



Teaching and Reform of Pattern Recognition Course Under the Background of Artificial Intelligence

Duan Mei^(✉)

Faculty of Mathematics and Computer Science, Guangdong Ocean University,
Zhanjiang 524088, Guangdong, China
mathexp2014@126.com

Abstract. With the popularity of artificial intelligence technologies and concepts, pattern recognition courses have received widespread attention. The traditional pattern recognition course is full of teaching contents and less class time, students are not highly motivated, the teaching mode is single, and the teaching content is old and lacks the introduction of the latest research results. In this paper, we reform the course from three aspects: optimizing teaching contents, improving teaching mode, and motivating students to learn.

Keywords: Pattern recognition · Teaching reform · Hybrid teaching

1 Introduction

Artificial intelligence has become an important technology to support the national economy and industrial development. It is profoundly changing the way of human production and life, such as swiping face through the door, swiping fingerprints to unlock cell phones so on. The State Council attaches great importance to the development of artificial intelligence, and the development plan for a new generation of artificial intelligence formulated in 2017 clearly states that “artificial intelligence is a strategic technology to lead the future.” In April 2018, the Ministry of Education (MOE) released the “AI Innovation Plan for Higher Education Institutions” (Teaching Technology [2018] No. 3). The goal of “improving the talent cultivation system in the field of artificial intelligence” was proposed. It also requires that by 2020, the optimized layout of colleges and universities’ scientific and technological innovation systems and discipline systems to adapt to the development of new generation AI will be basically completed. In addition, it sets up and promotes the construction of first-level disciplines in artificial intelligence. This program was quickly responded to by several colleges and universities, setting off a surge in artificial intelligence education.

As one of the major sub-disciplines of artificial intelligence, pattern recognition is a discipline that combines theory and practice, is closely related to synthesis and theory, and is also an important part of information science and control science. Its theory is based on the basic theoretical knowledge of matrix theory, probability theory, and

mathematical statistics. Its technology is vital in human-computer interaction, automatic driving, industrial manufacturing, medical engineering, and genetic technology. As the demand for pattern recognition and machine learning talents in various fields of society has increased significantly, universities have offered pattern recognition courses for senior undergraduate and graduate students. It can be seen that the opening of pattern recognition courses is of great significance to improve their research strength, enrich the discipline curriculum, and enhance students' employment competitiveness.

2 Problems in Teaching Pattern Recognition Courses

2.1 The Course Has Much Content and a Few Hours

Pattern recognition is a highly theoretical course. Its theoretical foundation mainly includes subjects and basic courses in advanced mathematics, linear algebra, probability theory and mathematical statistics, numerical optimization methods, signals, and systems. It also partially involves knowledge of generalized function analysis, stochastic processes, and digital signal processing [1]. Only three courses, Advanced Mathematics, Linear Algebra, and Probability and Mathematical Statistics, have been offered in the lower undergraduate years. In contrast, the other courses are specialized courses offered in the senior or graduate years. The course is also closely integrated with engineering practice, requiring students to be familiar with at least Matlab and C programming languages and use some relevant library toolkits. Pattern recognition courses have more content but are usually only allowed to be completed in no more than 48 class hours, including labs. The author's department offers a pattern recognition course with 36 class hours of theoretical instruction and 12 class hours of laboratory instruction. Therefore, this course is short, heavy, demanding, and difficult for students to understand, which is very difficult and challenging to teach compared with other professional courses.

2.2 Difficult to Motivate Students to Learn

After transitioning from high school to the undergraduate level, students face changes such as the increased difficulty of teaching content, increased number of courses and lectures, and fast progress of lectures. Some students have difficulties in learning and even frustration. Moreover, the pattern recognition course is highly theoretical and requires a lot of proof derivation in the teaching process. This situation leads to a relatively weak connection between theory and practice, which makes the teaching atmosphere lose vitality, students have difficulty listening to the lectures without interest, and the teaching effect is not satisfactory.

2.3 Single Mode of Teaching

In preliminary teaching, teachers usually use one textbook and one reference book as teaching resources, and all the contents are taught in the traditional lecture format. That is, the teacher explains, and students listen to the lecture and complete the homework after the class. This teaching mode makes students rely heavily on the teacher's arrangement of

course content, resulting in students only passively accepting knowledge and lacking the enthusiasm and initiative to think. With the development of Internet technology, students have access to more and more sources of knowledge. The existing MOOC and Coursera resources are still not fully utilized in classroom teaching; research results published in top conferences and journals in the field of pattern recognition are not introduced into the classroom.

2.4 The Teaching Content is Old and Lacks an Introduction to the Latest Research Results

In the selection of textbooks, many universities still adopt pattern recognition textbooks published 20 years ago or even earlier. Although these textbooks are the classics of classics, they do not integrate the recent progress of pattern recognition technology and current research hotspots. Recently, the knowledge and methods involved in pattern recognition courses have developed rapidly, especially deep learning techniques. Deep learning has led to the proliferation of various new recognition systems and their successful application in daily life. Such new technologies and methods are not covered and reflected in the previous lecture contents, so students cannot keep abreast of the progress of the latest research results.

All of the above have seriously deviated from the original purpose of setting up this course and are incompatible with our talent training objectives. In order to enhance the strength of scientific research, enrich the discipline curriculum system, and enhance the competitiveness of students' employment, it is necessary to reform the teaching of the traditional pattern recognition course.

3 Exploring Reforms for Pattern Recognition Courses

3.1 Optimize Teaching Content

3.1.1 Clarify the Focus of the Course

After discussion, the course team focuses on pattern recognition methods of statistical types in response to the situation of less class time and more content. It mainly includes cluster analysis, discriminant function, geometric classification method, feature selection, extraction, and so on. The K-means algorithm is the most widely used clustering analysis algorithm and can be taught in conjunction with image segmentation techniques. The discriminant function method is based on advanced mathematics and linear algebra and involves optimization methods for solving the objective function. This part of the content contains a large number of formula derivations. When teaching, the derivation process of the formula should be clear, and the formula results will be clearly explained. The probabilistic classification method based on the statistical decision is based on probability theory and mathematical statistics, which is the critical content of pattern recognition. For this part, classical topics in pattern recognition, such as face recognition and fingerprint recognition, can be introduced to help students further understand abstract theoretical knowledge. When teaching feature selection and extraction, feature extraction methods based on subspace methods are taught as supplementary content, making students understand the research hotspots in this field and stimulating students' interest in research.

3.1.2 Introduction of Frontier Technologies in the Research Field

Pattern recognition has been developing extremely rapidly in recent years and is being applied in an increasingly wide range of directions. It is necessary to teach the frontier knowledge of the subject and introduce its development trend in time so that students can clearly understand it [2]. In the teaching process, combining the basic theories learned with the current cutting-edge issues being researched in academia would be useful. It will enable students to learn the basic theories and understand and grasp how these theories are applied in practical research. Thus, it will provide students with good research ideas in their subsequent work, which is an important measure of developing students' innovative thinking ability.

3.2 Improvement of Teaching Mode

In order to solve the problems of pattern recognition course, such as less class time, more content, and a single teaching method, we can adopt the hybrid teaching mode of independent online learning and offline flipped classroom for 12 class hours of pattern recognition theory lessons [3, 4]. The pattern recognition course's online and offline hybrid teaching process is designed as follows.

3.2.1 Pre-course Educational Preparation

In the pre-course phase, students are guided to learn each knowledge point independently through the online course resources using online teaching methods. The teaching resources of the course come from the MOOC platform, through which the course videos are released according to the course time, and students are allowed to complete the online learning tasks within the specified time. In addition, the online quizzes, assignments, and discussions on the MOOC platform can deepen students' understanding of the content learned to a certain extent and facilitate students to give timely feedback to the instructor on what they do not understand. Then, teachers can make targeted lesson preparation based on the platform's feedback information and statistics to adjust the offline teaching content and pace in time. Doing this well can solve, to a certain extent, the problems of teaching content, few teaching hours, and differences in students' foundation and learning ability mentioned above.

3.2.2 Classroom Teaching Organization

Since the teacher has already assigned the next stage of education at the pre-class stage, appropriate adjustments should be made in offline classroom teaching. Instead of focusing on the derivation of calculation formulas and theoretical knowledge, teachers can reinforce essential knowledge and the practical application and practice of knowledge points and organize students to discuss in groups in the classroom. Through online pre-reading before class, students have generally mastered the basic knowledge of the next class, so teachers should focus on interactive communication with students in the classroom. Teachers can set up thematic classroom discussions focusing on students' online knowledge learning. The content of the classroom discussion can be the deepening and extension of the online content or the extension of a certain algorithmic idea. The offline

classroom discussion can be used to stimulate students' interest in learning knowledge and cultivate their excellent habit of thinking deeply about problems.

3.2.3 Post-class Teaching Sublimation

Teachers post knowledge summary materials to the course group for students to view after class, consolidate knowledge points promptly, and assign specific practical tasks to the group. Students develop their innovative thinking, knowledge integration, and practical and collaboration ability through practical tasks. At the same time, the latest pattern recognition technology is appropriately pushed in the course group to expand students' horizons and stimulate their learning interests. In addition, teachers need to summarize and reflect on themselves based on students' online learning and offline classroom performance to provide effective personalized guidance to students later.

3.3 Motivating Students to Learn

3.3.1 Problem-Driven Teaching

Mobilizing students' active thinking is an important means to improve classroom teaching effectiveness. Question-driven teaching [5] can play a good role, allowing students to switch from follow-along learning to active inquiry learning. There is also a good classroom interaction effect. Compared with teaching students directly, questioning and questioning can also slow down the pace of the class and relax students' brains in a tense state of thinking.

The classroom design for applying this teaching tool includes analyzing the course content and designing questions suitable for questioning. The appropriate sessions for guided questioning include: first, at the juncture of two related courses to direct students' thoughts to the following course content; second, near the end of a class to get students' minds loaded with questions for the next class; and third, at the beginning of a class to quickly direct students' thoughts to the course content. Asking questions can be followed by the flexible option of asking students to answer and not asking them to answer as needed.

For example, the following two levels of guided questions are designed the introduction the idea of the K-nearest neighbor classification improvement method: on the one hand, the idea of K-nearest neighbor classification is simple, easy to implement, and gets many applications. On the other hand, students are asked whether the idea of K-nearest neighbor classification is perfect. Is there any room for improvement? Second, K-nearest neighbor classification adopts the principle of majority rule, i.e., the test sample is classified into whichever category has the most training samples among the K nearest neighbors of the test sample. However, K-nearest-neighbor classification ignores the fact that the spatial proximity of K-nearest-neighbors is obviously different from that of the test sample, and according to the experience of "those who are close to the test sample are closer to the test sample," is it possible to assume that the closer nearest-neighbor sample should have more influence on the classification of the test sample? Based on the above two levels of questions, students will be very receptive to the idea of improving the K-nearest-neighbor classification method by using the distance between the nearest-neighbor sample and the test sample.

In addition, it is also a good practice to design questions closely related to the course content in the classroom by combining popular social hot issues that people are concerned with and then introducing the teaching content after drawing students' attention.

3.3.2 Humorous Language and Examples of Analogy

The teaching content of science and engineering courses is relatively boring, and there is a lot of course content, and students tend to lose concentration and become fatigued. Therefore, the appropriate use of visual and humorous language and analogies [6] in the classroom is not only helpful in mobilizing students' attention but also very conducive to their understanding of knowledge. Depending on the actual situation, the examples can be given before or after the knowledge point is explained. Experience has shown that using humorous language after a fifteen-minute lecture on pure curriculum knowledge can be very effective in increasing students' attention and improving the effectiveness of classroom teaching.

In classroom practice, the use of humor and humorous language should also be used properly. Generally speaking, in the process of creating a relaxed and enjoyable classroom environment, the necessary seriousness of the classroom as a place of knowledge transfer should be maintained; in classroom language, humor and banter should be distinguished, and appropriate language should be used without exceeding the rules.

4 Conclusions

With the popularization of artificial intelligence from concept to application, the pattern recognition course teaching has been given new requirements and missions. In this paper, we have actively explored the reform of pattern recognition teaching at the undergraduate level in terms of teaching content, teaching mode, and motivation of students' learning. These measures can be summarized as follows: In terms of optimizing the teaching content, the focus of the course teaching is clarified, cutting-edge technologies in the research field are introduced; in terms of changing the teaching mode, the hybrid teaching mode of independent online learning and offline flipped classroom is adopted; in terms of motivating students to learn, the problem-driven teaching style and enjoyable teaching are adopted. These measures have achieved good results in improving teaching quality.

Acknowledgments. This work was supported by the Collaborative Education Project of Industry-University Cooperation of the Ministry of Education (Nos. 202101055003, 202102517018).

References

1. Christopher M B. Pattern recognition and machine learning [M]. Cambridge: Springer, 2006.
2. Zhang Y P, Yan M D, Chang Q. Teaching reform and practice of pattern recognition course based on the background of artificial intelligence [J]. Shanxi Education (Higher Education), 2018(11): 26, 40.
3. Wen Zhang, Li Su, Bo Xu, Qiang Zhang, Zhen Yang. Research on Online and Offline Mixed Golden Course Based on Flipped Classroom [J]. Advances in Social Science Education and Humanities Research, 2020, 480: 222–226.

4. Lv R X, Sun W J, Ma J. Exploration of Online and Classroom Mixed Teaching Mode in Advanced Mathematics [J]. Journal of Jilin Institute of Chemical Technology, 2021, 38(08): 50–53.
5. Zhengqin Xu, Wendong Zhao, Laixian Peng, Hai Wang. Application and Research of Problem-driven Approach in Identifying Protocol Teaching [C]. Proceedings of 4th International Conference on Modern Management, Education Technology and Social Science (MMETSS 2019). Advances in Social Science, Education and Humanities Research, 2019(351): 467–472.
6. Yong Xu, Design and Practice of Novel and Interesting Teaching Methods for Pattern Recognition Course [J]. Education and Teaching Forum, 2021(16): 97–100.

Open Access This chapter is licensed under the terms of the Creative Commons Attribution-NonCommercial 4.0 International License (<http://creativecommons.org/licenses/by-nc/4.0/>), which permits any noncommercial use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.

