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# Blockchain-based reputation system for peer reviewing

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Master's Thesis

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Máster en ingeniería informática

Masters degree in software engineering

Facultad de Informática

Universidad Complutense de Madrid

Curso 2017/2018

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# Blockchain-based reputation system for peer reviewing

*Memoria que presenta para optar al master en ingeniería informática*

**Viktor Jacynycz García**

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*A mi madre, porque sí*

*A mi hermano, porque también*

*A jenny, poque tl*

*A mi padre, porque yokse*





# Agradecimientos

*I find your lack of faith disturbing*  
Darth Vader, Star Wars: A New Hope.

I thank you.



# Resumen

...  
...

... Resumen chulo



# Índice

<b>Agradecimientos</b>	<b>IX</b>
<b>Resumen</b>	<b>XI</b>
<b>1. Introduction</b>	<b>1</b>
1.1. Objective . . . . .	2
1.2. In this work . . . . .	2
<b>2. State of the art</b>	<b>5</b>
2.1. Cooler Section . . . . .	5
<b>3. Methodology &amp; Technology</b>	<b>9</b>
3.1. Methodology . . . . .	9
3.1.1. Brainstorming . . . . .	9
3.1.2. Value proposition canvas . . . . .	10
3.2. Technology . . . . .	10
3.2.1. IPFS . . . . .	10
<b>4. Platform Description</b>	<b>13</b>
4.1. Hot Section . . . . .	13
<b>5. Results and discussion</b>	<b>17</b>
5.1. Cool Section . . . . .	17
<b>6. Conclusions and future work</b>	<b>21</b>
6.1. Cool Section . . . . .	21
<b>Bibliografía</b>	<b>25</b>



# Índice de figuras





# Índice de Tablas



# Capítulo 1

## Introduction

*Who Watches the Watchmen?*

Watchmen - Alan Moore

Scientific research nowadays is based on publications in journals with a high impact factor[1], the most well-known is the Journal Citation Reports (*JCR*). This factor was originally determined by the Science Citation Index, born in 1955[2] but nowadays it is managed by a private company dedicated to benefit from the work of researchers[3]. This poses two important problems when it comes to entering the world of academic research:

The first is that scientific journals that want to maintain their impact factor, have to make sure that the articles that come out in their issues have a large number of citations, so they are always going to look for novel and high-impact articles. Therefore, the editors of these journals will have a network of reviewers on which they can trust to review the article. But sometimes these reviews are not entirely objective, there are many cases of unfavorable reviews due to gender causes, especially in scientific fields [4].

Besides, it is necessary to consider that the time of revision for an article is excessively long, causing the process of academic investigation being quite slow [5].

The second problem is that the benefits of the scientific distribution are centralized in publication systems, nor the authors, the reviewers or the readers get money from it. Today, with electronic paper distribution, universities purchase site licenses for online access to journal contents. This system implies an additional cost for the universities who want to advance in their research fields and does not have enough money for it. However, site licenses are not always disadvantageous. Some journals issued by private companies and universities adjust their prices to maximize subscriptions [6]. But generally, people who earn money from this paper-based system only act as an intermediary between the authors, the reviewers and the readers.

The internet offers the possibility to meet people all around the world, and when it comes to trust total strangers, you should have a system in which you can rely to deposit you trust in them. Reputation systems are the solution to this problems, since they offer you a first good impression of an unknown person [7].

Editors who want to assign the review of a paper to a series of reviewers have to rely on them beforehand. Thus limiting the spectrum of fields that can be revised to the fields in which those reviewers are experts. If you want to broaden the scope of reviewers with more fields of expertise, you need to contact new reviewers. But there is no easy way to predict reviewer quality from reviewers training and experience factors [8], so a rating system of reviewers should be useful for journals to select the best reviewers. The solution is a reviewer reputation network, in which reviewers get rated based on their reviews and build up their reputation based on good practices, and helpful reviews. In this network, publishers who have to find new reviewers for their papers, do not have to know them beforehand, since trust is placed in the reputation network instead of the person itself.

## 1.1. Objective

We aim to challenge middlemen in science publication such as traditional publishers. Particularly, we propose a decentralized publication system for open science, allowing 1) paper submissions, 2) assignment of reviewers, 3) peer review, and, as a novelty, 4) the rating of peer reviews. With this distributed system, we aim to improve the quality and efficiency of reviews and knowledge distribution, helping editors, authors, and reviewers:

- Editors and journals will be able to find the best peer reviewers in their fields of interest, and those that respond quickly. Thus reducing time-to-publish and publishing costs.
- Authors will be able to submit papers to time-responsive, free, open access journals, and forget about slow, unfair and unaccountable anonymous reviews.
- Reviewers will finally have their work recognized.

We are interested in exploring the following challenges, that could be dealt with our technology:

- Reduce time-to-review by rewarding on-time reviewers.
- Measure and prevent sexism, nepotism and other abuses in peer review.
- Develop fully autonomous decentralized journals.
- Explore fully free publication systems for Open Access science, while enabling innovative business models.
- Explore alternative and open metrics for papers, journals and reviewers.

## 1.2. In this work

In this work there will be the following sections:

- 
- **State of the art:** This chapter is about what methods, systems and technologies try to change the actual publication systems and how good or bad they are.
  - **Methodology and Technology:** This chapter is about the methodology I followed during the realization of this work, and the technologies I have used to face the challenges and why I decided to use them.
  - **Platform description:** This is the main chapter of this work. It contains the platform description, its implementation, how it works, why is better than the actual publication systems, the challenges I have faced during the realization and the internal structure of the final system.
  - **Results and discussion:** This chapter is about the results obtained after the realization of the work proposed in this project, how it will affect the scientific community and how I measured the potential impact if it becomes a wide-used publication system.
  - **Conclusion and future work:** This chapter is about the implications of this work in the scientific community and settles the next steps to follow to create an ecosystem of autonomous publication systems without the need of middlemen such as journals or editors, proposing a future PhD about this subject.



## Capítulo 2

# State of the art

*The needs of the many outweigh the needs of the  
few*

Spock - The Wrath of Khan

### 2.1. Cooler Section

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## Capítulo 3

# Methodology & Technology

*The needs of the many outweigh the needs of the  
few*

Spock - The Wrath of Khan

### 3.1. Methodology

The idea of this project came up in a Hackathon in September 2017. We were a group of 4 developers and we had one month to create an idea and a small prototype to implement in the blockchain.

To give birth to the idea of a decentralized publication system for open science we used agile methodologies.

#### 3.1.1. Brainstorming

Brainstorming was part of the first step to define what are we going to do. We threw a lot of ideas into a white board without discrimination, no matter if the ideas were very hard or easy to implement.

After saying enough ideas to fill the board we filtered the ones that were impossible to achieve. Then, each one voted the best three, making a ranking of the 3-4 best projects to start working on. Finally, we argued what were the best one and then we started developing the project backbone.

After the first session of brainstorming that lasted approximately 4 hours we were ready to create a value proposition canvas to define all the aspects of the project.

### 3.1.2. Value proposition canvas



## 3.2. Technology

To face the challenges proposed by this project, there are many possibilities to distribute both the data and the information about the reputation network. To build a robust and decentralized system i

### 3.2.1. IPFS

IPFS stands for Interplanetary File System. It is a peer-to-peer file-sharing protocol that uses a cryptographic hashes to store files in a distributed network. IPFS works very similar to HTTP protocol but in a BitTorrent way. It can be seen as a giant git repository where everyone can store, share and exchange files[9].

IPFS merges three main ideas: Distributed Hash Tables, BitTorrent, Git and Self-Certified Systems.

#### 3.2.1.1. Distributed Hash Tables

A distributed hash table(*DHT*) is a decentralized structure that works very similar to a hash table. Hash tables are used to identify items in a database. The table performs

simple mathematical operations generating a random string called hash. The hash acts as a pointer that directs to the data, this allows the user to find data directly instead of looking through the entire database[10].

In a distributed hash table, any node can use a hash as a key to retrieve data. This system includes a data structure called “keyspace” that is a set of all possible keys, which is split up across the nodes in the system. The mapping of the keys is made by another function that describes the distance from one key to another. All the nodes have an identifier and a set of identifiers pointing to all its neighbors nodes. If a node is removed from the network, only a small portion of the data must be recovered by other nodes[10].

This system makes *DHTs* scalable, fast and robust. It is used by frameworks such as Tapestry [11], Chord [12], Kelips [13], Kademlia [14] and IPFS [9]. These platforms are similar in cost and performance if they are tested in a large enough network. They behave very fast when it comes to searching for a key through massive networks of nodes[15], that’s why it is used by IPFS to create its distributed file system.

#### 3.2.1.2. BitTorrent - File sharing

BitTorrent [16] is a P2P file sharing system used worldwide. In this system, files are divided into very small chunks of data, and are shared in a peer-to-peer network. Each peer aims to maximize its download rate by connecting to low latency peers. In BitTorrent’s network, peers with high upload rate will get higher download rate, so the key is balancing the network bandwidth between downloading and uploading files[17].

IPFS uses three main features from BitTorrent’s protocol[9]:

- BitTorrent’s data exchange protocol rewards nodes who contribute to the network, and punishes the ones who don’t.
- BitTorrent tracks the availability of file chunks, sending the rarest first rather than sending the most common ones.
- IPFS uses PropShare[18] bandwidth allocation strategy to improve BitTorrent’s behavior facing exploitable scenarios.

#### 3.2.1.3. Git - Version control system

Git is a distributed version control system (*DVCS*)[19]. Git was born in 2005 when the development process of the Linux kernel lost its version control system. The Linux kernel is one of the biggest free software projects nowadays, it has a great team of developers behind and the code usually changes very frequently. In 2002 the team used BitKeeper as VCS since they had a free license. But in 2005 when this license was over, Linus Torvalds decided to develop his own VCS[20].

Git was designed to be scalable and distributed, and the most important factors that IPFS inherits from Git are: [9]:

- Git implements a Merkle Directed Acyclic Graph [21], an object that reflects changes in a file system in a distributed way.

- Objects are identified by the cryptographic hash of their contents.
- Version changes only update preferences and add objects. To broadcast version changes, git only needs to transfer the new objects and update the remote references.

#### **3.2.1.4. Self-Certified File Systems**

## Capítulo 4

# Platform Description

*The needs of the many outweigh the needs of the  
few*

Spock - The Wrath of Khan

### 4.1. Hot Section

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## Capítulo 5

# Results and discussion

*The needs of the many outweigh the needs of the  
few*

Spock - The Wrath of Khan

### 5.1. Cool Section

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## Capítulo 6

# Conclusions and future work

*The needs of the many outweigh the needs of the few*

Spock - The Wrath of Khan

### 6.1. Cool Section

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Aenean quis lectus congue, vehicula leo porta, viverra velit. Suspendisse potenti. Etiam fermentum tempus enim. Integer ac pharetra odio, eget facilisis velit. Praesent auctor risus nec mauris imperdiet maximus. Mauris venenatis nisi vitae aliquam fermentum. Ut volutpat bibendum tincidunt. Nam quis risus at orci porttitor blandit ac a nulla. Ut ipsum quam, dapibus eu ligula id, molestie accumsan elit. Nam rhoncus sem sit amet elit finibus, posuere porttitor augue facilisis.



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*Y así, del mucho sleer y del poco dormir, se le  
secó el cerebro de manera que vino a perder el  
juicio.*

Miguel de Cervantes Saavedra

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*–¿Qué te parece desto, Sancho? – Dijo Don Quijote –  
Bien podrán los encantadores quitarme la ventura,  
pero el esfuerzo y el ánimo, será imposible.*

*Segunda parte del Ingenioso Caballero  
Don Quijote de la Mancha  
Miguel de Cervantes*

*–Buena está – dijo Sancho –; fírmela vuestra merced.  
–No es menester firmarla – dijo Don Quijote–,  
sino solamente poner mi rúbrica.*

*Primera parte del Ingenioso Caballero  
Don Quijote de la Mancha  
Miguel de Cervantes*

