Research on Practical Teaching of Machine Learning Course Based on Huawei ModelArts Cloud Platform

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Abstract. The practical teaching of the machine learning course is a crucial link that connects algorithm theory with engineering applications. The traditional experimental mode is facing challenges such as limited computing resources, scattered development environments, and disconnection from industrial processes. This paper takes Huawei Cloud ModelArts as the core carrier and systematically explores the method of reforming the experimental teaching by fully migrating the experimental environment to the ModelArts cloud platform. It has completely restructured the goals, contents, models and evaluation system of the machine learning course practical teaching. A new practical teaching paradigm is constructed with a progressive model of "basic experiments - comprehensive projects - innovation competitions", aiming to cultivate innovative talents with modern artificial intelligence engineering practice capabilities.

Keywords: ModelArts cloud platform, machine learning; experimental teaching reform, engineering ability, project-drivencomponent

1 Introduction

Machine learning, as the core and frontier of artificial intelligence, its teaching effectiveness directly affects a country's talent competitiveness in the intelligent era. Experimental teaching directly determines students' practical innovation ability and industry adaptability. However, the current machine learning experimental teaching in universities generally faces the following problems: Firstly, the environment configuration is complex and inefficient. Students need to spend a lot of time setting up and maintaining heterogeneous environments such as Python, TensorFlow/PyTorch on their personal computers, with frequent version conflicts, and "configuring the environment" rather than "conducting experiments" becoming a common pain point. Secondly, the computing power bottleneck is prominent. When dealing with models of a certain scale (such as deep learning) and datasets, the computing power of personal computers is insufficient, severely restricting the depth and breadth of experiments. Thirdly, the experimental process is fragmented. Experiments are mostly isolated algorithm verifications, lacking a complete project process experience from data collection, preprocessing, model training and optimization to service deployment, mak-

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ing it difficult for students to form a systems engineering perspective. Fourthly, the evaluation method is one-sided and simplistic. It mainly relies on experimental reports and final codes, ignoring the core ability dimensions such as scheme iteration, performance optimization and innovative thinking during the experimental process.

In recent years, with the popularization of machine learning technology and the expansion of the scale of deep learning models, traditional localized experimental teaching has faced prominent challenges such as computational power bottlenecks, complex environment configuration, and inconvenient collaboration. Against this backdrop, the practice teaching model based on cloud platforms has become the core direction of reform. Among them, Huawei Cloud, with its complete AI development suite, stable domestic services, and education-oriented solutions, has been widely applied in universities and vocational education, giving rise to a series of teaching innovation studies.

The core of the experimental teaching reform lies in "clouding" and "servicizing" computing resources, mainstream frameworks, and development tools, so that students can focus on algorithmic thinking and practice itself. Early research focused on how cloud platforms could address the fundamental bottlenecks in experimental learning. Li and Wang [1]designed a special experiment based on the distributed training function of ModelArts, effectively cultivating students' engineering optimization skills. At the level of course integration, Zhang's team [2] used Huawei Cloud AI Gallery to build an open case library, achieving an advanced teaching model of "case reproduction - improvement and innovation" for the computer vision course.Meanwhile, cloud platforms have promoted the penetration of experimental teaching into a wider range of disciplines. Chen et al. [3]utilized the automatic learning tools of ModelArts in the finance major, successfully lowering the AI application threshold for non-computer major students. For the cultivation of talents in the domestic technology ecosystem, Huang et al. [4] innovatively combined the Huawei Ascend MindSpore framework with ModelArts, designing a full-process experiment from training to deployment. More cutting-edge exploration has begun to focus on the collaboration between software and hardware, Sun [5] studied how to use the Huawei Cloud CANN suite to conduct AI chip application development experiments, bridging the teaching gap between algorithms and underlying hardware.Reform has also driven innovations in teaching concepts and assessment methods. Zhao [6] proposed a process evaluation model based on cloud platform learning behavior data, achieving refined management of the experimental process. While Zhou and Zheng [7]from the perspective of industry-academia integration, expounded on how to build a school-enterprise collaborative experimental project based on Huawei Cloud industry practice cases, significantly enhancing students' ability to solve complex real-world problems.

Experimental teaching should build an integrated practical loop of "problem - data - algorithm - system", extending the experimental scenarios from closed standardized data sets to real-world industrial problems; expanding the experimental goals from the pursuit of single indicator accuracy to considering the comprehensive performance of model efficiency, deployability, and resource consumption. The teaching focus shifts from "explaining algorithms" to "cultivating system engineering capabilities for solving complex problems", promoting students' transition from "code implementers" to "solution architects" in thinking.

2 The Teaching Empowerment of the ModelArts Platform

The "Intelligent Base" industry-academia integration collaborative education program of Huawei has provided valuable platforms and resources to solve these problems. The Huawei Cloud ModelArts platform, as a one-stop AI development and operation platform for developers, integrates the full-chain capabilities of data governance, intelligent annotation, model development, training, deployment, and monitoring. [8] This research aims to deeply explore how to use the ModelArts platform as the core, focusing on building a new type of experimental teaching system that is "cloud-native, project-integrated, and process-intrinsic". The aim is to solve the problems of isolation, superficiality, and disconnection from industrialization in traditional experiments.

The ModelArts platform empowers experimental teaching in multiple dimensions. It provides a pre-configured Notebook development environment with mainstream frameworks, which students can access through a browser, enabling them to enter the experimental state in "zero configuration" within seconds. [9] At the same time, the elastic supply of GPU/NPU (Tianxin) computing power enables students to seamlessly handle large-scale data and complex model training, elevating the depth and breadth of the experiments to an industrial level. ModelArts toolizes and visualizes the AI project life cycle. Based on the cloud-based project space, it supports collaborative coding, data sharing, version control, and experiment tracking by multiple users. Teachers can monitor the progress, resource consumption, and model performance of each group in real time, achieving refined and process-oriented teaching guidance and management.

The teaching reform content for enhancing students' practical ability in machine learning courses is divided into three parts: teaching methods, practical content, and evaluation system, as shown in Figure 1. Update machine learning practical cases, add Huawei experiments and competition projects. Introduce case-driven teaching methods, study real application cases, and enable students to intuitively experience the process of machine learning technology solving practical problems. Adopt the project-based learning model to stimulate students' enthusiasm for active learning and cultivate teamwork spirit. The reform of practical content includes three aspects: case practice, project practice, and competition practice. The practical platform adopts the development platform ModelArts provided by Huawei. The evaluation system is a diversified student evaluation system centered on "practice", covering multiple dimensions such as experimental reports, project reports, and competition achievements, and comprehensively evaluating students' learning effectiveness.

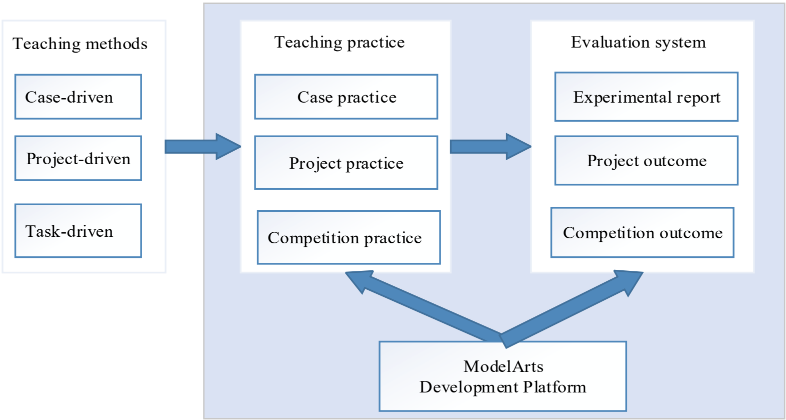

Fig. 1. Reform of Practical Teaching in Machine Learning Courses

3 Teaching System for Machine Learning Courses

With the support of the "intelligent foundation", we have systematically restructured the machine learning course.

3.1 Teaching Objectives

The machine learning course aims to enable students to systematically master the core theories and algorithms of machine learning, while establishing a complete capability chain from problem modeling to engineering implementation. Students not only need to understand the basic paradigms and mathematical models such as supervised learning, unsupervised learning, and deep learning, but also need to proficiently use mainstream frameworks (such as MindSpore) for code implementation, model training, and performance evaluation. The course emphasizes "full-stack" practice, with the goal of enabling students to independently complete the standardized process of data preprocessing, feature engineering, model selection, and optimization, and to preliminarily understand the engineering concepts of model compression, deployment, and running on edge devices (such as Ascend Atlas 200 DK), laying a solid technical foundation for subsequent industrial applications and research and development.

The deeper training objective lies in shaping students' engineering thinking and innovation capabilities. Through the introduction of real industrial scene data sets and comprehensive projects, the course trains students to convert abstract algorithms into solutions for practical problems, and to consider their reliability, efficiency, and deployability. Combined with the "course-credential-challenge-creation" model, the course encourages students to apply what they have learned to competition challenges or innovation projects, aiming to stimulate their enthusiasm for independent exploration, cultivate rigorous scientific analysis habits, teamwork spirit, and sensitivity to technological development trends. The ultimate goal is to cultivate a comprehensive

AI talent with solid theoretical foundation, capable of adapting to the rapid iteration of industrial demands, and with continuous learning and innovation capabilities.

3.2 Strengthening the Practical System

A three-level progressive practical system of "basic experiments - comprehensive projects - innovation competitions" has been established. The teaching content not only requires understanding classic algorithms such as linear models, decision trees, SVM, deep learning, ensemble learning, reinforcement learning, etc., but also explains the Da Vinci architecture of the Ascend chip, the concept of heterogeneous computing, as well as the design ideas of MindSpore such as automatic parallelization and the combination of dynamic and static graphs, to help students establish an overall understanding of the domestic technology system.

The machine learning course experiment based on the Huawei Intelligent Base Project is centered on the core logic of "full-stack practice and software-hardware collaboration". It starts from the development of cloud-based algorithm models using the MindSpore framework[10], and then proceeds to model lightweighting and end-device deployment using the Atlas 200 DK developer kit, completing a complete AI application loop that covers data, algorithms, computing power, and scenarios. Through experiments as shown in Table 1, students not only can implement classic algorithms by themselves, but also will have hands-on experience in deploying cloud models to physical hardware and conducting real-time inference, thus deeply understanding the key challenges and solutions from theoretical models to industrial implementation. Systematically, they will build engineering practice and innovation capabilities within the Ascend AI ecosystem.

Table 1. Machine Learning Course Experiment Based on the Huawei Intelligent Base Project

Experiment Name	Core Technology Stack	Content	Experimental Objectives
Linear Regression and Housing Price Prediction	MindSpore/ Python, NumPy	Implement the gradient descent method and train the linear regression model	Master loss function, gradient descent, and automatic differentiation
Logistic Regression and Iris Flower Classification	MindSpore/ scikit-learn	Multi-class logistic regression, Softmax and cross-entropy	Understand the construction of classification models and evaluation metrics
Decision Tree and Random Forest Practical Application	MindSpore/ scikit-learn	Credit card fraud detection, feature importance analysis	Master tree models and application of ensemble learning
Support Vector Machine and Kernel Function	MindSpore/ scikit-learn	Non-linear SVM, RBF kernel function application	Understand kernel techniques and classification boundaries

Fully Connected Neural Network and MNIST Classification	MindSpore	Build MLP to implement handwritten digit recognition	Be familiar with basic modules and training process of the framework
Convolutional Neural Network and CIFAR-10 Classification	MindSpore	Build CNN model (LeNet/ResNet)	Master CNN structure and image classification
Recurrent Neural Network and Text Sentiment Analysis	MindSpore	LSTM/GRU for sentiment classification	Master sequence models and NLP processing
Real-time Image Classification Application	Atlas 200 DK,	Camera Invoke the camera for real-time inference and display results	Implement a complete end-side AI application
Object Detection Practical (YOLOv5)	Atlas 200 DK, ATC, OpenCV	Deployment of YOLO model and real-time detection	Master complex model deployment and optimization

The MindSpore framework [11]of Huawei serves as the core platform for machine learning course experiments, meeting the needs of both teaching and practice. Its most significant feature lies in the establishment of a complete technical loop that is "unified, collaborative, and autonomous". On one hand, it provides teachers and students with a unified programming paradigm that covers the entire lifecycle of machine learning, from data preprocessing, model construction, automatic differentiation, training optimization to lightweight deployment, all of which can be efficiently completed within the same framework, significantly reducing the learning cost and complexity of switching between multiple toolchains. On the other hand, MindSpore has achieved deep software and hardware collaboration with Ascend AI processors and Huawei Cloud ModelArts platform. In the experiments, students can personally experience the convenience of "one-time development, full-scenario deployment", seamlessly converting large models trained in the cloud into lightweight formats that can run efficiently on mobile or edge devices. This "cloud-edge-end" integrated practice is something that traditional framework courses cannot offer.

Atlas 200 DK is an AI developer kit launched by Huawei. Its core is based on Huawei's self-developed Ascend AI processor, which is specifically designed for edge computing and end-side AI applications. [8]It integrates a variety of hardware interfaces and provides a complete set of toolchains from model training, format conversion to end-side deployment. This kit enables developers to practice model lightweighting, heterogeneous computing scheduling and low-power inference in real resource-constrained environments, fully replicating the industrial-level "cloud-edge-end" collaborative AI development process. It is an ideal hardware platform for learning and exploring edge AI technologies.

Comprehensive projects: As the core assessment of the course, students are required to use what they have learned to complete a project with a certain complexity and application value on the Ascend platform. From problem definition, data acquisition and cleaning, model selection and training (utilizing Ascend computing power), evaluation and optimization to final reports/demonstrations. [12]The entire process simulates the enterprise AI project development process. With "project case-driven" as the core, compared with traditional lecture-style teaching, the project case-driven teaching method pays more attention to exercising students' thinking ability, improving their autonomous learning ability, enhancing their ability to solve practical problems, and cultivating innovative consciousness. Huawei Shengteng has established the "Course - Certificate - Competition - Innovation" model, which combines traditional classrooms ("Course") with technical certifications such as HCIA-AI from Huawei, making the learning goals clearer and aligning with industry standards directly.

3.3 Experimental Evaluation Reform

Establish an "process quantification, diverse outcomes" experimental evaluation mechanism. Build a diversified evaluation system centered on "practice", which covers various dimensions such as regular performance, experimental reports, project reports, competition achievements, and innovation and entrepreneurship achievements, to comprehensively evaluate students' learning effectiveness.

Utilize the process data of the experimental platform to conduct quantitative analysis of students' code submission frequency, model iteration times, quality of experimental logs, and project space dynamics, achieving objective evaluation of learning attitude and effort process.

(1) Process Evaluation (40%): Completeness of experimental logs, ModelArts platform logs, code submission history, project space dynamics. |

(2) Outcome-based Evaluation (40%): Project report quality, final model performance indicators (such as accuracy, F1-score), functionality and robustness of the deployed service, experimental report, model evaluation report, online API stress test.

(3) Innovation(20%): Innovation of the solution, technical difficulty, optimization effect, performance optimization comparison.

4 Practice of Teaching Reform in Machine Learning Courses

In order to enhance students' understanding and application ability of machine learning knowledge, as well as cultivate their analytical skills and innovative consciousness, the teaching reform of the machine learning course mainly focuses on four aspects: teaching design, teaching objectives, teaching interaction, and teaching feedback as shown in Figure 2. The teaching model embodies the concept of gradual progress and is divided into three stages: presenting theoretical knowledge - guiding experiments - guiding competitions, as shown in Figure 3.

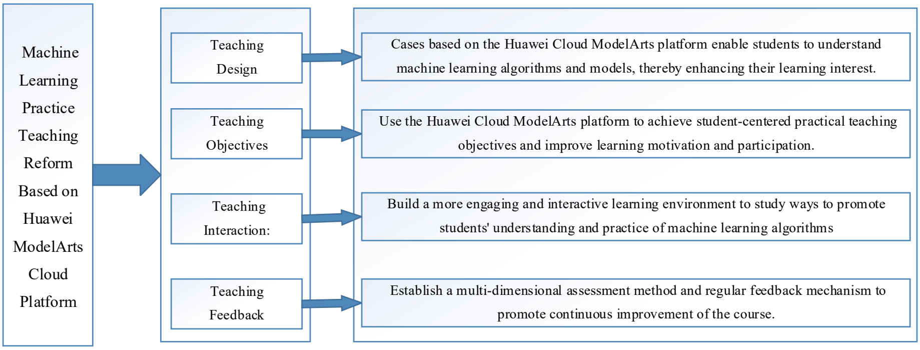

Fig. 2. Reform of Teaching in Machine Learning

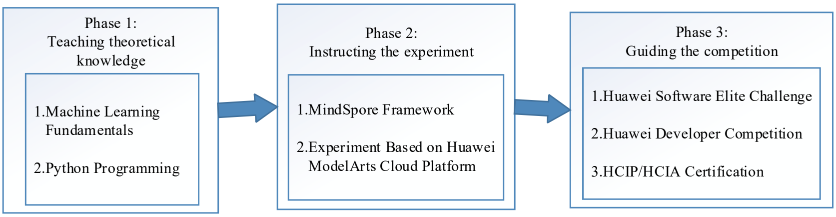

Fig. 3. Three-stage Teaching Model

Through the two-year teaching cycle, the reform has shown initial results. Students' learning enthusiasm and engineering capabilities have significantly improved, and they have shown strong interest in domestic technologies. The ability to solve real problems, teamwork, and engineering document writing have been generally strengthened.

The alignment of teaching with the industry's cutting-edge level has improved. Course content is updated dynamically, and by the time students graduate, they have mastered mainstream industrial-level tools. Their employment competitiveness has increased, and they are particularly favored by employers seeking solutions for independent and controllable technologies.

The teaching team's capabilities have been upgraded. Participating teachers have transformed into "dual-qualified" teachers through project training and practical guidance, and their research directions have become more closely integrated with the industry.

The production-education integration ecosystem is taking shape. Courses serve as a bridge connecting the school and the Huawei ecosystem. Outstanding students are recommended to intern or be employed at Huawei and its ecosystem enterprises, forming a positive interaction.

At the same time, we also face some challenges and need to explore further directions:

The smoothness of the learning curve: New technology stacks such as MindSpore have certain learning thresholds for both teachers and students. More rich gradient-based teaching resources and tutoring materials need to be developed.

Sustainability and fair access to computing resources: How to ensure that all students can stably and fairly obtain sufficient Shenteng computing resources for experiments and project development requires more refined resource management strategies.

Teaching adaptation of industry cases: Real industry cases are often too complex. How to effectively trim and abstract them into project tasks suitable for undergraduate or master's education requires deeper joint research by the school and enterprises.

The machine learning experimental teaching reform based on the Huawei Cloud ModelArts platform is a successful exploration that reshapes traditional practical teaching with advanced cloud-based productivity tools. By systematically integrating cloud computing power, industry-level tool chains, and real project scenarios, it not only efficiently resolves the long-standing problems of resources and environment, but also deeply promotes the transformation of experimental teaching from "isolated verification" to "full-process construction", and from "knowledge-oriented" to "ability-oriented" paradigms. The students trained under this model possess the key qualities necessary to solve complex AI problems in a cloud-coordinated environment, providing a solid and effective teaching practice solution for cultivating a large number of outstanding engineers in China's new-generation artificial intelligence industry competition who are "both knowledgeable and proficient in practical operations". With the further integration of cloud-native technology and AI, such experimental teaching models based on integrated cloud platforms will become an inevitable trend and important direction of engineering education reform in the new engineering discipline context.

5 Conclusion and Prospect

The teaching reform of the machine learning course based on Huawei's "Intelligent Foundation" is a profound practice of integrating industry and education. By systematically integrating domestic leading AI technologies, real industrial scenarios, and abundant ecological resources into the talent cultivation process, it effectively resolves core issues such as the disconnection between theory and practice, lagging teaching content, and insufficient engineering literacy in traditional teaching. It has initially established a new teaching model that is oriented towards industrial demands, focuses on innovation capabilities, and strengthens domestic technology literacy.

With the deepening of the "Intelligent Foundation" project and the increasingly prosperous domestic AI ecosystem, such reforms should further develop in depth: First, expand from "single-course reform" to "course groups" and even "professional systems" reform; second, extend from the application of technical tools to a broader educational quality improvement dimension covering AI ethics, governance, and security; third, evolve from cooperation between universities and individual enterprises to an open community that connects a wider industrial ecosystem. The ultimate goal is to cultivate a large number of outstanding talents who are proficient in cutting-edge AI technologies, deeply understand industrial logic, and possess a sense of patriotism and self-reliance in technology, thus laying a solid foundation for the country's innovative development in the era of artificial intelligence.

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