

Reproducibility Crisis in Computer Science

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1 INTRODUCTION

Before the advent of scientific journals, science was rarely public, and the advantages of making it open were less than its disadvantages. Some of the scientific papers were even coded in anagrams, so that only a restricted number of people could have access to it. Many scientists, including Galileo, Newton, Kepler, and Hooke, made their discoveries into something they could profit. Following the closed science logic though, it is difficult to identify ownership and priority of scientific discoveries: for instance, Leibniz and Newton both claimed priority in discovering calculus. Furthermore, Merton [4] arguments in favor of open science are that, knowledge-creation is more efficient if scientists work together, and it is morally binding on the professional scientist.

In 1998, Steve Mann coined the word *open science* and in modern times, scientific research is moving towards openness and free knowledge. However, there are still research data, journals, and paper which are not accessible to all. Data is not open due privacy and secrecy by for-profit organizations, and papers are not open because they are published in pay-walled journals.

Being our field of research computer science, and in particular big data on blockchain technology and cryptocurrencies, we want to enhance the main challenges of doing good scientific research when research data and source code are not openly accessible. In addition to the efficiency and priority problems listed above, excessively closed research data can lead to reproducibility issues, especially where scientific discoveries are driven by computationally heavy experiments performed on big data analysis. We will show in this manuscript how closed code or closed research data lead to reproducibility problems, hence, bad science.

2 OPEN SCIENCE

Open science is the movement to make scientific research (i.e. data, software, publications) accessible to all levels of an inquiring society, amateur or professional [6]. However, the term open science encapsulates many different concepts, such as: open educational resources, open access, open peer review, open data, open source, and open methodology [3]. Also, according to Fecher et al. (2014) [2], there are different open science schools. They can be for instance, oriented towards a pragmatic, public, or democratic approach, but the purpose is commonly identifiable in opening up the process of knowledge creation, making knowledge freely available for everyone, and enabling science to be accessible for citizens. We focus in particular on the open access, and open data concepts, enhancing difficulties for scientists, amateur and professionals to contribute in scientific development and innovation, if research data are not openly accessible.

Our research topic involves blockchain technology and cryptocurrencies. By definition of blockchain, research data are all public and always available. If we then perform searches in a topic of our interest, using public and open source web applications to explore research data, such as Dataverse [1] or Google Dataset Search¹, we can easily find the information we need about real-world implementation of blockchain technology, such as Bitcoin [5]. However, not all data in different fields of computer science are easily accessible. If we perform research about privacy, or eHealth for instance, we will not get the same amount of results, and most of the research data are not public.

3 PRIVACY PRESERVING

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¹<https://toolbox.google.com/datasetsearch>

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