Free software and research

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***Abstract* – Free software licenses are a natural choice in a research environment. In the following, we will try to back this simple statement with some considerations and examples, in an effort to analyse the significant interactions between free software and research.**

I. WHAT IS FREE SOFTWARE

Free software is rooted in the concepts of freedom of speech and free exchange of information. In scientific environments, the latter concept is especially prized. Free and easy diffusion of information is generally regarded as one of the main forces behind the exceptionally fast growth of scientific knowledge over the last three centuries.

However, the freedom of exchanging ideas is not simply a practical matter: it lies at the base of the concepts of freedom of thought and freedom of expression. Just like ideas, software is immaterial, and can be easily reproduced and transmitted. Just like ideas, its growth and evolution benefit from free diffusion. And just like ideas, more and more software is involved in society, producing effects that are ethical, economical, political and in a general sense, cultural.

During the Eighties, Richard Stallman formalised the concept of free software for the first time. Stallman's definition [1] is widely recognised as the canonical definition of free software. It consists of four rules, the *four freedoms*:

Freedom 0, or fundamental Freedom: the freedom to execute the program, for any purpose.
Freedom 1: the freedom to study the program, and adapt it to your needs.
Freedom 2: the freedom to redistribute copies.
Freedom 3: the freedom to improve the program, and release your improvements to the public.

Freedoms 1 and 3 require access to the source code. *A program released with a software license that grants the four freedoms is said to be free software*. Notice that free in *free software* refers to freedom, not price.

II. FREE SOFTWARE AND RESEARCH

Modern science is connatural with the free exchange of knowledge. All scientific research today relies heavily on a free and flowing exchange of information, in all possible forms: congresses, conferences, magazines, web sites, professor invitations, seminars, remote and face-to-face cooperation, common research projects are all considered essential features of the modern scientific environment. They enable the cross-fertilisation of ideas, open the minds of researchers, contribute significantly to the birth of new concepts, and form the foundations for the incremental improvement of results. Moreover, these features create a peer-to-peer network of mutual control that makes advancement of science outstandingly reliable — and nonetheless efficient — among the complex processes created by human civilisation.

Free software is a natural product of a research environment [2]. The birth and development process of software has much in common with that of scientific ideas. Just like scientific research, software is improved by learning from others' results, a process which is much more efficient if the software source code is disclosed, similarly to disclosing the details of scientific findings.

Growth through the accumulation of results is common to scientific research and software. Isaac Newton said that if he had seen further, it was by standing on the shoulders of giants. Software development shows a similar pattern: most successful programs grow with time, they evolve and improve incrementally. Both in the research and software fields, open knowledge greatly helps the process, and this is only possible if modification is allowed.

Science is credible because in principle everyone can check its results. In order to make this principle applicable, researchers are encouraged to publish their results in a form that allows complete and accurate scrutiny by any independent third party, usually in the form of scientific papers detailing all the relevant points. This is similar to the way free software programs can gain credibility: by making their source code available, thus opening up to scrutiny by any third party.

Credibility and reliability come hand in hand. Scientific results are reliable because they are independently repeatable. A good scientific paper makes it possible to reproduce the results of an experiment, be it physical or conceptual, by disclosing enough details for independent researchers to reproduce the experiment and verify that the results are the same. Something similar happens for software, where the reliability of a program can be tested by making the source code available for inspection and recompilation on different machines and architectures.

With scientific research, cooperation is the name of the game. Research languishes without cooperation: it is a mental habit for researchers, who should, and generally do, find it natural to exchange ideas and results. A cooperative environment is as fertile for software development as it is for research: software developers find it easy and natural to exchange pieces of code and ideas, and can benefit from the work of others.

III. REFERENCES

[1] The Free Software Definition, FSF, 1985 and continuously updated, <http://gnu.org/philosophy/free-sw.html>.
[2] Free software/free science, Christopher M. Kelty, November 2001, First Monday, Vol. 6, N. 12.