

Teaching Reform of Communication Principles Course Based on Python

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Abstract. In view of the current teaching situation of information and communication engineering specialties, the existing problems in the course of Communication Principles are analyzed, this paper puts forward the teaching reform for Communication Principles course based on Python for the first time. The reform integrates Python into theory teaching, experiment operation and course design. The teaching objectives, teaching contents, and teaching methods with Python are designed and explored. Implementing the teaching mode of Python language assisted course teaching can help students to clarify the teaching objectives and understand the abilities they should achieve. According to the indicators of teaching practice, it shows that this reform helps to save experimental cost, stimulate learning interest, improve the teaching quality and learning effectiveness of Communication Principles course.

Introduction

Communication Principles is an important basic specialized course for information and communication engineering specialties [1]. Communication Principles course includes strong theory, abstract concepts, numerous mathematical reasoning and formulas, which make it very difficult to understand and master. Therefore, when teaching this course, besides in-class teaching, formula derivation and theoretical homework, dynamic demonstration and experimental verification are necessary and effective ways to help students understand and master knowledge. At present, some colleges and universities use MATLAB as an auxiliary tool to assist teaching by adding course experiment and course design. It not only enriches the teaching content, but also increases the flexibility and interaction of teaching methods, thus achieving good teaching results.

As a scientific computing platform which integrates numerical analysis, matrix operation, signal processing and graphics display, MATLAB has a rich scientific computing toolkit, which can easily realize the theoretical verification and system design simulation of communication principles. However, during the teaching, we find that there are many practical problems in using MATLAB as an assistant teaching tool, which are illustrated as follows.

(1) Although MATLAB supports scripting and process-oriented and object-oriented programming, it differs significantly from C/C++ in code style, data definition and grammar rules. Even though students have learned C/C++ language, they still have to re-learn when using matlab, so it is generally difficult to get started.

(2) The original design purpose of MATLAB is to facilitate the modeling of scientific computing problems, which does not match the basic emphasis of Communication Principles.

(3) MATLAB is mainly for high-level scientific researchers, its application in industry is relatively narrow, which does not have enough attraction for most undergraduates whose learning objective is to meet the practical application and meet the needs of work. Students only regard it as a temporary tool in the curriculum.

These are all practical problems in the teaching process, and have become an urgent problem to further improve the teaching quality of Communication Principles. In recent years, with the rapid development and expansion of Python language, using Python instead of MATLAB and establishing the teaching system of Communication Principles based on Python have become feasible solutions to the above problems [2].

The Rise of Python Language

From the mid-20th century to today, in the short 70 years, information and computer technology have experienced rapid development, and many different programming languages have emerged, such as Pascal, Fortran, C, C++, Java, PHP, C#. Each programming language has its limitations. Guido von Rossum, the designer of Python, wants to provide a language that can be programmed as easily as some scripting languages, as well as C's ability to easily call functional interfaces of computer [3].

Compared with languages like C/C++ and Java, Python has the following advantages [4]:

(1) Simple and easy to learn. Python is a language that represents the thought of simplism. Its grammar is simple and easy to learn. This enables students to focus on problem solving rather than learning the language itself.

(2) Object-oriented. Python supports both process-oriented programming and object-oriented programming.

(3) Scalability. In order to improve the running efficiency, we can use C/C++ to write key code, and then use them in Python program.

(4) Mixed programming. Python is called glue language because it is easy to mix Python with other languages. In this way, the existing toolkits can be easily used to improve the efficiency of development.

(5) Rich library. Python has a powerful standard library, and Python's ecosystem has begun to expand to third-party packages, such as web.py for Web frameworks, numpy for scientific computing, and Matplotlib for data visualization.

As a cross-platform programming language, Python has been transplanted to many platforms such as Linux, Windows, Mac and Android. Because of Python's openness, it has abundant mature library support from the open source community, so it can accomplish various tasks based on Python, such as data acquisition, image processing, machine learning, and scientific computing and so on.

Due to these advantages of Python, it has gained wide support from the industry. For example, at Google, Python is the third most used programming language after C++ and Java. The development team using Python is also the third largest research and Development Department of Google. The most popular Python platform around the world are Tensorflow and Google App Engine from Google, Caffe from Berkeley AI Research (BAIR) and Berkeley Vision and Learning Center and so on [5].

Meanwhile, many foreign universities (such as MIT, Stanford University, UCLA, etc.) have used Python as the teaching object of programming language. On Coursera and other online education platforms, you can find Python courses from Michigan University, Rice University, Johns Hopkins University and many other universities, However, the domestic work in this area is far from enough. There are only a few of colleges and universities offering Python language teaching in China till now.

Reform Scheme

The research proves that Python teaching can improve students' active learning ability, learning interest and enthusiasm, and problem solving ability.

Reform of Course Teaching Content. According to the orientation and the goal of Communication Principles course, we reform and re-plan the course content, which is divided into basic part, ability part and application part. The basic part mainly includes basic concepts and basic communication system structure; the ability part includes basic principles and advanced data processing through functional structure; the application part includes the different designs and applications of different knowledge learned from this course. From these three parts of learning, students can carry out project in combination with their major comprehensively and systematically, so as to achieve the effect of learning for application. This form of curriculum content organization not only helps teachers to deliver the teaching knowledge points in the teaching process, but also helps students to understand the overall structure of the curriculum. At the same time, follow the principle of gradual progress, so that students gradually improve their thinking ability and system ability. The division of teaching content [5] is shown in Table 1.

Table 1. Structure of teaching content

COURSE CONTENT LEVEL	COURSE CONTENT MODULE	SPECIFIC KNOWLEGE POINT	LIBRATY
BASIC PART	Signals Sepctra System	Information and merit; Digital communication signal processing; classification of Signals; Spectral density; Random signals; Signal transmission through linear systems; Noise;	Math Random
ABILITY PART	Formatting Baseband Modulation Baseband Demodulation Bandpass Modulation ; Bandpass Demodulation	Formatting; Baseband System; Pulse Code Modulation; Quantizaton; ASK/PSK/DPSK Detection of Binary Signals in Gaussian Noise; Intersymbol Interference; Equalization; Coherent Detection; Noncoherent Detection; Error Performance for Binary System; QPSK/8PSK/16QAM;	Math Random Numpy Matplotlib
APPLICATION PART	Advanced Technology	OFDM MIMO	Math Random Numpy Matplotlib

Reform of Teaching Mode. According to the characteristics and learning ideas of the Communication Principles, the whole teaching process is organized to integrate the traditional "theory" and "practice" together. After the teacher has finished theoretical class, the students can immediately practice and verify it, and cooperate with the corresponding exercises to consolidate the understanding of the knowledge points. This kind of teaching process organization can solve students' problems about teaching content in time, and make students benefit from both thinking and skills.

Take the knowledge of QPSK signal as an example. Students usually feel difficult to understand the concepts of I signal and Q signal. We encourage students to use Python to simulate and plot the waveforms of I signal, Q signal and the synthetic waveforms as shown in fig.1 to help them understand and grasp this knowledge more easily.

On the basis of this visual programming, teachers should further develop students' learning interest, actively implement the "student-centered" teaching concept, change the traditional teaching mode, and establish case-based teaching and other diversified teaching models [6]. As the example demonstrated, the teaching orientation of Communication Principles course should aim at satisfying characteristics and needs of the major, highlighting students' innovative thinking ability, exploring the new teaching mode and teaching content, researching new teaching model and teaching method which can enable students to transform the knowledge they have learned into their abilities so as to achieve the goal.

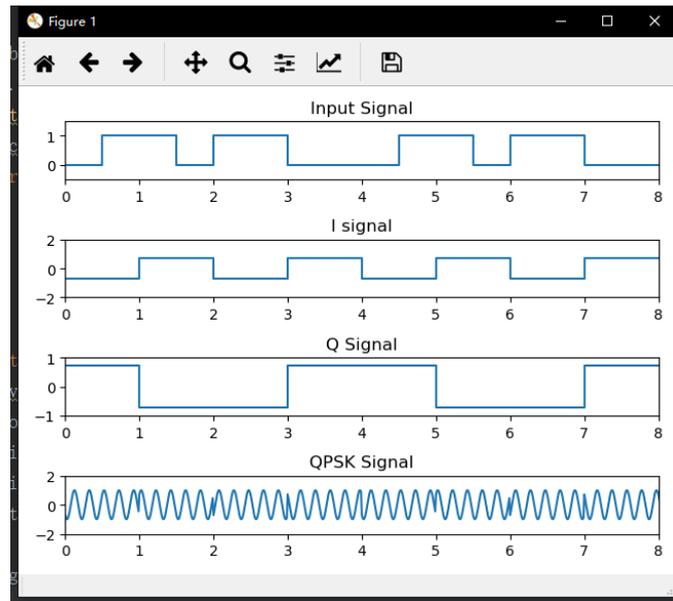


Figure 1. QPSK signal demonstration using Python

Summary

This paper presents a teaching reform of Communication Principles course based on Python language. The introduction of Python into the teaching of Communication Principles enriches the teaching content, expands the teaching methods, facilitates students to understand the teaching content and carry out independent learning, helps to cultivate students' practical ability, and lays a good foundation for future work. Practice of Python based teaching reform for communication engineering students is an attempt to improve the teaching quality of the course. During the process of teaching, we need to contact the actual situation of our students, make continuous innovation and reform to achieve better results and cultivate useful talents for our society.

References

- [1] F. Chen, Discussions on teaching reform of communication principals based on application oriented education, International Conference of Economics and Management, pp560-563, 2015.
- [2] C. Yan, Q. Ye, and X. Hua, The communication principal teaching reform based on applied talents cultivation, Chizhou Xueyuan Xuebao, vol (27): 141-143, 2013.
- [3] X. Huang, H. Tang, and Bo Wang, Teaching reform of digital signal processing course based on Python, Journal of EEE, vol 40(1):56-59, 2018.
- [4] K. Qin, G. Liu, A preliminary study of university teaching reform oriented to Python application, Computer Education, vol (9):22-25, 2017.
- [5] W. Huang, Y. Tang, TensorFlow, Publishing House of Electronics Industry, 2017.
- [6] X. Xu, X. Ding, Exploration on the reform of talents training model for new subjects facing sustainable competitiveness, University Teaching in China, vol (6): 13-17, 2017.