OPEN SOURCE SOFTWARE AND PEER REVIEW

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ABSTRACT. We compare open source software development to peer review in academia.

The debate between Open Source (os) and closed source proprietary software has been going on for some time. Proponents are usually passionate in their support and sometimes virulent in their criticisms.

In this article I compare the Open Source development methodology to the system of peer review in academia. My hope is to focus attention on the practices that can be implemented and disseminated, rather than criticise this or that firm for producing poor quality software.

TWO STYLES OF SOFTWARE DEVELOPMENT

Let us first examine two famous os software: the \TeX\ typesetting system and the Linux kernel.

As is perhaps well known, \TeX\ was written by Don Knuth in the ’70s because he was fed up of the poor quality of the proofs from his publisher. He learnt the fundamentals of typesetting and font design, and produced \TeX\ and MetaFont.

At this point, there are no known bugs in either programme. Knuth promised a small monetary remuneration for each bug found, and not surprisingly the two programmes are supremely robust that do exactly what their author intended them to do.

The entire source for \TeX\ can be downloaded from any of the ctan archives. Knuth discusses the code in detail in \TeX\: The program [Knu86]. It is likely that better versions of many of the algorithms used in \TeX\ are known today. However, as yet there exists no programme or package that provides an implementation as robust and versatile as \TeX\. Commercial typesetting packages such as Adobe’s Acrobat Writer produce wonderful documents with great ease, however, they cannot beat \TeX\ at what it was designed to do. In particular, for mathematical typesetting there is nothing that comes even close to \TeX\.

The Linux kernel was developed initially by Linus Torvalds from the minix kernel designed by Andrew S Tanenbaum. Torvalds initially developed the kernel for his own use, but its popularity spread rapidly and within a couple of years it had become a major volunteer project.

The Linux operating system, which is built around the Linux kernel, is now widely used. It is extremely popular in universities and in the Unix community. It has become something of a showcase for the os community.

As a programme it is not bug-free. In fact it is under active development, and major versions are brought out on a frequent basis. Major criticism of the kernel has centred around its not satisfying the definition of ‘a modern operating system.
kernel', for instance being *monolithic* as opposed to being a *microkernel*, ie merely an arbiter for the interactions of various processes.

In any case, the Linux kernel has a solid presence in the world of computers. Its code is available free and in its entirety. Whereas many volunteers work on various bits of the kernel, a select few ultimately decide which of those percolate to the released version. The code is rigorously tested, and bugs are found quickly and usually eliminated.

In contrast to these programmes, we have the world of closed source, proprietary software. The contrast is primarily in the culture and the mechanism of development, though os advocates gleefully point to the poor quality of some very popular commercial software.

It should be unfair to pretend that all commercial software is bad. Some products, such as Adobe Writer and Rational’s Purify have a wide following and are held in high regard by their users. Therefore, the problem is not with the source code being closed to outside scrutiny per se.

Typical complaints against bad software are:

1. there is a big gap between advertised or perceived capability and actual capability,
2. the vendor did not fix common bugs even on repeated requests,
3. there are *obvious* bugs, ie bugs that could have been eliminated by minimal testing on the part of the vendor, and
4. poor reliability.

There are thus two main complaints: poor design and implementation, and the irresponsibility of the vendor in dealing with bug reports and customer problems.

Vendor irresponsibility depends on the social culture within the company and its market strength. We shall not discuss it here.

The design and the implementation on the other hand are the major concern. These depend primarily on the quality of developers hired by the vendor and their attitude to the product. This is something that the customer cannot control directly.

In this environment, the only instances when good design and robust implementation are enforced is when the vendor interacts closely with the customers, and respects and values their suggestions and needs. What this does is to make the customer a direct part of the testing, debugging and extension cycle. This is the best that can be done in the absence of open code scrutiny.

Therefore, in case of the closed source vendor, the quality of the product depends very substantially on the ability and integrity of the individual developers. There is no way of ensuring good design and implementation. This is the biggest weakness of the closed source system.

There is good reason to believe that closed source companies regard this situation as being very convenient. It permits them to charge premium prices for bug fixes and upgrades. It allows them to get away with not doing a good job. Considering that software downtime costs the world economy billions of dollars per annum, this is a serious situation.

**Publications and peer review**

The standard paradigm for publication of new work in academia is submission to a refereed journal. An academic writes a paper, he then sends it to a journal
in his field. The journal then has the article reviewed by experts who then inform the journal whether the paper is fit for publications. An article is regarded fit for publication in a research journal if it:

1. presents substantially new and original results, or
2. presents a substantially novel and useful interpretation or application of known results, or
3. is of an expository nature, and provides a summary or survey of the latest developments in a field.

So the purpose of peer review is to ensure the quality of published papers. The system as it exists has been criticised in recent times, there has been much debate over electronic versus print journals. It is felt by many that the system in practice is not very effective. However, no one disputes the necessity of peer review. In fact the biggest critics of the current system lament that in practice, adequate review is not provided by the system [KKvdP03].

The quality of papers in the best journals is witness to the efficacy of this system. Of course, much depends on the integrity and ability of the individual authors. Since every academic is not of the calibre of Grothendieck (who incidentally did not care to publish very much) or Feynman or Knuth, the academic world depends on peer review to maintain the quality of papers and to detect errors. In fact even great mathematicians make mistakes: a famous recent example is Andrew Wiles’ proof of Fermat’s last theorem. His initial proof had an error, which was caught by the referees. He then emended the error, and the new corrected proof was finally published in the *Annals*, about a year after the initial submission [W95].

**Software and peer review**

The greatest strength of open source software is the peer review. The free and unrestricted availability of the source code leads to open scrutiny and debate. At the very minimum, it expands the tester base. The result is that the more popular or crucial an open source project is, the more likely it is to be scrutinised, and thus such projects tend to be robust, well designed, and have fewer bugs. Bugs are also more likely to be detected and eliminated.

Recently there has been a major push by some of the bigger companies based on the closed source model, to stifle testing and review. Not surprisingly, the first victims were researchers who pointed out major flaws in the design. Rather than being thanked they were threatened with arrest in one case, and actually arrested in another.

This kind behaviour is pernicious. It rewards poor design and practice. It will lead to the deployment of unreliable and insecure systems that will be easy prey for the maliciously inclined. At the very minimum they are going to cost the world economies huge losses.

**Conclusion**

In this article I have equated the open source system to the system of peer review in academia. The advantages of the latter are clear to all, and the same advantages can be found in the case of open source software development.

The quality of closed source software is too dependent on the ability of the individual programmers. The software industry should be aiming to produce better and more robust software. It is perverse to think that the short term gain that
companies make by dragging their feet over bug correction and testing, compensates for the huge losses made by the economy as a whole.

References

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