Practical activities in network courses for MOOCs, SPOCs and eLearning with Marionnet

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Technical learning is generally two-fold: theory, that presents the new notions, and practical activities, where skills are trained. Distance education (MOOC, SPOC and eLearning classes) benefits from a very large variety of formats to deliver theoretical contents: videos, interactive animations, text... However, some practical activities require specific hardware that may not be reasonably owned by students neither by university structures.

In this paper we will focus on computer network courses. Practical activity include installing, configuring and exploiting computer networks that feature several computers, routers, switches and a potentially large number of cables. Students that follow online courses cannot reasonably be obliged to own all this hardware, whereas laboratories and practical activities are essential for such technical classes.

Marionnet is a virtual network laboratory that emulates physical networks of computers and devices such as cables, hubs, switches and routers. It features an intuitive graphical user interface, making it really easy to use without requiring any specific training. It accurately reproduces the behavior of a real network, and gives the user access to each device's terminal in order to allow him/her to configure the said device.

Marionnet uses lightweight components to emulate each device of the network, such as specifically patched User-Mode Linux virtual machines[3] and the VDE communication layer[4]. Hence, a Marionnet virtual network as a small memory footprint, so that non-trivial networks can be emulated on reasonably sized, not-so-recent computers without any memory usage issue.

Moreover, the networks built with Marionnet and the configuration of the machines and devices can be saved for further usage or to be transmitted to an instructor. A network and its configuration is called a *project*. A project is saved in a single file which is actually made of two parts: a representation of the network, and the state of the machines. The state of the machine is actually the modifications that were made from the initial state of its filesystem; this is a *copy-on-write* file, which takes typically a few megabytes of disk space.

As a consequence, Marionnet files can also be exchanged between students and instructors, which is a really interesting feature for eLearning courses. Instructors can send examples or partially configured networks to students, and students can send networks made as assignments or questions to their instructors.

In this paper, we present Marionnet, a virtual network laboratory, and how it can be used in distance education to implement practical activities in network classes that should normally require students to have access to specific hardware. Marionnet provides virtual network equipment such as routers, switches, computers and cables, and allows users to design a whole network on a single computer. The hardware in Marionnet is virtualized and can therefore be configured like real devices, making the practical activities that are using it very realistic.

References

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