. The specific contents include: the history of database technology, data models, architecture of database systems, composition of database systems; relational databases; SQL language; relational systems and query optimization; relational data theory and normalization; database design; transactions, failure recovery and concurrency control; database security and integrity constraints.Through the study of this course, students will acquire theoretical knowledge and practical application abilities in basic database knowledge, database design, database management and maintenance. **Knowledge Modules** **Module 1:** Overview of Database SystemsWeight: 4/48Competence Level: Memorization & Comprehension **Module 2:** Relational DatabasesWeight: 4/48Competence Level: Memorization, Comprehension & Application **Module 3:** Fundamentals of SQL Server DatabaseWeight: 4/48Competence Level: Memorization & Comprehension **Module 4:** Standard Database Language SQLWeight: 24/48Competence Level: Memorization, Comprehension, Application & Analysis **Module 5:** Relational Database Design TheoryWeight: 4/48Competence Level: Memorization, Comprehension & Application **Module 6:** Database DesignWeight: 4/48Competence Level: Memorization, Comprehension, Application & Analysis **Module 7:** Database ManagementWeight: 4/48Competence Level: Memorization, Comprehension & Application
Forms of examination	The overall grade for this course consists of continuous assessment and the final examination. The grade is evaluated on a percentage scale, with 60 being the passing score for the course. The final examination is a closed-book exam with a duration of 100 minutes, accounting for 60% of the overall grade. It comprehensively assesses students' ability to learn, analyze, and solve complex problems. The continuous assessment component accounts for 40% of the overall grade and includes: (1) class participation 12%; (2) regular assignments 12%; and (3) laboratory experiments 16%. Class participation is evaluated comprehensively based on students' contributions to class discussions, the quality of their questions and answers, their participation in group discussions, and their classroom discipline.
Study and examination requirements	Following the examination regulations, students must have selected and registered for the courses.

Reading list	1.Wang Fengling. Principles and Applications of Database Systems [M]. Xidian University Press, 2022. 2.Wang Shan,Du Xiaoyong,Chen Hong. Introduction to Database Systems (6th Edition) [M]. Higher Education Press, 2023. 3.Li Guoliang, Feng Jianhua, Chai Chengliang. Database System Theory: From Fundamental Principles to System Construction[M]. Higher Education Press, 2024. 4.Wang Xuhui. Database Technology and Its Application in the Big Data Environment [J]. Information Recording Materials, 2023, 24(03). 5.Wu Dan. The Application Value and Methods of Distributed Database Technology [J]. Digital Communication World, 2023(04).
Revision Date	V2024.1, September 2024. V2024.2, December 2025, Update: Credits and workload are calculated based on ECTS.

Machine Learning

Module name	Machine Learning		
Code	3080717351		
Semester	Fall, 5th Semester		
Contact person	Yu Bin, AMEEN FADHL HASAN ALKASEM		
Language	Chinese		
Relation to curriculum	Compulsory, Professional Core Course		
Type of teaching, contact hours	Lecture method, demonstration method, group discussion method, case analysis, laboratory experiment method, tool-assisted teaching, personalized tutoring Teaching duration: 4 hours per week, totaling 16 weeks and 64 hours in total.		
Work load	Total Workload (Estimated): 112 hours Teaching hours: 64 hours Self-study hours: 48 hours, including after-class assignments, exam preparation time, etc.		
Credit points	4		
Recommended prerequisites	Advanced Mathematics, Linear Algebra, Probability and Mathematical Statistics, Python Programming, Introduction to Artificial Intelligence		
Learning out-comes and their corresponding PLOs	Course Learning Outcomes (CLOs)	Description	Supported PLOs
	CLO1	Course Objective 1: To apply the fundamental principles of mathematics, statistics, and machine learning to identify and articulate complex engineering problems in Artificial Intelligence involving data modeling, prediction, and Pattern Recognition; to conduct literature reviews and data analysis to summarize problem characteristics and derive valid conclusions, thereby providing a basis for subsequent algorithm selection and model design.	**R2**
	CLO2	Course Objective 2: To conduct research on typical tasks such as classification, regression, and clustering using machine learning theory and scientific methods; to appropriately select research approaches, design experiments for model training, validation, and evaluation, analyze and interpret experimental data, and draw well-founded conclusions about model performance and generalization capabilities through comprehensive information analysis.	**R4**
	CLO3	Course Objective 3: To systematically investigate model optimization, parameter tuning, and performance bottleneck issues using scientific research methods in Deep Learning and complex model scenarios; to design comparative experiments to evaluate the performance differences among various algorithms, hyperparameters, or network architectures; to analyze experimental results and derive reproducible, verifiable research conclusions; and to develop foundational research capabilities in machine learning problems.	**R4**

	CLO4	Course Objective 4: To select and utilize appropriate modern engineering and AI tools (e.g., Python, Scikit-learn, TensorFlow/PyTorch frameworks) to address complex machine learning challenges in Artificial Intelligence, performing data preprocessing, model development, training, prediction, and simulation; to understand the limitations of these tools and models, and appropriately evaluate their applicable scenarios and constraints.	**R5**
Content	The "Machine Learning" course is a core component of the Artificial Intelligence program, designed to provide an in-depth exploration of fundamental theories, key technologies, and practical applications of Deep Learning. The curriculum covers the construction, training, and optimization of deep neural networks, including the application of convolutional neural networks (CNNs) in image recognition, as well as the roles of recurrent neural networks (RNNs) and long short-term memory networks (LSTM) in Natural Language Processing and time series analysis. Through this course, students will learn how to design and implement complex Deep Learning models and apply them to solve real-world problems such as image classification, speech recognition, and machine translation. Emphasizing the integration of theory and practice, the course employs project-based exercises and case studies to develop students' hands-on skills and innovative thinking, laying a solid foundation for their future research and career development in artificial intelligence. Knowledge Module 1: Basic Concepts of Machine Learning (Weight: 8/64; Level: Memory + Understanding) Knowledge Module 2: Basic Methods of Machine Learning (Weight: 8/64; Level: Understanding + Application) Knowledge Module 3: Decision Trees and Classification Algorithms (Weight: 8/64; Level: Understanding + Application + Analysis) Knowledge Module 4: Cluster Analysis (Weight 8/64, Level: Understanding + Application) Knowledge Module 5: Neural Networks (Weight: 8/64; Levels: Understanding + Application + Analysis) Knowledge Module 6: Bayesian Network (Weight: 8/64; Level: Understanding + Application) Knowledge Module 7: Support Vector Machine (Weight 8/64, Level: Understanding + Application + Analysis) Knowledge Module 8: Fundamentals of Deep Learning (Weight: 8/64; Levels: Understanding + Application + Creation)		
Forms of examination	The overall grade for this course consists of continuous assessment and the final examination. The grade is evaluated on a percentage scale, with 60 being the passing score for the course. The final examination is a closed-book exam with a duration of 100 minutes, accounting for 50% of the overall grade. It comprehensively assesses students' ability to learn, analyze, and solve complex problems. The continuous assessment component accounts for 50% of the overall grade and includes: (1) daily performance 15%; (2) regular assignments 15%; and (3) computer-based laboratory exercises 20%. Class participation is evaluated comprehensively based on students' contributions to class discussions, the quality of their questions and answers, their participation in group discussions, and their classroom discipline.		
Study and examination requirements	Following the examination regulations, students must have selected and registered for the courses.		

Reading list	[1] Zhou Zhihua. Machine Learning [M]. Tsinghua University Press, 2016. [2] Christopher M.[2] Christopher M. Bishop. Pattern Recognition and Machine Learning[M]. Springer, 2006. [3] Goodfellow I, Bengio Y, Courville A. Deep Learning[M]. MIT Press, 2016. [4] He K, Zhang X, Ren S, [4] He K, Zhang X, Ren S, et al. Deep Residual Learning for Image Recognition[C]//Proceedings of the IEEE conference on Computer Vision and Pattern Recognition. 2016: 770-778. [5] Vaswani A, Shazeer N, Parmar N, [5] Vaswani A, Shazeer N, Parmar N, et al. Attention Is All You Need[C]//Advances in Neural Information Processing Systems. 2017: 5998-6008.
Revision Date	V2024.1, September 2024. V2024.2, December 2025, Update: Credits and workload are calculated based on ECTS.

Deep Learning

Module name	Deep Learning		
Code	3080717268		
Semester	Spring, 6th Semester		
Contact person	Li Yao, Li Changlong		
Language	Chinese		
Relation to curriculum	Compulsory, Professional Core Course		
Type of teaching, contact hours	Lecturing method；Demonstration method；Laboratory experimental method Teaching Hours: 4 hours per week for 12 weeks, totaling 48 hours.		
Work load	Total Workload (Estimated): 84 hours Teaching hours: 48 hours Self-study hours: 36 hours, including after-class assignments, exam preparation time, etc.		
Credit points	3		
Recommended prerequisites	Python Programming, Machine Learning, Data Structures and Algorithms		
Learning out-comes and their corresponding PLOs	Course Learning Outcomes (CLOs)	Description	Supported PLOs
	CLO1	Course Objective 1: Through the deep learning course, students will master core theories such as neural networks, gradient descent, and backpropagation, and be able to integrate foundational knowledge from mathematics, natural sciences, and engineering to address complex engineering challenges in Artificial Intelligence, including image processing, speech recognition, and natural language processing.	**R1**
	CLO2	Course Objective 2: To apply fundamental principles of mathematics and engineering science to identify and articulate complex engineering problems related to deep learning; to obtain relevant information through literature review and research; to analyze and summarize issues such as model performance, overfitting, and generalization ability; and to draw valid conclusions.	**R2**
	CLO3	Course Objective 3: To design scientific research protocols based on deep learning theory, develop experimental plans, select datasets and network architectures, train and test models, analyze and interpret experimental data, and derive sound research conclusions through information integration.	**R4**

	CLO4	Course Objective 4: To foster awareness of self-directed and lifelong learning, enable students to track cutting-edge technologies and industry trends in deep learning, independently master new models and frameworks, develop critical thinking skills and the ability to drive technological iteration, and adapt to the rapidly evolving demands of the artificial intelligence field.	**R11**
Content	This course is a core curriculum for relevant disciplines, focusing on cutting-edge technologies in the field of deep learning. It covers in-depth study of fundamental theories such as neural network architectures and backpropagation algorithms; application of deep learning frameworks like PyTorch or TensorFlow; and practical case studies of deep learning in areas including computer vision, natural language processing, and speech recognition. Through this course, students will master the fundamental principles of deep learning, develop proficiency in programming mainstream frameworks, and learn to apply Deep Learning techniques to solve real-world problems. The course aims to foster innovative thinking and practical skills, equip students with the ability to conduct sustained in-depth research in artificial intelligence, and lay a solid foundation for future professional or academic pursuits. Knowledge Module 1: Overview of Deep Learning (Weight: 2/48; Difficulty Level: Understanding) Knowledge Module 2: Fundamentals of Neural Networks and Backpropagation (Weight: 8/48; Difficulty Level: Understanding + Application) Knowledge Module 3: Convolutional Neural Network (CNN) (Weight ratio: 12/48; Difficulty Level: Application + Analysis) Module 4: Comparison between Recurrent Neural Networks (RNN) and Transformers (Weight ratio: 14/48; Difficulty Level: Application + Analysis + Implementation) Knowledge Module 5: Deep Learning Engineering Practices and Applications (Weight: 12/48; Difficulty Level: Application + Innovation)		
Forms of examination	The overall grade for this course consists of continuous assessment and the final examination. The grade is evaluated on a percentage scale, with 60 being the passing score for the course. The final examination is a closed-book exam with a duration of 100 minutes, accounting for 60% of the overall grade. It comprehensively assesses students' ability to learn, analyze, and solve complex problems. The continuous assessment component accounts for 40% of the overall grade and includes: (1) class participation 12%; (2) regular assignments 12%; and (3) interim tests 16%. Class participation is evaluated comprehensively based on students' contributions to class discussions, the quality of their questions and answers, their participation in group discussions, and their classroom discipline.		
Study and examination requirements	Following the examination regulations, students must have selected and registered for the courses.		
Reading list	[1] Deep Learning, Ian Goodfellow et al., People's Post and Telecommunications Press, 2017 [2] Deep Learning framework PyTorch, Chen Yunqian et al., Electronic Industry Press, 2022 [3] Neural Networks and Deep Learning, Qiu Xipeng, Machinery Industry Press, 2020 [4] Deep Learning Engineering Practice, by Li Mu et al., People's Posts and Telecommunications Press, 2023 [5] Advances in Natural Language Processing and Deep Learning Research [J], Tao Jianhua, Journal of Automation, 2024		
Revision Date	V2024.1, September 2024. V2024.2, December 2025, Update: Credits and workload are calculated based on ECTS.		

Artificial Intelligence Application Development Tools

Module name	Artificial Intelligence Application Development Tools		
Code	3080903333		
Semester	Fall, 5th Semester		
Contact person	Gong Aiai, Ma Xueting		
Language	Chinese		
Relation to curriculum	Compulsory, Entrepreneurship and Innovation Education Course		
Type of teaching, contact hours	Lecture method, demonstration method, group discussion method, case analysis, laboratory experiment method, tool-assisted teaching, personalized tutoring Teaching duration: 2 hours per week, totaling 16 weeks, for a cumulative period of 32 hours.		
Work load	Total workload (estimated): 84 credit hours Total class hours: 32 hours Self-study hours: 52 hours, including: homework, reference materials for expansion and improvement, exam preparation time, and tool familiarity.		
Credit points	3		
Recommended prerequisites	Linear Algebra, Advanced Mathematics, Introduction to Artificial Intelligence		
Learning outcomes and their corresponding PLOs	Course Learning Outcomes (CLOs)	Description	Supported PLOs
	CLO1	Be proficient in mainstream tools across the entire AI application development workflow, and establish a comprehensive knowledge system for the toolchain.	**R1**
	CLO2	Proficiently use development tools such as data processing, model training, and deployment debugging to complete basic development tasks.	**R3**
	CLO3	Capable of appropriately selecting and proficiently utilizing modern AI engineering tools such as development frameworks, open-source models, and debugging tools for complex AI application scenarios, enabling the completion of development tasks including model inference, program simulation, and functional testing.	**R5**
	CLO4	Master the integration methods of AI tools with front-end and back-end systems, and possess joint development capabilities.	**R6**
	CLO5	Develop capabilities in tool selection, efficiency optimization, and problem diagnosis to support both scientific research and engineering practice.	**R10**

Content	This course serves as a comprehensive training module within the dual-practice component of the Artificial Intelligence program, tailored for AI engineering application development scenarios and structured around the core sequence of "tool mastery − model deployment − functionality development − practical implementation." Utilizing mainstream AI development frameworks, open-source tools, and platforms, the course provides hands-on training that equips students with proficiency in using common AI development tools, understanding model deployment workflows, and mastering functional module development techniques. Through collaborative projects, students undertake model debugging, feature development, and solution optimization, thereby enhancing their practical ability to apply intelligent development tools in solving real-world AI engineering challenges. Knowledge Module 1: AI Development Environment and Basic Tools (Weight: 2/32, Level: Understanding) Knowledge Module 2: Data Processing and Analysis Tools (Weight: 4/32, Level: Understanding) Knowledge Module 3: Model Training and Inference Tools (Weight: 8/32, Level: Memory) Knowledge Module 4: AI System Integration and Deployment Tools (Weight: 8/32, Level: Memory) Knowledge Module 5: Industry AI Application Development Tools (Weight: 10/32, Level: Application)
Forms of examination	The overall grade for this course consists of continuous assessment and the final exam. The grade is evaluated on a percentage scale, with 60 being the passing score for the course. The final exam counts for 50% and uses a combination of course design, project implementation, and results presentation for overall evaluation. The continuous assessment component accounts for 50% of the overall grade and includes: (1) class participation 12%; (2) regular assignments 12%; and (3) interim tests (16%); (4) experiment or project process10%. Class participation is evaluated comprehensively based on students' contributions to class discussions, the quality of their questions and answers, their participation in group discussions, and their classroom discipline.
Study and examination requirements	Following the examination regulations, students must have selected and registered for the courses.
Reading list	[1] Practical Guide to Python Artificial Intelligence Development Tools, edited by Wang Song, Machinery Industry Press, 2024,1st edition. [2] Applications and Development of Artificial Intelligence Frameworks, edited by Li Zhi, Electronic Industry Press, 2022,2nd edition. [3] Fundamentals of Intelligent Application Development Technology, edited by Chen Ming, Higher Education Press, 2021,1st ed. [4] Liu Lin, Zhou Kai. Performance comparison and application research of mainstream artificial intelligence development frameworks [J]. Computer Engineering and Science, 2023,45(06):1120−1126. [5] Zhao Yang, Wu Hao. Research on Optimization of AI Application Development Based on Pre-trained Models [J]. Information Technology, 2020,44(09):56−61.
Revision Date	V2024.1, September 2024. V2024.2, December 2025, Update: Credits and workload are calculated based on ECTS.

Artificial Intelligence + Innovative Applications

Module name	Artificial Intelligence + Innovative Applications		
Code	3080903334		
Semester	Spring, 6th Semester		
Contact person	Gong Aiai, Amjad Ali Amjad		
Language	Chinese		
Relation to curriculum	Compulsory, Entrepreneurship and Innovation Education Course		
Type of teaching, contact hours	Lecture method, demonstration method, group discussion method, case analysis, project-based learning method, personalized tutoring Teaching duration: 2 hours per week, totaling 16 weeks, for a cumulative period of 32 hours.		
Work load	Total workload (estimated): 84 credit hours Total class hours: 32 hours Self-study duration: 52 hours, including: pre-class preparation, post-class review and consolidation, assignment completion, error identification and correction, supplementary resource exploration for advanced learning, summary and gap identification/addressing, and exam preparation time.		
Credit points	3		
Recommended prerequisites	Linear Algebra, Advanced Mathematics, Introduction to Artificial Intelligence		
Learning out-comes and their corresponding PLOs	Course Learning Outcomes (CLOs)	Description	Supported PLOs
	CLO1	Capable of addressing complex engineering challenges in cross-domain AI integration, developing application models tailored to industry-specific requirements, and designing functional modules, implementation solutions, and system workflows for intelligent innovative products; able to incorporate innovative concepts during the design phase while comprehensively considering safety standards, legal regulations, socio-cultural factors, and environmental considerations to create scientifically sound and compliant AI innovation solutions. 。	**R3**
	CLO2	Capable of leveraging fundamental theories of Artificial Intelligence and employing scientific research methods to investigate complex cross-disciplinary applications of AI, establishing well-defined research pathways, and designing innovative experimental protocols for validation; able to analyze experimental data and application outcomes, synthesize diverse information sources, derive scientifically valid conclusions, and possess strong capabilities in innovative applied research and analysis.	**R4**

	CLO3	Capable of fulfilling various roles—including team member and project leader—in a multidisciplinary collaborative team environment; actively listening to team members' feedback, assigning tasks appropriately, fostering mutual support, and working efficiently together to complete innovative project development; fully leveraging the advantages of teamwork while demonstrating strong collaborative skills.	**R8**
	CLO4	Demonstrates strong engineering communication and presentation skills, capable of drafting design reports and proposal documents addressing innovative AI application challenges, as well as delivering project presentations and defending research outcomes. Possesses a global perspective, able to consult foreign industry literature, comprehend cross-cultural technological differences, and possesses fundamental cross-cultural communication skills.	**R9**
	CLO5	Proficient in mastering the fundamental principles and decision-making methods of engineering management in artificial intelligence, with a clear understanding of the entire lifecycle process of innovative projects; capable of performing project planning, personnel allocation, schedule control, cost management, and other managerial tasks across multidisciplinary application scenarios, demonstrating foundational capabilities in engineering project management.	**R10**
Content	This course serves as a comprehensive training program within the dual-practice component of Artificial Intelligence education, targeting cross-disciplinary integration and innovative application scenarios in AI. It follows a structured framework encompassing "theoretical integration − innovative conceptualization − solution design − project implementation." Leveraging cutting-edge AI technologies and real-world interdisciplinary applications, the course provides hands-on training that equips students with an understanding of multi-industry integration principles in AI, innovative product design methodologies, and project development management processes. Students will learn to develop innovative concepts, create prototypes, and conduct outcome evaluations, while cultivating their innovative thinking, teamwork skills, and project management capabilities to enhance their overall practical competence in cross-domain AI innovation applications. Knowledge Module 1: Fundamentals and Industry Applications of Cross-disciplinary Integration in Artificial Intelligence (Weight: 6/32; Level: Memory + Understanding) Knowledge Module 2: Innovative Design Thinking and Solution Development in Artificial Intelligence (Weight: 7/32; Level: Understanding + Application) Knowledge Module 3: Innovative Application Experiment Design and Data Analysis Research (Weight: 7/32; Level: Applied + Analytical) Knowledge Module 4: Artificial Intelligence Project Management and Team Collaboration Development (Weight: 6/32; Level: Analysis + Evaluation) Knowledge Module 5: Integrated Innovation Project Design and Outcome Optimization Presentation (Weight: 6/32; Level: Application + Evaluation + Creation)		

Forms of examination	The overall grade for this course consists of continuous assessment and the final exam. The grade is evaluated on a percentage scale, with 60 being the passing score for the course. The final exam counts for 50% and uses a combination of course design, project implementation, and results presentation for overall evaluation. The continuous assessment component accounts for 50% of the overall grade and includes: (1) class participation 12%; (2) regular assignments 12%; and (3) interim tests (16%); (4) experiment or project process10%. Class participation is evaluated comprehensively based on students' contributions to class discussions, the quality of their questions and answers, their participation in group discussions, and their classroom discipline.
Study and examination requirements	Following the examination regulations, students must have selected and registered for the courses. This course evaluates students through a combination of regular assessments and the final exam, comprehensively assessing their ability to learn and analyze complex problems. A percentage-based evaluation system, with 60 points being the passing score for this course.
Reading list	[1] Innovative Applications and Practices of Artificial Intelligence, edited by Zhang Lei, Machinery Industry Press, 2024,1st edition. [2] Cross-disciplinary Integration and Innovative Design in Artificial Intelligence, edited by Wang Yang, Electronic Industry Press, 2022,2nd edition. [3] Engineering Project Management and Team Collaboration, edited by Li Jun, Higher Education Press, 2021,1st ed. [4] Chen Ming, Lin Da. Research on Cross-domain Innovative Applications of Artificial Intelligence in Multiple Scenarios [J]. Computer Application Research, 2023,40(07):2085−2090. [5] Wu Jie, Huang Chen. Research on Optimization of Artificial Intelligence Innovation Project Life Cycle Management [J]. Journal of Engineering Management, 2020,34(10):45−50.
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Circuit Principles

Module name	Circuit Principles		
Code	3080717353		
Semester	Fall, 3rd Semester		
Contact person	Gao Wei		
Language	Chinese		
Relation to curriculum	Elective, Professional Elective Course		
Type of teaching, contact hours	Lecture method, demonstration method, group discussion method, task-driven approach, case-based teaching method, visual illustration teaching method Teaching duration: 2 hours per week, totaling 16 weeks, for a cumulative period of 32 hours.		
Work load	Total workload (estimated): 56 credit hours Total class hours: 32 hours Self-study duration: 24 hours, including: pre-class preparation, post-class review and consolidation, assignment completion, error identification and correction, supplementary resource exploration for enhancement, summary and gap identification/addressing, and exam preparation time.		
Credit points	2		
Recommended prerequisites	Advanced Mathematics, University Physics		
Learning out-comes and their corresponding PLOs	Course Learning Outcomes (CLOs)	Description	Supported PLOs
	CLO1	Course Objective 1: To enable students to understand the applications and developmental trends of circuit theory, develop initial skills in analyzing practical circuits, design circuits according to real-world needs, integrate multidisciplinary knowledge to solve electronic circuit engineering problems, and cultivate a scientific approach characterized by enthusiasm for science and a commitment to factual accuracy.	**R1**
	CLO2	Course Objective 2: To enable students to master the fundamental methods for analyzing and calculating circuits, develop essential skills for circuit experiments, further enhance their critical thinking and analytical-computational abilities, and achieve a solid mastery of these competencies.	**R2**
	CLO3	Course Objective 3: To enable students to proficiently apply these knowledge in analyzing and solving problems at the appropriate level, fostering a rigorous, meticulous work ethic, and innovative thinking.	**R3**

	CLO4	Course Objective 4: To enable students to communicate effectively, learn from each other's strengths during the design and debugging of Circuit Principles, fully leverage individual capabilities, collaborate seamlessly to complete microcontroller projects, develop practical skills, foster innovation awareness, enhance their ability to apply microcontroller knowledge comprehensively to solve real-world engineering problems, and achieve holistic personal growth.	**R3**
Content	This course serves as a fundamental professional course for the Artificial Intelligence major and plays a crucial role within its curriculum framework. Through this course, students will gain an understanding of the significance and historical development of circuit theory in the field and related disciplines; become familiar with circuit analysis and design methodologies; master analytical and computational techniques for DC circuits, AC circuits, and circuit transient processes; develop their logical reasoning and analytical skills; and establish a solid foundation for subsequent courses such as Fundamentals of Analog Electronics, Fundamentals of Digital Electronics, and Power Electronics Technology, as well as for pursuing engineering careers related to this discipline. Knowledge Module 1: Understand and become familiar with the general steps of practical circuit analysis, and develop the concept of a physical circuit model (weight: 2/32; Level: Understanding) Module 2: Master the relationship constraints among components such as resistors, capacitors, inductors, independent sources, controlled sources, mutual inductors, and ideal transformers (weight: 4/32; difficulty level: Memory) Module 3: Master the concepts and calculation methods for parameters such as voltage, current, power, input resistance, output resistance, time constant, and power factor (weight: 8/32; Level: Applied) Knowledge Module 4: Master analytical methods such as the equivalent transformation method, systematic approaches (branch method, loop method, node method), and transform domain techniques (phasor method, Laplace transform), enabling analysis of complex linear circuits (Weight: 10/32; Level: Analysis). Knowledge Module 5: Master key circuit theorems (superposition theorem, Thevenin theorem, etc.) and apply them to circuit analysis (weight: 8/32, Level: Analysis)		
Forms of examination	The overall grade for this course consists of continuous assessment and the final examination grade. The grade is evaluated on a percentage scale, with 60 being the passing score for the course. The final examination is in the form of a course report, accounting for 60% of the overall grade. Students are required to submit a course report. The continuous assessment component accounts for 40% of the overall grade and includes: (1) class participation 12%; (2) attendance and discipline 12%; and (3) laboratory work, accounting 16% Class participation is evaluated comprehensively based on students' contributions to class discussions, the quality of their questions and answers, their participation in group discussions, and their classroom discipline.		
Study and examination requirements	Following the examination regulations, students must have selected and registered for the courses.		

Reading list	[1] Principles of Circuits (5th Edition), edited by Qiu Guanyuan, Higher Education Press, 2006 [2] Circuit Principles [M], edited by Han Dong, Shanghai Scientific and Technical Publishers, 2020. [3] Circuit Principles [M], edited by Fan Chengzhi. Machinery Industry Press, 2001 [4] Fundamentals of Intelligent Hardware Circuit Design, edited by Li Tao, Machinery Industry Press, 2021,1st ed. [5] Zhang Heng, Liu Jie. Optimal design of low-power circuits for smart hardware [J]. Electronic Technology Applications, 2023,49(09):78−83.
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Signals and Systems

Module name	Signals and Systems		
Code	3080717254		
Semester	Fall, 3rd Semester		
Contact person	Gao Wei		
Language	Chinese		
Relation to curriculum	Elective, Professional Elective Course		
Type of teaching, contact hours	Lecture method, demonstration method, case-based teaching, project-based learning approach Teaching duration: 2 hours per week, totaling 16 weeks, for a cumulative period of 32 hours.		
Work load	Total workload (estimated): 56 credit hours Total class hours: 32 hours Self-study duration: 24 hours, including: pre-class preparation, post-class review and consolidation, assignment completion, error identification and correction, supplementary resource exploration for enhancement, summary and gap identification/addressing, and exam preparation time.		
Credit points	2		
Recommended prerequisites	Advanced Mathematics, Linear Algebra		
Learning outcomes and their corresponding PLOs	Course Learning Outcomes (CLOs)	Description	Supported PLOs
	CLO1	Course Objective 1: Through the study of Signals and Systems, students will acquire a fundamental understanding of continuous-time and discrete-time Signals and Systems, and develop their ability to analyze, design, and simulate signals and linear systems.	**R2**
	CLO2	Course Objective 2: Through this course, students will master the fundamental analytical methods for linear time-invariant systems and develop their ability to analyze and solve problems.	**R2**
	CLO3	Course Objective 3: Through this course, students will master systematic analysis methods in the time domain, frequency domain, and complex frequency domain, while developing independent learning skills and engineering application capabilities.	**R6**
	CLO4	Course Objective 4: To master Fourier series, Fourier transform, Laplace transform, and Z-transform, thereby enhancing students' competencies, fostering their innovative thinking, developing their ability to comprehensively apply microcontroller knowledge in solving practical engineering problems, and promoting overall personal development.	**R4**

Content	This course builds upon advanced mathematics, linear algebra, and complex functions, establishing essential theoretical foundations for analyzing continuous and discrete signals as well as linear systems in the time, frequency, and complex domains—key prerequisites for subsequent courses such as Digital Signal Processing, digital image processing, intelligent sensing, and machine learning. It serves as a compulsory core course designed to cultivate signal processing and system analysis capabilities in Artificial Intelligence programs. Knowledge Module 1: Overview of Continuous and Discrete Time Signals and Systems (Weight: 2/32; Level: Understanding) Knowledge Module 2: Fundamental Analysis Methods for Linear Time-Invariant Systems (Weight: 4/32; Level: Memory) Knowledge Module 3: System Analysis Methods in the Time Domain, Frequency Domain, and Complex Frequency Domain (Weight: 8/32; Level: Analysis) Knowledge Module 4: Fourier Series and Fourier Transform (Weight: 10/32, Level: Applied) Knowledge Module 5: Laplace Transform and Z Transform (Weight: 8/32, Level: Applied)
Forms of examination	The overall grade for this course consists of continuous assessment and the final examination grade. The grade is evaluated on a percentage scale, with 60 being the passing score for the course. The final examination is in the form of a course report, accounting for 60% of the overall grade. Students are required to submit a course report. The continuous assessment component accounts for 40% of the overall grade and includes: (1) class participation 12%; (2) attendance and discipline 12%; and (3) laboratory work, accounting 16% Class participation is evaluated comprehensively based on students' contributions to class discussions, the quality of their questions and answers, their participation in group discussions, and their classroom discipline.
Study and examination requirements	Following the examination regulations, students must have selected and registered for the courses.
Reading list	[1] Signals and Systems, edited by Zheng Junli, Higher Education Press, 2023,4th edition. [2] Digital Signal Processing [M], edited by Gao Xiquan, Xi'an University of Electronic Science and Technology Press, 2017 [3] Practical Tutorial on Signals and Systems, edited by Zhang Min, Electronic Industry Press, 2022,2nd edition. [4] Fundamentals of Signal Processing in Intelligent Systems, edited by Liu Hao, Machinery Industry Press, 2021,1st ed. [5] Li Ran, Guo Kai. Signal optimization processing techniques for intelligent sensing systems [J]. Modern Electronic Technology, 2020,43(15):67–71.
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Natural Language Processing

Module name	Natural Language Processing		
Code	3080717272		
Semester	Fall, 3rd Semester		
Contact person	Zhou Xuan, Lin Shulan		
Language	Chinese		
Relation to curriculum	Elective , Professional Elective Course		
Type of teaching, contact hours	Teaching methods include lectures, case studies, algorithm explanations, problem discussions, group debates, classroom presentations, experimental exercises, programming implementations, and course projects. Teaching duration: 2 hours per week, totaling 16 weeks and 32 hours in total.		
Work load	Total workload: 56 credit hours Total class hours: 32 hours Self-study duration: 24 hours, including post-class reading, programming exercises, experiment preparation, report writing, and assessment review.		
Credit points	2		
Recommended prerequisites	Python Programming, Data Structures and Algorithms, Probability and Mathematical Statistics, Machine Learning		
Learning out-comes and their corresponding PLOs	Course Learning Outcomes (CLOs)	Description	Supported PLOs
	CLO1	Understand the fundamental tasks, typical workflows, and key concepts of Natural Language Processing; master essential techniques such as text representation, tokenization, part-of-speech tagging, and syntactic analysis; and apply these skills to analyze specific problems.	R2
	CLO2	Proficient in using Python and common Natural Language Processing tools and frameworks for corpus preprocessing, feature engineering, model training, result evaluation, and error analysis; possesses the ability to apply modern tools to solve practical problems.	R4
	CLO3	Be capable of designing well-structured processing workflows or model architectures for tasks such as text classification, sentiment analysis, named entity recognition, machine translation, or question answering, and implementing and optimizing them according to specific task requirements.	R7

	CLO4	The ability to compare and analyze the effectiveness of various Natural Language Processing methods through experiments, to review relevant literature and interpret experimental results, and to formulate well-structured experimental conclusions along with improvement recommendations.	R7
Content	This course is a specialized program within the Artificial Intelligence discipline, primarily designed for applications in text information processing and language intelligence. It follows a structured framework encompassing "text acquisition − language analysis − model construction − task application." The curriculum systematically covers fundamental concepts of Natural Language Processing, Chinese-specific information processing methods, classical machine learning approaches, deep learning techniques, and the practical implementation of pre-trained language models, enabling students to understand the evolution of Natural Language Processing from rule-based methods to data-driven approaches and ultimately to large-scale model architectures. Through a combination of theoretical instruction and hands-on exercises, students will master essential processes including text preprocessing, feature representation, sequence labeling, text classification, sentiment analysis, and generative tasks, while developing skills to select appropriate models, design experiments, analyze results, and refine solutions for specific applications. The course emphasizes the integration of theory with practice, focusing on cultivating students' ability to apply AI technologies to real-world language data processing challenges. Knowledge Module 1: Overview of Natural Language Processing and Text Representation (Weight: 4/32; Level: Understanding) Knowledge Module 2: Chinese Word Segmentation, Part-of-Speech Tagging, and Basic Syntax Analysis (Weight: 6/32; Level: Understanding + Application) Knowledge Module 3: Text Feature Engineering and Classic Natural Language Processing Methods (Weight: 8/32; Level: Applied + Analytical) Module 4: Deep Learning and Pre-trained Language Models (Weight: 8/32; Level: Analysis + Evaluation) Knowledge Module 5: Comprehensive Experiments and Practical Applications in Natural Language Processing (Weight: 6/32; Level: Applied + Creative)		
Forms of examination	The overall grade for this course consists of continuous assessment and the final examination grade. The grade is evaluated on a percentage scale, with 60 being the passing score for the course. The final examination is in the form of a course report, accounting for 60% of the overall grade. Students are required to submit a course report. The continuous assessment component accounts for 40% of the overall grade and includes: (1) class participation 12%; (2) regular assignments 12%; and (3) interim tests 16%. Class participation is evaluated comprehensively based on students' contributions to class discussions, the quality of their questions and answers, their participation in group discussions, and their classroom discipline.		

Study and examination requirements	Following the examination regulations, students must have selected and registered for the courses.
Reading list	[1]Jacob Eisenstein. Introduction to Natural Language Processing. MIT Press, 2019. [2] Delip Rao, Brian McMahan. Natural Language Processing with PyTorch. O′ Reilly Media, 2019. [3] Zong Chengqing. Statistical Natural Language Processing (2nd ed.). Tsinghua University Press, 2013. [4] Devlin J, Chang M W, Lee K, [4] Devlin J, Chang M W, Lee K, et al. BERT: Pre-training of Deep Bidirectional Transformers for Language Understanding[C]//Proceedings of NAACL-HLT. 2019: 4171-4186. [5] Tao Jianhua, Huang Tiejun. Research Progress in Natural Language Understanding for General Artificial Intelligence [J]. Journal of Automatic Chemistry, 2024.
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Linux System Programming

Module name	Linux System Programming		
Code	3080717356		
Semester	Fall, 3rd Semester		
Contact person	Zhang Liping, Zhang Xiaohong		
Language	Chinese		
Relation to curriculum	Elective, Professional Elective Course		
Type of teaching, contact hours	Lecturing method；Demonstration method；Laboratory experimental method Teaching Hours: 4 hours per week for 8 weeks, totaling 32 hours		
Work load	Total Workload (Estimated): 56 hours Teaching hours: 32 hours Self-study hours: 24 hours, including after-class assignments, exam preparation time, etc.		
Credit points	2		
Recommended prerequisites	C Language Programming		
Learning out-comes and their corresponding PLOs	Course Learning Outcomes (CLOs)	Students will master the knowledge and skills required for Linux, gain in-depth understanding of tasks, issues, and solutions in Linux practice.	Supported PLOs
	CLO1	Course Objective 1: Understand the fundamental characteristics, advantages, and applications of the Linux operating system across various scenarios; master core commands and functions of Linux, and proficiently use common commands for system management and maintenance; gain an in-depth understanding of shell script development and execution, enabling you to write simple shell scripts for automating routine tasks.	**R2**
	CLO2	Course Objective 2: Enable students to master the core technologies of Linux System Programming, select appropriate techniques, resources, and modern engineering tools to solve complex engineering problems in Artificial Intelligence, perform problem prediction and simulation, and understand the limitations of available tools and methods.	**R5**
	CLO3	Course Objective 3: To foster students' interest and passion for the Linux operating system, stimulating their desire for proactive learning and exploration; to guide them in developing a rigorous and meticulous work attitude with emphasis on quality and efficiency; and to cultivate teamwork spirit and collaboration skills enabling them to complete project tasks collaboratively.	**R8**

Content	This course provides a step-by-step introduction to Linux system fundamentals, beginning with setting up a Linux environment and mastering the basics of the Vim editor. It covers essential and advanced file operations, file security mechanisms, advanced system commands, user and group management, culminating in an in-depth exploration of core Shell programming concepts such as variables, branching, looping, and functions. The curriculum progresses from foundational understanding to comprehensive application skills and engineering analysis capabilities. Knowledge Module 1: Linux Environment Installation and VIM Usage (Weight: 4/32; Level: Understanding) Knowledge Module 2: Fundamentals of Linux File Operations (Weight: 4/32; Level: Understanding + Application) Knowledge Module 3: Advanced Linux File Operations (Weight: 4/32; Level: Understanding + Application + Analysis) Knowledge Module 4: Linux File Security (Weight: 4/32; Level: Understanding + Application) Knowledge Module 5: Advanced Linux Operations (Weight: 4/32; Level: Application + Analysis) Knowledge Module 6: User and User Group Management (Weight: 4/32; Level: Understanding + Application) Knowledge Module 7: Shell Programming (Variables, Branching, Loops, Functions) (Weight: 4/32; Level: Application + Analysis) Knowledge Module 8: Practical Linux Engineering Cases (Weight: 4/32; Level: Applied + Analytical)
Forms of examination	The overall grade for this course consists of continuous assessment and the final examination grade. The grade is evaluated on a percentage scale, with 60 being the passing score for the course. The final examination is in the form of a course report, accounting for 60% of the overall grade. Students are required to submit a course report. The continuous assessment component accounts for 40% of the overall grade and includes: (1) class participation 12%; (2) regular assignments 12%; and (3) interim tests 16%. Class participation is evaluated comprehensively based on students' contributions to class discussions, the quality of their questions and answers, their participation in group discussions, and their classroom discipline.
Study and examination requirements	Following the examination regulations, students must have selected and registered for the courses.
Reading list	[1] Linux Operating System (4th Edition), Shao Guojin, Zhang Na, Electronic Industry Press, May 2022 [2] "Deep Understanding of the Linux Kernel (Third Edition)" by Bove and Sist, China Electric Power Press, January 2017 [3] Linux Operating System (Micro-Lecture Edition) (2nd Edition), Yang Yun, Tsinghua University Press, January 2023 [4] Fundamentals of Linux and Service Management (Based on CentOS 7.6), Tang Qianlin, Li Xianyun, People's Posts and Telecommunications Press, 2019 [5] Principles and Applications of the Linux Operating System, by Zhang Ling and Zhou Xu, Xi'an University of Electronic Science and Technology Press, April 2017

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Digital Signal Processing

Module name	Digital Signal Processing		
Code	3080717255		
Semester	Fall, 3rd Semester		
Contact person	Zhao Dandan, Li Qihua		
Language	Chinese		
Relation to curriculum	Elective, Professional Elective Course		
Type of teaching, contact hours	Teaching methods include lecture-based instruction, case studies, questioning, inquiry-based learning, group discussions, project-based practice, and computer lab experiments. Teaching duration: 4 hours per week, totaling 8 weeks, for a cumulative period of 32 hours.		
Work load	Total workload (estimated): 56 credit hours Total class hours: 32 hours Self-study duration: 24 hours, including: pre-class preparation, post-class review and consolidation, assignment completion, error identification and correction, supplementary resource exploration for enhancement, summary and gap identification/addressing, and exam preparation time.		
Credit points	2		
Recommended prerequisites	Advanced Mathematics, Linear Algebra, Signals and Systems		
Learning outcomes and their corresponding PLOs	Course Learning Outcomes (CLOs)	Description	Supported PLOs
	CLO1	Course Objective 1: Acquire the fundamental mathematical and theoretical knowledge required for Digital Signal Processing, and be capable of applying signal processing theory to describe and analyze solutions for practical systems. Through studying sampling theories in the time and frequency domains, understand the intrinsic relationships between continuous and discrete signals, as well as periodic and non-periodic signals; develop analytical skills in Digital Signal Processing; and apply basic principles and engineering methods to describe and design complex engineering problems.	**R2**
	CLO2	Course Objective 2: Develop the ability to apply mathematical, natural science, engineering fundamentals, and specialized knowledge to analyze signal-related problems in practical engineering applications. Master the discrete Fourier transform and its fast algorithms; understand the common architectures of digital filters and their fundamental design principles; grasp the physical concepts underlying filter parameters; and conduct solution analysis for real-world engineering challenges.	**R4**

	CLO3	Course Objective 3: Develop the ability to analyze and design signal processing algorithms using the MATLAB platform. Demonstrate proficiency in applying the DFT for signal spectrum analysis, designing IIR and FIR filters, analyzing filter responses, constructing frame-based signal processing experimental systems, and cultivating comprehensive skills for solving practical engineering problems.	**R7**
Content	This course is one of the most essential foundational courses for majors in electronic and electrical information fields such as Communication Engineering, Electronic Information Engineering, and Information Engineering. It establishes a comprehensive theoretical framework for analyzing discrete signals and systems, along with corresponding system models; provides systematic and effective approaches for signal and system analysis from multiple perspectives, including the time domain and transform domains; and introduces various design and calculation methods for filters. Digital Signal Processing is a discipline with strong theoretical and engineering dimensions. The course emphasizes the close integration of its theory with practical engineering applications, enabling students to gain a deep understanding of the core principles and essence of signal processing. Knowledge Module 1: Overview of Digital Signal Processing (Weight: 1/32, Level: Understanding) Knowledge Module 2: Discrete-Time Signals and Systems (Weight: 2/32, Level: Understanding) Knowledge Module 3: Fourier Transform and Spectral Analysis (Weight: 2/32; Level: Understanding + Application) Module 4: Discrete Fourier Transform (DFT) and Fast Algorithms (Weight: 2/32; Level: Applied + Analytical) Knowledge Module 5: Infinite Impulse Response (IIR) Filters (Weight: 2/32; Level: Application + Analysis) Knowledge Module 6: Finite Impulse Response (FIR) Filters (Weight: 2/32; Level: Application + Analysis) Module 7: Hilbert Transform and Multirate Signal Processing (Weight: 2/32; Level: Understanding + Application) Knowledge Module 8: Z Transformation (Weight 4/32, Level: Application + Analysis) Module 9: Digital Filter Design for Infinite Impulse Response (Weight: 5/32; Level: Application + Evaluation) Knowledge Module 10: Signal Analysis and Detection Based on DFT (Weight: 5/32; Level: Applied + Evaluation) Knowledge Module 11: Filter-Based Signal Processing Techniques (Weight: 5/32; Level: Application + Evaluation)		
Forms of examination	The overall grade for this course consists of continuous assessment and the final examination grade. The grade is evaluated on a percentage scale, with 60 being the passing score for the course. The final examination is in the form of a course report, accounting for 70% of the overall grade. Students are required to submit a course report. The continuous assessment component accounts for 30% of the overall grade and includes: (1) class participation 10%; (2) regular assignments 10%; and (3) interim tests 10%. Class participation is evaluated comprehensively based on students' contributions to class discussions, the quality of their questions and answers, their participation in group discussions, and their classroom discipline.		
Study and examination requirements	Following the examination regulations, students must have selected and registered for the courses.		

Reading list	[1] Digital Signal Processing: Theory and Applications, edited by Yu Yibiao and Sun Bing, Southeast University Press, 2021,4th edition. [2] Discrete-Time Signal Processing (3rd), Alan V. Oppenheim, Ronald W. Schafer. Electronic Industry Press, 2011. [3] Fundamentals of Digital Signal Processing，Joyce Van de Vegte，Prentice Hall, 2002 [4] Principles and Implementation of Digital Signal Processing, edited by Wu Zhenyang, Southeast University Press, 1997. [5] Introduction to Digital Signal Processing, edited by Hu Guangshu, Tsinghua University Press, 2013,2nd edition.
Revision Date	V2024.1, September 2024. V2024.2, December 2025, Update: Credits and workload are calculated based on ECTS.

Construction and Application of Knowledge Graphs

Module name	Construction and Application of Knowledge Graphs		
Code	3080717248		
Semester	Spring, 6th Semester		
Contact person	Zhao Hui, Li Changlong		
Language	Chinese		
Relation to curriculum	Elective, Professional Elective Course		
Type of teaching, contact hours	Lecture-based teaching, case study instruction, inquiry-based problem learning, group discussions, and project-based practice Teaching duration: 4 hours per week, totaling 8 weeks, for a cumulative period of 32 hours.		
Work load	Total workload (estimated): 56 credit hours Total class hours: 32 hours Self-study duration: 24 hours, including: pre-class preparation, post-class review and consolidation, assignment completion, error identification and correction, supplementary resource exploration for enhancement, summary and gap identification/addressing, and exam preparation time.		
Credit points	2		
Recommended prerequisites	Data Structures and Algorithms, Python Programming, Data Structures and Algorithms, Machine Learning		
Learning out-comes and their corresponding PLOs	Course Learning Outcomes (CLOs)	Description	Supported PLOs
	CLO1	Course Objective 1: Master the fundamental concepts, architectural framework, and construction process of knowledge graphs; understand core principles such as knowledge representation, ontology modeling, and entity linking; and enhance awareness of data intelligence and technological innovation by integrating domestic large-scale models with advancements in knowledge engineering.	**R2**
	CLO2	Course Objective 2: Master knowledge extraction, integration, storage, and reasoning methods; be capable of designing ontologies and constructing knowledge graphs according to requirements; and possess the ability to analyze and design knowledge graph system solutions.	**R3**
	CLO3	Course Objective 3: To utilize mainstream tools for constructing, visualizing, and developing knowledge graphs, enabling comprehensive implementation across the entire data–knowledge–intelligent service workflow with strong engineering application capabilities.	**R5**
	CLO4	Course Objective 4: Complete data governance, graph construction, and system debugging in team projects; foster effective communication and collaboration; and develop innovative thinking and the ability to solve complex engineering problems.	**R10**

Content	This course addresses the talent demands in artificial intelligence, big data, and intelligent information processing by systematically covering knowledge graph lifecycle technologies, enabling students to master knowledge representation, ontology engineering, knowledge extraction and integration, graph storage, knowledge reasoning, and industry applications. Through a combination of theoretical instruction and practical projects, it cultivates expertise in knowledge engineering and intelligent system applications while enhancing capabilities in data governance and innovative design. Knowledge Module 1: Overview of Knowledge Graph (Weight: 2/32, Level: Understanding) Knowledge Module 2: Knowledge Representation and Ontology Modeling (Weight: 4/32; Level: Understanding + Application) Knowledge Module 3: Knowledge Extraction and Knowledge Fusion (Weight: 8/32; Levels: Understanding + Application + Analysis) Knowledge Module 4: Knowledge Storage, Reasoning, and Query (Weight: 12/32; Levels: Understanding + Application + Analysis) Knowledge Module 5: Knowledge Graph Tools and Industry Applications (Weight: 6/32; Level: Application + Analysis + Creation)
Forms of examination	The overall grade for this course consists of continuous assessment and the final examination grade. The grade is evaluated on a percentage scale, with 60 being the passing score for the course. The final examination is in the form of a course report, accounting for 60% of the overall grade. Students are required to submit a course report. The continuous assessment component accounts for 40% of the overall grade and includes: (1) class participation 12%; (2) regular assignments 12%; and (3) interim tests 16%. Class participation is evaluated comprehensively based on students' contributions to class discussions, the quality of their questions and answers, their participation in group discussions, and their classroom discipline.
Study and examination requirements	Following the examination regulations, students must have selected and registered for the courses.
Reading list	[1] Knowledge Graph: Methods, Practices, and Applications, Wang Haofen et al., Electronic Industry Press, 2020 [2] Knowledge Graphs and Deep Learning, Liu Zhiyuan et al., Tsinghua University Press, 2022 [3] Introduction to Knowledge Graphs, Chen Huajun, Electronic Industry Press, 2021 [4] Construction and Practical Application of Knowledge Graphs, by Xiao Yanghua et al., China Machine Press, 2023 [5] Sun Yu, Liu Chuan, Zhou Yang. Research progress on knowledge graph construction and reasoning driven by Deep Learning [J]. Computer Engineering and Applications, 2025
Revision Date	V2024.1, September 2024. V2024.2, December 2025, Update: Credits and workload are calculated based on ECTS

Data Mining and Analysis

Module name	Data Mining and Analysis		
Code	3080717251		
Semester	Spring, 6th Semester		
Contact person	Fang Xiaoxue, Zhao Hui		
Language	Chinese		
Relation to curriculum	Elective , Professional Elective Course		
Type of teaching, contact hours	Lecture method, case-based teaching, questioning, inquiry-based learning, group discussions, project-based practice Teaching Hours: 4 hours per week for 8 weeks, totaling 32 hours		
Work load	Total workload (estimated): 56 hours Teaching hours: 32 hours Self-study hours: 24 hours, including: pre-class preparation, post-class review and consolidation, assignment completion, error identification and correction, supplementary resource exploration for enhancement, summary and gap identification/addressing, and exam preparation time.		
Credit points	2		
Recommended prerequisites	Introduction to Artificial Intelligence Majors, Introduction to Artificial Intelligence, Pattern Recognition, Machine Learning, Deep Learning		
Learning out-comes and their corresponding PLOs	Course Learning Outcomes (CLOs)	Description	Supported PLOs
	CLO1	Course Objective 1: To ensure that students, through the study of the Data Mining and Analysis course, acquire the essential theories, core algorithms, and practical engineering skills required in the fields of data mining and machine learning, thereby laying a solid foundation for future data analysis applications and scientific research.	**R4**
	CLO2	Course Objective 2: Students will be able to apply knowledge of data mining and machine learning, combined with modern data analysis tools and information technology, to effectively predict, simulate, and solve complex data engineering problems, while recognizing the limitations of the algorithms, tools, and techniques employed.	**R5**
	CLO3	Course Objective 3: Through in-depth study of Data Mining and Analysis techniques, students will acquire fundamental knowledge, standards, and specifications in the field of data engineering; be capable of conducting thorough analyses of project data collection, preprocessing, modeling, and deployment strategies based on this knowledge to evaluate their feasibility and effectiveness; comprehensively consider the impact of solutions on various aspects, including society, health, safety, legal considerations, and culture; and clearly understand their responsibilities within data engineering practice.	**R6**

Content	Data mining is a core tool in data science research, widely applied in fields such as natural sciences, e-commerce, and artificial intelligence. This technology targets multivariate statistical populations, efficiently processes massive multidimensional datasets without requiring additional dimensionality reduction, and represents a typical comprehensive analytical approach for multiple variables. Centered on data mining and machine learning, the course systematically covers essential skills, including data preprocessing, classification, clustering, and association rule mining, equipping learners with the ability to execute practical data mining tasks using specialized tools and laying a solid foundation for data analysis and model application in the field of artificial intelligence. Knowledge Module 1: Overview of Data Mining (Weight: 4/32; Levels: Memory, Understanding, Application) Knowledge Module 2: Data and Data Platforms (Weight: 4/32; Levels: Memory, Understanding, Application) Knowledge Module 3: Data Preprocessing and Feature Engineering (Weight: 4/32; Levels: Memory, Understanding, Application) Knowledge Module 4: Correlation Analysis (Weight: 4/32; Levels: Memory, Understanding, Application) Knowledge Module 5: Decision Trees (Weight: 4/32; Levels: Memory, Understanding, Application) Knowledge Module 6: Integrated Learning (Weight: 4/32; Levels: Memory, Understanding, Application) Knowledge Module 7: Bayesian Classification (Weight: 4/32; Levels: Memory, Understanding, Application) Knowledge Module 8: Neural Networks and Deep Learning (Weight: 4/32; Levels: Memory, Understanding, Application)
Forms of examination	The overall grade for this course consists of continuous assessment and the final examination grade. The grade is evaluated on a percentage scale, with 60 being the passing score for the course. The final examination is in the form of a course report, accounting for 60% of the overall grade. Students are required to submit a course report. The continuous assessment component accounts for 40% of the overall grade and includes: (1) class participation 12%; (2) regular assignments 12%; and (3) interim tests 16%. Class participation is evaluated comprehensively based on students' contributions to class discussions, the quality of their questions and answers, their participation in group discussions, and their classroom discipline.
Study and examination requirements	Following the examination regulations, students must have selected and registered for the courses.
Reading list	[1] Data Mining and Machine Learning, authored by Xu Xueqi and Xu Aiting, Tsinghua University Press, August 2025,1st edition [2] Python Data Analysis and Mining, by Xu Qin and Liu Zhijun, Huazhong University of Science and Technology Press, January 2024,1st edition [3] Concepts and Techniques of Data Mining, by Han Jiawei, Machinery Industry Press, July 2025,1st edition [4] Practical Data Analysis and Mining with Python, by Zhang Liangjun, Mechanical Industry Press, December 2019,2nd edition [5] Statistical Learning Methods, by Li Hang, Tsinghua University Press, May 2019,2nd edition
Revision Date	V2024.1, September 2024. V2024.2, December 2025, Update: Credits and workload are calculated based on ECTS.

Principles and Applications of Microcontrollers

Module name	Principles and Applications of Microcontrollers		
Code	3080717256		
Semester	Spring , 6th Semester		
Contact person	Zhang Liping		
Language	Chinese		
Relation to curriculum	Elective, Professional Elective Course		
Type of teaching, contact hours	Lecturing method；Demonstration method；Laboratory experimental method Teaching Hours: 4 hours per week for 8 weeks, totaling 32 hours		
Work load	Total Workload (Estimated): 56 hours Teaching hours: 32 hours Self-study hours: 24 hours, including after-class assignments, exam preparation time, etc.		
Credit points	2		
Recommended prerequisites	Analog Circuits and Digital Circuits, C Language Programming, Circuit Principles		
Learning outcomes and their corresponding PLOs	Course Learning Outcomes (CLOs)	Master embedded system and STM32-related technologies, and possess capabilities in system analysis, design, debugging and tool application.	Supported PLOs
	CLO1	Understand the current state and technological trends of embedded systems, master essential knowledge, including the fundamental architecture of typical embedded systems, common peripherals, and basic development techniques. Apply mathematical and engineering principles to comprehend, analyze, and solve common complex engineering challenges in AI-driven embedded applications, thereby establishing a solid foundation for practical implementation.	**R1**
	CLO2	Through course case studies and hands-on practical training, students will be able to design functional modules for microcontrollers, write basic code, and debug systems tailored to practical requirements such as simple smart devices and AI terminals. The designs will prioritize stability, security, and usability, enabling the development of viable embedded control solutions that can operate effectively in real-world scenarios.	**R3**
	CLO3	Guide students to proactively consider practical factors such as power consumption control, resource efficiency, environmental compatibility, and operational safety in microcontroller development and device applications; understand the actual impacts of embedded technology applications on the environment and society; and cultivate a responsible engineering design mindset that emphasizes energy conservation, environmental protection, and alignment with sustainable development requirements.	**R6**

	CLO4	Master the entire workflow of small-scale microcontroller development projects, including task decomposition, development sequencing, and monitoring debugging and testing acceptance; demonstrate collaboration within team settings by allocating responsibilities, managing timelines, and ensuring product quality; and be capable of executing standard embedded system projects along with fundamental coordination management.	**R10**
Content	This course covers the principles and methodologies of Embedded System Design, providing a comprehensive overview of the development process. Focusing on the STM32 series of ARM chips, it explains system architecture and operating principles, enabling students to master development techniques for STM32 and ARM Cortex-M cores, become proficient with MDK and PROTEUS tools, and develop practical skills in embedded system development and engineering. Knowledge Module 1: Overview of Embedded Systems (Weight: 1/32; Level: Understanding) Knowledge Module 2: ARM Cortex-M Architecture (Weight: 2/32; Level: Understanding + Application) Knowledge Module 3: STM32 Microcontroller (Weight: 4/32; Level: Understanding + Application + Analysis) Knowledge Module 4: Application Engineering Implementation (Weight: 4/32; Level: Understanding + Application) Knowledge Module 5: GPIO (Weight: 6/32; Levels: Application + Analysis) Knowledge Module 6: Interrupts (Weight: 3/32; Level: Understanding + Application) Knowledge Module 7: Clock Systems and Timer Systems (Weight: 4/32; Level: Application + Analysis) Knowledge Module 8: DMA Controller and USART (Weight: 4/32; Level: Application + Analysis) Knowledge Module 9: ADC and DAC (Weight: 4/32; Level: Application + Analysis)		
Forms of examination	The overall grade for this course consists of continuous assessment and the final examination grade. The grade is evaluated on a percentage scale, with 60 being the passing score for the course. The final examination is in the form of a course report, accounting for 60% of the overall grade. Students are required to submit a course report. The continuous assessment component accounts for 40% of the overall grade and includes: (1) class participation 12%; (2) regular assignments 12%; and (3) interim tests 16%. Class participation is evaluated comprehensively based on students' contributions to class discussions, the quality of their questions and answers, their participation in group discussions, and their classroom discipline.		
Study and examination requirements	Following the examination regulations, students must have selected and registered for the courses.		

Reading list	[1] Principles and Development of Embedded Systems, by Lai Shuming, Electronic Industry Press, 2021,1st ed. [2] Principles and Design Implementation of Embedded Operating Systems, Yan Hairong, Tsinghua University Press, 2023 [3] Principles and Applications of Embedded Microprocessors — Based on the ARM Cortex-M3 Microcontroller (STM32 Series), by Yan Hairong et al., Tsinghua University Press, 2014 [4] ARM Cortex-M3 Embedded Development and Applications (STM32 Series), by Zhang Xinmin et al., Tsinghua University Press, 2016 [5] Principles and Applications of Embedded Systems — Based on the ARM Cortex-M3 Core in the STM32F103 Microcontroller Series, by Wang Yihan et al., Tsinghua University Press, 2016 [6] Embedded Real-Time Operating System μC/OS-II (2nd Edition), Jean J. Labrosse, Beijing University of Aeronautics and Astronautics Press, 2003
Revision Date	V2024.1, September 2024. V2024.2, December 2025, Update: Credits and workload are calculated based on ECTS.

Computer Vision

Module name	Computer Vision		
Code	3080717222		
Semester	Spring, 6th Semester		
Contact person	Zhu Min, Zhou Meihong		
Language	Chinese		
Relation to curriculum	Elective, Professional Elective Course		
Type of teaching, contact hours	Lecture method, case-based teaching, questioning, inquiry-based learning, group discussions, project-based practice Teaching Hours: 2 hours per week for 16 weeks, totaling 32 hours.		
Work load	Total workload (estimated): 56 hours Teaching hours: 32 hours Self-study hours: 24 hours, including after-class assignments, exam preparation time, etc.		
Credit points	2		
Recommended prerequisites	Introduction to Artificial Intelligence, Python Programming		
Learning out-comes and their corresponding PLOs	Course Learning Outcomes (CLOs)	Description	Supported PLOs
	CLO1	Master the fundamental theories and engineering principles of Computer Vision, enabling one to identify and analyze complex engineering problems in the visual domain by leveraging mathematical and professional expertise; develop scientific analytical conclusions through literature review and synthesis, thereby cultivating critical thinking skills for addressing engineering challenges.	**R2**
	CLO2	Master classical visual algorithms and deep learning-based visual methods; capable of designing visual functionality solutions and model workflows tailored to practical application requirements, integrating innovative design thinking while considering engineering factors such as safety, compliance, and social impact.	**R3**

	CLO3	Master scientific research methodologies in the field of Computer Vision, capable of independently designing and validating experiments, analyzing and interpreting model training data and experimental results, comprehensively evaluating them to derive valid research conclusions, and possessing specialized research capabilities.	**R4**
	CLO4	Proficient in mainstream visual development tools, frameworks, and dataset resources; capable of performing visual model training, simulation, and engineering validation; with a clear understanding of the application scenarios and technical limitations of various tools.	**R5**
	CLO5	Foster a lifelong learning mindset in the field of Artificial Intelligence, proactively keep up with cutting-edge computer vision technologies and novel algorithms, develop critical thinking skills, and continuously adapt to evolving industry technological demands.	**R11**
Content	This course focuses on developing practical skills in visual intelligence technologies, covering image fundamentals, filtering, feature detection, object recognition, image segmentation, and deep learning-based vision. Students will learn to accomplish visual tasks and enhance their comprehensive application and innovation capabilities. Knowledge Module 1: Overview of Computer Vision (Weight: 2/32; Level: Understanding) Knowledge Module 2: Image Fundamentals and Preprocessing (Weight: 4/32; Level: Understanding + Application) Knowledge Module 3: Classic Image Features and Detection (Weight: 6/32; Level: Understanding + Application + Analysis) Knowledge Module 4: Visual Deep Learning (Weight 12/32; Levels: Understanding + Application + Analysis + Creation) Knowledge Module 5: Visual System Applications and Project Practice (Weight: 8/32; Level: Application + Analysis + Evaluation + Creation)		
Forms of examination	The overall grade for this course consists of continuous assessment and the final examination grade. The grade is evaluated on a percentage scale, with 60 being the passing score for the course. The final examination is in the form of a course report, accounting for 60% of the overall grade. Students are required to submit a course report. The continuous assessment component accounts for 40% of the overall grade and includes: (1) class participation 12%; (2) regular assignments 12%; and (3) interim tests 16%. Class participation is evaluated comprehensively based on students' contributions to class discussions, the quality of their questions and answers, their participation in group discussions, and their classroom discipline.		

Study and examination requirements	Following the examination regulations, students must have selected and registered for the courses.
Reading list	[1] Computer Vision: Algorithms and Applications, Ma Songde et al., Tsinghua University Press, 2023 [2] Deep Learning and Computer Vision, Zhou Zhihua et al., Higher Education Press, 2024 [3] Digital Image Processing, Gonzalez, Electronic Industry Press, 2022 [4] OpenCV Computer Vision Programming, Yu Shiqi et al., China Machine Press, 2023 [5] Recent Advances in Convolutional Neural Networks for Visual Recognition (2020–2025)
Revision Date	V2024.1, September 2024. V2024.2, December 2025, Update: Credits and workload are calculated based on ECTS.

Internet of Things and Smart Sensor Technology

Module name	Internet of Things and Smart Sensor Technology		
Code	3080717275		
Semester	Spring, 6th Semester		
Contact person	Wang Weihua		
Language	Chinese		
Relation to curriculum	Elective, Professional Elective Course		
Type of teaching, contact hours	Lecture method, case-based teaching, questioning, inquiry-based learning, group discussions, project-based practice, experimental operations, programming exercises Teaching duration: 2 hours per week, totaling 16 weeks, for a cumulative period of 32 hours.		
Work load	Total workload (estimated): 56 credit hours Teaching hours: 32 hours Self-study duration: 24 hours, including after-class assignments, exam preparation time, etc.		
Credit points	2		
Recommended prerequisites	Circuit Principles, Signals and Systems, Digital Signal Processing, Embedded System Design		
Learning outcomes and their corresponding PLOs	Course Learning Outcomes (CLOs)	Description	Supported PLOs
	CLO1	Understand the concept, current development status, and trends of the Internet of Things; master its architecture; and be capable of analyzing key challenges in IoT applications.	**R2**
	CLO2	Master core technologies such as sensor networks, recognition technology, M2M (Machine-to-Machine), and data fusion to build foundational IoT systems.	**R2**
	CLO3	Proficient in IoT middleware, information security, and distributed systems, capable of designing and testing IoT systems.	**R3**
	CLO4	Master the design methodologies and case studies of IoT systems, with strong capabilities in engineering practice and solving complex problems.	**R4**
	CLO5	Continuously monitor emerging sensors and cutting-edge IoT technologies, update knowledge reserves through critical thinking, and align with industry-driven technological advancements.	**R11**

Content	This course focuses on cutting-edge IoT technologies, providing a systematic exposition of key theories, technical frameworks, and system design methodologies to equip students with comprehensive expertise in IoT technology implementation across the entire lifecycle. Knowledge Module 1: Overview of Embedded Systems (Weight: 1/32; Level: Understanding) Knowledge Module 2: Internet of Things Architecture (Weight: 1/32; Level: Understanding + Application) Knowledge Module 3: Wireless Sensor Networks (Weight: 2/32; Level: Understanding + Application) Knowledge Module 4: Automatic Recognition Technology (Weight: 2/32; Level: Understanding + Application) Knowledge Module 5: M2M (Weight: 4/32; Level: Application + Analysis) Knowledge Module 6: IoT Data Fusion Technology (Weight: 6/32; Level: Understanding + Application) Knowledge Module 7: Geographic Information Systems (Weight: 2/32; Level: Understanding) Knowledge Module 8: IoT Distributed Systems (Weight: 2/32; Level: Understanding) Knowledge Module 9: IoT Middleware Design (Weight: 4/32; Level: Understanding + Application) Knowledge Module 10: IoT Information Security (Weight: 2/32; Level: Understanding + Application) Knowledge Module 11: IoT System Design and Case Studies (Weight: 6/32; Level: Application + Analysis + Creation)
Forms of examination	The overall grade for this course consists of continuous assessment and the final examination grade. The grade is evaluated on a percentage scale, with 60 being the passing score for the course. The final examination is in the form of a course report, accounting for 60% of the overall grade. Students are required to submit a course report. The continuous assessment component accounts for 40% of the overall grade and includes: (1) class participation 12%; (2) regular assignments 12%; and (3) interim tests 16%. Class participation is evaluated comprehensively based on students' contributions to class discussions, the quality of their questions and answers, their participation in group discussions, and their classroom discipline
Study and examination requirements	Following the examination regulations, students must have selected and registered for the courses.
Reading list	[1] Internet of Things Technology and Applications, Wang Jiabin et al., Tsinghua University Press [2] Internet of Things Technology and Application Development, Xiong Maohua et al., Tsinghua University Press, 2014 [3] Radio Frequency Identification (RFID) Technology and Applications, Huang Yousen, Electronic Industry Press, 2011 [4] Internet of Things Radio Frequency Identification (RFID) Technology and Applications, Huang Yulan, People's Post and Telecommunications Press, 2013 [5] MOOCs offered by Chinese universities and online course resources from Zhihuishu
Revision Date	V2024.1, September 2024. V2024.2, December 2025, Update: Credits and workload are calculated based on ECTS.

Principles and Applications of Non-Relational Databases

Module name	Principles and Applications of Non-Relational Databases		
Code	3080717258		
Semester	Fall, 5th Semester		
Contact person	Yan Lingling, Zhou Meihong		
Language	Chinese		
Relation to curriculum	Elective, Professional Expansion Course		
Type of teaching, contact hours	Lecture method, case-based teaching, questioning, inquiry-based learning, group discussions, project-based practice Teaching duration: 4 hours per week, totaling 8 weeks, for a cumulative period of 32 hours.		
Work load	Total workload (estimated): 56 credit hours Total class hours: 32 hours Self-study duration: 24 hours, including: pre-class preparation, post-class review and consolidation, assignment completion, error identification and correction, supplementary resource exploration for enhancement, summary and gap identification/addressing, and exam preparation time.		
Credit points	2		
Recommended prerequisites	Introduction to Database Systems, Computer Networks, Linux Operating System, Java Programming		
Learning outcomes and their corresponding PLOs	Course Learning Outcomes (CLOs)	Description	Supported PLOs
	CLO1	Course Objective 1: Acquire fundamental engineering knowledge in database theory, data structures, computer networks, and computer architecture; understand the underlying mathematical models, storage principles, and distributed computing theories of non-relational databases; and be capable of applying mathematical and computer engineering fundamentals to analyze engineering challenges related to unstructured and massive data storage in AI applications.	**R1**
	CLO2	Course Objective 2: Address complex business scenarios involving Artificial Intelligence and big data (e.g., user profiling, knowledge graphs, log storage, IoT data) by designing non-relational database solutions, constructing data models, selecting system architectures, and developing functional modules; ensuring consideration of data security, compliance, storage costs, and operational risks during solution design, incorporating innovative design thinking while adapting to industry-specific constraints.	**R3**

	CLO3	Course Objective 3: By integrating engineering practice, analyze the impacts of engineering practices such as large-scale deployment of non-relational databases, data redundancy, and cluster operation and maintenance on resource consumption, information security, data privacy, the ecosystem, and industrial economics; clarify the social responsibilities and sustainability requirements of big data database engineering practices.	**R6**
Content	This course is a core engineering application course for majors in Artificial Intelligence, big data, and computer science, focusing on the theoretical principles, technical architecture, and practical implementation of NoSQL databases. It systematically covers the development context and fundamental theories of NoSQL databases, addresses the storage requirements of massive, high-concurrency, and multi-modal data in AI applications, and provides hands-on training with mainstream databases such as Redis, MongoDB, and Neo4j. The course aims to equip students with the expertise to solve complex data storage and management challenges in AI, while fostering skills in modern tool utilization, teamwork, ethical standards, and lifelong learning. Knowledge Module 1: Basic Concepts and Development Background (Weight: 2/32; Level: Understanding) Knowledge Module 2: Comparison between Relational Databases and NoSQL (Weight: 2/32; Level: Memory + Understanding + Evaluation) Knowledge Module 3: The Four Major Types of NoSQL Databases: Key-Value, Document, Column Family, and Graph Database (Weight: 4/32; Level: Memory-based – Evaluation) Module 4: NoSQL Performance, Security, High Availability, and Persistence Mechanisms (Weight: 2/32; Level: Analysis + Evaluation) Knowledge Module 5: Key-Value Database Redis Operations and Applications (Weight: 4/32; Level: Application – Analysis) Knowledge Module 6: MongoDB Document Database Operations and Modeling (Weight: 4/32; Level: Application + Evaluation) Knowledge Module 7: Column Family Database – Principles and Basic Usage of HBase (Weight: 4/32; Level: Understanding + Application) Knowledge Module 8: Basic Usage of the Graph Database Neo4j and Introduction to Knowledge Graphs (Weight: 4/32; Level: Understanding – Application) Knowledge Module 9: System Design and Implementation Based on NoSQL (Weight: 6/32; Level: Advanced)		
Forms of examination	The overall grade for this course consists of continuous assessment and the final examination grade. The grade is evaluated on a percentage scale, with 60 being the passing score for the course. The final examination is in the form of a course report, accounting for 60% of the overall grade. Students are required to submit a course report. The continuous assessment component accounts for 40% of the overall grade and includes: (1) class participation 12%; (2) regular assignments 12%; and (3) interim tests 16%. Class participation is evaluated comprehensively based on students' contributions to class discussions, the quality of their questions and answers, their participation in group discussions, and their classroom discipline.		
Study and examination requirements	Following the examination regulations, students must have selected and registered for the courses.		

Reading list	[2] Research on distributed storage technology for big data based on non-relational databases [J]. He Zhenxing. Digital Communication World, 2025(10):17−19,4. [3] Kang R, Chen Y B, Liu Y, Kang R, Chen Y B, Liu Y, et al. ABase: The Multi-tenant NoSQL Serverless Database for Diverse and Dynamic Workloads in Large-Scale Cloud Environments[C]//Proceedings of the 2025 ACM SIGMOD International Conference on Management of Data. 2025: 1789-1802. [2] The Essence of NoSQL, by Martin Fowler and Pramod Sadalage, People's Post and Telecommunications Press, 2013. [3] Design and Implementation of Redis, edited by Jianhong Huang, Machinery Industry Press, 2014. [4] Principles of NoSQL Databases (2nd Edition), edited by Zuo Yunxiao, People's Post and Telecommunications Press, 2023.
Revision Date	V2026.1, March 2026. V2026.2, April 2025, Update: Credits and workload are calculated based on ECTS.

Embedded System Design

Module name	Embedded System Design		
Code	3080717261		
Semester	Fall, 5th Semester		
Contact person	Wang Weihua		
Language	Chinese		
Relation to curriculum	Elective, Professional Expansion Course		
Type of teaching, contact hours	Lecture method, case-based teaching, questioning, inquiry-based learning, group discussions, project-based practice, experimental operations, programming exercises Teaching duration: 2 hours per week, totaling 16 weeks, for a cumulative period of 32 hours.		
Work load	Total workload (estimated): 56 credit hours Teaching Hours: 32 hours Self-study duration: 24 hours, including: after-class assignments, exam preparation time, etc.		
Credit points	2		
Recommended prerequisites	Circuit Principles, Analog Circuits and Digital Circuits, C Language Programming		
Learning out-comes and their corresponding PLOs	Course Learning Outcomes (CLOs)	Description	Supported PLOs
	CLO1	Understand the current state and technological development trends of embedded systems, master the fundamental architecture of typical embedded systems, and be capable of identifying and analyzing critical aspects of complex engineering challenges in artificial intelligence applications.	**R2**
	CLO2	Master the fundamental architecture, instruction set, internal memory structure, and usage methods of the STM32 microprocessor; be capable of designing embedded system solutions tailored to specific requirements.	**R2**
	CLO3	Master the principles and programming of STM32 peripherals, including startup, SysTick, GPIO, interrupts, clock/timer modules, etc., and be capable of conducting experiments systematically and analyzing results.	**R3**
	CLO4	Master the structural principles and configuration of DMA, USART, ADC, and DAC, and be capable of selecting appropriate tools to perform analysis, design, and verification of embedded systems.	**R3**

	CLO5	Based on embedded engineering standards, conduct project design; objectively evaluate the impact of product implementation on safety, environmental sustainability, and economic efficiency; adhere to industry guidelines; and foster a commitment to sustainable engineering practices and professional accountability.	**R6**
	CLO6	Participate in interdisciplinary embedded joint projects, capable of serving as a team member or project leader; incorporate team suggestions, allocate tasks reasonably, and collaborate effectively to complete comprehensive embedded development tasks.	**R8**
Content	This course covers the principles and methodologies of Embedded System Design, providing a comprehensive overview of the development process. Focusing on the STM32 series of ARM chips, it explains system architecture and operating principles, enabling students to master development techniques for STM32 and ARM Cortex-M cores, become proficient with MDK and PROTEUS tools, and develop practical skills in embedded system development and engineering. Knowledge Module 1: Overview of Embedded Systems (Weight: 1/32; Level: Understanding) Knowledge Module 2: ARM Cortex-M Architecture (Weight: 2/32; Level: Understanding + Application) Knowledge Module 3: STM32 Microcontroller (Weight: 4/32; Level: Understanding + Application + Analysis) Knowledge Module 4: Startup Files and SysTick (Weight: 4/32; Level: Understanding + Application) Knowledge Module 5: GPIO (Weight: 6/32; Levels: Application + Analysis) Knowledge Module 6: NVIC and EXIT (Weight: 3/32; Level: Understanding + Application) Knowledge Module 7: Clock Systems and Timer Systems (Weight: 4/32; Level: Application + Analysis) Knowledge Module 8: DMA Controller and USART (Weight: 4/32; Level: Application + Analysis) Knowledge Module 9: ADC and DAC (Weight: 4/32; Level: Application + Analysis)		
Forms of examination	The overall grade for this course consists of continuous assessment and the final examination grade. The grade is evaluated on a percentage scale, with 60 being the passing score for the course. The final examination is in the form of a course report, accounting for 60% of the overall grade. Students are required to submit a course report. The continuous assessment component accounts for 40% of the overall grade and includes: (1) class participation 12%; (2) regular assignments 12%; and (3) interim tests 16%. Class participation is evaluated comprehensively based on students' contributions to class discussions, the quality of their questions and answers, their participation in group discussions, and their classroom discipline.		
Study and examination requirements	Following the examination regulations, students must have selected and registered for the courses.		

Reading list	[1] Principles and Development of Embedded Systems, by Lai Shuming, Electronic Industry Press, 2021,1st ed. [2] Principles and Design Implementation of Embedded Operating Systems, Yan Hairong, Tsinghua University Press, 2023 [3] Principles and Applications of Embedded Microprocessors — Based on the ARM Cortex-M3 Microcontroller (STM32 Series), by Yan Hairong et al., Tsinghua University Press, 2014 [4] ARM Cortex-M3 Embedded Development and Applications (STM32 Series), by Zhang Xinmin et al., Tsinghua University Press, 2016 [5] Principles and Applications of Embedded Systems — Based on the ARM Cortex-M3 Core in the STM32F103 Microcontroller Series, by Wang Yihan et al., Tsinghua University Press, 2016 [6] Embedded Real-Time Operating System μC/OS-II (2nd Edition), Jean J. Labrosse, Beijing University of Aeronautics and Astronautics Press, 2003
Revision Date	V2024.1, September 2024. V2024.2, December 2025, Update: Credits and workload are calculated based on ECTS.

Java Programming

Module name	Java Programming		
Code	3080900261		
Semester	Fall, 5th Semester		
Contact person	Li Qi, Liu Xiaofeng		
Language	Chinese		
Relation to curriculum	Elective, Professional Expansion Course		
Type of teaching, contact hours	Lecture method, demonstration method, group discussion method, laboratory experiment method, tool-assisted teaching, personalized tutoring Teaching duration: 2 hours per week, totaling 16 weeks, for a cumulative period of 32 hours.		
Work load	Total workload (estimated): 56 credit hours Total class hours: 32 hours Self-study duration: 24 hours, including: pre-class preparation, post-class review and consolidation, assignment completion, error identification and correction, supplementary resource exploration for enhancement, summary and gap identification/addressing, and exam preparation time.		
Credit points	2		
Recommended prerequisites	C Language Programming, Data Structures and Algorithms, Discrete Mathematics		
Learning out-comes and their corresponding PLOs	Course Learning Outcomes (CLOs)	Description	Supported PLOs
	CLO1	Course Objective 1: Understand the fundamental concepts and core principles of object-oriented programming; master the syntactic specifications, classes and objects, encapsulation, inheritance, polymorphism, and other essential theories of the Java language; and acquire the foundational knowledge and engineering literacy required for Java-based programming.	**R1**
	CLO2	Course Objective 2: To apply object-oriented principles to analyze and break down real-world problems, identify and define classes, objects, attributes, and methods, and possess the ability to translate business requirements into program models.	**R2**
	CLO3	Course Objective 3: Be able to design appropriate class structures based on requirements, implement features such as encapsulation, inheritance, and polymorphism, complete the design, coding, and debugging of small object-oriented programs, and possess modular programming capabilities.	**R3**

	CLO4	Course Objective 4: Students will master program compilation and execution in the JDK environment, become proficient in editing, compiling, running, and debugging programs using integrated development environments such as Eclipse and IDEA, acquire version management skills and fundamental debugging techniques, and develop the ability to utilize modern tools for software development.	**R5**
Content	This course serves as a core foundational course for computer science majors, using the Java language as its platform to systematically teach object-oriented programming concepts and skills. Key topics include classes and objects, encapsulation, inheritance, polymorphism, interfaces, abstract classes, packages, exception handling, and commonly used class libraries. Through theoretical study combined with extensive programming practice, students will master object-oriented analysis, design, and implementation methods, develop modular thinking, code quality awareness, and engineering proficiency, thereby laying a solid foundation for subsequent courses such as framework development, web development, and mobile development. Knowledge Module 1: Fundamentals of the Java Language and Overview of Object-Oriented Programming (Weight: 4/32; Level: Understanding) Knowledge Module 2: Classes and Objects, Packaging, Construction Methods (Weight: 6/32; Level: Application) Knowledge Module 3: Inheritance, Method Overwriting, Super Keyword (Weight: 6/32; Level: Application) Knowledge Module 4: Polymorphism, Abstract Classes, Interfaces (Weight: 6/32; Level: Application + Analysis) Knowledge Module 5: Exception Handling, Common Classes, Introduction to Sets (Weight: 6/32, Level: Application) Knowledge Module 6: Comprehensive Object-Oriented Project Practice (Weight: 4/32, Level: Creative)		
Forms of examination	The overall grade for this course consists of continuous assessment and the final examination grade. The grade is evaluated on a percentage scale, with 60 being the passing score for the course. The final examination is in the form of a course report, accounting for 60% of the overall grade. Students are required to submit a course report. The continuous assessment component accounts for 40% of the overall grade and includes: (1) class participation 12%; (2) regular assignments 12%; and (3) interim tests 16%. Class participation is evaluated comprehensively based on students' contributions to class discussions, the quality of their questions and answers, their participation in group discussions, and their classroom discipline.		
Study and examination requirements	Following the examination regulations, students must have selected and registered for the courses.		
Reading list	[1] Joshua Bloch. Effective Java[M]. 3rd Edition. Boston: Addison-Wesley, 2018. [2] Kay S. Horstmann. Java Core Technologies, Volume I (Fundamentals) [M]. 12th edition. Beijing: Machinery Industry Press, 2022. [3] Sun Weiqin. Java Object-Oriented Programming [M]. 2nd ed. Beijing: Electronic Industry Press, 2019. [4] Kathy Sierra. Head First Java [M]. 3rd ed. Beijing: China Electric Power Press, 2023. [5] Qin Biao. Comparative teaching of object-oriented programming courses C++ and Java [J]. Computer Education, 2024(04):144–164+153. [6] Tao Jing. Experimental Study on the Encapsulation of Object-Oriented Programming in Java [J]. Information and Computers, 2024(02):115–118.		
Revision Date	V2024.1, September 2024. V2024.2, December 2025, Update: Credits and workload are calculated based on ECTS.		

C++ Object-Oriented Programming

Module name	C++ Object-Oriented Programming		
Code	3080717264		
Semester	Fall, 5th Semester		
Contact person	Yan Lingling, Liu Xiaofeng		
Language	Chinese		
Relation to curriculum	Elective, Professional Elective Course		
Type of teaching, contact hours	Teacher-centered methods: Lecture Method, Demonstration Method Interactive methods: Group Discussion Method, Case Analysis Method Practical methods: Laboratory Experiment Method Total contact hours: 4 hours/week, 8 weeks, 32 hours		
Work load	Total estimated workload: 56 hours Teaching hours: 32 hours Self-study hours: 24 hours (including homework, exam preparation, etc.)		
Credit points	2		
Recommended prerequisites	C Language Programming, Data Structures and Algorithms, Discrete Mathematics		
Learning out-comes and their corresponding PLOs	Course Learning Outcomes (CLOs)	The core mission of this course is to enable students to: Develop software design capabilities using object-oriented programming languages. Choose appropriate development languages for specific problems in software development.Solve practical problems using object-oriented techniques. Cultivate rigor, practicality, and an awareness of object-oriented software development.Integrate theory with practice and apply knowledge to social practice. Enhance the ability to observe society, identify requirements, and establish positive academic values, thereby improving comprehensive professional qualities.	Supported PLOs
	CLO1	**Course Objective 1：** Apply mathematics, natural science, and software engineering knowledge to analyze complex engineering problems in C++ object-oriented programming, design solutions based on object-oriented features, and complete program development, debugging, and optimization.	**R1**
	CLO2	**Course Objective 2：** Analyze problems using the concepts and creation methods of classes and objects; identify classes, objects, and object initialization; design class methods, call methods, debug programs; and compare syntax differences with C language.	**R2**
	CLO3	**Course Objective 3：** Design base classes and derived classes; define access permissions for class members; design data members and function members; understand name conflicts in inheritance and master resolution methods.	**R3**

	CLO4	**Course Objective 4：** Select and use appropriate modern engineering and information technology tools for C++ object-oriented programming tasks (analysis, design, coding, testing, debugging, maintenance); understand tool applicability and limitations to improve efficiency and quality.	**R5**
Content	This course is a professional elective for software engineering majors. Object-oriented software development integrates abstraction, encapsulation, inheritance, and polymorphism to create modular, highly abstract, reusable, extensible, and maintainable software. It focuses on object-oriented programming principles and mechanisms. Prerequisite: C Language Programming. Follow-up courses: Java Programming, .NET Development, etc. Knowledge Modules & Cognitive Levels: 1. Classes and Objects (weight: 2/32, level: Understand) 2. Special Functions and Members (weight: 4/32, level: Remember + Understand + Apply) 3. Inheritance and Derivation (weight: 9/32, level: Understand + Apply + Analyze) 4. Templates (weight: 6/32, level: Understand + Apply + Analyze) 5. Polymorphism and Virtual Functions (weight: 9/48, level: Understand + Apply + Analyze + Evaluate) 6.C++ Files and I/O Control (weight: 2/48, level: Remember + Understand + Apply)		
Forms of examination	The overall grade for this course consists of continuous assessment and the final examination grade. The grade is evaluated on a percentage scale, with 60 being the passing score for the course. The final examination is conducted as an assessment component, accounting for 50% of the overall grade. Students are required to submit a course report. The continuous assessment component accounts for 50% of the overall grade and includes: (1) class performance 15%; (2) regular assignments 15%; and (3) computer-based laboratory exercises 20%. Class performance is evaluated comprehensively based on students' contributions to class discussions, the quality of their questions and answers, their participation in group discussions, and their classroom discipline.		
Study and examination requirements	Following the examination regulations, students must have selected and registered for the courses.		
Reading list	[1] Zhao X H. C++ Object-Oriented Programming and Project Practice [M]. Beijing: Tsinghua University Press, 2024. [2] Zhou F G, Gao W C. Basic Course of C++ Object-Oriented Programming [M]. Beijing: Tsinghua University Press, 2020. [3] Lin S, Deng N. Construction and practice of competency-oriented object-oriented programming course [J]. Journal of Computer Technology and Education, 2024, 12(4): 74-79. [4] Pei Z, Tian X X, Li B X. Teaching reform and practice of object-oriented programming C++ enabled by knowledge graph [J]. Journal of East China Normal University (Natural Science), 2024(5): 112-122. [5] Li H L, Xue H L, et al. Teaching reform of object-oriented programming course with “one-drive, multi-integration, four-progress and six-stage” [J]. Computer Education, 2024(12): 112-118. [6] Holton I, Van Waelde P. Getting Started with C++20 (6th ed.) [M]. Trans. Zhou B S. Beijing: Tsinghua University Press, 2022.		
Revision Date	V2024.1, September 2024. V2024.2, December 2025, Update: Credits and workload are calculated based on ECTS.		

Computer Science English

Module name	Computer Science English		
Code	3080900245		
Semester	Spring, 6th Semester		
Contact person	Fang Xiaoxue, Amjad Ali Amjad, DR AITIZAZ ALI, AMEEN FADHL HASAN ALKASEM		
Language	English		
Relation to curriculum	Elective, Professional Expansion Course		
Type of teaching, contact hours	Lecture method, case analysis method, situational teaching method, group discussion method Teaching Hours: 2 hours per week for 16 weeks, totaling 32 hours		
Work load	Total workload (estimated): 56 credit hours Teaching hours: 32 hours Self-study hours: 24 hours, including pre-class preparation, post-class review and consolidation, assignment completion, supplementary material exploration for advancement, and exam preparation time.		
Credit points	2		
Recommended prerequisites	University English, C Language Programming, Principles of Operating Systems, Principles of Computer Networks		
Learning outcomes and their corresponding PLOs	Course Learning Outcomes (CLOs)	Description	Supported PLOs
	CLO1	By integrating content on engineering ethics and professional ethics education, students are guided to not only master computer-specific English but also recognize engineers' social responsibilities. Through case studies and practical project exercises, their service-oriented mindset is cultivated, enabling them to apply professional knowledge to socioeconomic development.	R6

	CLO2	By reading and analyzing English scientific and technical literature, students develop engineering thinking skills and product research capabilities. Additionally, through practical activities based on real-world engineering project cases, their engineering practice abilities are enhanced.	R1
	CLO3	Through professional English instruction, we enhance students' communication skills in English, enabling them to communicate effectively with peers both domestically and internationally. Additionally, by staying abreast of global software technology trends and incorporating the latest English-language resources, we help students rapidly stay informed about cutting-edge technological advancements worldwide.	R9
	CLO4	Through team projects and case studies, students develop teamwork skills and software project management capabilities across multiple disciplines. By simulating real-world work environments, students can assume roles as core team members or team leaders.	R8
	CLO5	We cultivate students' autonomous learning and lifelong learning capabilities by incorporating the latest technological advancements and encouraging participation in international exchanges, enabling them to keep pace with developments in software engineering. Additionally, innovative practical projects are designed to foster students' creativity and hands-on skills.	R11

Content	"Computer Professional English" integrates computer science expertise with English language skills. This course serves both as a fundamental professional course mandated by computer science curricula and as a crucial supplement to undergraduate students' general English education. Its content primarily covers computer-related specialized knowledge and provides practical guidance for real-world applications. The prerequisite for this course is "College English," while subsequent requirements include reading English literature for graduation projects and acquiring foundational professional knowledge, thereby laying the groundwork for students' further research and development of specialized competencies. Through guided study of selected texts, the course enables students to familiarize themselves with and master computer-specific English terminology, enhance their ability to read technical English materials, and develop proficiency in interpreting professional English publications as well as performing translation tasks related to their field. Knowledge Module 1: Computer Hardware (Weight: 2/32; Level: Memory + Understanding) Knowledge Module 2: Computer Software and Software Development (Weight: 4/32; Level: Memory + Understanding + Application) Knowledge Module 3: Program Design, Programming Languages, and Computer Programming (Weight: 8/32; Level: Memory + Understanding + Application) Knowledge Module 4: Operating Systems (Weight: 2/32; Level: Memory + Application) Knowledge Module 5: Networking Devices and Topologies (Weight: 4/32; Level: Understanding + Application) Knowledge Module 6: Cloud Storage and Big Data (Weight: 4/32; Level: Memorization + Application) Knowledge Module 7: Data Mining (Weight: 2/32; Level: Understanding + Application) Knowledge Module 8: E-commerce (Weight: 2/32; Level: Memory + Application) Knowledge Module 9: AI (Weight: 4/32; Level: Memory + Understanding + Application)
Forms of examination	The overall grade for this course consists of continuous assessment and the final examination grade. The grade is evaluated on a percentage scale, with 60 being the passing score for the course. The final examination is in the form of a course report, accounting for 60% of the overall grade. Students are required to submit a course report. The continuous assessment component accounts for 40% of the overall grade and includes: (1) class participation 12%; (2) regular assignments 12%; and (3) interim tests 16%. Class participation is evaluated comprehensively based on students' contributions to class discussions, the quality of their questions and answers, their participation in group discussions, and their classroom discipline.
Study and examination requirements	Following the examination regulations, students must have selected and registered for the courses.

Reading list	1. Computer Professional English [M], Zhang Qianghua, Si Aixia, China Machine Press, 2024. 2. Computer Professional English [M], by Jin Zhiquan and Zhang Xing'er, Electronic Industry Press, 2020. 3. Downey, Allen B. Think Python: How to Think Like a Computer Scientist[M]. O'Reilly Media, 2024. 4. Howe P N .ChatGPT has a language problem - but science can fix it.[J].Nature,2024. 5. Chi G .The Spoken English Practice System Based on Computer English Speech Recognition Technology[J].Mobile Information Systems,2022. 6. Xie L ,Shang Z,Wang X.Research on the Teaching of Computer English under the Network Environment[J].Higher Education and Practice,2024. 7. Wenxia L ,Weiming S .The English Teaching Mode under the Environment of Computer Technology[J].Mobile Information Systems,2022.
Revision Date	V2024.1, September 2024. V2024.2, December 2025, Update: Credits and workload are calculated based on ECTS.

Big Data Collection and Processing

Module name	Big Data Collection and Processing		
Code	3080717260		
Semester	Spring, 6th Semester		
Contact person	Li Yao, Zhu Min		
Language	Chinese		
Relation to curriculum	Elective, Professional Expansion Course		
Type of teaching, contact hours	Lecture method, demonstration method, case analysis method, laboratory experiment method Teaching duration: 2 hours per week, totaling 16 weeks, for a cumulative period of 32 hours.		
Work load	Total workload (estimated): 56 credit hours Total class hours: 32 hours Self-study duration: 24 hours, including: pre-class preparation, post-class review and consolidation, assignment completion, error identification and correction, supplementary resource exploration for enhancement, summary and gap identification/addressing, and exam preparation time.		
Credit points	2		
Recommended prerequisites	Python Programming, Principles of Database Systems, Data Structures and Algorithms		
Learning out-comes and their corresponding PLOs	Course Learning Outcomes (CLOs)	Description	Supported PLOs
	CLO1	Course Objective 1: Through the study of Big Data Collection and Processing, students will master the fundamental principles and engineering methods of data collection, preprocessing, storage, and analysis; be capable of applying mathematical, natural science, and engineering science principles to identify, articulate, and analyze complex engineering problems in Artificial Intelligence; draw effective conclusions through literature review and information organization; and develop rigorous data thinking skills and scientific research literacy.	**R2**
	CLO2	Course Objective 2: Through this course, students will master methods for multi-source data acquisition, data cleaning, data transformation, and system process design. They will be able to develop data processing models, design functional modules and system solutions tailored to real-world scenarios, demonstrate innovative thinking in their designs, comprehensively consider constraints such as social, safety, health, legal, cultural, and environmental factors, and enhance their ability to solve complex engineering problems.	**R3**

	CLO3	Course Objective 3: Through practical training in data collection, cleaning, analysis, and system development, students will develop strong technical communication skills, document preparation abilities, and interpersonal communication competencies; be capable of effectively addressing complex big data-related engineering challenges with peers and the public; possess a fundamental international perspective and cross-cultural communication skills; respect technical standards and cultural differences; and comprehensively enhance their overall engineering competence and teamwork capabilities.	**R9**
Content	This course is a comprehensive applied course designed to enhance students' technical application skills. It enables students to understand the fundamental processes of Big Data Collection and Processing, master methods for multi-source data collection, data cleaning, data transformation, data standardization, and data preprocessing, become familiar with common big data collection tools and data processing frameworks, and, through practical experiments, perform data collection, cleaning, processing, and analysis tasks tailored to business requirements. The course aims to cultivate students' ability to integrate theoretical knowledge to analyze and solve real-world problems, while fostering and enhancing their innovative design capabilities and overall competence in combining theory with practice. Knowledge Module 1: Overview of Big Data and Fundamentals of Collection (Weight: 2/32; Level: Understanding) Knowledge Module 2: Multi-source Data Collection Methods and Tools (Weight: 6/32; Level: Understanding + Application) Knowledge Module 3: Data Cleaning and Exception Handling (Weight: 8/32; Level: Application + Analysis) Knowledge Module 4: Data Transformation, Integration, and Standardization (Weight: 10/32; Levels: Application + Analysis + Evaluation) Knowledge Module 5: Comprehensive Data Processing Practice (Weight: 6/32; Level: Application − Creation)		
Forms of examination	The overall grade for this course consists of continuous assessment and the final examination grade. The grade is evaluated on a percentage scale, with 60 being the passing score for the course. The final examination is in the form of a course report, accounting for 60% of the overall grade. Students are required to submit a course report. The continuous assessment component accounts for 40% of the overall grade and includes: (1) class participation 12%; (2) regular assignments 12%; and (3) interim tests 16%. Class participation is evaluated comprehensively based on students' contributions to class discussions, the quality of their questions and answers, their participation in group discussions, and their classroom discipline.		
Study and examination requirements	Following the examination regulations, students must have selected and registered for the courses.		
Reading list	[1] Data Acquisition and Preprocessing (2nd Edition), edited by Lin Ziyu, People's Post and Telecommunications Press, 2025. [2] Big Data Collection and Preprocessing Technology, edited by Tang Shiwei, Tian Feng, Gai Xuan, and Li Xuegui, Tsinghua University Press, 2022. [3] Big Data Collection and ETL Technology Applications, edited by Li Junhua, Beijing Institute of Technology Press, 2025. [4] Introduction to Big Data (2nd ed.), edited by Mei Hong, Higher Education Press, 2024. [5] Wang Haofen, Chen Huajun. Research Progress on Key Technologies for Big Data Collection and Governance [J]. Journal of Computer Science, 2024.		

Revision Date	V2024.1, September 2024. V2024.2, December 2025, Update: Credits and workload are calculated based on ECTS.

Software Engineering

Module name	Software Engineering		
Code	3080903245		
Semester	Spring, 6th Semester		
Contact person	Huang Chao, Cao Xiuping		
Language	Chinese		
Relation to curriculum	Elective，Professional Expansion Course		
Type of teaching, contact hours	Lecture method, demonstration method, group discussion method, case analysis Teaching duration: 2 hours per week, totaling 16 weeks, for a cumulative period of 32 hours.		
Work load	Total workload (estimated): 56 credit hours Total class hours: 32 hours Self-study duration: 24 hours, including: pre-class preparation, post-class review and consolidation, assignment completion, error identification and correction, supplementary resource exploration for enhancement, summary and gap identification/addressing, and exam preparation time.		
Credit points	2		
Recommended prerequisites	"C Language Programming", "Data Structures and Algorithms", "Principles of Database Systems"		
Learning outcomes and their corresponding PLOs	Course Learning Outcomes (CLOs)	Description	Supported PLOs
	CLO1	Course Objective 1: Through the study of Software Engineering, students will acquire fundamental concepts of software engineering, the software life cycle, core development models, requirements engineering, software design, as well as the foundational theories and methods of testing and maintenance; while addressing the current state of China's software industry development and its needs for independent R&D, they will solidify their core engineering knowledge in software engineering.	**R1**
	CLO2	Course Objective 2: Through this course, students will master the fundamental approaches and methods for software problem analysis, identify practical issues such as requirement deviations, design defects, and quality risks in software projects, apply software engineering principles to decompose, analyze, and pinpoint complex software problems, and enhance their system-level problem analysis and logical reasoning skills.	**R2**
	CLO3	Course Objective 3: Through practical training in software design and development, students will systematically integrate software engineering theory with programming practices, enabling them to complete preliminary design, detailed design, and functional module development based on software requirements. They will acquire fundamental capabilities in software system design and development, laying a solid foundation for subsequent complex software system development.	**R3**

	CLO4	Course Objective 4: Through the study and application of software project management knowledge, participants will master core project management methodologies—including project planning, task decomposition, schedule control, quality assurance, and risk management—and be capable of participating in and executing the full lifecycle management of small-scale software projects, developing essential project management competencies and practical skills.	**R10**
Content	Software Engineering is a core course for the Software Engineering major, designed to systematically introduce the theoretical framework, development methodologies, design specifications, and project management techniques of software engineering. It covers essential topics such as an overview of software engineering, software life cycle models, requirements engineering, software preliminary and detailed design, coding standards, testing techniques, maintenance practices, and project management. Through this course, students will acquire a solid understanding of fundamental principles and practical approaches in software engineering, develop skills in software system analysis, design, development, and basic project management, cultivate a standardized, engineering-oriented mindset for software development, and establish a robust theoretical and practical foundation for careers in software development and project management. Knowledge Module 1: Overview of Software Engineering (Weight: 2/32; Level: Memorization + Understanding) Knowledge Module 2: Software Life Cycle and Development Models (Weight: 4/32; Level: Memory + Understanding + Application) Knowledge Module 3: Requirements Engineering (Weight: 6/32; Level: Understanding – Analysis) Knowledge Module 4: Software Design (Weight: 8/32; Level: Understanding – Creation) Knowledge Module 5: Software Coding and Specifications (Weight: 4/32; Level: Understanding + Application) Knowledge Module 6: Software Testing (Weight: 4/32; Level: Understanding + Application) Knowledge Module 7: Software Project Management (Weight: 4/32; Level: Memorization + Understanding + Application)		
Forms of examination	The overall grade for this course consists of continuous assessment and the final examination grade. The grade is evaluated on a percentage scale, with 60 being the passing score for the course. The final examination is in the form of a course report, accounting for 60% of the overall grade. Students are required to submit a course report. The continuous assessment component accounts for 40% of the overall grade and includes: (1) class participation 12%; (2) regular assignments 12%; and (3) interim tests 16%. Class participation is evaluated comprehensively based on students' contributions to class discussions, the quality of their questions and answers, their participation in group discussions, and their classroom discipline.		
Study and examination requirements	Following the examination regulations, students must have selected and registered for the courses.		

Reading list	[1] Zhang Haifan, Mou Yongmin. Introduction to Software Engineering (8th Edition) [M]. Beijing: Tsinghua University Press, 2022. [2] Roger S. Pressman. Software Engineering: Research Methods for Practitioners (9th ed.) [M]. Beijing: Machinery Industry Press, 2021. [3] Zhou Su, Wang Wen. Practical Tutorial on Software Engineering [M]. Beijing: Science Press, 2023. [4] Li Li, Wang Yanqiu. Research on the Optimization of the Teaching System for Software Engineering Courses [J]. Computer Education, 2024. [5] Chen Yang, Zhang Min. Exploration of software engineering teaching reform oriented toward engineering certification [J]. Computer Engineering and Science, 2023,45(S1):112−116. [6] Liu Qiang, Zhang Hua. Practice and Research on the Engineering-Based Teaching Model for Software Engineering [J], China Information Technology Education, 2022.
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Artificial Intelligence Comprehensive Design

Module name	Artificial Intelligence Comprehensive Design		
Code	3080717274		
Semester	Spring, 6th Semester		
Contact person	Lin Shulan, Yu Wei		
Language	Chinese		
Relation to curriculum	Elective，Professional Expansion Course		
Type of teaching, contact hours	Lecturing method；Demonstration method；Practices Teaching Hours: 2 hours per week for 16 weeks, totaling 32 hours		
Work load	Total Workload (Estimated): 56 hours Teaching hours: 32 hours Self-study hours: 24 hours, including after-class assignments, project development, exam preparation time, etc.		
Credit points	2		
Recommended prerequisites	Introduction to Artificial Intelligence Majors, Python Programming, Data Structures and Algorithms, Machine Learning		
Learning out-comes and their corresponding PLOs	Course Learning Outcomes (CLOs)	Description	Supported PLOs
	CLO1	Course Objective 1: Master the AI system design process, requirement analysis, and solution evaluation; be capable of completing the overall design of small-scale intelligent systems.	**R2**
	CLO2	Course Objective 2: Be capable of selecting appropriate algorithms and models for data processing, model training, and optimization, with strong engineering implementation skills.	**R4**
	CLO3	Course Objective 3: Adhere to engineering standards and ethical requirements, and engage in team collaboration, project management, and deliverable production.	**R6**
	CLO4	Course Objective 4: Be capable of testing, evaluating, and iteratively optimizing AI systems to produce comprehensive design documentation.	**R8**
	CLO4	Course Objective 5: To develop comprehensive AI application designs tailored to industry scenarios, demonstrating innovative thinking and engineering competence.	**R10**

Content	This advanced course in Artificial Intelligence is designed to enhance students' engineering competencies, adopting a project-driven approach throughout the entire process. It covers the complete lifecycle of AI systems—from requirements analysis and solution design to algorithm selection, model development, system integration, and testing optimization—strengthening practical application skills, teamwork capabilities, and innovative design abilities to meet professional graduation requirements. Knowledge Module 1: Overview of AI Integrated Design (Weight: 2/32, Level: Understanding) Knowledge Module 2: Requirements Analysis and Solution Design (Weight: 4/32; Level: Understanding + Application) Knowledge Module 3: Data Processing and Feature Engineering (Weight: 8/32; Level: Application + Analysis) Knowledge Module 4: Model Selection, Training, and Optimization (Weight: 8/32; Levels: Application + Analysis + Evaluation) Knowledge Module 5: System Integration, Testing, and Deployment (Weight: 6/32; Level: Application + Creation) Knowledge Module 6: Project Documentation and Outcome Presentation (Weight: 4/32; Level: Applied + Evaluation)
Forms of examination	The overall grade for this course consists of continuous assessment and the final examination grade. The grade is evaluated on a percentage scale, with 60 being the passing score for the course. The final examination is in the form of a course report, accounting for 60% of the overall grade. Students are required to submit a course report. The continuous assessment component accounts for 40% of the overall grade and includes: (1) class participation 12%; (2) regular assignments 12%; and (3) interim tests 16%. Class participation is evaluated comprehensively based on students' contributions to class discussions, the quality of their questions and answers, their participation in group discussions, and their classroom discipline.
Study and examination requirements	Following the examination regulations, students must have selected and registered for the courses.
Reading list	[4] Machine Learning, edited by Zhou Zhihua, Tsinghua University Press, 2016. [2] Statistical Learning Methods (2nd Edition), edited by Li Hang, Tsinghua University Press, 2019. [3] Neural Networks and Deep Learning, edited by Qiu Xipeng, Machinery Industry Press, 2020. [4] Practical Guide to Artificial Intelligence Engineering, edited by Zhu Qiongling, Electronic Industry Press, 2022. [5] Tan Jianrong, Liu Zhenyu. Theory and Methods of Comprehensive Product Design Driven by Artificial Intelligence [J]. Journal of Mechanical Engineering, 2023. [6] Zhou Zhihua, Yang Qiang. Comprehensive Design and System Construction of Artificial Intelligence in the Era of Large Models [J]. Journal of Computer Science, 2024.
Revision Date	V2024.1, September 2024. V2024.2, December 2025, Update: Credits and workload are calculated based on ECTS.

Fundamentals of Large Models

Module name	Fundamentals of Large Models		
Code	3080717358		
Semester	Spring, 2nd Semester		
Contact person	Zhu Min, DR AITIZAZ ALI		
Language	Chinese		
Relation to curriculum	Compulsory, Integrated Practical Course		
Type of teaching, contact hours	Lecture method, demonstration method, group discussion method, case analysis method, laboratory experiment method, centralized project practice, hands-on development, debugging and deployment, personalized tutoring Teaching hours: 4 hours per week, for a total of 12 weeks, amounting to 48 hours		
Work load	Total workload (estimated): 112 credit hours Total class hours: 48 hours Self-study duration: 64 hours, covering post-class material review, project design, experimental preparation, project refinement, and assessment preparation.		
Credit points	4		
Recommended prerequisites	Introduction to Artificial Intelligence, Python Programming		
Learning out-comes and their corresponding PLOs	Course Learning Outcomes (CLOs)	Description	Supported PLOs
	CLO1	Course Objective 1: Master the core architecture, training principles, and application paradigms of large-scale models; understand prompt engineering, fine-tuning, and evaluation methods; and develop a systematic engineering perspective.	**R1**
	CLO2	Course Objective 2: Be capable of independently performing data processing, prompt design, model invocation, effect optimization, and result validation, with proficient mastery of all practical tools required for large-scale model applications.	**R2**
	CLO3	Course Objective 3: To design and implement comprehensive large-scale model application projects, complete project development, testing, optimization, and performance analysis, thereby significantly enhancing engineering practice and problem-solving skills.	**R3**
	CLO4	Course Objective 4: To foster efficient collaboration in team projects, complete project presentations, technical report writing and defenses, while developing innovative thinking, communication skills, and comprehensive practical abilities.	**R3**

Content	This course is a hands-on practical program centered on large-scale model application development, emphasizing hands-on practice, project-driven learning, and engineering skills cultivation. Students complete deliverable application projects through comprehensive practical training. Knowledge Module 1: Overview and Core Technologies of Large Models (Weight: 2/48, Level: Understanding) Knowledge Module 2: Prompt Engineering and Model API Applications (Weight: 10/48; Level: Understanding + Application) Knowledge Module 3: Data Processing and Model Tuning Practice (Weight: 10/48; Level: Application + Analysis) Knowledge Module 4: Building Large Model Application Systems (Weight: 10/48; Level: Application + Analysis + Creation) Knowledge Module 5: Intensive Project Practice and Report Writing (Weight: 16/48; Level: Application + Analysis + Evaluation + Creation)
Forms of examination	The overall grade for this course consists of continuous assessment and the final examination grade. The grade is evaluated on a percentage scale, with 60 being the passing score for the course. The final examination takes the form of a comprehensive project design and oral defense, accounting for 50% of the overall grade. Students are required to submit their project design and present it in a defense session. The continuous assessment component accounts for the remaining 50% of the overall grade and is evaluated comprehensively based on students' task completion and the quality of their work.
Study and examination requirements	Following the examination regulations, students must have selected and registered for the courses.
Reading list	[1] Zhang Qi, Gui Tao, Zheng Rui, Huang Xuanjing. Large-scale language models: from theory to practice [M]. Beijing: People's Post and Telecommunications Press, 2024. [2] Zhao Xin, Wen Jirong. Large Language Models [M]. Beijing: Renmin University of China Press, 2024. [3] Wang Zhenli. Fundamentals and Practices of Large-Scale Language Model Development [M]. Beijing: Peking University Press, 2024. [4] Zhou Ming, Liu Qun. The Technical Framework and Core Design Methods of Large Models [J]. Journal of Computer Science, 2024. [5] Ren Lei, Wang Haiteng, Dong Jiabao. Industrial large models: System architecture, key technologies and typical applications [J]. China Science: Information Science, 2024.
Revision Date	V2024.1, September 2024. V2024.2, December 2025, Update: Credits and workload are calculated based on ECTS.

Generative AI Development

Module name	Generative AI Development		
Code	3080717359		
Semester	Spring, 2nd Semester		
Contact person	Gong Aiai, Yu Wei		
Language	Chinese		
Relation to curriculum	Compulsory , Integrated Practical Course		
Type of teaching, contact hours	Lecture method, demonstration method, group discussion method, case analysis method, project-based learning method, personalized tutoring Teaching duration: 4 hours per week, totaling 12 weeks and 48 hours in total.		
Work load	Total workload (estimated): 112 credit hours Total class hours: 48 hours Self-study duration: 64 hours, covering post-class material review, project design, experimental preparation, project refinement, and assessment preparation.		
Credit points	4		
Recommended prerequisites	Introduction to Artificial Intelligence, Python Programming, Deep Learning		
Learning out-comes and their corresponding PLOs	Course Learning Outcomes (CLOs)	Description	Supported PLOs
	CLO1	Course Objective 1: Master the core principles and mainstream technical frameworks (e.g., Transformers, diffusion models), and development fundamentals of generative AI; understand its application logic in text, image, and speech scenarios; and identify key concepts and technical boundaries throughout the development process.	**R2**
	CLO2	Course Objective 2: Be capable of independently building, debugging, and optimizing simple generative AI models; proficiently use relevant development tools to perform basic generation tasks (e.g., text generation, image generation); and possess the ability to resolve common technical issues during development.	**R3**
	CLO3	Course Objective 3: By integrating real-world business scenarios, students will be able to design well-structured generative AI development solutions, apply acquired technologies to simple project implementations, cultivate a systematic AI development mindset, and establish a solid practical foundation for future careers in generative AI-related fields.	**R5**

Content	This course is a comprehensive applied course designed to enhance students' technical application skills. It enables students to understand the core principles and technical framework of generative AI, master methods for building, debugging, and optimizing generative AI models, become familiar with commonly used generative AI development tools and their application scenarios, and, through practical experience, be capable of designing, developing, and deploying simple generative AI projects tailored to specific needs. The course aims to cultivate students' ability to apply theoretical knowledge comprehensively in analyzing and solving real-world challenges in generative AI development, while fostering and enhancing their innovative design capabilities and overall competence in integrating theory with practice. Knowledge Module 1: Overview of Generative AI 4/48 Memory + Understanding Knowledge Module 2: Core Principles and Technical Framework of Generative AI (8/48) – Understanding + Application Knowledge Module 3: Generative AI Development Tools and Basic Operations 12/48 Understanding + Application + Analysis Knowledge Module 4: Building, Debugging, and Optimizing Generative AI Models (16/48: Application + Analysis + Creation) Knowledge Module 5: Generative AI Project Implementation and Deployment 8/48 Application + Analysis + Evaluation
Forms of examination	The overall grade for this course consists of continuous assessment and the final examination grade. The grade is evaluated on a percentage scale, with 60 being the passing score for the course. The final examination takes the form of a comprehensive project design and oral defense, accounting for 50% of the overall grade. Students are required to submit their project design and present it in a defense session. The continuous assessment component accounts for the remaining 50% of the overall grade and is evaluated comprehensively based on students' task completion and the quality of their work.
Study and examination requirements	Following the examination regulations, students must have selected and registered for the courses.
Reading list	[1] Generative Artificial Intelligence, authored by Tao Jianhua, He Ran, and Liu Si, published by Tsinghua University Press [2] General Knowledge of Artificial Intelligence and AIGC Applications, edited by Wang Lei and He Zongyao, Tsinghua University Press [3] "Focusing on ChatGPT: Applications and Frontiers of Generative Artificial Intelligence," edited by Shen Yushi, Li Lan, and Ding Jieyao, Tsinghua University Press [4] Zhou Ming, Liu Qun. Core Technologies and Development Paradigms of Generative AI [J]. Journal of Computer Science, 2024 [5] Ren Lei, Cheng Xueqi. Key Technologies and Challenges in Multimodal Generative AI Development [J]. China Science: Information Science, 2025
Revision Date	V2024.1, September 2024. V2024.2, December 2025, Update: Credits and workload are calculated based on ECTS.

Human-Computer Interaction Design

Module name	Human-Computer Interaction Design		
Code	3080717360		
Semester	Fall, 3rd Semester		
Contact person	Yu Xiaoyan, Li Qihua		
Language	Chinese		
Relation to curriculum	Compulsory, Integrated Practical Course		
Type of teaching, contact hours	Lecture method, demonstration method, questioning method, group discussion, whole-class seminar, group projects, independent research, computer-assisted instruction (CAI), unit-based teaching, practice exercises, laboratory learning, simulation and games, personalized tutoring Teaching hours: 4 hours per week, for a total of 12 weeks, amounting to 48 hours		
Work load	Total workload (estimated): 112 credit hours Total class hours: 48 hours Self-study duration: 64 hours, covering post-class material review, project design, experimental preparation, project refinement, and assessment preparation.		
Credit points	4		
Recommended prerequisites	Introduction to Artificial Intelligence; C Programming Language; Data Structures and Algorithms		
Learning out-comes and their corresponding PLOs	Course Learning Outcomes (CLOs)	Description	Supported PLOs
	CLO1	Course Objective 1: To be capable of investigating complex engineering problems based on artificial intelligence theory and scientific methods, selecting research approaches, designing feasible experiments, analyzing and interpreting experimental data, and drawing reasonable and valid conclusions through information synthesis.	**R4**
	CLO2	Course Objective 2: To be capable of selecting and applying appropriate technologies, resources, modern engineering methods, and AI tools to address complex engineering challenges in artificial intelligence-related fields — including predicting and simulating such problems—and to recognize their limitations.	**R5**
	CLO3	Course Objective 3: To cultivate a sound political stance, worldview, outlook on life, and values; to practice the core socialist values; to develop competencies in humanities and social sciences along with a strong sense of social responsibility; and to understand and adhere to engineering ethics and standards in artificial intelligence practice while fulfilling professional responsibilities.	**R7**

Content	This course is a core compulsory practical course for undergraduate students in the Artificial Intelligence program. Centered on users and utilizing AI application scenarios as its foundation, it focuses entirely on the interaction design process to help students master fundamental principles of human-computer interaction, proficiency in prototyping tools, interface design, implementation of interaction logic, and user testing methodologies, enabling them to complete a comprehensive AI product interaction design project from requirements analysis to prototype iteration. The course adopts an engineering-oriented, application-driven approach, fostering design thinking, practical skills, and innovative awareness to enhance students' overall capabilities in conducting interaction design and implementing requirements for intelligent systems. Knowledge Module 1: Fundamentals of Human-Computer Interaction and Tool Practice (Weight: 6/48; Level: Understanding + Application) Knowledge Module 2: User Research and Requirements Analysis Practice (Weight: 6/48; Level: Understanding + Analysis) Knowledge Module 3: Interface and Prototype Design Practice (Weight: 10/48; Level: Applied + Creative) Knowledge Module 4: Practical Implementation of Interaction Logic and Animation Effects (Weight: 12/48; Level: Application + Analysis) Knowledge Module 5: AI Scenario Interaction Design Practice (Weight: 10/48; Level: Applied + Creative) Knowledge Module 6: Testing Iteration and Results Presentation Practice (Weight: 4/48; Level: Evaluation + Creation)
Forms of examination	The overall grade for this course consists of continuous assessment and the final examination grade. The grade is evaluated on a percentage scale, with 60 being the passing score for the course. The final examination takes the form of a comprehensive project design and oral defense, accounting for 50% of the overall grade. Students are required to submit their project design and present it in a defense session. The continuous assessment component accounts for the remaining 50% of the overall grade and is evaluated comprehensively based on students' task completion and the quality of their work.
Study and examination requirements	Following the examination regulations, students must have selected and registered for the courses.
Reading list	[1] Wang Jian, Liu Zhengjie. Human-Computer Interaction Design (2nd Edition) [M]. Beijing: Higher Education Press, 2022. [2] Dong Shihai, Wang Heng. Fundamentals of Human-Computer Interaction (4th Edition) [M]. Beijing: Tsinghua University Press, 2021. [3] Li Leshan. Human-Computer Interface Design [M]. Beijing: Electronic Industry Press, 2020. [4] Zhang Xiaolong, Xu Jing. Evolution of Human-Computer Interaction Design Paradigms and Key Technologies in the Intelligent Era [J]. Journal of Computer Science, 2024,47(6):1210–1235. [5] Liu Zhengjie, Wu Yafeng. A review of natural human-computer interaction design for large-scale models [J]. Journal of Software Science, 2024,35(7):2561–2588.
Revision Date	V2024.1, September 2024. V2024.2, December 2025, Update: Credits and workload are calculated based on ECTS.

Robot Operating System (ROS)

Module name	Robot Operating System (ROS)		
Code	3080717361		
Semester	Fall, 3rd Semester		
Contact person	Yu Xiaoyan, Zhou Xuan		
Language	Chinese		
Relation to curriculum	Compulsory, Intralized practical course		
Type of teaching, contact hours	Lecture method, demonstration method, questioning method, group discussion, whole-class seminar, group projects, independent research, computer-assisted instruction (CAI), unit-based teaching, practice exercises, laboratory learning, simulation and games, personalized tutoring Teaching duration: 2 hours per week, totaling 16 weeks, for a cumulative period of 32 hours.		
Work load	Total workload (estimated): 84 credit hours Total class hours: 32 hours Self-study duration: 52 hours, covering post-class material review, project design, experimental preparation, project refinement, and assessment preparation.		
Credit points	3		
Recommended prerequisites	Python Programming, C Programming, Data Structures and Algorithms, Introduction to Artificial Intelligence		
Learning out-comes and their corresponding PLOs	Course Learning Outcomes (CLOs)	Description	Supported PLOs
	CLO1	Course Objective 1: To develop solutions for complex engineering problems in robotics and Artificial Intelligence, construct problem models, functional modules, and system workflows that meet requirements, demonstrate innovative thinking in design, and comprehensively consider social, health, safety, legal, cultural, and environmental factors.	**R3**
	CLO2	Course Objective 2: To analyze and evaluate the impacts of ROS engineering practices on health, safety, environment, legal compliance, economic and social sustainability based on engineering background knowledge, and to understand the responsibilities engineers must undertake.	**R6**
	CLO3	Course Objective 3: To cultivate a sound political stance, worldview, outlook on life, and values; to practice the core socialist values; to develop humanistic literacy and a sense of social responsibility; and to adhere to engineering ethics and professional standards in AI and robotics engineering practices while fulfilling their responsibilities.	**R7**

Content	This course is a core compulsory practical course for the Artificial Intelligence program specializing in intelligent robotics, built around the Robot Operating System (ROS) as its central platform. It covers the entire process of robot system development, including modeling, communication, sensors, navigation, control, and project implementation. The course aims to cultivate students' capabilities in developing, debugging, and deploying robotic systems, enhance their engineering design skills, innovative thinking, and awareness of safety standards, thereby laying a solid foundation for advanced studies and engineering applications in areas such as intelligent robotics, autonomous navigation, and human-machine interaction. Knowledge Module 1: ROS Fundamentals and Environment Configuration (Weight: 2/32; Focus: Understanding + Application) Knowledge Module 2: Practical Implementation of ROS Communication Mechanisms (Weight: 4/32; Requirements: Understanding + Analysis) Knowledge Module 3: Robot Modeling and URDF/Xacro (Weight: 8/32; Applications + Creation) Knowledge Module 4: Sensor Data Processing and Simulation (Weight: 6/32; Application + Analysis) Knowledge Module 5: ROS Navigation and Control Practice (Weight: 8/32, Application + Creation) Knowledge Module 6: Integrated Project Development and Defense (Weight: 4/32; Evaluation: +, Creativity: +)
Forms of examination	The overall grade for this course consists of continuous assessment and the final examination grade. The grade is evaluated on a percentage scale, with 60 being the passing score for the course. The final examination takes the form of a comprehensive project design and oral defense, accounting for 50% of the overall grade. Students are required to submit their project design and present it in a defense session. The continuous assessment component accounts for the remaining 50% of the overall grade and is evaluated comprehensively based on students' task completion and the quality of their work.
Study and examination requirements	Following the examination regulations, students must have selected and registered for the courses.
Reading list	[1] Wu Hongmai, Xia Qixiao, Jin Xiaoming. Fundamentals of the ROS Robot Operating System [M]. Beijing: Machinery Industry Press, 2025. [2] Zhang Yunzhou, Wang Junyi, Han Quancheng. Principles and Applications of the ROS Robot Operating System [M]. Beijing: Science Press, 2022. [3] Liu Xiangquan, Zhang Wanjie. Introduction to and Practice of the Robot Operating System (ROS2) [M]. Beijing: Machinery Industry Press, 2024. [4] Macenski S, Foote T, Gerkey B, [4] Macenski S, Foote T, Gerkey B, et al. Robot Operating System 2: Design, architecture, and uses in the wild[J]. Science Robotics, 2022. [5] Lu Jingjing, Qin Yunchuan, Liu Zhizhong, et al. A Review of Security Research on the Robot Operating System ROS [J]. Journal of Software Science, 2024.
Revision Date	V2024.1, September 2024. V2024.2, December 2025, Update: Credits and workload are calculated based on ECTS.

Unity Virtual Reality Development

Module name	Unity Virtual Reality Development		
Code	3080717362		
Semester	Spring, 4th Semester		
Contact person	Lin Shulan		
Language	Chinese		
Relation to curriculum	Compulsory, Integrated Practical Course		
Type of teaching, contact hours	Lecturing method；Demonstration method；Practices Teaching Hours: 4 hours per week for 12 weeks, totaling 48 hours		
Work load	Total Workload (Estimated): 112 hours Teaching hours: 48 hours Self-study hours: 64 hours, including after-class assignments, project development, exam preparation time, etc.		
Credit points	4		
Recommended prerequisites	C++ Object-Oriented Programming, Visual Effects (VFX), Introduction to Artificial Intelligence, Human-Computer Interaction Design		
Learning out-comes and their corresponding PLOs	Course Learning Outcomes (CLOs)	Description	Supported PLOs
	CLO1	Course Objective 1: Master the architecture of the Unity engine and the VR development workflow, enabling the creation of VR scenes and implementation of basic interactive features.	**R3**
	CLO2	Course Objective 2: To perform VR system requirements analysis, interface design, and interaction logic design, demonstrating strong engineering design capabilities.	**R5**
	CLO3	Course Objective 3: Adhere to engineering standards and team collaboration guidelines to complete the division of labor, development, and integration of the VR project.	**R6**
	CLO4	Course Objective 4: Be capable of optimizing performance, testing, and troubleshooting VR systems, and producing comprehensive engineering documentation.	**R7**

Content	This course is a core practical program for the Artificial Intelligence major, focusing on virtual reality and intelligent interaction. Using Unity as the development platform, it systematically covers the VR development workflow, 3D scene creation, interaction system design, performance optimization, and real-world project implementation, cultivating students' capabilities in VR application development, intelligent interaction design, and engineering practice to meet ASIIN certification graduation requirements. Knowledge Module 1: Fundamentals of the Unity Engine and VR Development (Weight: 4/48; Level: Understanding) Knowledge Module 2: 3D Scene Construction, Materials, and Lighting Systems (Weight: 10/48; Level: Understanding + Application) Knowledge Module 3: C# Scripting and VR Interaction Logic Development (Weight: 14/48; Level: Application + Analysis) Knowledge Module 4: UI Systems, Animation Systems, and Particle Systems (Weight: 8/48; Level: Applied) Knowledge Module 5: VR Performance Optimization, Debugging, and Deployment (Weight: 8/48; Level: Analysis + Evaluation) Knowledge Module 6: Comprehensive VR Project Implementation and Outcome Presentation (Weight: 4/48; Level: Creative)
Forms of examination	The overall grade for this course consists of continuous assessment and the final examination. The grade is evaluated on a percentage scale, with 60 being the passing score for the course. The final examination is a closed-book exam with a duration of 100 minutes, accounting for 60% of the overall grade. It comprehensively assesses students' ability to learn, analyze, and solve complex problems. The continuous assessment component accounts for 40% of the overall grade and includes: (1) class participation 12%; (2) regular assignments 12%; and (3) interim tests 16%. Class participation is evaluated comprehensively based on students' contributions to class discussions, the quality of their questions and answers, their participation in group discussions, and their classroom discipline.
Study and examination requirements	Following the examination regulations, students must have selected and registered for the courses. This course employs a combination of formative and summative assessments to comprehensively evaluate students' ability to learn and analyze and solve complex problems. A percentage-based evaluation system, with 60 points being the passing score for this course.
Reading list	[5] Official Unity Tutorial: Practical VR Development, edited by Zhou Zhihua, People's Posts and Telecommunications Press, 2022. [2] Principles and Practices of Virtual Reality Development, edited by Li Hang, Electronic Industry Press, 2021. [3] Unity 3D Game Development and Design (3rd Edition), edited by Qiu Xipeng, Tsinghua University Press, 2020. [4] Human-Computer Interaction and VR Interface Design, edited by Zhu Qiongling, China Machine Press, 2023. [5] Practical Development of the Unity VR Project. China Water & Power Press, 2022. [6] Design and Engineering Practices of VR/AR Systems. Higher Education Press, 2021.
Revision Date	V2024.1, September 2024. V2024.2, December 2025, Update: Credits and workload are calculated based on ECTS.

Smart Hardware Technology

Module name	Smart Hardware Technology		
Code	3080717363		
Semester	Spring, 4th Semester		
Contact person	Wang Weihua		
Language	Chinese		
Relation to curriculum	Compulsory, Integrated Practical Course		
Type of teaching, contact hours	Lectures, case-based teaching, task descriptions, problem discussions, group debates, phased reports, project implementation, hardware setup, program debugging and integration testing, personalized tutoring Teaching duration: 2 hours per week, totaling 16 weeks and 32 hours in total.		
Work load	Total workload (estimated): 84 credit hours Total class hours: 32 hours Self-study duration: 52 hours, covering post-class material review, project design, experimental preparation, project refinement, and assessment preparation.		
Credit points	3		
Recommended prerequisites	Analog Circuits and Digital Circuits, C Language Programming, Python Programming.		
Learning outcomes and their corresponding PLOs	Course Learning Outcomes (CLOs)	Description	Supported PLOs
	CLO1	Understand the fundamental components, typical architectures, and development processes of intelligent hardware systems; be capable of identifying requirements based on specific application tasks and develop a well-structured collaborative design approach for hardware and software integration.	R4
	CLO2	Capable of performing data acquisition, interface configuration, program download, online debugging, and result verification using development boards, sensor modules, debugging tools, and standard development environments; possesses the ability to conduct development practices with modern tools.	R5
	CLO3	Capable of designing experimental protocols for smart hardware projects, testing and analyzing system performance, power consumption, stability, and response performance, and refining the design based on experimental results.	R4

	CLO4	Be capable of comprehensively considering factors such as power consumption control, usage safety, reliability, maintainability, and resource efficiency in smart hardware application design, while understanding the impact of engineering practices on the environment and sustainable development.	R6
Content	This course serves as a comprehensive training program within the intensive practical component of the Artificial Intelligence curriculum, targeting smart terminals, IoT devices, and edge computing scenarios, and revolves around the core framework of "perception−control−communication−application". Through integrated training involving development boards, sensors, actuators, and embedded software, students will master the fundamental architecture of intelligent hardware systems, interface connection methods, data acquisition processes, and control implementation workflows. Through hands-on project practice, they will complete system deployment, program debugging, and performance optimization, thereby enhancing their engineering skills in applying AI-related knowledge to specific hardware platforms. Knowledge Module 1: Overview of Smart Hardware Systems and Development Environment (Weight: 4/32; Level: Understanding) Knowledge Module 2: Sensors, Actuators, and Interface Connections (Weight: 6/32; Level: Understanding + Application) Knowledge Module 3: Embedded Control, Data Acquisition, and Communication Implementation (Weight: 8/32; Level: Application + Analysis) Knowledge Module 4: Edge Intelligence Deployment and System Integration (Weight: 8/32; Level: Analysis + Creation) Knowledge Module 5: Integrated Project Design, Debugging, and Optimization (Weight: 6/32; Level: Application − Creative)		
Forms of examination	The overall grade for this course consists of continuous assessment and the final exam. The grade is evaluated on a percentage scale, with 60 being the passing score for the course. The final exam counts for 50% and uses a combination of course design, project implementation, and results presentation for overall evaluation. The continuous assessment component accounts for 50% of the overall grade and includes: (1) class participation 12%; (2) regular assignments 12%; and (3) interim tests (16%); (4) experiment or project process10%. Class participation is evaluated comprehensively based on students' contributions to class discussions, the quality of their questions and answers, their participation in group discussions, and their classroom discipline.		
Study and examination requirements	Following the examination regulations, students must have selected and registered for the courses.		

Reading list	[1] Wang Jian, Liu Hui. Intelligent Hardware Technology and Applications [M]. Beijing: Higher Education Press, 2023. [2] Huang Tongcheng, Zhang Shiliang. Practical Development of Embedded Intelligent Hardware [M]. Beijing: Electronic Industry Press, 2022. [3] Li Fangyuan. Fundamentals of Internet of Things and Smart Hardware Design [M]. Beijing: Machinery Industry Press, 2024. [4] Zhou Yijun, Chen Xi, Ma Dianfu. Research on Low-Power Intelligent Hardware Chip Architecture and Design Technologies [J]. Journal of Computer Science, 2024,47(4):791−812. [5] Zhang Tao, Guo Yu, Wu Jun. Key Technologies and Development Trends for AI Deployment on Smart Hardware Devices [J]. Microelectronics & Computer Science, 2024,41(3):8−15.
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Navigation and Positioning Technologies

Module name	Navigation and Positioning Technologies		
Code	3080717364		
Semester	Spring, 4th Semester		
Contact person	Zhao Dandan, Huang Chao		
Language	Chinese		
Relation to curriculum	Compulsory, Integrated Practical Course		
Type of teaching, contact hours	Lecture-based instruction, case-based teaching, task-oriented guidance, problem analysis, group discussions, algorithm comparison and presentation, data processing experiments, simulation validation, comprehensive project training, personalized tutoring Teaching duration: 2 hours per week, totaling 16 weeks and 32 hours in total.		
Work load	Total workload (estimated): 84 credit hours Total class hours: 32 hours Self-study duration: 52 hours, covering post-class reading, algorithm derivation, data processing, project practice, and assessment preparation.		
Credit points	3		
Recommended prerequisites	Discrete Mathematics, Linear Algebra, Probability Theory and Mathematical Statistics, Python Programming, Signals and Systems.		
Learning outcomes and their corresponding PLOs	Course Learning Outcomes (CLOs)	Description	Supported PLOs
	CLO1	Master the fundamental concepts, typical application scenarios, and key methodologies of navigation and positioning technologies; be capable of selecting appropriate technical approaches for specific tasks and developing comprehensive system solutions.	R3
	CLO2	It enables the use of modern tools such as positioning data processing, simulation analysis, and visualization to process, analyze, and validate results from GNSS, inertial navigation, or indoor positioning data.	R5
	CLO3	Capable of performing design tasks such as position fusion, path planning, or error analysis for navigation challenges in mobile robots, smart terminals, or unmanned systems, and developing actionable solutions.	R3
	CLO4	Be capable of effectively dividing tasks, communicating, and collaborating with team members within the course project to jointly complete the conceptual design, experimental validation, and result presentation of the navigation and positioning system.	R8

Content	This course serves as a comprehensive training module within the intensive practical component of the Artificial Intelligence program, focusing on navigation and positioning requirements in mobile robots, unmanned systems, and intelligent terminals. It covers fundamental topics such as satellite navigation, inertial navigation, indoor positioning, and multi-source information fusion, enabling students to understand the entire process—from positioning principles and error sources to the implementation of navigation algorithms—and enhancing their ability to solve real-world navigation and positioning engineering problems through data processing, simulation validation, and project-based training. Knowledge Module 1: Overview of Navigation and Localization Technologies and Coordinate Fundamentals (Weight: 4/32; Level: Understanding) Knowledge Module 2: GNSS Positioning Principles and Error Analysis (Weight: 8/32; Level: Understanding + Analysis) Knowledge Module 3: Inertial Navigation and Multi-Sensor Fusion (Weight: 8/32; Level: Application + Analysis) Knowledge Module 4: Indoor Localization Methods and Typical Algorithms (Weight: 6/32; Level: Application + Analysis) Knowledge Module 5: Navigation Path Planning and Comprehensive Application Practice (Weight: 6/32; Level: Analysis – Creation)
Forms of examination	The overall grade for this course consists of continuous assessment and the final exam. The grade is evaluated on a percentage scale, with 60 being the passing score for the course. The final exam counts for 50% and uses a combination of course design, project implementation, and results presentation for overall evaluation. The continuous assessment component accounts for 50% of the overall grade and includes: (1) class participation 12%; (2) regular assignments 12%; and (3) interim tests (16%); (4) experiment or project process10%. Class participation is evaluated comprehensively based on students' contributions to class discussions, the quality of their questions and answers, their participation in group discussions, and their classroom discipline.
Study and examination requirements	Following the examination regulations, students must have selected and registered for the courses.

Reading list	[1] Tan Shusen. Principles and Applications of Satellite Navigation and Positioning [M]. Beijing: National Defense Industry Press, 2021. [2] Wang Yanhui, Qian Lexiang. Fundamentals of Navigation and Positioning Technology [M]. Beijing: Higher Education Press, 2022. [3] He Qiusheng, Zhao Jianhui. Integrated Indoor-Outdoor Positioning Technology and Its Applications [M]. Beijing: Electronic Industry Press, 2023. [4] Yang Yuanxi, Xu Junyi. Key Technologies and Development Trends of Next-Generation Satellite Navigation and Positioning [J]. Journal of Surveying and Mapping, 2024,53(2):161−178. [5] Li Qingquan, Yang Bisheng. A review of multi-source information fusion navigation and positioning methods [J]. Surveying and Mapping Bulletin, 2024, (5):1−8.
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Structural Modeling Design

Module name	Structural Modeling Design		
Code	3080717365		
Semester	Fall, 5th Semester		
Contact person	Zhang Xiaohong, Ma Xueting		
Language	Chinese		
Relation to curriculum	Compulsory, Integrated Practical Course		
Type of teaching, contact hours	Lecture-based instruction, case studies, task specifications, problem discussions, group debates, phased presentations, project implementation, model development, simulation analysis and optimization debugging, personalized tutoring Teaching duration: 2 hours per week, totaling 16 weeks and 32 hours in total.		
Work load	Total workload (estimated): 84 credit hours Total class hours: 32 hours Self-study duration: 52 hours, covering post-class material review, project design, experimental preparation, project refinement, and assessment preparation.		
Credit points	3		
Recommended prerequisites	Advanced Mathematics, Introduction to Artificial Intelligence Majors		
Learning outcomes and their corresponding PLOs	Course Learning Outcomes (CLOs)	Description	Supported PLOs
	CLO1	Capable of addressing complex structural engineering challenges in intelligent equipment within the field of Artificial Intelligence, effectively utilizing modern digital design tools such as 3D modeling and simulation analysis to perform structural modeling, mechanical simulation, and model testing; accurately applying relevant technical resources for structural prediction and simulation validation; and objectively evaluating the applicability and limitations of various modeling and simulation tools.	R5
	CLO2	Be capable of establishing a correct worldview, outlook on life, and set of values; practicing the core socialist values; possessing humanistic literacy and a sense of social responsibility; in intelligent structural modeling and design engineering practice, complying with structural design standards, data confidentiality regulations, and professional ethics in the industry; emphasizing product safety and human-machine interaction safety; and clearly understanding the professional responsibilities incumbent upon engineering practitioners.	R7

	CLO3	Possesses strong engineering communication and presentation skills, capable of drafting design reports, creating engineering drawings, and delivering design presentations for complex structural modeling projects; able to clearly articulate design concepts and participate in defense sessions; demonstrates a basic international perspective, can consult foreign design literature, understand cross-cultural technical communication differences, and possesses fundamental cross-cultural communication skills.	R9
	CLO4	Possessing a strong awareness of autonomous learning and lifelong learning in the interdisciplinary field of structural design and artificial intelligence, capable of proactively mastering cutting-edge technologies such as advanced modeling software, intelligent design generation, and lightweight structures; able to employ critical thinking to evaluate the merits of various modeling approaches and meet the evolving demands for iterative development of structural design technologies in the smart industry.	R11
Content	This course serves as a comprehensive training program within the intensive practical component of the Artificial Intelligence curriculum, targeting design scenarios for intelligent equipment, robotic structures, and smart carrier architectures. It follows a structured framework encompassing "structural cognition − modeling and design − simulation analysis − model optimization." Utilizing 3D modeling software and simulation tools, the course provides integrated practical training that enables students to master fundamental mechanical structures, 3D modeling techniques, structural assembly design methodologies, and model simulation processes. Through project-based exercises, students learn to construct structural models, adjust parameters, render models, and verify performance, thereby enhancing their engineering proficiency in utilizing digital tools for intelligent structural modeling and design. Knowledge Module 1: Fundamentals of Structural Modeling and Engineering Design Specifications (Weight: 2/32; Level: Memory + Understanding) Knowledge Module 2: Operation of 3D Modeling Software and Basic Model Creation (Weight: 6/32; Level: Understanding + Application) Knowledge Module 3: Component Assembly Design and Engineering Drawing Generation (Weight: 8/32; Level: Applied + Analytical) Knowledge Module 4: Structural Mechanics Simulation and Model Performance Verification (Weight: 6/32; Level: Analysis + Evaluation) Knowledge Module 5: Comprehensive Modeling Project Design and Model Optimization Practice (Weight: 10/32; Level: Application + Evaluation + Creation)		

Forms of examination	The overall grade for this course consists of continuous assessment and the final examination grade. The grade is evaluated on a percentage scale, with 60 being the passing score for the course. The final examination takes the form of a comprehensive project design and oral defense, accounting for 50% of the overall grade. Students are required to submit their project design and present it in a defense session. The continuous assessment component accounts for the remaining 50% of the overall grade and is evaluated comprehensively based on students' task completion and the quality of their work.
Study and examination requirements	Following the examination regulations, students must have selected and registered for the courses.
Reading list	[1] Fundamentals and Practical Examples of 3D Modeling, edited by Wang Xue, Machinery Industry Press, 2024,1st ed. [2] Mechanical Structure Design and Simulation Analysis, edited by Li Gang, Electronic Industry Press, 2022,2nd edition. [3] Fundamentals of Engineering Drawing and Structural Modeling, edited by Zhang Jianhua, Higher Education Press, 2020,1st ed. [4] Liu Chang, Zhao Xin. Research on Intelligent Equipment Structure Optimization Design Based on 3D Modeling [J]. Mechanical Design and Manufacturing, 2023,11(02):189–192. [5] Chen Hao, Wang Lei. Performance analysis of lightweight intelligent structural modeling and simulation [J]. Computer Simulation, 2020,37(12):412–416.
Revision Date	V2024.1, September 2024. V2024.2, December 2025, Update: Credits and workload are calculated based on ECTS.

Intelligent Control Development

Module name	Intelligent Control Development		
Code	3080717366		
Semester	Fall, 5th Semester		
Contact person	Zhang Xiaohong		
Language	Chinese		
Relation to curriculum	Compulsory, Integrated Practical Course		
Type of teaching, contact hours	Lectures, case-based teaching, task descriptions, problem discussions, group debates, phased reports, project implementation, hardware setup, program debugging and integration testing, personalized tutoring Teaching duration: 4 hours per week, totaling 12 weeks and 48 hours in total.		
Work load	Total workload (estimated): 112 credit hours Total class hours: 48 hours Self-study duration: 64 hours, covering post-class material review, project design, experimental preparation, project refinement, and assessment preparation.		
Credit points	4		
Recommended prerequisites	Analog Circuits and Digital Circuits, C Language Programming, Python Programming, Data Structures and Algorithms		
Learning out-comes and their corresponding PLOs	Course Learning Outcomes (CLOs)	Description	Supported PLOs
	CLO1	Capable of addressing complex engineering challenges in the field of intelligent control by establishing problem models tailored to the characteristics of controlled systems, and designing functional modules for intelligent controllers such as fuzzy control and neural network control while developing corresponding control system solutions; able to integrate algorithmic optimization principles throughout the design process, comprehensively considering safety requirements, environmental constraints, and practical application needs.	R3
	CLO2	Capable of performing simulation modeling, algorithm debugging, and parameter optimization for intelligent control systems using tools such as Matlab and Python, based on system performance metrics and practical engineering requirements. Possesses comprehensive skills in control system development, solution validation, and functional iteration, enabling the design of intelligent solutions tailored to industrial control scenarios.	R3

	CLO3	Capable of integrating the engineering context of intelligent control systems to analyze their impacts on production safety, personnel health, ecological environment, and socio-economic outcomes in industrial applications; able to evaluate resource consumption and compliance issues in intelligent control engineering practices, and clarify engineers' responsibilities in green production, workplace safety, and sustainable development.	R6
	CLO4	Possessing autonomous learning capabilities and a lifelong learning mindset in the intersection of intelligent control and artificial intelligence, with proactive engagement in cutting-edge technologies such as novel intelligent control algorithms and embedded intelligent control systems; capable of applying critical thinking to analyze the advantages, disadvantages, and applicable scenarios of various control algorithms, thereby meeting the evolving technological demands of the AI industry.	R11
Content	This course serves as a comprehensive training program within the intensive practical component of the Artificial Intelligence major, targeting application scenarios such as industrial intelligent control and smart equipment, and follows the core framework of "modeling − algorithms − simulation − development". Leveraging simulation software and hands-on control projects, the course enables students to master fundamental theories of intelligent control, principles of typical intelligent control algorithms, and methods for modeling controlled systems; become familiar with the processes involved in intelligent controller design, programming, and system debugging; and through project-based practice, complete the construction of control systems, algorithm optimization, and performance testing, thereby enhancing their comprehensive practical ability to apply knowledge of artificial intelligence and control theory to real-world engineering applications. Knowledge Module 1: Fundamental Theories of Intelligent Control and Modeling of Controlled Systems (Weight: 6/48; Level: Memory + Understanding) Knowledge Module 2: Principles of Fuzzy Control and Controller Design (Weight: 10/48; Level: Understanding + Application + Analysis) Knowledge Module 3: Neural Network Control Algorithms and Model Development (Weight: 12/48; Level: Application + Analysis) Knowledge Module 4: Principles of Adaptive Control and Optimization Control Algorithms (Weight: 10/48; Level: Understanding + Evaluation) Knowledge Module 5: Simulation Development and Comprehensive Practice of Intelligent Control Systems (Weight: 10/48; Level: Application + Evaluation + Innovation)		

Forms of examination	The overall grade for this course consists of continuous assessment and the final examination grade. The grade is evaluated on a percentage scale, with 60 being the passing score for the course. The final examination takes the form of a comprehensive project design and oral defense, accounting for 50% of the overall grade. Students are required to submit their project design and present it in a defense session. The continuous assessment component accounts for the remaining 50% of the overall grade and is evaluated comprehensively based on students' task completion and the quality of their work.
Study and examination requirements	Following the examination regulations, students must have selected and registered for the courses.
Reading list	[1] Principles and Applications of Intelligent Control, edited by Cai Zixing, Tsinghua University Press, 2024,4th edition. [2] Intelligent Control: Theoretical Foundations, Algorithm Design and Applications, edited by Liu Jinkun, Tsinghua University Press, 2023,2nd edition. [3] Intelligent Control, edited by Li Shiyong, Tsinghua University Press, 2021,2nd edition. [4] Wang Zhenhua, Li Gang. Research on Industrial Intelligent Control Optimization Based on Improved Neural Networks [J]. Control Engineering, 2022,29(05):952−958. [5] Zhang Yu, Chen Ming. Design and Simulation Analysis of Fuzzy Adaptive Intelligent Control Systems [J]. Computer Simulation, 2020,37(08):321−325.
Revision Date	V2024.1, September 2024. V2024.2, December 2025, Update: Credits and workload are calculated based on ECTS.

Intelligent Recommendation Technology

Module name	Intelligent Recommendation Technology		
Code	3080717367		
Semester	Spring, 6th Semester		
Contact person	Liu Xiaofeng, Wang Xinjiao		
Language	Chinese		
Relation to curriculum	Compulsory, Integrated Practical Course		
Type of teaching, contact hours	Lectures, case-based teaching, questioning, inquiry-based learning, teaching seminars (including group discussions), project-based practice, and personalized tutoring Teaching Hours: 2 hours per week for 16 weeks, totaling 32 hours		
Work load	Total workload (estimated): 84 hours Teaching hours: 32 hours Self-study hours: 52 hours, including after-class assignments, exam preparation time, etc.		
Credit points	3		
Recommended prerequisites	Introduction to Artificial Intelligence, Machine Learning, Data Mining and Analysis, Deep Learning		
Learning outcomes and their corresponding PLOs	Course Learning Outcomes (CLOs)	Description	Supported PLOs
	CLO1	Course Objective 1: Master the fundamental theories, core algorithms, and technical frameworks of intelligent recommendation technology; understand the architectural design and full-process logic of recommendation systems; and develop the capability to research recommendation algorithms and design implementation solutions.	**R4**
	CLO2	Course Objective 2: Master the proficient use of Python, recommendation frameworks, and Machine Learning/Deep Learning tools to complete recommendation model training, tuning, evaluation, and deployment; be capable of selecting appropriate tools and algorithms for specific business scenarios; and understand technical limitations.	**R5**
	CLO3	Course Objective 3: Based on recommendation system engineering standards, evaluate the feasibility, effectiveness, and safety of recommendation schemes; consider social impacts such as user privacy, data security, and algorithmic fairness; and clarify engineering implementation responsibilities.	**R6**

Content	Intelligent recommendation technology represents a core application area of artificial intelligence and data mining, widely utilized in e-commerce, short video platforms, news feeds, social media, and other scenarios as a pivotal technology bridging users and information. This course focuses on hands-on practice, covering the entire recommendation system lifecycle by systematically explaining mainstream techniques such as collaborative filtering, content-based recommendation, deep learning-based recommendation, and ranking models, while addressing practical aspects including data collection, feature engineering, model development, training and evaluation, and deployment. Emphasizing practical engineering skills, the course integrates real-world datasets and project cases to equip students with proficiency in using leading recommendation frameworks and tools, enabling them to independently design, develop, and optimize intelligent recommendation systems—laying a solid foundation for algorithm development and business implementation in the field of artificial intelligence. Knowledge Module 1: Overview of Intelligent Recommendation Technology (Weight: 2/32; Levels: Memory, Understanding, Application) Knowledge Module 2: Recommended Data Processing and Feature Engineering (Weight: 4/32; Levels: Memory, Understanding, Application) Knowledge Module 3: Collaborative Filtering Recommendation Algorithm (Weight: 4/32; Levels: Memory, Understanding, Application) Knowledge Module 4: Content-Based Recommendation (Weight: 4/32; Levels: Memory, Understanding, Application) Knowledge Module 5: Classic Recommended Models (Weight: 4/32; Levels: Memory, Understanding, Application) Knowledge Module 6: Deep Learning Recommendation Model (Weight ratio: 4/32; Levels: Memory, Understanding, Application) Knowledge Module 7: Recommendation System Evaluation and Optimization (Weight: 4/32; Levels: Memory, Understanding, Application) Knowledge Module 8: Comprehensive Project Practice (Weight: 6/32; Levels: Memory, Understanding, Application)
Forms of examination	The overall grade for this course consists of continuous assessment and the final examination grade. The grade is evaluated on a percentage scale, with 60 being the passing score for the course. The final examination takes the form of a comprehensive project design and oral defense, accounting for 50% of the overall grade. Students are required to submit their project design and present it in a defense session. The continuous assessment component accounts for the remaining 50% of the overall grade and is evaluated comprehensively based on students' task completion and the quality of their work.
Study and examination requirements	Following the examination regulations, students must have selected and registered for the courses.

Reading list	[1] Pan Lusheng, Ma Guojun. Research Progress on Intelligent Recommendation Technology Empowered by Large Models [J]. Journal of Software Science, 2024,35(4):1421−1446. [2] Deep Learning Recommendation Systems, by Wang Zhe, Electronic Industry Press, March 2020,1st edition [3] Large Model-Based Intelligent Recommendation Systems: Technical Analysis and Development Practices, by Liang Zhiyuan and Han Xiaochen, Tsinghua University Press, April 2025,1st ed. [4] Intelligent Recommendation Technology, by Pan Weike, Lin Jing, and Ming Zhong, Tsinghua University Press, April 2022 [5] Building Enterprise-Level Recommendation Systems: Algorithms, Engineering Implementation, and Case Studies, by Liu Qiang, China Machine Press, July 2021,1st ed.
Revision Date	V2024.1, September 2024. V2024.2, December 2025, Update: Credits and workload are calculated based on ECTS.

Group Intelligence and Bionic Computing

Module name	Group Intelligence and Bionic Computing		
Code	3080717368		
Semester	Spring, 6th Semester		
Contact person	Wang Xinjiao		
Language	Chinese		
Relation to curriculum	Compulsory, Integrated Practical Course		
Type of teaching, contact hours	Lectures, case-based teaching, questioning, inquiry-based learning, teaching seminars (including group discussions), self-directed inquiry learning, personalized tutoring, and project-based practice Teaching duration: 4 hours per week, totaling 12 weeks and 48 hours in total.		
Work load	Total workload (estimated): 112 credit hours Total class hours: 48 hours Self-study hours: 64 hours, including: post-class material review, project design, experiment preparation, and exam preparation time.		
Credit points	4		
Recommended prerequisites	Linear Algebra, Introduction to Artificial Intelligence, Data Structures and Algorithms		
Learning outcomes and their corresponding PLOs	Course Learning Outcomes (CLOs)	Description	Supported PLOs
	CLO1	Course Objective 1: Through this course, students will be able to address complex optimization and engineering problems in the field of Artificial Intelligence by designing appropriate problem models and solution approaches based on swarm intelligence and bionic computing theories, develop functional modules for algorithms, and demonstrate innovative thinking throughout the design process while comprehensively considering practical constraints such as algorithm efficiency and application scenarios.	**R3**
	CLO2	Course Objective 2: Cultivate proper values and engineering ethics awareness; understand the ethical issues—such as fairness, privacy protection, and explainability—that may arise from the practical application of collective intelligence and bionic computing algorithms; and consciously adhere to engineering professional ethics and standards in algorithm design and engineering practice while fulfilling corresponding social responsibilities.	**R7**
	CLO3	Course Objective 3: Understand and master the fundamental principles of engineering management and decision-making methods for swarm intelligence algorithm projects; be capable of planning the entire lifecycle of algorithm design, implementation, and testing within a multidisciplinary context; allocate tasks and resources efficiently; and complete the development and delivery of bionic computing-related projects as required.	**R10**

Content	This course is a core course for the Artificial Intelligence major, designed to cultivate students' ability to solve complex optimization problems using theories of swarm intelligence and bionic computing. It enables students to understand the fundamental concepts, historical development, and representative models of swarm intelligence and bionic computing; master the principles, implementation processes, and methods of classical algorithms such as the Ant Colony Algorithm and Particle Swarm Optimization Algorithm; become familiar with improvement strategies and engineering applications of bionic algorithms; and, through experimental and project-based practice, be capable of designing, implementing, debugging, and optimizing swarm intelligence algorithms tailored to specific practical requirements. The course aims to develop students' ability to comprehensively apply theoretical knowledge to analyze and solve complex engineering problems, while fostering and enhancing their innovative design capabilities and overall competence in integrating theory with practice. Knowledge Module 1: Overview of Collective Intelligence and Bionic Computing (Weight: 2/48; Level: Understanding) Knowledge Module 2: Principles of Classic Collective Intelligence Algorithms (Weight: 8/48; Level: Understanding + Application) Knowledge Module 3: Core Models and Implementation of Bionic Computing (Weight: 12/48; Levels: Understanding + Application + Analysis) Knowledge Module 4: Improvement and Optimization of Collective Intelligence Algorithms (Weight: 12/48; Levels: Application + Analysis + Evaluation) Knowledge Module 5: Engineering Applications and Project Practice of Collective Intelligence Algorithms (Weight: 14/48; Level: Application + Creation)
Forms of examination	The overall grade for this course consists of continuous assessment and the final examination grade. The grade is evaluated on a percentage scale, with 60 being the passing score for the course. The final examination takes the form of a comprehensive project design and oral defense, accounting for 50% of the overall grade. Students are required to submit their project design and present it in a defense session. The continuous assessment component accounts for the remaining 50% of the overall grade and is evaluated comprehensively based on students' task completion and the quality of their work.
Study and examination requirements	Following the examination regulations, students must have selected and registered for the courses.
Reading list	[1] Yang Shuying, Zhang Hua. Collective Intelligence and Bionic Computing: Implementation Using Matlab Technology [M]. Electronic Industry Press, 2012. [2] Zhang Guohui, Wen Xiaoyu. Collective Intelligence [M]. Tsinghua University Press, 2022. [3] Li Shiyong, Li Yan, Wang Yuehong. Principles and Implementation of Intelligent Algorithms – Swarm Intelligence Optimization Algorithms [M]. Tsinghua University Press, 2025. [4] Gong Maoguo, Luo Tianshi, Li Hao, et al. A review of collaborative research on swarm intelligence for evolutionary computation [J]. Journal of Electronics and Informatics, 2024,46(5):1716–1741. [5] Cheng Baopeng, Fang Yangwang, Peng Weishi, et al. Comprehensive performance evaluation of swarm intelligence algorithms based on an improved radar chart method [J]. Journal of Beihang University, 2023,49(10):2780–2789.
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Chatbot Development

Module name	Chatbot Development		
Code	3080717369		
Semester	Spring, 6th Semester		
Contact person	Li Mingyan, He Qin, Zhou Xuan		
Language	Chinese		
Relation to curriculum	Compulsory, Integrated Practical Course		
Type of teaching, contact hours	Lectures, case-based teaching, questioning, inquiry-based learning, teaching seminars (including group discussions), self-directed inquiry learning, personalized tutoring, and project-based practice Teaching duration: 2 hours per week, totaling 16 weeks, for a cumulative period of 32 hours.		
Work load	Total workload (estimated): 84 credit hours Total class hours: 32 hours Self-study hours: 52 hours, including post-class material review, project design, experimental preparation, project refinement, and assessment preparation.		
Credit points	3		
Recommended prerequisites	Python Programming, Introduction to Artificial Intelligence, Data Structures and Algorithms		
Learning out-comes and their corresponding PLOs	Course Learning Outcomes (CLOs)	Description	Supported PLOs
	CLO1	Course Objective 1: To apply Natural Language Processing and dialogue management technologies to identify and analyze complex engineering challenges in chatbot systems, develop technical solutions through a literature review, and formulate robust analytical conclusions.	**R2**
	CLO2	Course Objective 2: To design and implement comprehensive solutions for chatbot application scenarios, develop system architectures and functional modules, demonstrate innovative thinking, and comprehensively address practical constraints such as performance and user interaction experience.	**R3**
	CLO3	Course Objective 3: To effectively communicate with industry peers and users regarding the design and development outcomes of chatbot systems, including preparing technical reports, project presentations, and functional specification documents, demonstrating strong professional communication skills.	**R9**
	CLO4	Course Objective 4: Understand the engineering management process of chatbot projects, and be capable of performing project planning, task allocation, and schedule management within multidisciplinary teams, while completing system development, testing, and delivery as required.	**R10**

Content	This course is a core practical course for the Artificial Intelligence major, designed to cultivate students' abilities in designing, developing, and deploying intelligent chatbots. It equips students with fundamental theories such as natural language understanding, dialogue management, and intent recognition; familiarizes them with common chatbot frameworks, development workflows, and implementation techniques; and enables them to build comprehensive chatbot systems tailored to real-world applications. The course emphasizes the integration of theory and practice, enhancing students' capabilities in engineering development, innovative design, and teamwork. Knowledge Module 1: Overview of Chatbot Technology (Weight: 2/32, Level: Understanding) Knowledge Module 2: Fundamentals of Chatbot Natural Language Processing (Weight: 6/32; Level: Understanding + Application) Knowledge Module 3: Chatbot Framework and Core Module Implementation (Weight: 10/32; Levels: Understanding + Application + Analysis) Knowledge Module 4: Chatbot Optimization and Evaluation (Weight: 4/32; Levels: Application + Analysis + Evaluation) Knowledge Module 5: Chatbot Project Practice and Development (Weight: 10/32; Level: Application + Creation)
Forms of examination	The overall grade for this course consists of continuous assessment and the final examination grade. The grade is evaluated on a percentage scale, with 60 being the passing score for the course. The final examination takes the form of a comprehensive project design and oral defense, accounting for 50% of the overall grade. Students are required to submit their project design and present it in a defense session. The continuous assessment component accounts for the remaining 50% of the overall grade and is evaluated comprehensively based on students' task completion and the quality of their work.
Study and examination requirements	Following the examination regulations, students must have selected and registered for the courses.
Reading list	[1] Bird S, Klein E, Loper E. Python for Natural Language Processing [M]. People's Post and Telecommunications Press, 2010. [2] Gao Jie, Galley M, Li L. Neural approaches to conversational artificial intelligence [M]. Morgan & Claypool Publishers, 2019. [3] Liu Jianping. Practical Development of Chatbots [M]. China Machine Press, 2023. [4] Wang Chao. Design and Implementation of an Intelligent Dialogue System Based on Large Models [J]. Computer Engineering and Applications, 2024,60(2):1−12. [5] Li Haitao. Research on Architecture Design and Performance Optimization of Intelligent Customer Service Robots [J]. Computer Applications and Software, 2023,40(7):189−195.
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Reinforcement Learning

Module name	Reinforcement Learning		
Code	3080717370		
Semester	Fall, 7th Semester		
Contact person	Zhao Yuxia, Zhou Meihong		
Language	Chinese		
Relation to curriculum	Compulsory, Integrated Practical Course		
Type of teaching, contact hours	Lectures, case-based teaching and questioning, inquiry-based problem learning, instruction and discussion (including group discussions), project-based practice, personalized tutoring Teaching Hours: 2 hours per week for 16 weeks, totaling 32 hours		
Work load	Total workload (estimated): 84 hours Teaching hours: 32 hours Self-study hours: 52 hours, covering pre-class preparation, post-class review and consolidation, assignment completion, error identification and correction, reference material consultation for further learning, summary and gap filling, as well as exam preparation time.		
Credit points	3		
Recommended prerequisites	Python Programming, Machine Learning, Deep Learning		
Learning out-comes and their corresponding PLOs	Course Learning Outcomes (CLOs)	Description	Supported PLOs
	CLO1	Course Objective 1: Master the fundamental framework, core algorithmic principles, and solution processes of reinforcement learning; be capable of designing models and solutions for complex engineering problems such as intelligent decision-making; demonstrate innovative thinking in algorithm selection and system design; and fully consider societal, safety, ethical, and environmental constraints.	R3
	CLO2	Course Objective 2: Understand the application value of reinforcement learning in engineering scenarios such as intelligent systems, robotics, autonomous driving, and recommendation systems; evaluate the impact of related technological practices on health, safety, social equity, and sustainable development; and clarify engineers' responsibilities.	R6
	CLO3	Course Objective 3: To cultivate the ability for self-directed and lifelong learning, enabling students to track and master cutting-edge algorithms and industry trends, develop literature analysis skills, critical thinking abilities, and technology transfer capabilities, while adapting to the rapid advancements in Artificial Intelligence.	R11

	CLO4	Course Objective 4: Through interdisciplinary algorithm transfer and specialized training in cutting-edge technologies, this program further develops students' independent learning capabilities, enabling them to independently analyze new algorithmic papers, adapt to unfamiliar technical frameworks, and derive conclusions from one case study to others; while enhancing their professional critical thinking skills and laying a foundation for lifelong learning literacy essential for sustained technological innovation in artificial intelligence.	R11
Content	This course is designed for students in artificial intelligence and intelligent science-related disciplines, providing a systematic overview of the theoretical foundations, classical algorithms, engineering implementations, and cutting-edge applications of reinforcement learning. Focusing on Markov decision processes, it covers dynamic programming, Monte Carlo methods, temporal difference learning, value function approximation, policy gradient, actor-critic networks, and deep reinforcement learning. Through hands-on experiments and project-based practice using tools like OpenAI Gym, the course aims to develop students' ability to model, solve, and optimize complex intelligent decision-making problems while emphasizing algorithmic ethics, safe deployment, and sustainable development principles. Knowledge Module 1: Overview of Reinforcement Learning (Weight: 2/32; Difficulty Level: Understanding) Knowledge Module 2: Markov Decision Process (Weight: 6/32; Difficulty Level: Understanding + Application) Module 3: Value-Based Reinforcement Learning Algorithms (Weight: 6/32; Difficulty Level: Application + Analysis) Module 4: Policy-Based Reinforcement Learning Algorithms (Weight: 8/32; Difficulty Level: Application + Analysis + Innovation) Knowledge Module 5: Fundamentals and Applications of Deep Reinforcement Learning (Weight: 8/32; Difficulty Level: Application + Creation) Knowledge Module 6: Ethics, Safety, and Sustainability in Reinforcement Learning (Weight: 2/32; Difficulty Level: Understanding + Assessment)		
Forms of examination	The overall grade for this course consists of continuous assessment and the final examination grade. The grade is evaluated on a percentage scale, with 60 being the passing score for the course. The final examination takes the form of a comprehensive project design and oral defense, accounting for 50% of the overall grade. Students are required to submit their project design and present it in a defense session. The continuous assessment component accounts for the remaining 50% of the overall grade and is evaluated comprehensively based on students' task completion and the quality of their work.		
Study and examination requirements	Following the examination regulations, students must have selected and registered for the courses.		

Reading list	[1] Yu Yang, Qian Xu. Introduction to and Practice of Reinforcement Learning [M]. Beijing: Tsinghua University Press, 2022. [2] Guo Xian, Fang Yongchun. Reinforcement Learning: A Concise Introduction to Principles (2nd Edition) [M]. Beijing: Electronic Industry Press, 2021. [3] Ma Yufei, Wang Jian. Theory and Applications of Deep Reinforcement Learning [M]. Beijing: China Machine Press, 2023. [4] Sun Yu, Gao Yang. Research Progress and Development Trends of Deep Reinforcement Learning Algorithms [J]. Journal of Computer Science, 2024,47(3):589−615. [5] Liu Q, Fu QM. A Review of Key Technologies in Multi-Agent Reinforcement Learning [J]. Journal of Software Science, 2023,34(7):2701−2728.
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Visual Effect VFX

Module name	Visual Effect VFX		
Code	3080717371		
Semester	Fall, 7th Semester		
Contact person	Zhao Yuxia, Wang Xinjiao		
Language	Chinese		
Relation to curriculum	Compulsory, Integrated Practical Course		
Type of teaching, contact hours	Lectures, case-based teaching, inquiry-based problem learning, teaching seminars (including group discussions), and project-based practice Teaching duration: 4 hours per week, totaling 12 weeks and 48 hours in total.		
Work load	Total workload (estimated): 112 credit hours Teaching hours: 48 hours Self-study duration: 64 hours, including: pre-class preparation, post-class review and consolidation, assignment completion, error identification and correction, supplementary resource exploration for advanced learning, summary and gap identification/addressing, and exam preparation time.		
Credit points	4		
Recommended prerequisites	Python Programming, Computer Vision		
Learning outcomes and their corresponding PLOs	Course Learning Outcomes (CLOs)	Description	Supported PLOs
	CLO1	Course Objective 1: By mastering the fundamental concepts, industry classifications, and production workflows of visual effects (VFX), students will understand the core principles of film and television special effects, compositing, and motion graphics; accurately distinguish between live-action special effects and post-production visual effects applications; and develop a comprehensive knowledge system in VFX.	**R2**
	CLO2	Course Objective 2: Design implementable validation experiments, effect comparison experiments, and performance testing experiments in accordance with VFX industry standards, and standardize the execution of experiments, data collection, and result documentation. Be capable of conducting quantitative and qualitative analysis of experimental data — including special effects rendering quality, algorithm execution efficiency, and visual realism—and derive scientific and well-founded research conclusions by integrating experimental findings, industry standards, and theoretical foundations.	**R4**

	CLO3	Course Objective 3: Master methods for predicting special effects visuals, simulating camera movements, and modeling virtual environments using AI tools; be capable of employing these tools to simulate, validate, and preview complex VFX solutions. Understand the functional limitations, performance bottlenecks, and application constraints of various VFX software, AI visual algorithms, and rendering tools; learn to effectively address tool limitations and optimize implementation approaches based on specific project requirements.	**R5**
	CLO4	Course Objective 4: When engaging in engineering practices such as film and television visual effects and AI-driven digital content production, students will integrate perspectives from media engineering and the digital content industry to analyze how the special effects production process, computational resource consumption, and material utilization impact human health, production safety, and network environments. They will be capable of assessing risks associated with AI-generated VFX content regarding copyright laws, content compliance, and ethical considerations, while evaluating the role and potential challenges of digital visual industry development models for economic, social, and ecological sustainability.	**R6**
	CLO5	Course Objective 5: Cultivate a mindset of self-directed and lifelong learning, actively keeping abreast of emerging technologies, algorithms, and tools in interdisciplinary fields between artificial intelligence and visual effects (VFX), such as intelligent visual effects, AIGC-driven film and television production, and real-time rendering. Develop the ability to rapidly adapt to technological advancements and evolving industry demands in the visual effects sector, and independently master and apply new courses, tools, and solutions.	**R11**
Content	This comprehensive applied course is designed to enhance students' capabilities in digital visual creation and the application of special effects technologies. It enables students to understand the industry concepts, development framework, and production processes of visual effects (VFX), master fundamental principles of film and television visual effects as well as core techniques for shot compositing and image processing, become proficient in key technologies such as common VFX software operations, chroma key tracking, 3D effects, and color correction, and, through practical projects, develop the ability to design visual effects, composite materials, and debug and deliver final visual effects outputs according to cinematic production requirements. The course aims to cultivate students' capacity to apply theoretical knowledge comprehensively in analyzing visual challenges within film shots and creating effective visual effects, while fostering and enhancing their creative design skills, artistic sensibility, and overall competence that integrates theory with digital practice. Knowledge Module 1: Overview of Basic Visual Effects VFX (Weight: 2/48; Level: Memory – Understanding) Knowledge Module 2: VFX Imaging Fundamentals and Lens Principles (Weight: 8/48; Level: Understanding) Knowledge Module 3: VFX Compositing Techniques and Fundamentals of Special Effects Software Programming (Weight: 12/48; Level: Understanding – Application) Knowledge Module 4: Dynamic Tracking, Keying Processing, and Time-Based Effect Design (Weight: 12/48; Level: Application – Analysis) Knowledge Module 5: VFX Hardware Interfaces, Rendering Output, and Comprehensive Project Applications (Weight: 14/48; Level: Application – Creation)		

Forms of examination	The overall grade for this course consists of continuous assessment and the final examination grade. The grade is evaluated on a percentage scale, with 60 being the passing score for the course. The final examination takes the form of a comprehensive project design and oral defense, accounting for 50% of the overall grade. Students are required to submit their project design and present it in a defense session. The continuous assessment component accounts for the remaining 50% of the overall grade and is evaluated comprehensively based on students' task completion and the quality of their work.
Study and examination requirements	Following the examination regulations, students must have selected and registered for the courses.
Reading list	[1] Zhi Jin. Comprehensive Analysis of Principles and Case Studies in Film and Television Visual Effects [M]. [2] Li Huaipeng, Zhang Weikai. After Effects: Film and Television Special Effects and Compositing [M]. Peking University Press, 2018. [3] Liu Xishi. Visual Effects in Films and Audience Immersion Experience [J]. Daguan (Forum), 2024(7):67−69. [4] Su Xin. Research on the Application of Visual Effects Technology in Modern Film Production [J]. Film Studies, 2023(1):53−55. [5] Liu Xiaodong, Su Yang. Creating the Visual Effects Landscape of a China Sci-Fi Blockbuster — A Discussion with the Visual Effects Team on the Special Effects Creation and Implementation of The Wandering Earth [J]. Film Art, 2019(2):139-144.
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Graduation Internship

Module name	Graduation Internship		
Code	3120105527		
Semester	Spring, 8th Semester		
Contact person	Zhou Xuan, Wang Yu, et al.		
Language	Chinese		
Relation to curriculum	Compulsory, Integrated Practical Course		
Type of teaching, contact hours	Field investigation method, project-based learning method, online learning method, personalized tutoring Teaching duration: 8 hours per week, for a total of 4 weeks, amounting to 32 hours.		
Work load	Total workload (estimated): 180 credit hours Total class hours: 32 hours Self-study hours: 148 hours, including reference materials review, plan design, project refinement, and assessment preparation.		
Credit points	6		
Recommended prerequisites	Artificial Intelligence Comprehensive Design, Artificial Intelligence Application Development Tools, Artificial Intelligence + Innovative Applications		
Learning outcomes and their corresponding PLOs	Course Learning Outcomes (CLOs)	Description	Supported PLOs
	CLO1	Course Objective 1: To master the core engineering knowledge of this discipline, effectively integrate classroom-acquired theoretical knowledge with practical engineering requirements in internship settings, and flexibly apply professional principles and technical methods to address fundamental engineering challenges encountered during internships. This experience enables students to test and deepen their understanding of specialized knowledge, establish a knowledge system where theory and practice reinforce each other, develop essential skills in analyzing, breaking down, and solving engineering problems, and lay a solid foundation for future career development.	**R1**

CLO2	Course Objective 2: Master the fundamental operation of modern engineering tools, specialized software, and equipment required for the internship position; be capable of appropriately utilizing these tools to perform tasks such as data processing, drawing production, and process simulation according to internship requirements; understand the application scenarios and development trends of modern tools; learn to leverage them to enhance work efficiency and project quality; develop a habit of proper tool usage; and acquire practical skills in applying modern technological methods to support engineering task completion.	**R5**
CLO3	Course Objective 3: Develop a sound understanding of engineering ethics and professional values; consciously adhere to industry standards, professional codes, and the regulations of the internship organization; respect the workflow and professional boundaries of the internship role. In practice, uphold the principle of integrity, prioritize engineering safety, quality, and accountability, respect others' work achievements, and demonstrate integrity, self-discipline, dedication, and professionalism. Cultivate a strong sense of professional responsibility and commitment, and foster a professional ethos that respects life, science, and rules.	**R7**
CLO4	Course Objective 4: Develop strong personal professional competence, effectively manage internship tasks, proactively adapt to the internship environment, courageously overcome practical difficulties and challenges, and cultivate self-directed learning, self-management, and stress resilience. Additionally, learn to communicate effectively and collaborate closely with colleagues and team members at the internship site, actively support the team in completing all internship tasks, understand the importance of role division within a team, foster teamwork awareness and collaboration skills, and enhance practical abilities in interpersonal communication and teamwork.	**R8**
CLO5	Course Objective 5: Recognize the rapid pace of technological innovation in the engineering field, embrace the concept of lifelong learning, and develop proactive learning habits. During the internship, actively monitor cutting-edge industry technologies, sector trends, and job requirements; identify gaps in one's knowledge and skills; learn to independently gather learning resources and address knowledge deficiencies. Cultivate the ability for self-directed learning and continuous improvement, laying a foundation for lifelong learning essential for adapting to career changes and achieving personal long-term development.	**R11**

Content	"Graduation Internship" is a crucial comprehensive practical compulsory course that bridges classroom theoretical learning with real-world industry applications. The course utilizes authentic workplace scenarios from enterprises to provide hands-on training, guiding students to transform professional theories and engineering knowledge into practical skills and to proficiently apply modern specialized tools in solving real-world problems. It also fosters students' understanding of engineering ethics, professional standards, and teamwork capabilities, enhances their adaptability to future roles and sense of responsibility, promotes a lifelong learning mindset, comprehensively improves their practical competencies, and lays a solid foundation for both graduation projects and career development after graduation. Knowledge Module 1: Consolidation of Professional Theoretical Knowledge (Weight: 8/32; Level: Understanding) Knowledge Module 2: Practical Job Skills Training (Weight: 16/32; Level: Applied) Knowledge Module 3: Professional Competence and Comprehensive Skills (Weight: 2/32; Level: Understanding) Knowledge Module 4: Industry Overview and Career Development (Weight: 2/32; Level: Understanding) Knowledge Module 5: Problem Analysis and Summary Improvement (Weight: 4/32, Level: Evaluation)
Forms of examination	The total score for the graduation internship consists of formative assessment and summative assessment, both evaluated on a percentage scale. The formative assessment accounts for 50% of the total score, comprehensively evaluating the student's task completion, work quality, internship logs, weekly summaries, monthly summaries, attendance and discipline during the internship, as well as the combined evaluations from the enterprise mentor and the on-campus supervisor. The summative assessment accounts for the remaining 50%, taking the form of a comprehensive internship report and an on-site oral defense, which comprehensively examines the student's mastery of job-specific skills, ability to apply theoretical knowledge to solve practical problems, and level of professional competence. The final internship grade is classified into four tiers: Excellent (90–100), Good (80–89), Pass (60–79), and Fail (0–59). Students who receive a Fail must retake the internship with the following cohort before they can proceed to the graduation process.
Study and examination requirements	Following the examination regulations, students must have selected and registered for the courses.
Reading list	[1] Hua Qiuhong. Research on the Transformation and Development Training Model of Accounting Programs in Higher Vocational Education under the "Internet+" Artificial Intelligence Perspective [J]. Commercial Accounting, 2021, (08):126–129. [2] Wen Bowei, Li Shaomei, Zhou Zhao, et al. Reform and practice of graduation internships focused on cultivating higher-order thinking skills [J]. Geospatial Information, 2021,19(10):117–119+151. [3] Zhang Peigong. Graduation Internship Guidance [M]. Jinan: Shandong Science and Technology Press, 2006.11. [4] Zhang Ye, Wang Benfeng, Wang Yujiao. Practical Approaches to Graduation Internships and Employment Guidance in Higher Vocational Colleges [M]. Wuhan: Huazhong University of Science and Technology Press, 2012. [5] Wang Wenshuang, Wei Fenghui, Wang Xuemei. Graduation Internship Guidance [M]. Changchun: Jilin Science and Technology Press, 2000.
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Graduation Thesis (Design)

Module name	Graduation Thesis (Design)		
Code	3120105602		
Semester	Spring, 8th Semester		
Contact person	Zhao Dandan, Zhang Xiaohong, Zhou Xuan, et al.		
Language	Chinese		
Relation to curriculum	Compulsory, Integrated Practical Course		
Type of teaching, contact hours	Lecture method, questioning method, group discussion, peer teaching method, personalized tutoring, project-based research Duration: 12 weeks, totaling 64 hours		
Work load	Total workload (estimated): 360 credit hours Total teaching hours: 64 hours Self-study duration: 296 hours, covering literature review and data collection, project research and practical implementation, thesis writing, and defense preparation.		
Credit points	12		
Recommended prerequisites	Complete all general and specialized courses and earn the required credits.		
Learning outcomes and their corresponding PLOs	Course Learning Outcomes (CLOs)	Description	Supported PLOs
	CLO1	Course Objective 1: To proficiently apply core knowledge in mathematics, natural sciences, engineering fundamentals, and artificial intelligence to construct a comprehensive knowledge application system and accurately analyze complex engineering problems in AI-related fields. To utilize mathematical concepts for data modeling and analysis, employ principles from natural sciences to underpin technical logic, leverage engineering foundations to standardize design processes, integrate professional expertise to optimize solutions, and achieve seamless integration of multidisciplinary knowledge. Through graduation thesis (design) practice, students will significantly enhance their ability to identify, analyze, and solve complex engineering problems in the field of artificial intelligence, solidify their foundational skills in applying specialized knowledge, meet the requirements for engineering knowledge application at the undergraduate level, and establish a strong foundation for future career development and academic research.	**R1**

CLO2	Course Objective 2: To accurately identify complex engineering problems in the field of artificial intelligence, and by integrating professional knowledge with practical experience, design problem models, functional modules, and comprehensive system workflows that meet specific requirements. Throughout the entire solution design process, actively incorporate an innovative mindset, transcend conventional approaches, and propose reasonable and feasible innovations. Simultaneously, comprehensively consider various relevant factors such as social ethics, human health, public safety, legal regulations, cultural differences, and the ecological environment, balancing technical feasibility with social responsibility to ensure that the designed solutions are scientifically sound, standardized, and applicable to real-world scenarios. This will effectively enhance practitioners' practical skills, innovation capabilities, and overall competence in addressing complex engineering challenges in AI, thereby fulfilling the core practical objectives of undergraduate education.	**R3**
CLO3	Course Objective 3: To conduct research on complex engineering problems within the field by applying theories related to artificial intelligence and employing scientific, rational research methods. To independently select appropriate research approaches, design feasible experimental schemes, perform experimental operations in a standardized manner, systematically analyze and reasonably interpret experimental data, and derive scientific, effective conclusions that align with the research topic through comprehensive information synthesis and organization, thereby substantially enhancing one's research thinking and practical skills and meeting the requirements for developing research capabilities at the undergraduate level.	**R4**
CLO4	Course Objective 4: To effectively address complex engineering challenges in artificial intelligence-related fields by appropriately selecting and proficiently utilizing suitable technologies, resources, and modern engineering/AI tools, enabling the execution of tasks such as problem prediction and simulation. Additionally, to clearly understand the applicable scenarios and limitations of various tools, employ them systematically and efficiently to support research and solution design, enhance tool application skills, and meet the training objectives for modern tool utilization at the undergraduate level.	**R5**
CLO5	Course Objective 5: To understand and master the principles of engineering management and decision-making methods in artificial intelligence-related fields, and to have a clear understanding of the core requirements at each stage of the project lifecycle. To effectively apply management knowledge and decision-making methods in multidisciplinary and cross-domain intelligent environments, systematically advance projects related to graduation theses (designs), coordinate all aspects of work, enhance project management and collaborative application skills, and meet the competency requirements for project management development at the undergraduate level.	**R10**

	CLO6	Course Objective 6: Develop a clear awareness of self-directed learning and lifelong learning; actively engage with new knowledge and technologies in the field of artificial intelligence; and possess the ability to learn effectively amidst rapid industry developments. Through thesis (design) practice, cultivate critical thinking skills, learn to rationally evaluate the strengths and weaknesses of various technologies and methods, proactively address knowledge gaps, establish strong habits of self-directed learning, lay a solid foundation for future professional advancement and lifelong development, and meet the requirements for cultivating lifelong learning literacy at the undergraduate level.	**R11**
Content	The graduation thesis (design) constitutes a crucial practical component of talent development in higher education institutions and serves as a key phase in achieving undergraduate educational objectives. Its purpose is to cultivate students' ability to comprehensively apply acquired theoretical knowledge, professional expertise, and fundamental skills to analyze and solve real-world problems, thereby laying a solid foundation for their effective performance in future professional roles upon graduation. Knowledge Module 1: Effectively enhance the ability to apply comprehensive knowledge to identify, analyze, and solve complex engineering problems in Artificial Intelligence, solidifying the foundation for professional knowledge application. (Weight: 6/64; Level: refers to a single level, multiple levels, or a range). Knowledge Module 2: Ability to accurately identify complex engineering problems in artificial intelligence-related fields, and design problem models, functional modules, and complete system workflows that meet specific requirements by integrating professional knowledge with practical experience. (Weight: 12/64; Level: Memory + Memory− Understanding). Knowledge Module 3: Capable of conducting research on complex engineering problems within the field based on Artificial Intelligence theories and employing scientific, rational research methods. Able to independently select appropriate research approaches, design feasible experimental schemes, perform experimental operations in a standardized manner, systematically analyze and reasonably interpret experimental data, and derive scientific, effective conclusions that align with the research topic through comprehensive information synthesis and organization (weight: 18/64; Level: Understanding + Application). Module 4: Capable of rationally selecting and proficiently applying appropriate technologies, resources, and modern engineering/AI tools to address complex engineering challenges in AI-related fields, enabling the execution of tasks such as problem prediction and simulation. (Weight: 6/64; Level: Application; Sub-level: Application-Analysis + Analysis). Knowledge Module 5: Evaluates students' knowledge, skills, and competencies; focuses on assessing the depth and breadth of knowledge acquisition, the integration of theory with practice, proficiency in computer technology application, and problem-solving and adaptability abilities (weighting: 16/64; category: Evaluation + Creativity). Knowledge Module 6: Develop students' ability to comprehensively apply acquired knowledge in independently analyzing and solving problems, laying a solid foundation for future scientific research or academic pursuits (weight: 6/64; Level: Evaluation).		

Forms of examination	The graduation thesis (design) assessment implements full-process quality monitoring, covering stages such as proposal, mid-term inspection, final acceptance, plagiarism check, and defense review. The final grade is composed of three parts: the supervisor (30%), the reviewer (10%), and the defense committee (60%). The final grade is evaluated on a five-tier scale: Excellent (90–100), Good (80–89), Medium (70–79), Pass (60–69), and Fail (below 60). The supervisor assesses the student's task completion, work quality, independence, work attitude, and adherence to deadlines throughout the thesis writing process. The reviewer evaluates the academic rigor, structural completeness, and clarity of expression of the final written thesis. Only those with a similarity ratio below 30% are eligible to proceed to the defense. During the defense, students are required to submit their thesis or design project and respond to questions posed by the defense committee. The committee makes a comprehensive assessment of the defense outcome based on the quality of the written work, the student's presentation, and their ability to answer questions.
Study and examination requirements	Following the examination regulations, students must have selected and registered for the courses.
Reading list	[1] The university's previously issued "Work Specifications for Undergraduate Graduation Projects (Theses)" and "Writing Guidelines". [2] Academic papers, master's and doctoral dissertations, industry standards, patent documents, and other materials related to the research topic in the field of artificial intelligence. [3] Hengxing University Artificial Intelligence Undergraduate Talent Training Program (V2024.09) [M]. Qingdao, 2024. [4] China National Knowledge Infrastructure (CNKI), Wanfang, VIP. [5] Core journals related to this field, such as Journal of Computer Science, Journal of Software, Pattern Recognition and Artificial Intelligence, Computer Application Research, and Computer Science.
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