

# Curriculum Reform of Computer Organization and Architecture under the Epidemic Situation

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**Abstract:** Computer organization and architecture is the core hardware course of computer majors. Its abstract and obscure characteristics make it difficult for teachers to teach and students to learn. Under the epidemic situation, traditional teaching methods are facing new challenges, theoretical teaching lacks innovative thinking, experimental course lacks design content, and lacks of leading courses. The combination of online and offline is proposed, the advanced concepts at home and abroad, the FPGA technology and assembly programming design and other measures are introduced to improve the quality of training hardware talents.

**Keywords:** Computer Organization and Architecture; Online and Offline Integration; Advanced Concepts at Home and Abroad

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## 1. Introduction

“Computer Organization and Architecture” is a core professional basic compulsory course for computer major. Affected by the epidemic, this course faces some new challenges. The content of the computer organization and architecture is abstract and obscure, which makes it difficult for teachers to teach and students to learn. In addition, students cannot return to school during the epidemic, and the class is conducted online, which makes it difficult to grasp students’ understanding of the course.

The computer organization and architecture course is organized according to the five major functional components of the von Neumann architecture. It systematically explains the architecture of the computer and the working principles of each part. It focuses on the basic concepts and principles. The course starts in the fourth semester. The leading courses are the introduction to computer science and the fundamentals of digital and logic circuits, and lay the hardware foundation for the follow-up study of microcomputer principles and interface technology, and embedded system design.

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In summary, the computer organization and architecture course is one of the few hardware courses for computer major, and it plays a vital role in the training of computer major. However, due to the abstract and obscure nature of the course, it faces some new challenges especially under the epidemic situation. In view of these circumstances, the curriculum urgently needs to be reformed in terms of teaching form, teaching concept, and course content. Explain some of the shortcomings of the courses under the epidemic situation, adopting online and offline integration, introducing advanced concepts at home and abroad, introducing FPGA, adding assembly programming design and other measures to improve the classroom experience of students under the epidemic situation and attract students' interest to improve the teaching quality of computer organization and architecture.

## **2. Insufficiency of computer organization and architecture during the epidemic**

Combining my own experience in the teaching of computer organization and architecture in recent years, I conclude that the current courses have the following shortcomings:

### **2.1 The traditional form of class is facing new challenges**

During the epidemic, students were isolated at home and were unable to attend classes, which caused both teachers and students to face new challenges. Most teachers have inexperience in online classes and do not have good control over the classroom. Students tend to lose concentration when listening to online classes, and there are many cases where they hang up and do not listen. Teachers cannot find out that the effect of teachers' questioning is not good. In addition, there are various forms of online teaching platforms, each with its advantages and disadvantages. Compared with real classroom teaching, there is a big gap.

### **2.2 Theoretical teaching lacks innovative thinking**

The theoretical course teaching of computer organization and architecture adopts the traditional teaching mode, which is still carried out in accordance with the five major functional components of the Von Neumann architecture. HomeWorks are assigned to deepen the understanding of the content taught in the classroom. The content of the course is relatively old. It does not contain cutting-edge content and cannot keep up with the trend of the times.

### **2.3 The experimental class lacks design content**

The experimental class of computer organization and architecture is 18 hours. It is conducted after the theoretical class. It focuses on the five major functional components of the Von Neumann architecture computers. It mainly uses the experimental box of a specific model to carry out confirmatory experiments. It lacks innovation. During the epidemic, students cannot go back to school to use the development board, and they cannot fully mobilize students' enthusiasm for innovation.

### **2.4 Lack of leading courses**

The assembly programming design is one of the missing leading courses, which makes it difficult to understand the underlying hardware. The computer system hierarchy can be divided into microprogram design level, general machine level, operating system level, assembler level and high-level language level from the bottom to the upper level. The microprogram design level is the hardware signal directly executing on the computer. The "0101..." code is obscure and hard to remember. The operating system level shields the underlying details of the computer system, the high-level language level shields the hardware relevance, and assembly language can directly manipulate the hardware, which plays an important role in understanding the operating mechanism of the entire computer system.

## **3. Reform measures for computer organization and architecture during the epidemic**

In response to the shortcomings of the course, the curriculum group adopted the following measures to deal with:

### **3.1 Combination of online and offline classes**

Online teaching adopts the form of the Yangtze River Rain Classroom + MOOC platform, and offline students use the form of classroom supplementary lessons after returning to school. The Yangtze River Rain Classroom can support multi-platform access, i.e., attending the class through browsers, mobile phones, PC terminals and other platforms. Its main functions contain watching live broadcasts, teacher-student interaction during live broadcasts, and independent learning after class, etc. After class, students are asked to learn the videos of famous teachers through the MOOC platform, which is complementary to online classes. The offline method arranges make-up classes in time after students return to school, and solves students' confusions face-to-face, which is more efficient. The combination of online and

offline classes can increase students' acceptance of the course during the epidemic.

### **3.2 Introducing advanced concepts at home and abroad**

In response to the lack of innovative thinking in curriculum teaching, the curriculum group introduced teaching content from famous teachers at home and abroad, observed and learned from famous teachers online, and organized core teachers of the curriculum group to participate in relevant international education and teaching conferences and teacher training at home and abroad. The curriculum group observed the course videos of famous professors related with computer organization and architecture, such as Qin Leihua's "Computer Organization and Architecture" of Huazhong University of Science and Technology and David Wentzlafl's "Computer Architecture" of Princeton University. It fully absorbed the long-term quality courses of outstanding domestic and foreign scholars and integrated them into the course teaching. The curriculum group supports core teachers to participate in famous international conferences on education and teaching at home and abroad.

### **3.3 Introducing FPGA technology**

In response to the lack of design-oriented content in experimental course, the curriculum group added Field Programmable Gate Array (FPGA). FPGA programming mainly uses Verilog hardware language, the development platform uses Mentor ModelsimSE and Intel Quartus, the development board uses the ALINX 4010 development board. The ModelsimSE simulator supports the Verilog hardware description language to express logic circuit diagrams, logic expressions and digital logic systems, etc. Through the Quartus programmable logic device design software, the Verilog hardware description language can be converted to hardware implementation, logic circuit visualization and vector waveforms. The simulation and other functions. During the epidemic, students can independently complete the experiment content simulation according to their ideas. The generated sof file can be burned into the FPGA development board through the JTAG interface for execution, and the result on the development board can be verified.

### **3.4 Adding assembly programming design**

In response to the lack of assembly programming design, the curriculum group added lectures to introduce the content of assembly programming design to help students master the grammar of the assembly language. Assembler is a low-level programming language that can directly manipulate hardware. Learning assembly language can increase students' understanding of computer hardware. The curriculum group added the basic syntax of 80x86 assembler, addressing mode and instruction system, assembly programming tools, programming subroutine architecture, etc.

## **4. Conclusion**

In response to some problems in the teaching process of computer organization and architecture during the epidemic, targeted reform measures for the curriculum group were proposed, such as combination of online and offline classes, the introduction of advanced concepts at home and abroad, FPGA technology, and the assembly program design content. Those reform measures enhance students' experience in class during the epidemic, attract students' interest in hardware course, help students master the cutting-edge knowledge and practical applications of hardware courses, and improve students' hardware development capabilities.

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