



# The Practice of Artificial Intelligence Education for Non-computer Science Majors in Universities

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**Abstract.** Due to the extensive impact of AI technology on various disciplines, universal AI education has become an urgent demand, while the liberal education in AI is still in its infancy, plagued by multiple problems such as unclear training standards, no systematic teaching system, lack of practical environment and experimental cases, and lack of teachers. This paper introduces the teaching mode and method of AI liberal education course cooperated with Baidu, Inc. in all-round, which guides and improves students' application innovation ability of applying AI technology to cross disciplines.

**Keywords:** Artificial Intelligence · Liberal course · School-enterprise cooperation · Teaching reform

## 1 Introduction

Artificial intelligence (AI) technologies are changing nearly every area of our lives, transportation, healthcare, education, security, and so on. As one of the fastest-growing domains of computer science, AI is making a powerful impact on modern science and technology. The new generation of AI is developing rapidly under the joint drive of new theories and technologies such as mobile Internet, big data, supercomputing, sensor networks, and brain science. AI is expected to bring a revolution in the near future.

From a global perspective, several countries have made national strategies on AI. It has become a consensus to seize the high ground of AI and make talent training a strategic priority. The United States issued the executive order, titled “Maintaining American Leadership in Artificial Intelligence” [1]. The order proposed to expand opportunities for all Americans to gain the skills needed to participate in an AI-ready workforce. The AI-ready workforce includes people with a broad spectrum of capabilities, from those who are novices in technology but capable of using AI-based tools to those experts who create the next innovations at the cutting edge of AI [2]. According to the UK's National Artificial Intelligence Strategy, “ten-year plan to make Britain a global AI superpower”, to continuously develop, attract and train the best people to build and use AI is at the core of maintaining the UK's world-leading position [3]. The program shift the UK from a rich but siloed and discipline-focused national AI landscape to an inclusive, interconnected, collaborative, and interdisciplinary research and innovation ecosystem.

Japan plans to train 250,000 artificial intelligence personnel each year and become the world's top artificial intelligence talent country.

China has released several national strategies since 2013, including “Made in China 2025”, “New Generation of Artificial Intelligence Development Plan”, “Action Plan for Artificial Intelligence Innovation in Higher Education”, etc. The strategic plans have identified the urgent problems of AI talent training in China, focusing on the education concept of interdisciplinary, science and education integration, school-enterprise cooperation, and collaborative education, further proposing the development idea of building an integrated AI talent ecosystem of government, enterprises, universities and scientific research institutes [4].

## 2 Reconstructing AI Liberal Courses

In order to help more students to get access to artificial intelligence, we developed AI liberal course for students majored in non-computer science. The teaching team composed of Donghua University, Baidu University Cooperation Department carries out the project of artificial intelligence liberal course.

The project carries out industry-university cooperation in the construction of course objectives, teaching contents, teaching resources, experimental environment, and teaching cases to form an original curriculum system and teaching program. It will give students a taste of various technical topics in AI, enable them to take the first step toward solving real-world problems with AI, and promise them a future-proofing career.

### 2.1 Course Goals

Although non-computer majors and IT professionals have different roles in society, they are the source of AI applications in various fields. Based on Baidu's artificial intelligence talent training standards, we formulate general artificial intelligence course goals to provide guidance and constraints for course construction [5].

**Knowledge.** The concepts at the foundation of modern artificial intelligence; development history and trend; master the basic principles and implementation technologies of commonly used artificial intelligence algorithms; understand artificial intelligence application scenarios and engineering design principles of intelligent systems.

**Ability.** Ability to use programming language and AI support package, as well as use visual modeling tools to build common AI models; be able to integrate AI open services; be able to discover and analyze domain problem requirements, and participate in the design of AI solutions.

**Value.** To understand national artificial intelligence strategy, and form a sense of responsibility and mission to build an innovative science and technology country; to recognize the frontiers and challenges of artificial intelligence technology, cultivate intelligent thinking and the spirit of interdisciplinary innovation and exploration; to understand the limitations of artificial intelligence methods, and establish engineering ethics and intelligence safety consciousness.

## 2.2 Teaching Content

Artificial intelligence is a cross-integration discipline involving computer science, mathematics, cybernetics, information theory, psychology, and other fields. Its knowledge has a certain degree of theoretical dispersion. Many algorithms need mathematical education background to learn, and the application fields are diverse. For example, undergraduates of computer science are usually required to finish 4–6 series of courses, including basic theory of artificial intelligence, computer vision and pattern recognition, data analysis and machine learning, natural language processing, etc.

The liberal course has limited teaching hours, so it is difficult to select and build the content. While it should also be high-level, innovative, and challenging. However, only by leading students to stand at the forefront of IT technology and breaking the mystery of technology, can it stimulate students' curiosity and provide innovative applications in various disciplines with information technology support.

Starting from the training goals, sorting out the professional curriculum system, popular science materials, and products and services of leading companies, and fully considering the knowledge base and acceptance ability of students, the course content is set into 4 modules:

**History of AI.** By introducing the ups and downs of artificial intelligence, students will understand the changes of various schools of algorithms, the success and failure experience and lessons of typical applications, and the supportive environment of a new round of artificial intelligence technology and its impact on human social activities.

**AI Principles.** By introducing classic intelligent system principles from neural networks to expert systems to exhaustive searching, students will explore various tricks and approaches, for example, a tic-tac-toe game that uses a neural network to mimic the human player's strategy. Students will try to teach the game to play tic-tac-toe, and see how it learns to mimic wrong moves as well as right moves.

**Machine Learning Algorithms.** The course will introduce basic principles, implementation, and applications of machine learning algorithms and deep learning algorithms, including linear regression, logistic regression, decision trees, classification, ensemble learning, clustering, and k-means, etc. Students will acquire skills in application modeling, algorithm implementation, performance, analysis, and result interpretation. For example, students will be asked to complete a puzzle using several triangles to experience the application of genetic algorithms.

**AI Application Practice.** The course will introduce innovative thinking, AI application micro-lesson resource, product development concepts and vivid AI application practice cases in the industry. It will use the Baidu AI platform as an example to introduce the open services of AI and the calling method of the API interface, so as to expand the application ideas of AI for students.

The AI liberal education explores the fundamental concepts and algorithms of the modern artificial intelligence and dives into the ideas that give rise to technologies. The course uses Python language as the development tool, third-party algorithm libraries, and Baidu AI development interface as the support environment. The course takes the scikit-learn library and keras library as the common AI processing methods, and calls the

AI service interface of Baidu AI open platform to quickly implement the application field practice. Through the practice projects, students get access to the theory behind graph search algorithms, classification, optimization, and other topics in artificial intelligence and machine learning as they incorporate them into their own major programs. Table 1 shows the course modules and the corresponding course practices.

**Table 1.** General AI course content

Course content	Course practice
History of AI	AI services experiences: AI conversation, intelligent writing, python multidimensional data processing
AI principles	Animal identification, tic-tac-toe analysis, knowledge graph, puzzle, optimal value of function
Machine learning	Advertising forecast, house price forecast, cancer classification, telecom customer clustering, iris clustering
AI application	API service call: face recognition, voice recognition. Text recognition, natural language processing, Chinese character retrieval

### 2.3 Teaching Platform

A suitable deep learning platform is not only friendly to beginners and has a relatively low learning threshold, but also enables students to seamlessly connect with industry application problems and propose complete solutions. Choosing the right platform for learning can do more with less.

Domestic mainstream deep learning platforms include Baidu PaddlePaddle, Alibaba MNN, Tencent TNN, Huawei MindSpore, Xiaomi MACE, Didi DELTA and so on. Among them, Baidu PaddlePaddle is China's first open-source, technology-leading, and fully functional industrial-grade deep learning platform. It not only provides a framework for deep learning training and inference but also provides a basic model library, end-to-end development kit, and rich tool components in one, making it the leading domestic deep learning open source platform.

The course teaching platform is carried out on Baidu AI studio, which is an AI learning and practical training community for AI learners. The community provides support for teaching videos, quizzes, discussions, and practical assignment submission and review, which can assist in both online and offline teaching. To expand the course teaching that can keep the course novel and active, the AI studio community integrates an ever-increasing number of AI courses, plenty of deep learning sample projects, and classical datasets from various fields and other teaching resources [6].

### 2.4 Course Resources

The focus of each part of the course is different, so the training and assessment of AI knowledge, ability, and quality should be reflected in different ways. The comprehensive

online resources strengthen the learning process support and assist in the integration of online and offline teaching.

**Instructional Videos.** A total of 700 min of intensive instructional videos have been recorded to explain the principles and key points of knowledge, or to assist learning with animations and videos.

**Teaching Cases.** All chapters are equipped with demonstration and practical cases to support students in case reproduction, imitation, design, and implementation.

**Support Resources.** Each chapter has lecture notes, objective test questions, experimental questions, discussion questions, etc., forming a full range of auxiliary teaching support.

**Expanding Resources.** Micro-lecture videos and application cases from the AI studio platform are introduced in the corresponding chapters, which are closely integrated with cutting-edge applications and can effectively expand course teaching.

### 3 Building Full-Course Online Resources

The total teaching and experiment hours of the course are 48 h, and students from 10 majors of science, engineering and art classes take the course. Due to a large amount of content but limited credit hours and students' weak foundation in mathematics and programming, effective teaching methods must be explored in order to achieve teaching effectiveness and reach teaching objectives.

#### 3.1 Use Multimedia to Enhance Theoretical Explanation

Artificial intelligence technology is wide-ranging, and many techniques reflect the unique and innovative thinking of scientists. Many artificial intelligence algorithms are derived from computational questions, mathematical thinking, and bionics, etc. The explanation of knowledge is supplemented by rich multimedia materials, which not only deepen the visual understanding of knowledge but also make the exploration process of artificial intelligence full of scientific spirit and humanitarian sentiment. Some AI algorithms are abstract and difficult for students to understand, but through the demonstration teaching of multimedia materials, we can show the students the principle of algorithms, inspire them to experience the processing process visually, and help them understand and master the core of algorithms. For this purpose, a lot of relevant materials, courseware, and videos are collected and produced.

#### 3.2 Integration of Multiple Platforms for Practice

The goal of liberal education is to make students understand technology for solving practical problems in their own areas, therefore application practice is an indispensable training link. The course introduces several practical tools from Baidu better supporting the students' education background, so that the course can be developed in all aspects from theoretical teaching, applied practice to creative design, which solves the problems of experimental environment for large scale teaching [7].

**AI Studio.** A trinity of open data, open source algorithms, and free computing power in the cloud, providing an efficient learning and development environment for courses, and helping developers learn and communicate.

**Paddlepaddle Open Framework.** Formed a set of teaching programs and supporting platforms and practices for deep learning practice teaching, supporting deep learning algorithm applications.

**EasyDL.** Zero-threshold AI development for developers, one-stop support for intelligent annotation, model training, service deployment, and other functions, and support for rapid visual modeling.

**AI Open Services.** Driven by product development, a series of special applications for multiple data types and various industry sectors have been formed to support students to experience and integrate AI services.

With the support of these multi-level practical environments, demonstrative, verifying and developing type of experiments are designed for thinking, modeling, and practical developing skills according to the needs of liberal education with a close integration from shallow to deep, theory and practice.

### 3.3 Theme-Based Seminars to Expand Capabilities

Although artificial intelligence has become an industry, it is inextricably linked with its application areas. The course introduces data sets as well as cases from AI studio, various solutions in developing AI services, and a series of micro-lessons on innovative thinking and AI applications to expand students' horizons, combines cases with seminars and debates, and develops awareness of applied solutions and innovative approaches. During the semester, cases such as smart scales, transmission tower bird's nest recognition, wearing a mask, workpiece inventory, intelligent recommendation of recipes, and selection of winner prediction are discussed. The discussion is around the following questions: What is the nature of a problem? Is it a specific problem? How to get the dataset? How to solve it with AI methods? How difficult is it to solve the problem?

## 4 Team Project-Based Course Practice

This is a project-based course. In order to stimulate students' awareness and interest in the application of artificial intelligence, and to further discover and understand the intelligent needs of businesses in various fields, the course provides practical sessions. The class is divided into teams of 2 to 3 students each. This appropriate team size does make it easier to determine the exact contribution of each team member. Each team is free to choose their own specific project. Students learn through the process from an ambiguous problem description to a running solution through the entire process of designing and developing and implementing an AI application. The project tasks included the following:

**Table 2.** Project topic sample

Topic	Major
Carbon Alloy Microstructure Identification	Mechanical Engineering
Fiber Microscopic Image Classification	Textiles
Diagnosis based on patient's respiratory audio spectrum	Communication
Interior Decoration Style Identification	Industrial Design
Fungal Classification	Chemical Engineering
Ethnic Clothing Classification	Clothing Design
Online Invigilator Wisdom Eye	Business Administration

**Selecting Topic.** To excavate the application requirements in professional fields or in learning and life, and determine the topics. To encourage students to discover and design innovative topics through brainstorming. Table 2 shows that the project topics are closely related to the students' majors.

**Collecting Data.** To obtain and label the data sets. To encourage students to collect and organize their own data sets related to subject areas or social life in conjunction with the proposed task requirements, such as data from professional areas, experimental data, web crawling, etc. If it is a self-built dataset, the project will have extra creative bonus points.

**AI Solutions.** To propose specific regression analysis, classification tasks, or clustering task goals. To encourage students to search for cutting-edge research and application papers, perform algorithm reproduction and application integration, etc.

**Building Models and Performing Training.** To use at least 1 of the following implementation options.

*Programming Modeling.* To select one or more appropriate machine learning methods to build models, implement predictions, and evaluate and compare the performance of different data models.

*EasyDL Custom Model.* To use EasyDL for model training and publish as API; to write Python program to call API for model prediction application.

**Summarize.** To write a brief group paper and make a presentation. Students, when displaying their projects at the end of the semester, take pride in their accomplishments. Students responded: "Taking the course of artificial intelligence technology and application, we had a deeper understanding of what AI is and how to use AI technologies through the available platforms and resources. At the same time, we have also mastered one more programming language. By using these and a well-built platform, we can easily use AI to realize our various ideas, which will give us a great help in our professional studies."

## 5 Conclusion

The course instructors participate in enterprise curriculum training and seminars and discuss with enterprise experts. The course integrates enterprise teaching, practice environment case resources, and closely collaborates with industry-education integration. The university and enterprises collaborate to combine research project experience and enterprise education resources to condense teaching content, design and organize teaching cases, and enhance the teaching ability of the faculty team.

The course has been piloted from a small class to large scale teaching, and has been made a mandatory course for innovation classes in all disciplines. It expands the field of basic computer teaching, empowers students with cutting-edge information technology, and provides support in the field of artificial intelligence. At the same time, students are encouraged to participate in AI training camps and various competitions. These open computer competitions provide a space for students to freely expand from creative topic selection, program design to technology implementation, which provide a challenge platform for potential students.

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