Exploration and Practice of Jupyter Notebook in Artificial Intelligence Online Teaching

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Abstract. Online teaching has become the norm in college teaching under the continue pandemic. Therefore, Artificial intelligence (AI) which not only focus on theoretical derivation and knowledge explanation, but also emphasize on programme practice and project training, whether of having a suitable teaching tool becomes especially important when it comes to effective online teaching. In view of the actual needs of artificial intelligence online courses, this paper analyzes the functions and characteristics of Jupyter notebook, and propose one-stop solution for artificial intelligence online teaching with the ground of Jupyter notebook. In addition, this paper will mention the launch of online teaching tasks, practicing "integration of theory and practice", conducting teaching and external learning resources. All those mentioned will have a specific meaning in terms of artificial intelligence online teaching.

Keywords: Artificial Intelligence · Online Teaching · Integration of Theory and Practice · Jupyter Notebook

1 Introduction

In order to imply the idea of "Continual Studies without Suspension of Offline Classes", which is the policy instructed by the Ministry of Education [9], online teaching becomes a great challenge and went through a great development. All colleges and universities are striving to carry out various forms of online course teaching such as MOOCs, online live broadcasts and virtual simulation experiments, and carry out normalized teaching by integrating online elements, so as to ensure the normal teaching of colleges and universities during the special period of corona virus pandemic. And also to ensure college run as normal and protect students' interests.

With the continuous development of the fields in big data and artificial intelligence, artificial intelligence courses are becoming more and more well-known. Meanwhile, artificial intelligence courses are also more common due to corona virus pandemic. Because artificial intelligence involves comprehension, intersecting, course contents cover basics of mathematics, computer principles, covering algorithms, models and applications [7], thus artificial intelligence online courses not only requires theoretical

derivation, knowledge explanation and case analysis, but also students' simultaneous programming practice and project training.

For now, traditional offline teaching activities will use many tools such as PowerPoint, handouts, case studies, practical projects, student handouts and homework. However, those tools are separated from each other and have different formats and saving coding. This leads to difficulties on storage and sharing [12]. How to efficiently manage, integrate and share such teaching documents is one of the unsolved problems in online teaching of artificial intelligence courses. Therefore, this paper will analyze the basic operations and characteristics of Jupyter Notebook, and discuss how to use Jupyter Notebook to carry out online teaching of artificial intelligence courses.

2 Introduction to Jupyter Notebook

2.1 Jupyter Notebook and Its Characteristics

Jupyter Notebook is a web-based application for interactive computing, which can be applied to the whole process of computing including: exploration, documentation, code running, and results display which supports running of 40 analytical programming language web pages [8]. Jupyter Notebook opens in 'form' format, while users can write and run the code directly as mentioned in the official introduction. Results of the code execution process will also directly be displayed. The user can also directly edit and explain in the code block if they are editing the same page programme document.

Key features of Jupyter Notebook:

- It has the functions of syntax highlighting, indentation, and tab completion during the stage of programming;
- User can run the code directly through the browser, and display the running results below the code block;
- Display calculation results in many media format. And those media formats include: HTML, LaTeX, PNG, SVG, etc.;
- Supports Markdown syntax when writing documentation or statements for code;
- Supports LaTeX when writing mathematical descriptions.

2.2 Jupyter Notebook Installation and Configuration

2.2.1 Installation of Jupyter Notebook

It is recommended to use Anaconda for integrated installation. Anaconda is the first released version of Python, which includes Python, Jupyter Notebook, Conda and 180 more scientific and other dependencies [1]. The main interface is shown in Fig. 1.

2.2.2 Setting Up a New Working Directory

The default working directory of Jupyter Notebook is in the installation directory, this will bring inconvenient in subsequent usages. It is recommended to replace by another new path. Generate a config file via the directive, then use a text compiler to set a new working directory in the config file.
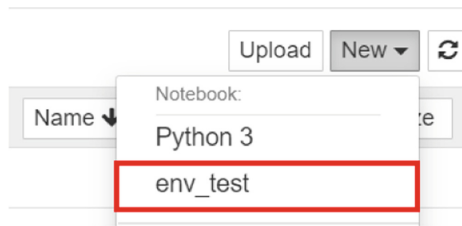
Fig. 1. Anaconda main interface.

Fig. 2. Selecting a Virtual Environment in Jupyter Notebook.

2.2.3 Add Environments of Conda into Jupyter Notebook

The virtual Python environment created in Anaconda needs to be written into the kernel file of Jupyter Notebook to associate with Jupyter Notebook. After the association is successful, run Jupyter Notebook to select the created virtual environment, as shown in Fig. 2 and Fig. 3.

3 Introduction to the Functions of Jupyter Notebook

3.1 Writing Teaching Documents

Markdown is a lightweight markup language. It can write plain text that is written purely by punctuation, which is very ideal for writing papers or teaching documents [2]. And Jupyter Notebook supports Markdown syntax as shown in Fig. 4.

In the artificial intelligence courses, it involves a lot of mathematical formulas, and a large number of network reference materials will be provided in the teaching process [11]. Using the Markdown syntax, lecturers can edit mathematical formulas, network addresses, and insert pictures directly in the document. For example. Edit the mean-square error, MSE (1) as shown.

$$E = \frac{1}{2} \sum_k (y_k - t_k)^2 \tag{1}$$
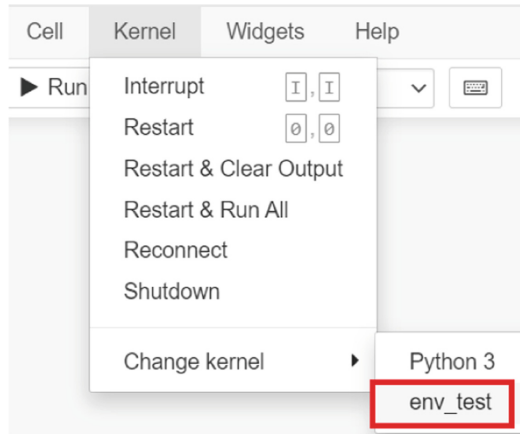
Fig. 3. Changing Kernerl in Jupyter Notebook.
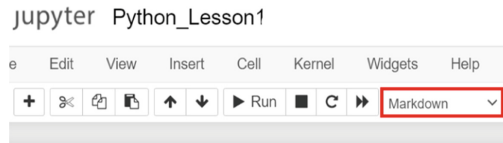
Fig. 4. Using Markdown in Jupyter Notebook.

Formula (1) can be represented by "$$ E = \frac{1}{2}\ sum_{k}{(y_k-t_k)}^2 $$", by mastering the basic rules and notation, even complex formulas can be easily expressed.

3.2 Demonstrating Teaching by Using Slides

Taking Live or recorded teaching will need slides to demonstrate through teaching online. By copying the Jupyter Notebook documents contents, and paste them to the Microsoft PowerPoint to typeset, it is going to waste a lot of the time and energy of the lecturers. Jupyter Notebook provides a RISE library, which can easily convert Notebook documents into PPT-like slides. In the Slides view, you can set the slide type of each cell and with a click can directly play the slideshow. Specific steps is shown in Fig. 5 and Fig. 6.
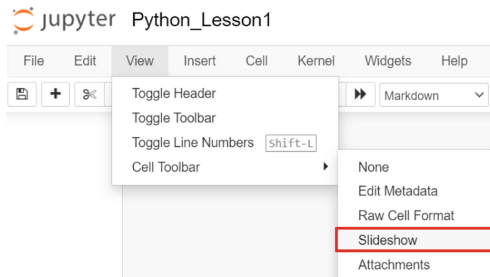
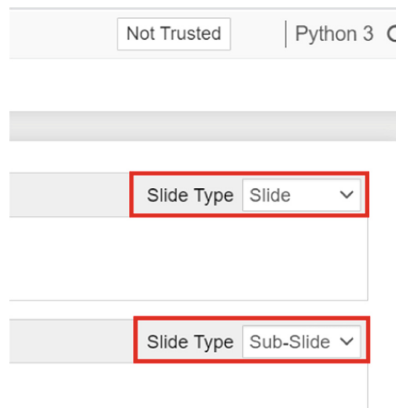**Fig. 5.** Coosing slideshow in Jupyter Notebook

Fig. 6. Setting the slide type for each cell

3.3 Programming Experiment and Results Investigation

Jupyter Notebook can supports a variety of programming languages including Python, R, Scala, Julia, etc., which can easily and quickly carry out experimental teaching on artificial intelligence teaching courses.

Taking the Python language as an example, Jupyter Notebook can not only execute code in real-time and interactively, but also execute the program as a whole. Also, results can be displayed in a graphical way, as shown in Fig. 7 and Fig. 8.

3.4 Save and Share Documents

All interactive calculations, writing documentation, mathematical formulas, pictures, and other rich media input and output in Jupyter Notebook are displayed through the form of documentation [4]. Jupyter Notebook is supportive in providing various file saving formats and supports exporting in.ipynb, JSON, HTML, Markdown, LaTeX, PDF and other formats as shown in Fig. 9.

```python
import matplotlib.pyplot as plt

plt.figure(figsize=(6, 4), dpi=100)
plt.grid()
plt.scatter(x, y1, c='red', marker='v')
plt.scatter(x, y2, c='green', marker='o')
plt.ylim([-2, 2])
plt.xlim([-1, 1])
plt.xlabel('x label', color='blue', size=12)
plt.ylabel('y label', color='blue', size=12)

plt.title('Plot of 2x and x**2', size =12)
plt.legend(['red', 'green'], loc=2)
plt.axvline(0, linestyle='dotted', color='b')
```

Fig. 7. Running the code.
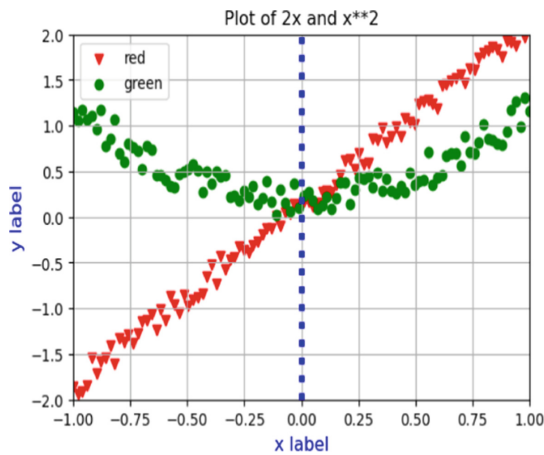
Fig. 8. Results in graphically display.

It is worth mentioning that various websites and platforms such as GitHub, blog, WeChat, Zhihu, and Evernote are already supporting Markdown syntax. Jupyter Notebook uses Markdown syntax to complete typeset documents, as long as they are saved in.md format files, they can be easily imported into the above-mentioned websites or platforms for sharing. Thus, tutor of the class can have more time to focus on writing and organizing teaching content without worrying about wasting energy on typesetting when they share it on other platforms later on.
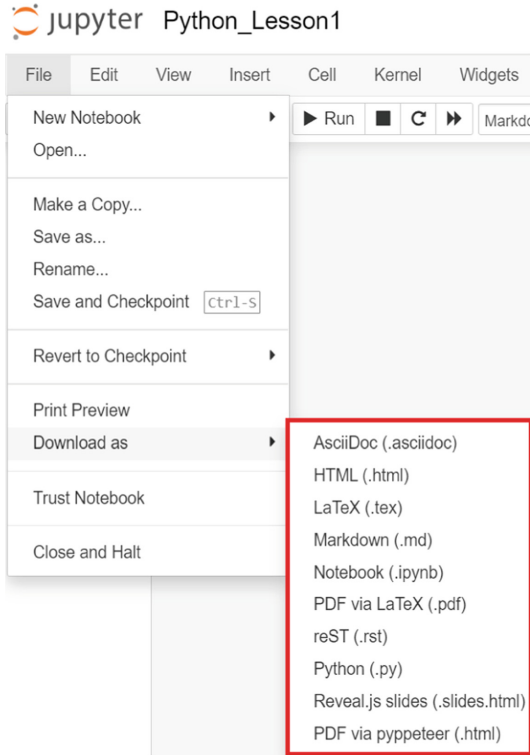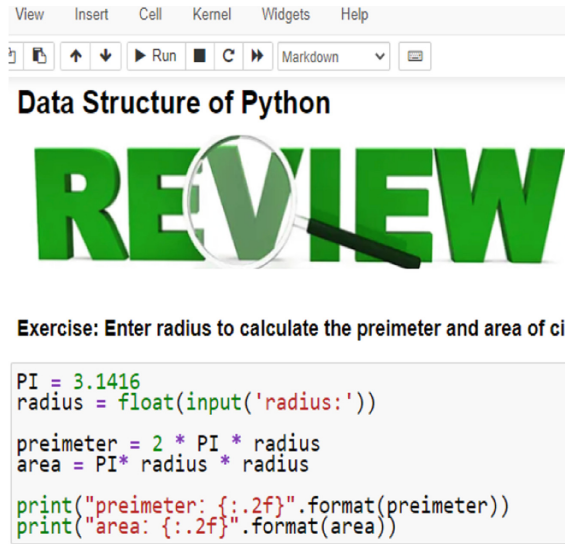
Fig. 9. Jupyter Notebook supporting various file

4 Application

According to the characteristics of artificial intelligence courses [6], in view of the existing problems, and combined them with the existing network teaching platform, we can accomplish artificial intelligence online courses with the following:

4.1 Facilitate Online Teaching

First of all, lecturers can prepare a Notebook document containing teaching objectives and learning materials for each course and submit and share it with students each time. Students can import documents into the local computers for course preview and preparation. Secondly, lecturers can use the Jupyter Notebook to perform slideshows or run code during the lecture, while students can take notes in the Notebook document, complete classroom exercises and other learning activities. Thirdly, the assigned after-school homework and the content of students' self-study expansion can also be written into the same course Notebook document and submitted through the online teaching platform. Last but not the least, lecturers can grade the students' work, give feedback and rate or evaluate them.

Fig. 10. Results in Jupyter Notebook

4.2 Supporting the "Theory & Integration" in Teaching

Jupyter Notebook documents support the editing and saving of graphics, codes, and running results, and can efficiently integrate teaching handouts, case codes, references resources, experimental data, and results evaluation. In addition, it can be shared and communicated between teachers and students, so as to provide convenience for the "Theory & Integration" in practical teaching [4, 10].

For example, a lecture can use Jupyter Notebook teaching document with many elements such as text, images, mathematical formulas, codes, and links, and the teaching documents can be saved as files in.ipynb format, which can be directly shared with students, and can be opened and used in students' development environment. With these functions, students can not only benefit from using Jupyter Notebook teaching materials for pre-class preparations, in class notes, but also after class studies and classwork/homework submission. The content of.ipynb file is shown in Fig. 10.

4.3 Enhance Usage on External Learning Resources Effectively

Artificial intelligence online teaching courses have high requirements on innovation [3], comprehensiveness, and more focus on self-learning and carry out extracurricular learning. These provided a very good ground to effectively enhance usage on external learning resources. Of course, carrying out extracurricular learning is also very important.

5 Conclusions

Jupyter Notebook is the one-stop solution for Artificial intelligence online teaching courses. It meets the needs of program development, documentation and presentation etc.

which are required for online courses. This not only facilitates teachers to carry out online teaching tasks, supports "integration of theory and practice" teaching, but also effectively increase usage on external learning resources. With the maturity and popularization of the Jupyter Notebook second generation, which is called JupyterLab, by strengthening the research and exploration of JupyterLab, Artificial intelligence online teaching must get more and more effective and comes with better solutions.

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