COGNET: The Planetary Cognition Delivery Network

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Abstract

Crowd-powered innovation platforms act to a large degree as silos: they cater the cognitive surplus of a bespoke, self-selected audience to a limited amount of high-value clients in a model where both stakeholders typically have to jump through a series of hoops to enrol to the services. We propose a fundamentally disruptive way for discovery with distributed crowds, by orchestrating already established online audiences for serendipitous crowdsourcing. Two recent developments make our proposition, The Planetary Cognition Delivery Network, compelling right now. First, online properties are struggling due to declining advertising revenues, caused by the proliferation of ad-blockers and a few key Internet giants taking an increasingly larger cut of the available revenue. Second, and perhaps somewhat counter-intuitively to the immediate perception in the Western world, the Internet is just now becoming widely available in many corners of the world, which provides an opportunity for a truly worldwide reach during the next decade or two. COGNET is designed to offer a frictionless participation mechanism for all three key stakeholders: requesters, providers, and contributors. It essentially orchestrates a distributed network of human cognition pools for arbitrary discovery tasks that could benefit from the vast cognitive surplus available through the internet.

Preamble

The introduction of crowdsourcing around 2006 as a scalable tool for academic data collection, as well as an area of methodological research, transformed data collection possibilities across a wide range of domains – including Human-Computer Interaction (HCI). The scale and ease with which potential participants could be recruited resulted in the rise of citizen science projects and ground truth data labelling for many artificial intelligence projects (Kittur et al. 2013). Nowadays, the major HCI conferences typically consist of at least one crowdsourcing track, in which the majority of presentations discuss recruitment through *Amazon's Mechanical Turk* and occasionally *Prolific*. While these platforms have no doubt changed how we see crowdsourcing, it almost seems like their dominance is stalling methodological innovation; Crowdsourcing is not limited to these platforms, and the affordances of these platforms should certainly not dictate *what is crowdsourcing*. We argue that these platforms are convenient to conduct research with and that the use and development of other, potentially better-suited systems, requires a substantial effort.

Yet, we believe that the community must strive to develop better tools rather than complacently accept the tools which are already in place.

Crowdsourcing typically mobilises online crowds to complete large tasks together. As the old-fashioned notion of one person being able to dream up a perfect solution to a given problem is replaced by multidisciplinary collaborations, harnessing the crowds has proven to be an excellent problem-solving strategy (Brabham 2008). A relatively recent (2016) *Science* article even goes as far as recognising crowdsourcing as a promising path to help unfold wicked problems, such as disease, climate change, or geopolitical conflicts (Michelucci and Dickinson 2016). Since then, crowd-powered approaches, including different citizen science projects and industrial tools that orchestrate human computation to label large datasets for the needs of artificial intelligence development, have pushed the limits on the (scale of) data that scientists can collect.

Both paid and non-paid crowdsourcing endeavours, however, suffer from the same problems, when it comes to the challenging, large-scale problems – problems that have the potential to change the world as we know it. Either the crowdsourcing markets will no longer grow in size due to a plethora of problematic issues (ethics, low pay, economics, lack of control, etc.), volunteers are not devoted to the work, or the workforce they can attract is not diverse enough when considered at a global scale (Vakharia and Lease 2015). Sir Francis Galton's early explorations on the wisdom of crowds, published in Nature in 1907 (Galton 1907), and countless related studies thereafter, however, clearly indicate that diversity of expertise is a crucial prerequisite for a crowd to be resourceful and smart about solutions to problems (Surowiecki 2005). Thus, it is doubtful that we will ever directly tap into one of the existing labour sources online to unfold all the potential solutions, their pros and cons, their geopolitical ramifications, and other yet unimaginable viewpoints to global-scale issues. Therefore, the right question to ask right now is: "who is missing from the crowd?" (Brabham 2008).

It is obvious that many people are missing: all major crowdsourcing platforms combined reach less than 0.01% of

the planet's theoretically reachable population. For instance, Amazon's Mechanical Turk, the biggest CS platform online, has approximately 0.5 million registered users worldwide (and about 15 000 daily active ones). Even on a theoretical level, this is approximately 1 in every 600 citizens in the US alone. Further, the majority of available workers in the paid labour markets are Caucasian or Asian (US + India being the biggest contributors). As aforementioned, the current solutions will not grow much more, due to a plethora of identified issues in management, quality control, fraud prevention, economic and ethical aspects, etc. (Vakharia and Lease 2015).

Given how many major corporations are preparing to make global broadband a reality through *e.g.* satellite-based access, it is far from unfair to assume that we shall soon be universally more connected with each other than ever before in human history. The question is, what are useful ways to harness this connectivity? In our vision, we develop toward a means to reach the many, diverse, and everywhere for exploring challenging problems – problems that by nature will greatly benefit from tapping into the massive global cognitive surplus. To this end, we are designing COGNET: a software-powered vision that orchestrates networks of human cognition for discovery concerning arbitrary problems. COGNET is disruptive but simultaneously plausible within the next ten years: we enable anyone with an existing audience, online or within geofenced areas, such as large physical campuses or residential areas, to join the network as a *cognition provider*. In exchange, COGNET rewards the providers for the additional cognitive surplus of their audiences with 1) a chance to participate to common, globally meaningful efforts (intrinsic and PR-value), 2) relevant activities for the audience (increased engagement), and 3) payments for both the provider as well as the individual audience members, using frictionless programmatic currencies (added revenue).

By orchestrating networks rather than individuals, COGNET imitates the exact strategy employed by wildly successful businesses such as Airbnb or the AliBaba Group to the crowdsourcing domain: to not own anything but to control the flow of networked resources. This will enable leveraging the global collective intelligence in an unprecedented fashion. COGNET benefits:

Science: We overcome limitations of crowdsourcing, especially concerning scale and diversity, aiming for an increase in our collective intelligence.

Society: Cognet contributes to everyone being able to contribute to issues that may have far-reaching consequences on society.

Equality: By connecting people from everywhere, including developing countries, to contribute and gain new ways to earn, thus learning useful skills in the global labour marketplace.

The opportunity and challenge of COGNET is far from just technical: at the very core of this vision are fascinating research questions on issues such as labour psychology at scale, quality of crowdsourced contributions, aggregation of contributions originating from diverse sources, combating fraudulent work and bots, and developing methodologies to automatically profile the audience of the cognition providers. Yet, our goal is to vastly expand the theoretical reach of crowdsourcing globally, and to provide a fully functional means for reaching more numerous and diverse labour forces than is currently possible. COGNET will provide a collective 'intelligence upgrade' to be used within problems that defy traditional problem-solving methods.

COGNET

In crowd-powered systems, crowds complete tasks for rewards. Crowds, tasks, and rewards can all take a plethora of different formats, but overall this is a straightforward way to break down most crowdsourcing systems. Using this as a framework for thought, COGNET goes beyond the state of the art as follows.

1. *Crowds*: Globally fully distributed, orchestrated as a network of cognition providers. These providers can be large websites, online forums, private Discord servers, or offline properties such as stadiums or *e.g.* a university campus, as a node in the bigger network of networks.
2. *Tasks*: COGNET facilitates completion of arbitrary, parallelisable web-based tasks. If a task can be implemented in a modern browser, it can be a task.
3. *Rewards*: Paid by blockchain-enabled stablecoins, rewards flow from requesters to workers fast, affordably, borderlessly, and in a fully programmatic fashion. The public anonymous address of a contributor also acts as the only data attribute attached to contributors in COGNET.

Using a more technical analogy, COGNET is in a way similar to the Content Delivery Networks (CDNs) that serve as the backbone of the Internet as we know it. Whereas CDNs serve content from edge servers to facilitate faster connections and avoid bandwidth issues, COGNET consists of distributed cognition providers that together contribute to the overarching goal of fast access to the collective intelligence of the many. In the following, we discuss the functionality of COGNET without going deep into the technical aspects due to space considerations.

Crowds

A fundamental principle of COGNET is radical openness; it welcomes anyone as a contributor. Contributors (workers) belong to one or many cognition providers. Providers, as discussed, are any entities that have audiences at their disposals: websites, forums, campuses, private discussion groups – literally any individuals or organisations that have access to a network of people, an audience. An individual contributor can be authenticated or a fully anonymous one, but only authenticated users are, naturally, eligible for payments. Potential authentication does not identify a contributor, however. In COGNET, contributors authenticate in a frictionless way by using their public address in a blockchain, such as Ethereum (Eth 2020) or Stellar (Ste 2020). This introduces a variety of benefits that fall under both tasks and rewards, as discussed next.

Tasks

COGNET operates online and provides zero templating rules or task design guidelines. In other words, any crowdtasks that can be implemented online and presented using the modern web stack are compliant with COGNET. The complexity of any system grows as a function of desired features. COGNET takes the opposite approach, and defines tasks in a very broad fashion, using the following key parameters for each task, as set by the task requesters:

1. A human-readable and extensive task description
2. Maximum number of submissions per one authenticated contributor
3. Reward paid for each authenticated submission
4. Maximum amount of submissions

This way, COGNET admittedly imposes a greater development burden for the developers of tasks, but this is arguably partially compensated with the rise of increasingly easy-to-use end-user web development tools powered by AI or operate using drag-and-drop (*e.g.*, (Wappler 2020)).

Rewards

Key to our model's versatility is the use of programmatic money, as implemented in the form of stablecoins using a suitable blockchain (*e.g. Ethereum* or *The Stellar*). Stablecoins are typically tethered to a currency, such as USD, and are aimed to provide fast, cheap, borderless transactions between the sender and the receiver. The benefits of stablecoins for a system like COGNET are clear: the only data that COGNET initially knows about an authenticated user is their public address in the blockchain, which is conveniently the payment endpoint as well. This also provides great flexibility for the contributors, as they can choose their way of managing the crypto assets any way they choose – either through interacting with the blockchain with online-based solutions such as *MyEtherWallet* (MyE) or installing one of the already existing browser extensions such as *MetaMask* (in case of Ethereum) (MetaMask) for a quick 2-click authentication with COGNET when using the user's own trusted browser. This way, users can either get notified instantly of inbound rewards (if using *e.g.* any of the myriad existing mobile blockchain explorers or wallet apps to monitor public addresses), or simply check their balance whenever is convenient for them.

While the use cases of stablecoins are still in development, several fast and reliable marketplaces exist where one can convert stablecoins to traditional currencies such as USD for withdrawal, or even load cryptocurrency-powered credit cards and spend directly online. IBM, for instance, supports a stablecoin pegged to the USD and implemented in The Stellar network, USD Anchor. Another benefit of digital currencies is their easy programmability, which allows for various innovative reward models to be implemented in COGNET. While the easiest way is to simply pay a fixed reward per authenticated participant contribution, using whatever design guidelines the requesters see as fit, this model also allows for more sophisticated models. Examples of such are contests or bounty-hunts, where the participant with the final 'accepted' solution, as dictated by the requester, is instantly rewarded with an escrowed bonus.

COGNET economics are not as simple as with traditional CS marketplaces, due to the large number of new stakeholders being involved: the providers. As discussed, these are the sites who offer the opportunity of participation in various ways (discussed in the next section). Our initial speculative designs gravitate toward a degree of autonomy for the providers, where they can choose what percentage of all rewards earned by their audience is kept by the provider and how much is distributed directly to the contributors. This provides the freedom to use the network as an auxiliary income source to traditional advertising, which also directly motivates the providers to join the COGNET to begin with.

Interaction Overview

Requesters: Adding Tasks to COGNET COGNET is designed as extremely lightweight for all stakeholders. For requesters, it offers a single entry point online, where any online-based tasks can be entered through their URL, along with a text-based description, keywords, and the amount of payment that will be escrowed by COGNET until completion of all requested work. Upon COGNET failing to deliver work after the set deadline, the funds are returned. Again using an analogy, the technicalities of the task insertion follow *Prolific*'s operating model: Requesters enter a URL to indicate where the task is located, and the task is rendered in an iFrame for workers to complete. Only in this case, the iFrames live massively distributed in the available properties: websites, forums, private areas, or even offline campuses on public displays (similar to (Heimerl et al. 2012)).

Providers: Offering Tasks to the Crowds Providers tap into COGNET by embedding a configurable element on the property they manage. There are two critical configuration parameters to the element: 1) the public blockchain address of the provider for receiving rewards later on, and 2) a thorough description of the property, including a list of relevant keywords. The description and keywords are used by COGNET to match tasks to the interests of an audience. Left blank, the COGNET embeddable element displays a random set of tasks available for allocation in the global task pool.

The embeddable element natively manages the blockchain-based authentication. Further, upon loading the component there is an additional option to pass the public address of the current user. This is enabled to be able to develop custom solutions so that the contributor's public address can be tied into *e.g.* the provider's user database and auto-populated every time the user logs in to the provider's site. The same mechanism also allows for the use of COGNET on campuses, as part of interactive public displays. Similar solutions have been successfully implemented *e.g.* in (Hosio et al. 2010), where an RFID tag was used to log in users to an interactive display.

Contributors: Discovering and Completing Tasks Contributors are any ordinary web site visitor or offline campus visitor. COGNET is in this sense no more complicated than any survey widget or an email sign up form on a website. The visitor sees the embedded element, discovers tasks,

logs in using the discussed blockchain-powered login flow to provide the public address, and contributes.

With offline campuses, COGNET follows the *situated crowdsourcing* paradigm (Heimerl et al. 2012). The embedded widget can be added to interactive screens for offering tasks. This limits the authentication options, however, as despite the advances in *e.g.* biometric authentication mechanisms, no standard, widely accepted approach to identify a user of a public display exists. Therefore, the platform should not restrict the providers to one. Instead, a generic mechanism of passing the public address of the contributor as a configuration parameter to the SDK allows for proprietary implementations for authentication, should the providers choose to do so.

COGNET: Rewarding for Completed Tasks COGNET rewards mechanism leverages lessons from various prior custom-built crowdsourcing deployments (*e.g.* (Hosio et al. 2014)): the tasks use the COGNET SDK to notify the network about their completion, triggering the flow of rewards (in this case digital stablecoins) per each task completion. The implementing property passes the public address of the contributor to the SDK via simple URL parameters, enabling crediting the correct contributor as the task is marked complete. COGNET stashes the money until a sufficient balance has been accumulated per provider, after which the funds are released and distributed. There are design tradeoffs to consider here since different stablecoins impose different transaction costs, yet most of them are significantly cheaper than making transactions in USD or EUR. The interaction with the SDK is thus remarkably simple, containing only the notification function, but at the same time it is powerful and generic enough to allow for contributions to the network.

Considerations and Foreseeable Future

In the name of full transparency, much of the vision of COGNET is a result of various informal discussions between crowdsourcing experts, merging related academic and business literature, and not yet backed with rigorous empirical evidence. The idea of massively distributed crowdsourcing to reach global audiences through e.g. advertising has been shown feasible (Ipeirotis and Gabrilovich 2014). We are currently working to find the first major financial contributors to COGNET through funding channels. Indeed, COGNET has once been rejected by the European Research Council due to it "sounding more like a startup than research" - which is not entirely a negative signal – as we aim to work with a long term vision and not an academic project that has a concluding date.

Great first beneficiaries for COGNET would be various health data operators. To this end, there is a clear need to crowdsource *e.g.* symptom data from ordinary citizens on a massive scale. As a testimony to this, *StuffThatWorks* (StuffThatWorks 2020) just raised 9 million USD to crowdsource experiences from ordinary citizens on which treatments seem to work for certain health conditions. It is projects like these that use the crowds for wicked health problems (Michelucci and Dickinson 2016), and that at the same time depends on reaching people outside the self-selected, paid crowdsourcing platforms.

Conclusion

COGNET shifts the focus from individual contributors to attracting new pools of cognitive surplus through the managers of online and offline properties. This can lead to a massive collective intelligence upgrade while simultaneously providing benefits for all stakeholders, and increase the global potential of human-computation in general.

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