Juppix: a Linux Live-CD for Undergraduate Students

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Abstract

Juppix is a Linux Live-CD with a comfortable programming environment for the Java, C and O'Caml programming languages that has been distributed to hundreds of undergaduate students at the University of Paris 7 over the last few years. We describe the lessons we learnt while compiling and distributing Juppix, and outline our future plans.

1   Background and motivation

Undegraduate teaching of programming at the University of Paris 7 is mostly based on Unix. During the first year, we use the Java programming language with some locally-developed packages [7] and the Emacs editor, in the second year, we add C and PHP, and third year students get to enjoy O'Caml.

While on campus, our students do have access to a few dozen reasonably configured machines running a system consisting of FreeBSD Unix and the KDE desktop. In periods of high affluence, such as just before a project deadline, our computer rooms tend to be overcrowded. Even in normal times, many students prefer to work from the comfort of their homes or to sit with their laptop in a nearby café.

It used to be the case that well-meaning lecturers and tutors helped students set up a Linux distribution on their personal machine. Unfortunately, destroying a student's MP3 collection by mistake is not a good way of staying popular, and visiting a student's home (especially a female student's home), even with the laudable goal of helping with a Linux installation, makes some of us uncomfortable.

Perhaps more importantly, many first year students are overwhelmed with the change in habits that we require from them: after years of clicking on the pretty icons of a Microsoft Windows environment, they are suddenly required to use a fairly sober KDE desktop, the command line and Emacs. The slight differences between the carefully tuned configuration that they access at the university and the default configuration of a general-purpose Linux distribution are often enough to confuse them.

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Live-CDs   A Live-CD is a bootable CD that provides a full operating system environment that can be run from the CD with no need to install any software on a computer's hard disk. While Linux Live-CDs have been around for as long as anyone can remember, with some very early Linux distributions using a Live-CD format [4], they have only become popular in recent years, probably because of CD-ROM drives becoming fast enough.

In recent years, the Live-CD concept has become increasingly popular, and there is a vast array of available Live-CD implementations of general-purpose operating systems, but also of appliance software such as routers, firewalls and kiosks to be deployed in public places. The concept has become popular enough for at least one major Linux distribution to risk using a Live-CD as their primary installation media [6].

Our department had had some extensive experience with Live-CDs in the late nineties and early naughts [1]. It was natural for us to think of distributing software to our students in this format.

2   The early days

In the autumn of 2004, the second author started experimenting with using a *Knoppix* Linux LiveCD [3] and manually replacing some little-used pieces of software (such as the KDE games and network security tools) with a full set of packages for Java programming. He distributed a few copies of these to members of his tutorial groups, encouraging them to try this at home.

When his CDs turned out to be fairly successful with his students, the first author convinced him to turn his one-day hack into a more ambitious project. Within a few weeks, we had compiled a list of Free software packages used for teaching in our first, second and third year courses, and started writing a set of scripts that would build a "Juppix" Live-CD image with no human interaction.

Writing the scripts turned out to be a pointlessly exciting exercice. At the time, *Debian GNU/Linux*, the Linux distribution on which Knoppix, and hence Juppix, is based, was not quite ready for unattended installation. Some packages refused to install or uninstall without human interaction, and others had configuration defaults that would lead to a broken installation. Hence, our scripts needed to go around patching the Knoppix filesystem before starting to uninstall and then install software.

Reconfiguring software   Another issue was that of the default configuration. Since the home directory of a LiveCD's user is typically not persistent, we wanted to provide our students with a comfortable default configuration, one that, as noted above is as similar as possible to the configuration of the machines in the university's computer rooms. In particular, we wanted a clean KDE desktop without annoying pop-up windows[1], and we wanted the default shortcuts to follow the well-established

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[1]Nonetheless, the authors bear no grudge towards the author of the infamous *KTip* applet.

pattern of the university configuration (a terminal, an Emacs editor, a keyboard layout switcher, etc.). We also wanted the shipped web browsers to include set of bookmarks that were likely to be useful, such as pointers to timetables, lecture notes, exam schedules, and, of course, to *xkcd*.

Older software turned out to be easy to reconfigure. For example, reconfiguring Emacs was a simple matter of adding a "`.emacs`" file to the default user's home directory ; reconfiguring the shell was done by appending some code to the default "`.bashrc`".

The KDE desktop, however, had clearly not been designed to be reconfigured from a script. KDE distributes its configuration files in a complex hierarchy rooted at a directory "`.kde`" in the user's home directory, and finding the exact location of *Konqueror*'s bookmarks or of *Kicker*'s icons and working out these files' syntax turned out to be a tedious and error-prone task. Our scripts remain brittle with respect to KDE version changes.

The *FireFox* web browser turned out to be an interesting case. A *FireFox* user's configuration is stored in a directory the name of which is randomly chosen on a per-user basis; the authors have no idea why this is done, and suspect that the FireFox developers like to be gratuitiously annoying. However, once the name *du jour* of the configuration directory has been identified, configuring FireFox is a simple matter of modifying two relatively well documented files ("`bookmarks.html`" and "`prefs.js`").

Legal issues   In the small-scale experiments performed in 2004, we had ignored some licensing issues, notably with the distribution of the Java "Development Kit" (JDK). Since the 2005 version was to be more widely distributed, we decided we could not afford an uncertain legal situation.

We considered a number of alternate implementations of Java that didn't have distribution issues. Unfortunately, all of the implementations that we experimented with at the time exhibited differences with Sun's implementation that, while minor, were significant enough to confuse beginners.

Sun's legal department were friendly and sympathetic, and encouraged us to include their Java implementation. Unfortunately, they appeared to be unwilling to state anything clearly. It took the first author two weeks of consistent harrassment over e-mail across 9 timezones before he managed to trick a very nice lady into producing a statement that was clear enough for our Head of Department.

We also had to give up on some software for legal reasons. At the time, our third-year course in Logic Programming used a well-known Prolog implementation from a Portuguese university. After investigating its licensing, it turned out that it contained an advertising clause, which we find obnoxious, and that some of the bundled libraries had a distinct license that did not allow redistribution at all. A painful week of e-mail exchanges did not allow us to converge to a satisfactory solution — the authors did not appear to care what we did with their software, but they were not willing to make any changes to their licensing. All versions of Juppix to date have shipped without a Prolog implementation.

Juppix 2005 By the end of October 2005 (two weeks after the start of the semester), we had a set of scripts that generated a CD image that we did not fear would not undermine our professional façade. We burnt 40 CDs by hand, and distributed them to our first-year students, 2 per tutorial group, asking them to share and copy the CDs among themselves.

3   Fixing mistakes

In the process of preparing and distributing the 2005 version of Juppix, we had made a number of fairly serious mistakes, which we felt we needed to fix for 2006.

Systematic distribution While most of our students have a fair amount of experience with copying CDs, asking them to organise distribution of Juppix turned out to be a mistake. In many cases, a tutor managed to make sure that all of hist students got a copy; in some groups, however, the original CDs ended up stuck at somebody's home after just a few copies had been made.

Additionally, the fact that our distributon was selective created a feeling of injustice among the students who weren't able to get a copy. There was even a formal complaint to our Head of Department, which he dutifully dumped on our desks before ignoring it.

At the encouragement of our Head of Department, we decided that if we were to distribute CDs to our students, we would distribute them to everyone, and order at least as many professionally-pressed CDs as we had first-year students.

Test suite During the development of the 2005 version of Juppix, we lost a lot of time dealing with silly mistakes. We would encounter an issue with e.g. the Caml mode not being configured properly in Emacs, which we would promptly fix, only in order to discover that, although they had been working perfectly the week before, the locally-installed Java classes were now broken.

We therefore proposed a fifth year project that consisted in developing a test suite for Juppix. The project was taken up by Glenn Rolland, who wrote a comprehensive set of shell scripts that tested the "serious" aspects of Juppix, notably the Emacs setup, the C and Java compilers and libraries, and the Apache/PHP installation. The test suite can be run on a Juppix instance connected to the Internet by simply downloading the scripts and running a shell script. Being able to comprehensively test what we feel is the core of Juppix whenever we build a new image has significantly reduced our chances of developing a stomach ulcer.

Working with Rolland turned out to be even more helpful than expected. As the first outsider who had ever had to run our scripts, Rolland did a fair amount of work to clean them up and make them easier to use. He automated the creation of bookmark files, so that we now could generate bookmarks for Konqueror and FireFox from a single source. His project report [5] remains the best description of the 2006 version of Juppix.

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4 Results

In October 2006, we designed cover art for Juppix and ordered a batch of 2000 professionally-pressed Juppix CDs; this cost our department roughly €2500. A few weeks later, we received five boxes of 400 CDs each. We set-up an e-mail alias for support (populated with a few Ph.D. students with good Linux experience), and gave out 40 CDs to every tutorial group.

Numbers Over two years later, three generations of first-year students have received Juppix CDs, and the 2000 units are mostly gone. Over the last three academic years, we estimate that roughly 1000 copies have been distributed to our first year students, an extra 500 copies went to students in higher years and in other departments (notably Bio-Informatics), and some 150 copies were distributed in other universities. Additionally, some 300 copies have been given out at various public events, notably the "*Fête de la Science,*" an annual exposition open to the general public (and their children).

We are aware of at least two instances of other universities burning their own runs of unmodified Juppix CDs. On the other hand, we are not aware of anyone modifying our scripts to produce Juppix-like CDs.

Students Students tend to consider the use of Juppix as being a compulsory part of their education, and they are very surprised when they learn that we don't object to their using a stock Linux distribution instead. While we have not performed any large-scale surveys, our tutors' estimates and the amount of traffic on the support alias indicate that usage rates are low at the beginning of the semester (in the 10 % range), and increase dramatically in the last week before the November exams. After they become more proficient with Linux, most students end up installing a stock Linux distribution, typically in their second or third year.

An unexpected but pleasant side effect is that the authors have earned the reputation of being Linux gurus, and hence have acquired the moral right to be Free Software fanatics. In past years, the first author would receive complaints that his Operating Systems lecture was too strongly centered around Unix, and didn't contain enough "useful" information, i.e. information that is directly applicable to Microsoft Windows. He is pleased to report that his students are now surprised when they discover that his lecture does mention Windows after all, and that he is not the Unix monoculturalist that they expected him to be.

Teaching staff Our teaching colleagues received Juppix in an overwhelmingly positive manner. A number of lecturers now systematically recommend Juppix at the beginning of their lectures, and we regularly receive requests for small batches of Juppix from tutors whom we don't personally know.

Some of our colleagues are Unix veterans, and consider Free Unices with a mixture of sarcasm and bitterness ("You youngsters are just repeating what we did in the eighties, without giving proper credit"). They were clearly impressed with our

ability to compile a CD of useful software in a few months of our copious free time, and distribute it legally to hundreds of students at a reasonable cost. The authors are pleased to report that they are now allowed to speak to the Unix veterans without first being spoken to[2].

Technical staff   We were uncertain of the reactions of the system administrators, who, we feared, might consider that we were encroaching on their territory. Just like the teaching staff, however, they soon realised that Juppix would reduce their support load, and were quick to recommend it to their users. The only complaints we have received from system administrators were about Juppix not being sufficiently up-to-date.

5   Current work: Juppix 2009

Over the last years, the 2006 version of Juppix has become increasingly out of date. While the software it contains is still useful, it fails to boot on an increasing number of recent machines, which is a serious issue as first year students tend to have very new hardware. Additionally, a number of hardware and software changes have occurred in the intervening years, which makes it possible to build a better Juppix now than it was in 2006.

New storage media   The price of DVD duplication has dropped significantly, to the extent that it becomes reasonable to consider distributing a live-DVD rather than a live-CD. While we have no intention of significantly expanding the functionality of Juppix, the increase in capacity (4.7 GB instead of 750 MB) will simplify our work, as we will no longer have to compromise between the conflicting goals of providing a complete programming environment and keeping the image size below 750 MB.

Additionally, most of our students own flash keys of 1 GB or more, rather than the 128 MB that were typical in 2006. It becomes useful to offer a version of Juppix that can be booted off a flash key, thus avoiding the slow speed of optical media.

Other changes   Since Wifi access points are more common now than they were in 2006, we hope to provide good support for common wireless hardware. This will probably require shipping with a Linux kernel different from Debian's default.

The licensing conditions of Sun's Java implementation have changed. The stock 1.6 JDK is still proprietary software, but can be redistributed under fairly reasonable conditions, and there exists a version called *OpenJDK* that is Free Software. We are currently evaluating the use of *OpenJDK*, with the option of switching back to the JDK if it proves unsuitable.

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[2]We have been avoiding the painful subjects, notably software patents.

Live-Helper Since we compiled Juppix 2006, Live-CD technology has improved significantly. Of particular note is the inclusion in the Debian GNU/Linux distribution of the *live-helper* and *live-initramfs* packages, which allow the reasonably automated creation of a live-CD, a live-DVD or a live-USB key.

We are currently working on a version of Juppix based on the *live-helper* scripts and on Debian's *lenny* distribution. The new version will still be built by a custom set of scripts, but these scripts will be driving the *live-helper* scripts rather than modifying an existing image. We expect to physically distribute a Live-DVD version to our students; for people wishing to download an image, we will offer at least two versions:

- an *iso-large* version, suitable for burning on DVD media, and including full documentation, graphical development environment, a complete TeX system and a word processor;

- an *iso-small* version, suitable for burning on CD media, including reasonable documentation, Emacs, and a minimal TeX system.

At the time of writing, it is not clear to us whether we will need to ship separate images for flash keys, or whether we will be able to install on a flash key from a live system booted from DVD.

6   Conclusions

Four years' experience with Juppix has taught us some important lessons.

- If your underground project is cool, tell your boss about it. If you think it's cool, he'll likely think so too.

- If you distribute something to your students, either distribute it to all of them, or don't do it at all. Students are quick to perceive differences in treatment as injustice.

- Don't lose time arguing with people who think that advertising clauses are a good idea, or who forbid redistribution. Dropping their software is easier on the nerves.

- Students are cheap, but the private sector is cheaper. Don't burn your own CDs, get them professionally pressed.

- Don't be afraid of the old Unix crowd.

- Don't be afraid of your system administrator.

Software availability

Ready-to-burn Juppix image files, the scripts used to build Juppix, and the test suite are available from `http://www.pps.jussieu.fr/~jch/software/juppix`.

References

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