Accomazzi, A., Budavári, T., Fluke, C., Gray, N., Mann, R.G., O'Mullane, W., Wicenec, A., and Wise, M. (2013) Astronomy and computing: a new journal for the astronomical computing community. *Astronomy and Computing*, 1. pp. 1-4. ISSN 2213-1337

Copyright © 2013 Elsevier B.V.

A copy can be downloaded for personal non-commercial research or study, without prior permission or charge

Content must not be changed in any way or reproduced in any format or medium without the formal permission of the copyright holder(s)

When referring to this work, full bibliographic details must be given

<http://eprints.gla.ac.uk/89585>

Deposited on: 015 August 2014

Enlighten – Research publications by members of the University of Glasgow_
<http://eprints.gla.ac.uk>

Astronomy and Computing: a new journal for the astronomical computing community[☆]

Alberto Accomazzi^a, Tamás Budavári^b, Christopher Fluke^c, Norman Gray^d, Robert G Mann^e, William O'Mullane^f, Andreas Wicenec^g, Michael Wise^h

^aHarvard-Smithsonian Center for Astrophysics, 60 Garden Street, Cambridge, MA 02138, USA

^bDept. of Physics & Astronomy, The Johns Hopkins University, 3400 North Charles Street, Baltimore, MD 21218, USA

^cCentre for Astrophysics & Supercomputing, Swinburne University of Technology, 1 Alfred Street, Hawthorn, 3122, Australia

^dSchool of Physics & Astronomy, University of Glasgow, Glasgow, G12 8QQ, UK

^eInstitute for Astronomy, University of Edinburgh, Royal Observatory, Blackford Hill, Edinburgh, EH9 3HJ, UK

^fEuropean Space Agency, European Space Astronomy Centre, E-28691 Villanueva de la Cañada, Madrid, Spain

^gInternational Centre for Radio Astronomy Research, University of Western Australia, 35 Stirling Highway, Crawley, WA 6009, Australia

^hASTRON (Netherlands Institute for Radio Astronomy), P.O. Box 2, 7990 AA Dwingeloo, The Netherlands

Abstract

We introduce *Astronomy and Computing*, a new journal for the growing population of people working in the domain where astronomy overlaps with computer science and information technology. The journal aims to provide a new communication channel within that community, which is not well served by current journals, and to help secure recognition of its true importance within modern astronomy. In this inaugural editorial, we describe the rationale for creating the journal, outline its scope and ambitions, and seek input from the community in defining in detail how the journal should work towards its high-level goals.

1. Introduction

Astronomy and Computing (A&C) is a new journal for the expanding community of people whose work focuses on the application of computer science and information technology within astronomy, rather than on astronomical research *per se*. This domain is an increasingly important part of astronomy, but one that is poorly represented in the astronomical literature, resulting in inefficient sharing of knowledge within its community and a difficulty on the part of the members of that community to establish the track record of refereed publications needed for career advancement in many astronomical institutions. The over-riding goal of A&C is to address these two problems by providing a venue for the publication of peer-reviewed papers on astronomical computing that will act as a focus for the community, aiding its progress through the effective transmission of knowledge, and helping it secure recognition of its true value to astronomy.

Some of the papers that will appear in A&C might otherwise have been published in an existing journal, but most would not, for reason of topic rather than quality. In Section 3 we outline some of the topics that fall within the scope of A&C, but that list is illustrative, not exhaustive, and we have deliberately not attempted to specify the boundaries of that scope too rigidly, because this is a rapidly changing field.

The range of topics to appear will be mirrored by the range of people writing and reading the papers. Some will be research astronomers with content to share that is of a more technical nature than what is usually published in the astronomical research literature. Some will be academic computer scientists reporting on astronomy-centred projects that are too ‘applied’ to find a comfortable place in the computer science literature. Many will have long track records in the application of computational techniques and technologies to astronomy, whether they started as astronomers, computer scientists or IT professionals. These groups may disagree on what they call what they do – ‘astronomical software development’, ‘astroinformatics’, ‘astronomical computing’, ‘computational astronomy’, or more – but what will be common to the papers that appear in A&C is that they focus on technical matters, not on presenting astronomical results.

In Section 2 we argue for the timeliness of the launch of A&C, whose aims and scope are outlined in Section 3. The topics listed there naturally lead to a set of different types of paper, as described in Section 4. Some of these may have additional online content associated with them, which we discuss in Section 5, along with other pragmatic issues relating to the publication of papers in A&C. Finally, Section 6 rounds off this editorial with an invitation to the community to help make a reality of the vision outlined here.

2. Astronomical computing as a discipline

The proponents of any new journal must justify why it is needed, and why that need is currently so pressing as to actually lead to the launch of the journal. In this Section we make the case for the necessity of creating A&C, and the timeliness of

[☆]The authors of this paper are the editors of A&C.

Email addresses: aaccomazzi@cfa.harvard.edu (Alberto Accomazzi), tamas.budavari@jhu.edu (Tamás Budavári), cfluke@astro.swin.edu.au (Christopher Fluke), norman@astro.gla.ac.uk (Norman Gray), rgm@roe.ac.uk (Robert G Mann), womullan@sciops.esa.int (William O'Mullane), andreas.wicenec@uwa.edu.au (Andreas Wicenec), wise@astron.nl (Michael Wise)

doing so now, based on the maturity of its target domain and the critical mass of the community it will serve.

2.1. *The justification for A&C*

Astronomy has long been a source of practically focused innovation. With the telescope, timekeeping, and computing, to name just three, astronomers have a proven record as early adopters of new technologies, often contributing generic innovation to these fields as well as acquiring the specific skills necessary to exploit those technologies in support of their own science.¹ In the cases of optics and instrumentation, and of precise timekeeping, as the technology developed it became more specialized, more removed from the perceived mainstream of astronomical research, and its specialists stopped thinking of themselves as astronomers doing technology on the side, and instead as technologists leading an independent sub-discipline of the larger astronomical project. That branching finds expression in the largely separate, but still mutually intelligible, publishing world of astronomical instrumentation, which has a thriving centre in the SPIE conference series.

This branching off, into a technologically led sub discipline, has already happened for astronomical computing, as reflected by the longevity of the ADASS² and ADA³ conference series. One difference between astronomical instrumentation and astronomical computing is that while the community undertaking the former appears content with its current publication options, that working in the latter domain is not, as evinced by the discussion at the ‘Birds of a Feather’ discussion at the 2010 ADASS conference in Boston, summarized in (Gray and Mann, 2011).

This discussion effectively concluded that, since there were journals other than the best-known ones, which professed willingness to accept the submission of software-related papers, the community should and would migrate to these. This turned out to be overoptimistic, and nothing like it appears to have happened in fact. In any case, it is not clear that colonizing an existing journal would give the discipline the definition and visibility that it needs to help it grow, and we believe that creating this disciplinary identity is as valuable a goal as any search for professional credit.

Gray and Mann (2011) present three main reasons why the community can no longer make do with a publication mechanism centred on the unrefereed proceedings of an annual conference: (i) a conference presents a single submission deadline per year, forcing authors to publish when the opportunity arises, not when the status of their project merits it; (ii) peer review can provide a quality threshold, and the existence of guidelines will lead authors to justify and elaborate their arguments to a greater degree, producing more comprehensive papers; and (iii) a journal – and especially a predominantly online journal – will not have the space constraints that bedevil conference proceedings,

and so will allow authors to give their material the detail it requires, and set it properly into its broad context of previous work in a way that is impossible in a brief conference report. However there is no intention that A&C will replace, say, the ADASS proceedings volume: the two are complementary, serving different community needs, and both outlets are necessary to ensure that those needs are met in full.

For example, the institutions that employ many of A&C’s intended authors and readers find it harder to assess personal attainment on the basis of a track record of successful projects than on a list of refereed publications, so a peer-reviewed journal is needed to provide vital support to career progression in this community. That the existing astronomical journals do not fulfil that role was demonstrated by (Gray and Mann, 2011) whose authors circulated for comment to the editors of the majority of them a set of abstracts of papers from the previous year’s ADASS conference (not all of those papers would necessarily be appropriate for A&C – the point of the exercise was to delineate for each journal the boundary in the computational domain beyond which they would deem a paper to be too technical for their audience). The responses varied slightly between the main astronomical journals, but the key finding from this exercise was that, unsurprisingly, they view technical computational material as a means to an end – the justification of a scientific result – rather than an end in itself. Papers that focus on the technical material will struggle to find a home in the existing astronomical journals, and, when they do, they will be greatly outnumbered by ‘straight’ astronomical research papers, so these journals will not provide an effective means of following the progress in astronomical computing. This is an issue not only for the growing number of astronomical computing specialists, but also for computer scientists with expertise in areas (for example data mining or management of ‘big data’) that overlap with astronomy and who need an interface to the astronomical community. More importantly, this lack of a natural home in the peer-reviewed literature leaves the technical material underreported and underexplained: authors tone down the technical detail and play up the associated astronomical result in order to get a paper accepted, to the detriment of those wishing to understand and build upon the technical lessons learnt.

2.2. *The timeliness of A&C*

There are several indicators that the astronomical computing community is reaching the critical mass that calls for the launch of a journal like A&C. A number of new conference series in this domain – for example .Astronomy⁴ and the international Astroinformatics conferences⁵ – are becoming established and accreting communities around themselves, while the *State of the Profession Position Papers*⁶ submitted to the 2010 US Astronomy and Astrophysics Decadal Survey included a number of papers (such as Borne et al. (2009)) highlighting its

¹The community has shown itself remarkably prescient. In a mid-1980s *Science* special issue (Brauman, 1986) and in (Wells, 1987) the community identified key technologies which have shown their longevity in practice.

²www.adass.org

³ada7.cosmostat.org

⁴dotastronomy.com

⁵See <http://www.astro.caltech.edu/ai12/> for *Astroinformatics 2012*

⁶See http://sites.nationalacademies.org/BPA/BPA_049492

growing importance to astronomy. This has been also been recognized by the recent establishment by both the American Astronomical Society and the International Astronomical Union of working groups covering the fields of astrostatistics and astroinformatics which are central to the scope of A&C.

This adoption of the word ‘astroinformatics’ reflects the use of analogous terms in other sciences: *bioinformatics* has a secure existence at the analogous intersection between biology and computing, absorbed by problems which are too technical to be of much interest to most research biologists, and perhaps too applied to be of interest to core computer science; *geoinformatics* has emerged in the same relation to geophysics. It might be asked why it has taken so long for astroinformatics to emerge as a field, especially given the willingness of the astronomical community to innovate in computational areas, as described earlier in this editorial. The same question could be asked of experimental particle physics, where the everyday work of many people who would still describe themselves as particle physicists would be viewed by others as applied computing in support of particle physics: they seem to view what they do as so central to experimental particle physics that there is no need to define an ‘X-informatics’ subdiscipline. By analogy, some of the authors of this editorial question the usefulness of the term ‘astroinformatics’ but, whatever the merits of the term, its growing use is indicative of the increasing importance of computation to astronomy, and underlines the timeliness of the launch of A&C.

3. Aims and scope

Having argued that the time is right for a journal devoted to the astronomical computing community, we now move on to discuss what an A&C article should look like and what it should contain.

As the journal’s web page⁷ says:

A&C will focus on the broad area between astronomy, computer science and information technology. The journal aims to publish the work of scientists and (software) engineers in all aspects of astronomical computing.

The web page also includes the following list of example topics:

- Scientific software engineering
- Computational infrastructure
- Computational techniques used for astrophysical simulations
- Visualization
- Data management, archives, and virtual observatory
- Data analysis, data mining and statistics
- Data processing pipeline and automated systems
- Semantics, data citation and data preservation

This list is illustrative only: we could easily have listed double this number of topics, and we stopped only because a more detailed list looks exhaustive, whereas a shorter one remains suggestive. The defining feature of an A&C paper will be that it focuses on computation in support of astronomy, not on the astronomical results obtained using computation. We do not expect to find ourselves in much competition with the existing set of core astronomy journals, nor with the more theoretical areas of the computer science literature; instead we are creating a complementary publication which will attract a class of articles which has not hitherto had a clear identity or shape.

The detailed definition of this identity and shape will emerge in the first years of the journal’s existence, and we anticipate having more interplay between authors, reviewers and editors than is usual in an established journal, as we collectively work out the ideal structure and content of an article in this area, and collectively identify what is and what is not in scope for the field.

4. Types of article

Perhaps the best way of describing the journal’s large scope is to describe the range of articles that we anticipate seeing submitted, and what we believe to be necessary or distinctive about them. We can identify at least the following broad categories, without necessarily being committed to them indefinitely.

The most typical **research (or standard) articles** will describe an innovative piece of work in the area, whether this is a distinct project – a new algorithm, or system, or approach, or application – or a major change in an established system, such as the restructuring of an existing pipeline. We expect to see a broad range of articles in this category, but there are some particular species we can identify from the outset.

One of these cases will be the **software release articles**. While a new major release of a piece of software, or a library, will be a natural point at which to consider an A&C article, it is not simply the increment of the version number that will warrant publication, but perhaps the intellectual contributions of a new algorithm, or the educative experience of a new software engineering process, or novel technology.

While A&C will be a natural home for a ‘code paper’, it will not act as a repository for code itself: we anticipate that a software release that is worth an A&C article will be one that is also worth being professionally packaged and released at a stable URL, preferably with the source being additionally available in a public code repository (and we suggest some suitable repositories in the author instructions). We regard such a distribution as formally part of the article for the purposes of refereeing the submission. Similarly, while we do not *require* that a new algorithm be accompanied by a released library implementation of it, we imagine that a referee from the community would take

⁷<http://www.journals.elsevier.com/astronomy-and-computing/>

some persuading that an algorithm without such an implementation was nonetheless sufficiently well corroborated by experience to warrant a scientific publication; while we can imagine circumstances in which an algorithm would be described without a *public* implementation, we think it unlikely that it would be published without at least the referee seeing the code. Finally, while we as an editorial board have a bias towards openly available code and open licences – if only because they make things simpler for a community that may wish to incorporate, adapt and extend the described code – we do not insist that code be licensed in such a way.

Similarly, we believe that A&C will be a natural home for **data release articles**, provided that these have significant technical content. The journal’s scope gives the authors of such articles the space to be as technically detailed as they could want in their description of the development and delivery of a new dataset, and might be natural counterparts to a simultaneous astronomy article in another journal, which concentrates on the science outputs.

We encourage the community to contribute **notes on practice**. These will be accounts of ‘lessons learned’ in the course of trying and either succeeding or failing with some technology or apparently promising approach. These papers will be as formal, and as much of a contribution, as a ‘standard’ article, but with two important differences. First, because they are notes on *practice* we will expect a different type of innovation from that necessary for a standard research article. That might be represented by the first, or at least an early, application of a technology to a problem in astronomy, or an application at a scale or in a fashion that represents a significant commitment of intellectual energy. Second, it should be irrelevant whether the application of that technology succeeded or failed: in either case, the project should be analysed in enough detail, and at such a level of abstraction, that it would allow a reader to understand *why* the project succeeded or failed, and to be able to use the information to predict with some confidence whether a similar planned project would be likely to succeed or fail in its turn. We expect those would most typically be technical reasons, but the social, administrative or technical context is important as well: a particular innovation may fail simply because it was applied in the wrong context, while it may succeed elsewhere.

Such a paper is arguably a type of **review article**. As well as the obvious analogues of review articles from other disciplines, we imagine we will see similar, broadly pedagogical, accounts of technologies applied to astronomical problems. For example, we can imagine that the early 2000s would have been a good time for a review article about ‘Technological prospects and experience of XML in Astronomy’, or the end of support for the IRAF or Starlink projects an opportunity for an engineering review of project management lessons, or we can imagine the High Level Expert Group on Scientific Data (2010) producing a version of their document as an A&C review article, or seeing a petascale visualization review such as Hassan and Fluke (2011) here.

We will also consider **white papers**, describing some ‘state of the nation’ in some respect, or plans for the future: for example, some of the submissions for the recent US Decennial Re-

view of astronomy could be repurposed as A&C articles (for example Borne et al. (2009)), as might forward looks such as Graham (2012) or Brescia and Longo (2012). While there may be a number of such articles in the first few years of the journal’s life, reflecting the state of maturity of the domain it serves, these will be authoritative and well grounded in expertise, and only accepted in response to an invitation from the editorial board: the same goes for review articles, and we encourage authors interested in writing one of either of these article types to contact an appropriate editor to discuss the scope and approach of their proposed paper. All other types of paper will be accepted as unsolicited contributions, although the editors are always available to discuss possible papers with authors.

As a form rather than a category, we will also introduce the **target article**, which is familiar in some other academic disciplines but not well known in the physical sciences. From time to time – possibly only once or twice a year – the editors will identify that a submitted paper provides one side to an argument that is underway within the community, and will, with the authors’ permission, make the paper a target article. They will then solicit substantial commentaries on it (of perhaps one or two pages in length) and then publish in a single package the original article, its commentaries, and a final summary from the target article’s authors, thereby presenting a broader coverage of the topic than would have resulted from the original paper alone. We expect the detailed form in this journal to evolve with experience.

Finally, we expect to publish occasional **special issues**, which may collect together papers resulting from a specific conference, relating to a particular major project, marking some substantial milestone or event, or which, through some other connection, comprise a coherent whole that is greater than the sum of its parts. As above, we look forward to proposals from the community.

5. Pragmatics

This section discusses a number of more practical matters.

As noted above, A&C will not act as a code repository itself, nor will it act as a data repository. However one of the key roles of an academic journal is to act as the long-term archive of a discipline’s activities, and we are aware that this activity may be expressed in the form of software which might not warrant a full-scale distribution – illustrative codes, or perhaps templates – and in other non-textual forms – we can imagine screencasts or simulation fly-throughs, for example. We have made no specific provision for this at this stage in the journal’s development, but instead aim to develop the support for such artefacts, building on the publisher’s existing experience of this in other journals, when and as it becomes clear what the community needs. The potential support is flexible, and so authors should feel free to offer supplementary material accompanying their articles; again, editors will be glad to discuss possibilities with authors.

Any contemporary astronomy-related journal has to make clear its relationship with arXiv and with the NASA Astrophysics Data System (ADS). A&C fully supports authors’ use

of arXiv: it supports authors submitting to the journal by providing the arXiv identifier of an already-uploaded preprint, and cooperates with authors uploading post-refereeing preprints. A&C papers will be indexed by ADS and will be findable through the traditional ADS metadata search ('Abstract Search'). Additionally, the full content of the papers will be indexed in ADS's new full-text search service, as part of ADS's ongoing collaboration with Elsevier. Thanks to the metadata curation performed by ADS, the arXiv version of a paper (if one exists) will be linked to its published record in ADS and, hence, be accessible through it.

A&C will follow Elsevier's 'article-based publishing' model, which means that articles will be assigned final volume and page numbers, will be assigned a DOI, and will appear in indexing services, as soon as they have passed successfully through the peer-review process.

6. Conclusions and an invitation

We believe that the launch of *Astronomy and Computing* represents an important stage in the emergence of 'astronomical computing' as a mature discipline within astronomy. We look forward to the journal acting as a voice, arena and inspiration for the community in the coming years and encourage the community to join with us in making that a reality.

References

- Borne, K.D., et al., 2009. Astroinformatics: A 21st century approach to astronomy. arXiv:0909.3892v1.
- Brauman, J.I., 1986. Computers. *Science* 231, 905. doi:10.1126/science.231.4741.905.
- Brescia, M., Longo, G., 2012. Astroinformatics, data mining and the future of astronomical research. ArXiv e-prints arXiv:1201.1867.
- Graham, M.J., 2012. The art of data science, in: Sarro, L.M., Eyer, L., O'Mullane, W., Ridder, J. (Eds.), *Astrostatistics and Data Mining*. Springer New York, volume 2 of *Springer Series in Astrostatistics*, pp. 47–59. doi:10.1007/978-1-4614-3323-1_4, arXiv:1106.3305.
- Gray, N., Mann, R.G., 2011. A journal for the astronomical computing community?, in: Evans, I.N., Accomazzi, A., Mink, D.J., Rots, A.H. (Eds.), *Proceedings of ADASS XX*, ASP. pp. 655–658. URL: http://www.aspbooks.org/a/volumes/article_details/?paper_id=32989, arXiv:1103.1982.
- Hassan, A., Fluke, C.J., 2011. Scientific visualization in astronomy: Towards the petascale astronomy era. *Publications of the Astronomical Society of Australia* 28, 150–170. doi:10.1071/AS10031.
- High Level Expert Group on Scientific Data, 2010. *Riding the Wave*. Final Report. European Commission. URL: <http://cordis.europa.eu/fp7/ict/e-infrastructure/docs/hlg-sdi-report.pdf>.
- Wells, D.C., 1987. Crystal gazing v. computer system technology projections, in: Di Gesù, V., Scarsi, L., Crane, P. (Eds.), *Selected Topics on Data Analysis in Astronomy: General Lectures Given at the II Workshop on Data Analysis in Astronomy*, Erice, Italy, April 20–30 1986. World Scientific, pp. 153–170.