Chapter 14

USING JAVA AND C# FOR EDUCATIONAL SIMULATORS: THE CASE OF SIMPLE-2

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Abstract: Due to the impact of the new technologies in our Society, special efforts to use them for teaching-learning computer architectures have been done. This work presents a simulator of a simple architecture (Simple-2) using two different technologies: Java and C#. In the one hand, the Java version is an applet which runs inside a web browser; in the other hand, the C# version runs as an application that needs a virtual machine be installed in the system. The impact of both technologies on first year Computer Science students has been analyzed, as well as the degree of learning achieved when using the simulator for learning an architecture in a semi-autonomous way.

Key words: computer architecture simulation; educational simulator.

1. INTRODUCTION

One of the core fields of Computer Science education at the University consists on learning those concepts related to computer structure and organization, as well as the interactions among computer components in order to run sequences of instructions. The result of this learning is a key matter in order students can successfully progress with their studies.

To complete this learning, a first stage may be considered to let the student acquire a global vision of computers, recognizing their functional units and the operation of every single unit. After that, the student has to assimilate the different ways in which those functional units interact. During this stage, ability to relate concepts and integrate them into a higher abstraction level is required, which involves a considerable difficulty, especially for first year students.
To help the students during this second stage, the concepts explained in the lectures should be reinforced. Solving exercises and doing practices in the laboratory usually are not enough, and other additional tools to stimulate the students to learn should be used. Several software solutions have been developed that allow the students to interact in order to simulate computer behavior and to observe program execution events\(^1\). There is also software that graphically represents the activity of every component of a computer and the way those components interact\(^2,3\). Students, in general, and Computer Science students, in particular, find quite attractive the possibility of working and learning through the Internet. That is one reason to explain the efforts in developing network learning tools and checking their efficiency in the learning process.

In the department of Electrical Engineering and Electronics at the University of Leon, a simulator of a simple processor (Simple-2\(^4\)) has been developed so as to be used by the students through a web server. There are two available versions: a Java applet, which runs in a web browser; and a C# application that must be downloaded and runs locally in the student’s computer. Anyway, both versions have the same interface and provide the same functionality. After using the software, its influence on the learning has been analyzed on the basis of the results of written tests fulfilled by the students.

2. **JUSTIFICATION OF THE WORK AND OBJECTIVES**

Computer Organization and Technology is one subject that students learn during their first year of the degree in Computer Science at the University of Leon (Spain). This subject involves two main blocks: the basics of *Analogical and Digital Electronics*, and, based on those fundamentals, *Computer Organization*.

The block related to Computer Organization begins with the description of the main functional units present in Von Neumann architecture based computers: Central Processing Unit, Memory Unit and Input/Output Unit. Next, the operation of the datapath is analyzed for a subset of one RISC processor, the MIPS, as described by Patterson\(^5\). The lectures are complemented with animated slide presentations that can be downloaded from the departmental website. Those presentations show the paths the data follow as well as how the control unit manages those paths. In the last part of the course, the concept of memory system is presented, including the possibility of using hierarchies to improve the performance. Finally, basic input/output techniques are studied.