

Scholar Agent Alfa: the Agents and Web Services Architecture for Citation Auctions

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Abstract. This paper introduces the design of a multi agent system for citations auctions that aim at changing the current Congresses and Journals peer-reviewed selection of papers. The presented version of the system, Alpha Rel. 1, allows the users to create agents along with the call for papers arena. The users set up their agents by e-mail, hence, the web-service, that is also used by both scientists and agents for bidding. *Scholar Agent* Alpha Rel. 1 is an open system, simple, yet useful, flexible and adaptive enough to become the underlying architecture for further developments. Functional real case uses of this system are shown and discussed in the paper.

Keywords. Citation auctions, congresses, journals, peer-review, complementary currencies, agents, web services.

1. Introduction

For many years both the scientific community and the volume of the scientific works have been steadily growing year after year. Their growth is unstoppable, because the publications became a key measure of research evaluation as well as a conduit of research benefits to the society. However, the space for publications in established venues is growing at much lower pace, creating ever deepening scarcity of reputable outlets for huge number of candidate works. That is why the scientific community uses peer review for their selection which suppose to ensure the quality and suitability of the selected works for publication in academic Congresses and Journals (CJ). In addition to several other major problems with peer-review, perhaps the most common complaint is that it is painfully slow: it typically takes several months (sometimes years) from the submission to the paper to be finally published. The *citation auctions* is an alternative selection method of the peer-review for selecting papers, making selection automatically (i.e. without human evaluation of the submissions) and very fast [3].

Alpha Release 1 defines the first architecture developed for citation auctions as envisioned in [3]. *Citations* € is used as an auction currency [2] to make explicit the internal private value that an author assigns to the quality of the submitted paper. The higher the bid, the more likely the paper will be selected for publication. If the bid correctly reflects the paper's quality, the author will earn extra citations compared to those he expended in the bid; otherwise the author will lose his money (in citations €). This new currency and citation auctions will profoundly change the ways in which scientists publish, market and collaborate on their scientific papers.

We envision that scientists may delegate bidding to their agents who will work on behalf of them and adjust their biddings in accordance with the budget restrictions set up by the scientists. We expect that the budget will be related to the internal private value that a scientist assigns to the work to be published [4]. In this case, the *Scholar Agents* aim to help the scientists to estimate the value of their papers by the exploration of the target audiences. Additionally, scientists can select the level of risk that they are willing to accept in the bidding by setting up the proper type of agents' behavior. As discussed in [3], citation auctions behave better than other approaches for automatic publication selection.

The Alpha Rel. 1 architecture for scholar agents is a step further on the path to make citation auctions reality. This first real implementation designed to test the idea with real users will let the observation of the scientists' demands for necessary functionalities. This architecture uses e-mail as the standard communication tool between scholars and their agents, and between both scholars and agents and the call for papers arena, with both the arena and the e-mail implemented as web services.

2. Agents and Web services

An *agent* is chosen as the proper metaphor for the development of the citation auctions architecture, even though there are no killer applications for agents, as discussed in [1]. Furthermore, as Terry R. Payne discuss in [7], agents are often criticized as representing a technology that is actively pursued in research laboratories but that rarely appears in deployed applications. Yet, many of the underlying technologies of agents have migrated into mainstream applications, at which point they are no longer referred to as agents.

It seems that *citation auctions* are not only an isolated application for which agents are essential, but rather a prototype of automation of user interactions in implementation of which agents can excel. Both users and agents need proper technologies to work properly over the internet, the presented implementation of citation auctions explores synergies between the agents and web services by allowing agents to call a set of web services. Furthermore, users need easy and intuitive means of communication with their agents, and since e-mail is already widely used in the scientific community, it is designated as a means for scientists to set up their agents, and for agents to answer to scientists. Once set up, agents send e-mail to bid for publication the same way as scholars do.

According to the W3C Web Services Architecture note [8], a Web Service is an abstract notion that must be implemented by a concrete agent. The agent is the concrete piece of software or hardware that sends and receives messages, while the service is the resource characterized by the abstract set of functionality that is provided. Web services have traditionally been transient and stateless processes that exist only during

service execution. In addition, these services are instantiated to perform a specific task. An agent, however, is often persistent and resource bound, providing only a single service to its peers at any given time [7].

Following these definitions, *Scholar Agents* are true agents because they are permanent entities that are capable of communicating and they encapsulate the services that they provide. However, the opinion of Jennings [9] is that there are five main properties necessary for an entity to deserve the name of *agent*. They would be addressed in the following versions of our system if the strong agency properties bring added value in the context of citation auctions.

3. User Requirements for Citation Auctions

The most important requirement for citation auction platform is the usability and availability. It should be available to as wide group of scientists as possible by exploiting the advantages of the internet. The usage has to be simple and intuitive, without any need for special client applications or serious prior knowledge.

That is why e-mail, a widespread and very common communication means, has been selected for communication with our agents and arena. Since all scholars have an e-mail address (let's suppose it is in the form of username@institution.edu), they can participate in auctions by sending simple bid messages to the address of an auction marketplace (which we will call *Arena*) set up for every call for papers, as shown in Fig. 1. Naturally, the system also uses e-mail to report to the scholar the effects of its activity and all significant related events.



The image shows a screenshot of an email composition window. On the left, there is a 'Send' button with a paper plane icon. To the right, there are fields for 'To...', 'Cc...', and 'Subject:'. The 'To...' field contains the email address 'arena@anguila.udg.edu;'. The 'Subject:' field contains the word 'bid'. Below these fields, the number '42' is displayed, representing the bid amount.

Fig. 1. Direct bid of €42,0 to the arena with the address arena@anguila.udg.edu.

As Fig. 2 (left) shows, it is also possible to register an agent using a simple e-mail. In the Alpha Rel. 1 the scholar agents are mediators between the scholars and the arena. The agent helps the scholar to repeatedly bid through several auction cycles, potentially as many as the number of publications to be issued [4]. Every created agent has its own e-mail address, username.agent@institution.edu, to reflect this is the agent of the scholar named username@institution.edu. Every scholar would be able and allowed to own at least one agent. However, Alpha Rel. 1 restricts the number of agents per scholar to one, therefore the identification of the agents is based on e-mail addresses with a ".agent" tag. For instance, Dr. Nick Sample sends from his mail account nick@institution.edu the message shown in Fig. 2 (left) to the arena to register and receive an agent.

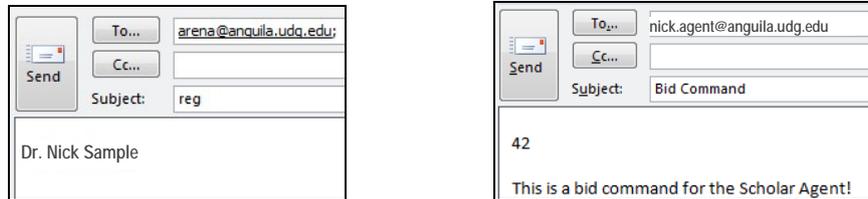


Fig. 2 Agent's registration (left) and scholar's bid command sent to the agent (right)

Then an agent with address nick.agent@anguila.udg.edu is created. When the scholar wants the agent to bid on his behalf, he composes the e-mail shown in Fig. 2 (right).

In Alfa Rel. 1, the scholar agent only accepts bid commands and reads the bid (€42.0) inside the e-mail. The remaining text is ignored. However, extensions of this simple e-mail approach are limitless. The scholar could determine the behavior of his agent or customize its bidding strategies. Agents may adapt their strategy according to the changing competition, plan for future auctions, undertake more risk to gain more rewards, and so on.

The *Arena* does differentiate between agents or human users bids and accepts both all the time. Scientists decide whether to use agents or not. We expect that the use of agents will spread quickly because they are more persistent and more efficient than the scientist themselves, working 24/7 everywhere in the world, on behalf of the scientists. This is already, to some extent, happening with e-Bay, where a person can set up software to represent him vs. other persons in e-Bay's auctions. This software inputs the maximum price (the highest limit) that a person wants or can pay for a product/service, and then this software adjusts this person bid against the bids of other people who may not even be aware of that fact, that it was a software that outbid them. Although there are not full agents yet on e-Bay, the bidding software has a basic property of autonomy. A natural evolution is to let the software to move from being reactive to being proactive and look for auctions of a product/service as soon as they appear. Our system assumes that agent-person interactions are useful and will be accepted by user, so in an arena, an agent and its owner are unique actors.

Scholar agents take decisions on behalf of their scholars. The arena and the agents report to the scholars the outcome of selection process. For instance, the winner of an auction cycle receives a notification message from the arena, and then the scholar will be allowed to submit the paper to the CJ for publication. Submission is done as a reply e-mail (with the paper attached) to the Arena's message. The prototype makes it possible that one scholar can win any number of cycles (naturally the number of the available cycles is equal to the number of papers to be published), and the system tracks exactly which submitted paper belongs to which cycle. Every cycle is devoted to the publication of one paper in the CJ. The scientists may finalize the submitted works until a deadline defined by the Arena in the acceptance e-mail because, in fact, it does not matter at what stage the submission is during an auction. What matters is the expected value assigned to the work (possibly in progress) by the author.

4. The Architecture of the *Scholar Agent Alpha Rel. 1* prototype

This section expands upon definitions postulated in [3] and further outlined in [4], with both some limitations and new notions related to the prototype whose main components are as follows.

Scholars – the scientists who plan to send their papers for publication

Scholar agents – agents that work on behalf of the scientists

Administrator – persons who maintain the system, edit arenas, etc.

Audience– scholars who might cite papers published in CJ

BoW– bank of wits that keeps track of **wallets**, the cash, in ϕ , of every scholar

Arena– auction marketplace assigned to every call for papers of every CJ.

The overall diagram of the implemented system is shown in Fig. 3.

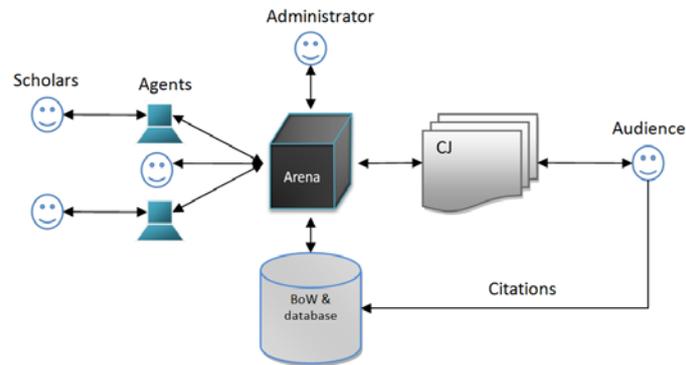


Fig. 3. Overall vision of the citation auctions approach. The arena activates its web services by means of e-mail. Agents are also set up by e-mail. All reports are exchanged by e-mail. Citations are tracked by external systems (such as Scholar.Google.com) and wallets are updated by the BoW.

4.1. The Selection Process

We have implemented a cyclic, second price sealed-bid auction that takes place before each publishing session/issue in the number of cycles equal to the number of papers to be published¹. The winner of each auction cycle is the publishing actor (scholar or agent) who placed the highest bid, and it is charged the price equal to the second highest bid in the cycle. As truth-revealing has been shown to be a dominant strategy in this case, the effective local decisions of each individual agent contribute towards effective overall system [3].

4.2. The Web Services

The web services have to deal with the complementary view of two distinct types of actors: the scholars and the (Scholar) Agents. Both of them require services from the

¹ The alternative is the so-called Uniform Price Second Bid (UPSB) auction [10], in which scholars and agents can place multiple bids for multiple publications and the price paid by all winners is equal to bid second to the lowest winning bid. Since it selects all published papers in a single cycle, the UPSB auction will be considered for the next version of the prototype.

Arena, while the Scholar Agents itself offer further services to the scholars. The Arena provides the following services, all invoked through e-mail:

- **Agent Registration**
The scholars use it to apply to the Arena for a new agent.
- **Scholar Registration**
When a scholar interacts with the arena for the first time (e.g., bid, agent registration...), then the arena registers an account for the scholar and her wallet is registered into the BoW.
- **Bid Registration**
This service is available for both types of actors. At every cycle, the Arena registers the submitted bids into a central database kept independently from the bidders.
- **Article Registration and Changing**
After the auction but before the deadline, the Arena receives or updates the submitted papers from the winners.
- **Reports**
The Arena sends the reports requested by the scholars and agents.

The following services of a Scholar Agent are invoked through e-mail:

- **Agent Set Up**
The scholar is able to set up the agent by a command message (bid, budget...etc). The agent then will try to win the auction cycle bidding within constraints defined in the set up.
- **Settings Change**
At any time after the agent set up, the scholar can reconfigure the behavior, budget for bids, etc of his agent by a new command.
- **Report Request**
It is similar to the Arena's reports service. It informs the scholar about the actual settings and the state of the auction (via ping message), and then automatically sends information at significant events or at every cycle.

These services are sufficient for providing the basic functionalities of the system for a usable and flexible agent-mediated citation auctions for publication selection environment. They will be reused and expanded in the future versions of the presented system.

5. The Functional Test

Several tests with real users were conducted to prove the suitability and usability of this prototype. A built-in monitoring, log and backup subsystems are included in the very first prototype, to collect and evaluate the results of the tests. Neither the audience nor their citations were simulated in these tests; the goal was uniquely to test the usability of the prototype.

5.1. The Test Parameters

- 7 PhD students acted as scientists competing for a publication

- The initial Wallet for everyone was €100
- Four papers were selected (therefore there were four cycles)
- Each cycle lasted for 30 minutes
- The deadlines for submitting the papers were one hour later than the end of the last cycle
- The Scholar Agents were simple mediators that used the maximum bid defined by the scholar, with no extra processing for strategy, maximum bid changes, etc.

5.2. The Rules of the Tests

The tests intended to provide the real usage of the system, which is why the only rule for the testers was: “behave like a scholar who wants to submit one valuable paper in a journal issue in which there will be four accepted papers”. The Wallet was the most important (awkward) limitation for the testers (€100 = 100 citations).

5.3. The Results of the Tests

The system satisfied the requirements of the Scholar Agent Alpha Rel. 1, described at beginning of this paper. All the seven testers registered an agent, but some of them bid directly without using their agents. However some unexpected anomalies have been revealed by this test. To make it clear the Table 1 shows a log of one auction cycle.

Bid_ID	Value	Bid through	Tester
8	€23	Agent	Gomez
9	€45	Agent	Silvana
10	€70	Agent	GaDo
11	€66	Agent	Arne
12	€99	Direct	Arne

Table 1. The log of an auction cycle

The 3rd cycle of the test is depicted in Table 1. It is remarkable because it contains interesting information about the working of the test system. The green highlighted row is important, because the tester did not do anything in this cycle. The user Silvana sent a bid command to her agent in the first cycle. In that cycle her bid was not a winner. Then, her agent automatically resent her bid to the second and third cycles, without her supervision.

There was a problem of underbidding. Arne sent a bid command to his agent, and his agent sent a bid value €66 to the auction. Suddenly, Arne changed opinion about the value of his paper and he sent directly a higher bid to the Arena. As seen in Table 1, he won the 3rd cycle with €99 but paid only €70. Since he expects to earn 99 citations, he will increase his Wallet by €29. Had he not increase his bid, the 3rd cycle’s winner would be GaDo with his agents’ Bid-ID 10, and he would have paid €66 and bring only 70 citations and apparently better paper by Arne (capable of gathering 29 more citations) would not appear. So, although it is not the aim of the Arena to gather the most citations in the auctions, gaining them back by future citations requires just that. This will be kept in future versions of the system, as this approach quickly penalizes the users and their agents who use tricks to win either by over or underbidding the values of their papers.

After completing four cycles of auction, the Arena had selected four papers from the seven candidates, and requested by e-mail submission of the final versions of the winners to be published in the CJ.

6. Conclusions and Future Work

After several tests we conclude that the approach based on *Scholar Agents* is workable. Users love the simple e-mail interface to communicate with their agents, and to start them working on behalf of the scholars. At the beginning, scholars had difficulty in understanding how the new citations currency worked. That difficulty was overcome by telling them that the operation using ϵ were like points in the miles traveler programs. Alpha Rel. 1 is stable and fast enough to be the base of the future development. It is developed as an open source.

We are encouraged by initial results of the user – agent - web services interactions based on e-mail communication in the architecture of *Scholar Agent*. The aimed target users of the systems, scholars, appear to be able to use it without serious usability problems. Further work has to be done to enrich the agents and web services architecture approach and make it more useful and secure. One important direction would be to add the cryptographic tools to communication and bids to avoid e-mail message spoofing.

To make the prototype easy to use we have created an information website (<http://eia.udg.edu/scholar-agent>) which offers detailed information about the project, the underlying ideas, and aimed goals, and one can download the updated version of the software.

7. Acknowledgements

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