Thoughts on the Teaching Reformation of Artificial Intelligence Courses

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Abstract: With the rapid growth of deep learning in recent years and the amazing performance shown by large language models, artificial intelligence (AI) has become popular again. AI, especially deep learning, becomes the most active research topics in recent years. It has enabled great progress in various scientific research domains. Following the trend, various majors in universities and colleges have offered artificial-intelligence-related courses. Given the problems existing in the current teaching of AI related courses, this article discusses several criteria that need to be followed in the teaching reformation of AI courses from two aspects such as the selection of course contents and the innovation of teaching methods. Our aim is to make the AI courses give full play to their due role, to enable students to effectively master theoretical knowledge and, at the same time, obtain the creative abilities to cope with the challenges imposed by the times and solve practical problems.

Keywords: Artificial Intelligence; Teaching Method Reformation; Courses

1. Introduction

For the definition of artificial intelligence (AI), we borrow here the definition from Russell and Norvig in their book "Artificial Intelligence: A Modern Approach"[1]: it is the intelligence displayed by machines, especially computers. AI is a research field in computer science that develops and studies methods and software that enable machines to perceive their environment and use learning and intelligence to take actions that maximize their chances of achieving set goals. Such machines can be called AI. AI technology has been widely used in industry, government, and scientific fields. Some typical applications of AI include search engines, targeted online advertising, recommendation systems, virtual assistants, autonomous driving vehicles, automatic voice translation, facial recognition, generative and creative tools, and superhuman play and analysis in strategy games. In recent years, with the rapid rise of deep learning and the amazing results brought by large language models, AI research has entered an unprecedented period of enthusiasm. Deep learning theories and technologies have enabled unprecedented breakthroughs in the research fields of computer vision and natural language processing. Some companies have started research on artificial general intelligence (AGI), such as OpenAI, DeepMind, and Anthropic. A 2020 survey showed that 72 AGI projects distributed in 37 countries/regions are under active research[2]. AGI refers to intelligent systems that can perform as well as or better than humans on a wide range of cognitive tasks. Narrow artificial intelligence refers to AI designed for specific tasks.

With the growth of application fields of AI technologies and the huge impacts on different professional fields, more and more majors are offering courses related to AI. Witnessed with the great success of AI in various research fields, it's very natural to reach the point that it's necessary for students and researchers from all walks of life to have a certain knowledge of AI, which will be of great help to their future work and scientific research. Since AI research covers a wide range of subfields, numerous theories and algorithms have been proposed. In order to let students learn more practical theories and technologies under the constraints of limited teaching hours, the selection of teaching content is very important. Looking at the current AI textbooks, there are a few problems. Firstly, different textbooks have their own choice of coverage. Secondly, the content in textbooks often cannot keep up with the pace of theoretical development, such that it cannot reflect the latest research progress in the field of AI. Finally, some or even most chapters in AI textbooks overlap with content in other related courses,

such as machine learning and data mining. In response to the above problems, this article puts forward several teaching content selection criteria, which can help teachers choose teaching content reasonably and make AI courses truly effective and useful.

In addition to choosing appropriate teaching content, an innovation in teaching methods is also necessary. For the theories and algorithms of AI, if we blindly adopt the traditional teaching method of "teacher talks while students listen", then the theoretical knowledge may be too boring and hard to digest. Students will gradually lose their interest in learning this topic. We believe that the appropriate teaching methods for AI courses should be able to fully stimulate students' learning enthusiasm, combine theory with practice, and consciously cultivate students' learning initiative and innovation awareness. To this end, this article proposes several effective teaching methods, hoping to contribute to the teaching reformation of AI related courses and make AI courses a course that students truly love. The students will, in turn, provide new impetus for the development of AI in the future.

2. Criteria for Teaching Content Selection

Due to the broad field of AI research, a good number of theories and algorithms have been proposed. However, the current AI course for computer science major generally only has a little more than 30 lecture hours. This dilemma makes choosing the teaching content crucial. The current AI textbooks on the market vary greatly in topic selection, and they often fail to keep up with the latest progress of AI research. In most cases, using a single textbook cannot meet the teaching needs well. In this case, we suggest that teachers start from the following aspects: 1) When selecting textbooks, teachers should try to find those that have been recently published, that is, the textbooks that include the latest research progress in the field of AI; 2) The content of the textbook should be classic, for example, those have great impact to the development of the field; 3) Only use the textbook as a reference, or refer to multiple textbooks at the same time. The teaching content can be selected from one or more textbooks according to actual needs. Regarding the selection of teaching content, this article puts forward several selection criteria for your reference.

2.1 Practicality Criteria

What is suitable is the best. For AI related courses in specific majors, teachers should choose the AI theories and algorithms that are suitable for solving the problems faced by the major. In this way, teachers can integrate theories with practice when teaching, so that students can fully realize the necessity of learning AI and stimulate their learning enthusiasm. Only through combining theory with practical needs, teachers can enable students to, not only master theoretical knowledge, but also gain the ability to solve the practical problems in their professional field. With the guidance of learning interests, teachers can also cultivate students' creative spirit. Through theoretical knowledge learning and practical training, students will be able to be handy in their future careers and let AI courses play their greatest role.

2.2 Forward-Looking Criteria

The research scope of AI is extremely broad, and the theories and algorithms proposed are countless. Under the constraints of limited teaching hours, which theories and algorithms should teachers choose to teach? We believe that in addition to the criteria of practicality mentioned above, the forward-looking criteria should also be followed. The so-called forward-looking criteria is to select as much of the latest research in the field of AI as possible, especially those new theories and methods of AI that may have potentially significant contributions to the specific professional field. Teachers can intentionally guide students to think about and solve problems faced in this field from a new perspective.

2.3 Complementarity Criteria

Some majors, especially majors related to computer science and information systems, in addition to offering AI courses, may also offer some related courses such as machine learning, data mining, natural language processing, computer vision, etc. The teaching topics of these courses are basically also within the AI research field, but the scope of interest is more focused on the theories and methods of a specific AI research subfield. Compared with them, AI course involves a wider range of research. When choosing teaching content, teachers should be clear about what students

have already learned or will learn in other related courses and try to avoid choosing content that has been covered or will be covered in other courses. Choosing theories and algorithms that are not covered by other courses makes AI course to be complementary to other related courses, which lets students learn as many new topics as possible instead of wasting time on boringly repeating topics. On the basis of practicality and forward-looking criteria, the complementarity criteria can make AI courses unique, allowing students to broaden their horizons and learn a wider range of artificial-intelligence-related research theories and algorithms.

2.4 Classicality Criteria

The three criteria mentioned above can help AI teachers determine the subfields of AI research to cover. After determining the subfields, since each subfield involves a lot of research outcomes, it is impossible to explain them one by one due to class time constraints. In this case, the teacher's choice of specific teaching content is crucial. This is the reason we propose the classicality criteria. The so-called classicality criteria refers to choosing those theories and algorithms that were first proposed to solve a problem and caused great repercussions，as well as have had an important impact on subsequent research. For each subfield, select several classical algorithms, explain clearly the basic techniques involved in this field, guide students to think actively, and cultivate students' innovative thinking.

To follow the above selection criteria, teachers of AI courses are required to have extensive knowledge, be very familiar with existing research problems in the specific professional field and research outcomes in the field of AI and understand the teaching situation of other related courses offered to students in the major. We believe that the four selection criteria proposed in this article can well help teachers of AI courses choose appropriate teaching content and make AI courses popular.

3. Reformation in Teaching Methods

The traditional teaching method in colleges and universities is in the form that teachers talk while students listen. For AI courses, if we only use this traditional teaching method without letting students participate in it or personally try to apply theoretical knowledge to solve practical problems, the theoretical knowledge will sound too boring, thus leading to students losing their interest in learning the topics. To take a step back, even if some students can memorize all the theoretical knowledge taught, they will lack the hands-on experience to solve practical problems, which is a more crucial part of AI courses. Therefore, in order to improve students' learning enthusiasm while cultivating students' innovative thinking and their ability to solve practical problems, the teaching methods of AI courses should go through reformation. In this regard, we believe that reforms can be carried out from the following aspects.

3.1 Seminar Teaching Method

To assist the traditional teaching method of "teachers talk while students listen", it's necessary to appropriately increase the weight of seminar teaching method. With the seminar teaching method, the teacher needs to ask some questions before the class and can also provide some reference materials. Students are required to read the provided materials first and they also need to check more information on their own and come up with their own solutions through reading the related materials. In class, the teacher encourages students to express their own opinions and question other people's solutions. Only in this way can every student participate in the course and transform from passively accepting knowledge to actively solving problems. Over time, they will develop the habit of thinking diligently and being good at questioning. This will, not only enable students to better master theoretical knowledge, but also enhance their ability to solve problems. This teaching method can better cultivate students' sense of innovation and innovative ability.

3.2 Group Presentation Teaching Method

The teacher can intentionally put forward several research directions and let the students be divided into groups freely. Each group can choose a research direction. The students need to find and read relative materials themselves, and even do some evaluations for some classical methods, organize them into a report, and explain it to the whole class. The teacher and other students can feel free to ask questions, and students who present their report need to answer the questions. This teaching method not only cultivates students' cooperative spirit but also enhances students' ability to proactively learn

and solve problems. This kind of exchange of roles between students and teachers can also allow students to experience and understand the difficulty of being a teacher, thus taking the lectures more seriously, and can also train students' confidence in speaking impassionedly to the audience.

3.3 Hands-on Experiments

For most majors, the reason why AI is important is that its theories and algorithms can solve practical problems in a particular professional field. When teachers teach AI theories and algorithms, they should integrate theory with practice so that students have more opportunities to participate in and use the theoretical knowledge they have learned to solve practical problems. Students must try it themselves, and teachers should also encourage students to think more when trying algorithms, such as to try to change the values of algorithm parameters to see their impact on the performance and encourage students to actively think about improvements to the algorithm. Only by participating in it can students change from passive to active and seek innovation in practice. Just as Mu Li emphasized the importance of hands-on practice in the book "Dive into Deep Learning" [3], in the teaching process of AI related courses, students' hands-on practice and participation determine, to a large extent, the success of the course.

After all, the lecture hours of AI courses are limited. In order to stimulate students to conduct more in-depth research in the field of AI, teachers can also consciously guide students to connect AI with their graduation projects and encourage them to choose AI related topics according to their own interests [4]. For example, for undergraduate students majoring in computer science in our university, judging from their current graduation project topic selection, very few students actively choose graduation project topics related to AI. They are more inclined to choose various practical system design topics (e.g. logistics management system, dormitory management system, examination system, etc.). This reflects to a certain extent that the AI courses have not fully stimulated students' interest in learning and scientific research awareness. Or the students simply cannot apply

what they have learned to accomplish a project. Teachers can intersperse content related to graduation project topics in the class, and consciously guide students to do more graduation project topics related to AI, stimulate students' awareness of scientific research, and cultivate more outstanding students with both the ability to solve practical problems and scientific research innovation.

4. Conclusions

In view of the problem of the broad field of AI research with the limited class hours of AI related courses, as well as the various problems of AI textbooks currently on the market, this article proposes several criteria for teachers of AI courses to choose teaching content. We hope that these selection criteria can help AI teachers choose appropriate teaching content so that AI courses can really play their due role. Also, in order to better cultivate students' ability to solve practical problems and innovative thinking, this article proposes several teaching method reformations. Appropriate teaching content, coupled with appropriate teaching methods, can fully stimulate students' enthusiasm for learning and change them from passively to actively learning. It can, not only cultivate students' ability to solve practical problems but also cultivate students' innovative thinking, making AI related courses a popular choice for students.

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