

Calude as Father of One of the Computer Science Journals*

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Abstract. The Journal of Universal Computer Science (“universal” to indicate that no area is excluded) was one of the first (if not **the** first) journal that published refereed papers on the Internet, yet also provided a printed “archive” version of all papers published during a year after the end of that year. It is also one of the few truly open access journals in computer science: both publication and access is free for everyone. In this paper we describe how the journal started, what problems it was confronted with, and how they were solved.

1 Introduction

The Internet was initially seen as tool for emails and for allowing the dissemination of scientific publications rapidly, much faster than using traditional refereed and printed journals.

Before the Web took off in a large way, three systems to handle information on the Web had been developed: (1) The WWW by a group of four at CERN (where only the alphabetically first, although by no means the most important one, is still mentioned—as consequence that in scientific contributions in computer science we tend to mention authors alphabetically, independent of who was most important); (2) The Gopher System, developed by Marc McCahill at the University of Minnesota and (3) The Hyper-G (later Hyperwave) System developed by the author and his team in Graz. First publications on those three systems appeared in 1990, and first prototypes were available in 1991. Gopher was leading for a while, until a graphic browser “Mosaic” was developed

* This paper is dedicated to Cris Calude on the occasion of his 60th birthday. I got to know Cris in person when I took on the position of Full Professor for Computer Science at the University of Auckland in the early nineties. At that time Cris and his family had left their home country Romania a short while ago. It was a pleasure to make friends with such a multi-talented scientist and generous person. We have been good friends ever since. If I have two wishes I have one for him: to continue to enjoy his life and to contribute to science in essential ways as he has done in the past many times (and one facet not many will know about is what is reported in this paper); and I have one wish for myself: that Cris and I meet more often. However, let me also mention one historic bit I am proud of: when I came to Auckland, Cris was still in an unacceptable junior position. I did my bit to help change this, with Cris being offered an endowed chair soon thereafter.

for WWW at the University of Illinois. Now Gopher started to disappear, and Hyperwave withdrew to niche applications like Intranet or scientific publishing. During my tenure at Auckland I had many chats with Cris Calude and he understood immediately that Hyperwave was a powerful tool to handle large amounts of data. In 1992 he suddenly surprised me with the idea to use Hyperwave as basis for an electronic journal: “You know”, he told me, “Arto Salomaa is willing to join us as foundation editor. So why don’t you show how good Hyperwave is, by allowing the publication of refereed material in various formats, by choosing a new way of refereeing, by allowing the addition of comments to contributions, by providing full text search and search by various categories (like title, author, ...), and by preparing a printed version at the end of each year. And then let us discuss how over time we can add more and more innovative features to our journal.” This is how *J.UCS*, the *Journal of Universal Computer Science* (meaning: covering all aspects of computer science) <http://www.JUCS.org> was born, given birth to by Cris who is top theorist, yet has his mind wide open for other issues whose significance he often realizes before the people deeply involved in technical details (as I was) do.

During my tenure as Professor at the University of Auckland my friend and college Cris Calude saw three interesting points with surprising clarity: (1) Why not use the Internet also for rapid dissemination of refereed material, if one can assure to speed up the refereeing process; (2) Once “published” in electronic form, no changes would be allowed to a paper (like in a printed version), but authors or readers would have the possibility to add comments (to correct typos, to add references, to clarify points in the paper, etc.); (3) To add “academic credibility”, material would also have to be published in printed form, with ISSN or ISBN number, and would have to enter the list of high-quality journals by being indexed by ISI and similar institutions.

In discussion between the three of us: Cris Calude, Arto Salomaa and myself it became clear that many additional powerful features could be integrated in a journal as planned. It was me (who would after all be responsible for the implementation) who had to argue to first get started on the basis of the three points mentioned, and postpone further developments depending on the success of *J.UCS*.

After all, there was more to solve than just the implementation!

2 The Start of *J.UCS*

To get *J.UCS* [J.UCS 2012] off the ground (in 1994!) each of the three issues mentioned had to be solved, and in doing so new problems surfaced.

2.1 Issue 1 (The Refereeing Process)

It was clear that to have a high-quality journal we would need 2–3 referees for each paper submitted. Covering all areas of computer science (using the ACM Categories with permission of ACM) required well over 200 referees: we started

with 176 in 1994, and are now at over 335, and growing, despite the sad fact that we have lost a few due to health problems or old age. Due to the special involvement of referees we call them members of the editorial board: they may delegate actual refereeing to colleagues, but are responsible for the quality of reports obtained.

The real challenge was, however, how to speed up the refereeing process. We decided to use an entirely new approach: rather than leaving it up to the editors-in-chief or the managing editor to select for each paper submitted suitable referees (members of the editorial board) we would send the abstract of each paper to all members of the editorial board and members would choose which one they will review. Thus, no member of the editorial board will ever receive a paper for refereeing that is a total misfit, nor will a member receive a paper when too busy to do the refereeing fast, with a maximum of four weeks allowed. This does indeed shorten the refereeing process dramatically if three members of the editorial board are willing to look at a paper. Unfortunately, there are still papers where referees are not found “automatically” and the managing editor together with the assistant to the managing editor has to intervene, potentially prolonging the reviewing process quite a bit. Basically, it is by now clear that some 300 members in the editorial board would suffice, if all were reasonably active. Not surprisingly, only a small percentage falls in this category, however. Thus, a further expansion of referees to catch enough active ones seems necessary.

The system of “voluntary reviewing” with a large number of members on the editorial board does create one potential problem: an author may contact three friends on the editorial board and ask them for a favourable review. While a conflict of interest can never be eliminated even with traditional reviewing systems, the “danger” in our system is clearly higher, hence we had to invent new techniques for handling such situations. This will be described in Section 3 of this paper.

Another issue was which kinds of file formats we would allow for submission, and which formats we would use for publishing. PDF was not as omnipresent as it is today, so we had to be more lenient: we allowed a number of different file formats for submission and published each paper in three formats: HTML, Postscript and PDF. We have retained the last two, but given up on HTML simply because formulae in HTML are a real headache (they have to be inserted as in-line images). As far as submissions are concerned, we are still very liberal and accept most common formats like PostScript, PDF, MS Word, RTF and LaTeX.

2.2 Issue 2 (Freezing Contributions But Allowing Comments)

It was clearly desirable that an accepted and published paper should be “frozen”, i.e. no later changes should be possible, much like in a printed journal. The temptation was not to be quite strict, but to allow corrections of typos or such. However, our decision was and remains that even such minor corrections are not possible “after the fact” in *J.UCS*, providing a source of stable, high-quality contributions.

However, in printed journals it is sometimes possible to correct errors in a later issue in a specific column “corrections” or such. In J.UCS we decided on a more modern way (indeed we believe it was the first electronic journal to allow this): anyone can add comments after a paper: the author can add corrections, readers can ask questions or voice criticism, the author can reply by writing another comment, etc. Thus, *J.UCS* allows an arbitrary intensive discussion of papers already published. In the past this feature has not been widely used, somewhat to our disappointment: we believe that in 1994 when the journal started the user community was not yet used to what later would be called the “interactive Web” or Web 2.0.

We remain proud to be one of the pioneers in this area.

2.3 Issue 3 (The Printed Version)

When starting *J.UCS* the idea was, see [Calude at all 1994], to first of all publish a CD at the end of every year with all papers of the preceding year, and to have not one server for J.UCS but a number of mirror servers, so that access would be fast in all parts of the world. We ended up with a printed version of all papers of one year, the “archival version”, rather than producing CDs. Further, the mirroring concept turned out to be superfluous, with the increase of bandwidth world-wide.

The challenge remained to have papers published electronically with exactly the same pagination and format as they would later appear in printed version. Indeed if you look at the PDF version of the very first paper in the very first volume published in 1995 you find what is shown in Fig. 1.:

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High-radix Division with Approximate Quotient-digit Estimation

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Fig. 1. Sample *J.UCS* front page

Thus, printing this paper when it has appeared electronically looks exactly like a reprint from the printed version of the journal which is likely to appear only up to a year later: note that the above paper appeared January 1995, but the volume containing all papers of 1995 only appeared in April 1996!

We believe that this idea to have a fast electronic publication which is fully citable and indeed also appears in printed form is one reason why *J.UCS* became as successful as it is (for details see Section 5). It is only fair to mention that we had one other main advantage going for us: Springer was sponsoring *J.UCS* under one condition: *J.UCS* would not be entirely free, but there would be an annual subscription fee of \$ 100,00 per university, i.e. for just \$ 100,00 arbitrarily many members of the University could read and print each paper in the journal. Although this was not quite the idea of open access, it was close enough (it seemed to us) and did help tremendously to make *J.UCS* better known in computer science circles. When we later decided to drop the subscription fee Springer did generously permit us to do so, signed over all remaining rights to us (at that point already Graz University of Technology) but did not support/sponsor it any more.

The paper on electronic publishing [Odlyzko 1994] is still excellent reading: it is fairly accurate in forecasting what would happen to scientific journals (many would go electronic by 2010) and that the costs, even with copy editing but cutting down on reviewing will be low. We quote:

My general conclusion is that it should be possible to publish scholarly journals electronically for well under \$1.000,00 per article, and probably under \$500,00, without losing much quality.

It is interesting to note that in *J.UCS* we initially published some 50–80 papers a year, and now are up to about 150. Multiplying this by \$500,00 gives \$75.000,00 per year, or some €60.000,00. And this is indeed the budget that we need for *J.UCS*. Of this, close to €20.000,00 is used for continued improvement and for formatting and printing; the remainder is used for running the server, but mainly for one editorial assistant. During the first years, the somewhat smaller costs were covered by Graz University of Technology alone, then later the Institute for Knowledge Management stepped in, still later UNIMAS in Kuching. And as of 2012 it is now a consortium of 8 groups, see [J.UCS 2012] that are jointly carrying the total cost that has gone up a bit to around €70.000. This allows the operation of *J.UCS* as open access journal: no fee for submission or publication, no fee for reading.

There are two further points to be mentioned: First, [Odlyzko 1994] was already recommending 18 years ago to do away with reviewing, replacing it by just copy-editing and comments/dialogues that would follow after publication, possibly leading to revisions, etc. *J.UCS* is more conservative and is still sticking to the refereeing process, although a number of collaborative undertakings on the Web based on the idea “Wisdom of Crowds” [Surowiecki et al 2005] suggest that a journal on that basis might be quite feasible, and indeed require fewer resources than a refereed journal. However, such journals would not be

recognized by the more important citation indices at this point in time, and this might be an obstacle to obtain some top papers. Second, there are many “open access” journals around today. However, in most cases (*J.UCS* is one of the few exceptions) reading is free, but authors have to pay for papers accepted, usually hundreds of US dollars, or even more. We are violently opposed to this approach: the temptation to accept a moderately good paper just because it will help financially is likely to reduce the overall quality of such journals.

3 Problems and Partial Solutions

In this section we want to address some of the problems we have encountered in *J.UCS*, and some attempts how to deal with them.

As explained in the previous section the already large number of members of editorial board (some 340 at the time of writing) is still not enough to assure short refereeing times, simply because only a fraction of potential candidates have time and are willing to take on a reviewing job at any particular moment.

This has a “trivial” consequence concerning the submission system: sending the abstract of an incoming paper to all members of the editorial board is not realistic any more. Rather, a match between the area of the paper submitted and the area of expertise/ knowledge of reviewers has to be established and only “suitable” editors are notified that a new submission in their area has been received. Although this does sound easy we will argue below that unfortunately it is not.

Further, with the very large number of members of the editorial board a more serious problem arises: how does one avoid a paper submitted being reviewed only or mainly by friends of the author(s)?

Of course conflict of interest (COI) situation do arise also in other areas like when employing or promoting a person on the basis of letters of recommendations, or such. Thus, we have tried to pose the following general problem: given two persons A and B, can one—by using information on the Web (including social networks)—make an educated guess whether A and B are friends? We have not finished exploring all avenues in this direction but we have tried to tackle the problem by (a) considering closeness of location (surely if a paper comes from a certain department and all reviewers come from the same department one cannot really expect objective reviews) and by (b) considering closeness of persons on the basis of citations, co-authorship, etc.

Let us discuss these two issues in turn. We have tackled (a) by implementing mash-ups. Indeed there are three types: (i) those that show where papers (over a certain period in a certain area) come from; (ii) those that show where editors come from; and (iii) where editors of a certain paper come from.

Note that while (i) and (ii) are openly available, (iii) is only available to the managing editor in chief. It is clear that (iii) allows the managing editor to check if there is a potential COI situation due to co-location. That we implemented also (i) and (ii) has two reasons: (ii) allows editors to check if enough editors in some field are available. It also allows authors to check if enough editors

are available that are considered “objective” for whatever reason. Like, would a Pakistani feel comfortable if all referees are from India, an Arab if all are from Israel? Mash-ups under (i) allow the managing editor in chief to find out in which part of the world certain areas are considered particularly important, and how the importance of areas might change over time. Or at least this was the idea behind those mash-ups: although the implementation has worked flawlessly now for years, the results are often less helpful than expected. Let us explain this by means of a particular example (which is, fortunately, not typical for most areas).

Fig. 2 shows all editors that have indicated that their area is knowledge management. Note that not a single person in the USA shows up. This allows three interpretations: (i) it is an area not of interest in the USA; (ii) *J.UCS* has failed to attract editors in this field in the USA (iii) something else is amiss.



Fig. 2. A mash-up showing editors in the area “Knowledge management”

Looking at Fig. 3 the situation becomes even more puzzling: the only papers that were written in the category knowledge management come from the USA! This is particularly surprising since one of the major conferences in knowledge management of which top papers always appear in *J.UCS* is [I-KNOW 2011]. Using the search function of *J.UCS* we can identify 120 papers that contain the word “knowledge”!



Fig. 3. A mash-up showing all papers that have been written with category knowledge management specified

Putting this together means: Papers that should be tagged as “knowledge management” are not tagged that way. Editors that should indicate that their area includes knowledge management forget to do so. Thus categories/indices/tagging have to be more carefully studied to turn mash-ups into universally usable tools. However, the example given is a bit arbitrary: knowledge management is not an ACM category and not used as term very widely. Areas such as tagging, knowledge discovery, data mining, e-Learning etc. might all be considered as parts of knowledge management, but are often not considered in this context both by editors and authors. Thus, the mash-up concept does indeed yield valuable results in other areas, but to use it in general, good ontologies or at least synonym dictionaries will still have to be developed.

The second approach to COI—in the sense that a referee may be a friend of an author whose paper is under review—has been studied in depth in the thesis of [Khan 2011a]. The most relevant work in our context is published in [Khan 2011b]. Without going into detail it is clear that persons who have co-authored a paper are likely to know each other; if A often cites B, and B often cites A, then even if they don’t know each other they seem to be on the same wavelength. If A and B have never co-authored a paper but both are often cited together in papers, again a certain relationship is likely.

We believe that based on information on the Web the question “are A and B likely to be friends” can still be studied from many additional other angles (that might be valuable for journal editors, but also in case of promotions, or hiring staff, etc.). Indeed, even the (more difficult) question “are A and B likely to be enemies” can probably be tackled using material on the Web to some extent. One point seems to be important: answers obtained in this fashion can never be trusted, and hence should not be “black and white”. I.e. systems should report a percentage of likelihood such as “A and B are friends with a likelihood of 92%”.

4 Additional Functions in *J.UCS*

We have noted earlier that papers once published in *J.UCS* cannot be changed any more. However, notes (comments) can be added to an arbitrary extent. This has led us early on to the idea of “Links into the future” (© H. Maurer). The basic idea is most easily explained by means of an example. Suppose a paper was written in the year 1998. A paper in 2006 extends some results of the earlier one, hence will have the 1998 paper in the list of references. So why not add as comment to the *J.UCS* paper of 1998 a remark that further work in this area has been done in another *J.UCS* paper in 2006, with a direct link to it, i.e. a link from 1998 to 2006, i.e. a link into the future?

The challenge of this is to also have links to papers in the future that have appeared elsewhere, or more generally, to even link to related papers written later, even if they do not explicitly refer to the earlier *J.UCS* paper (but do so implicitly by dealing with the same algorithm; or by pointing to a paper that itself points to the earlier *J.UCS* paper, etc.).

Over the years this basic idea has been expanded more and more, and there is still much room for further improvement. The classical paper in this area is probably [Afzal et al., 2007], although earlier and/or simpler versions exist, such as [Maurer, 2001], [Krottmaier, 2003], or [Dreher et al., 2008].

One of the powerful functions of *J.UCS* is searching. It can be restricted to a certain time-area, to the names of authors in titles or in full-text, allows logical connectives, etc.

5 Outlook

J.UCS is more than a journal that has some 85.000 distinct readers, and over 650.000 PDF files downloaded a year, and a five-year impact factor close to 0.8. It is one of the few journals that is truly open access: no charge for publishing, no charge for reading. It has sophisticated functions like complex searching, links into the future, a novel refereeing system, and is in the process of further expansion by allowing readers to find for each paper published “similar ones”, authors working in “a similar area”, profiles of such authors, and much more.

It also has to come to grips with an overwhelming flood of incoming papers, simply because many young researchers cannot afford to pay for a publication, nor can they accept long waiting times until their paper is or is not published.

We have indicated that *J.UCS* needs further high quality and active editors, yet we cannot send to all of them all abstracts of papers received, nor can we easily decide what to send to whom since the categories used by editors and by authors often disagree more than expected, as we showed in the discussion of Fig. 2 and Fig. 3.

J.UCS may have to switch to a two stage submission process: If a paper comes in from an author who is not yet an established scientist (measured by citation count or Hirsh index?) maybe we have to put the paper into an area for public comments, and let the community decide whether a serious reviewing should take place or not. All readers who are fans of Wikipedia, of crowd sourcing, and of the Wisdom of the Crowds [Surowiecki et al 2007] will be delighted to read this and will be disappointed to learn that it does not work in general: a great idea by a young scientist put to the public in an unintelligible way may well be snapped up by someone, and turned into a top-notch paper, never giving credit to the one who had the original idea.

Thus, *J.UCS* is by now more than a well accepted journal (the five year impact factor is now close to 0.8, quite high for computer science); it is also a great research and publishing project. I want to thank Cris Calude and Arto Salomaa for their pioneering vision that has not just provided me, but many, with much food for thought and further research. I wish all members of the *J.UCS* team continuing success: I have headed that team till end of 2011, but have handed it over to the new group of editors-in-chief, in particular the managing editor in chief as mentioned in [J.UCS 2012].

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