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An Open Letter

Professor Simon Tavaré
President, The London Mathematical Society
57-58 Russell Square
London. WC1B 4HS

Dear Professor Tavaré,

I am writing to express my concern at the recent announcement by LMS of the planned closure of the LMS Journal of Computation and Mathematics (JCM).

First let me indicate why I have an interest in this issue. My main research field is Computational Algebra (CA). For the past 25 years I have headed the Computational Algebra Group at the University of Sydney which typically comprises 8–15 full-time researchers. The long-term goal of the group is to develop effective algorithms for solving key computational problems in a range of areas of mathematics, with particular emphasis on algebraic geometry, group theory and number theory. Hence, we need ready access to existing work in the various fields of interest and we also need suitable journals to publish an average of 20 papers per year. The researchers in the group need to develop their careers by publishing in journals with a good reputation. Over a long period I have been involved in initiatives to establish suitable journals for this new field. In particular, I was a member of a small group that persuaded Academic Press to create the Journal of Symbolic Computation in 1985 and was one of the initial associate editors. However, I should state that I have never had any connection with JCM.

Computational Algebra, as a recognised research topic in mathematics, did not exist before 1970. Beginning around 1970, researchers discovered completely new algorithms that are much faster than classical algorithms for calculations such as computing the GCD of two polynomials over Z or factorising a polynomial over Z. During the 1970's and 1980's it gradually became clear that alongside the theoretical content of most branches of mathematics, there also exists a rich body of algorithms. This is particularly evident in the case of finite groups. By the late 1990's computational methods were increasingly used in developing theory. We have now reached the stage where tens of thousands of published mathematical papers dealing with theory cite some use of computational techniques in producing their results. As an example, a simple web search turned up some 5000 papers published up until 2013 citing the Magma Computer Algebra system alone. Also, computational methods make possible the application of many ideas from theoretical pure mathematics to applied problems. An example of this is the use of elliptic curves in cryptography.

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It is natural to assume that theoretical papers using standard computational tools would be published in the usual theoretical journals and this is what generally happens. Some CA papers also appear in theoretical journals but this can be unsatisfactory for several reasons. Firstly, the criteria used to assess a theoretical paper can be different to those employed for papers that are contributions to CA methods. Secondly, the development of the field of CA is greatly enhanced by having CA papers appear in specialised journals in that it allows people to quickly find papers of interest.

A small number of journals specialising in CA or more generally in computational mathematics (CM) have been created. The most important of these are the Journal of Symbolic Computation, Experimental Mathematics and JCM. In addition, Mathematics of Computation (Math Comp) and the Journal of Algebra each have sections for CA/CM type papers. The non-numerical section of Math Comp tends to be dominated by number theory papers and it is not seen as a suitable place to publish papers in areas of CA other than number theory.

In the beginning, CA algorithms tended to be based on fairly elementary theory but in recent years it has been found that deep theoretical ideas can be a basis for constructing very powerful algorithms. Examples include the development of n-descent to find rational points on curves having low genus, the use of the classification theorem for finite simple groups (CTFSG) as the basis for algorithms for finite groups, and computing properties of schemes using coherent sheaves. In the 1960's and 1970's CA was seen as having close links with computer science and many of the people involved in setting up JSC were on the CS side of the fence. While it does publish many papers that are concerned with algorithms based on deep mathematical ideas, JSC still has a strong CS orientation. The attraction of JCM is that it is at the mathematical end of the spectrum. It makes possible the publication of papers having deep mathematical content appear in a journal run by one of the world's premier mathematical societies. Authors accepted for publication in JCM can be confident that their paper will have credibility within the mathematical community.

The computational mathematics field is very active and now produces hundreds of papers every year. It has taken a number of years to reach the point at which a respectable number of good papers were being submitted to JCM. A journal in a new area takes time to be accepted and if it were to be continued one would expect it to become the journal of choice for good papers dealing with computational methods specific to a number of active research areas in (pure) mathematics. At present it attracts many strong papers in computational group theory and computational number theory but less in commutative algebra and algebraic geometry. It should be possible to remedy this without too much effort. The creation of JCM was a vote of confidence in the value and importance of computational mathematics and I fear that its closure will turn that into a vote of no confidence at a time when we are struggling to attract enough good graduate students into the area.

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The suggestion that JCM be replaced by another journal makes little sense as it will then take the new journal 10–15 years before it attracts sufficient good papers. Having closed one computational journal, prospective authors are likely to be very nervous about committing papers to a new LMS computational journal. It would be far better to revise the mission of JCM and continue to build on the existing author base.

I should point out that while it is not unknown for a journal to close, it is a serious matter to close a journal that is one of the few that specialise in a growing field such as computational mathematics. This will certainly impact the field in a negative way. Among other things, it damages the standing of papers that have been published in the journal.

In closing I mention a particularly valuable aspect of JCM. In March 2015, Jean-Pierre Serre gave a lecture at Harvard in which he expressed concern about some aspects of the effort that produced the CTFSG. A particular criticism was that many recent results in mathematics rely on the character tables that appear in *Atlas of Finite Groups* but there are no proofs of correctness for these tables. Each table was produced character-by-character by a mathematician who may have used a computer for performing arithmetic with the so-far known characters. An algorithm for computing character tables developed by my colleague Bill Unger in 2004 offered another approach. This algorithm takes as input, permutation or matrix generators for a group and applies a theorem of Brauer to induce the characters from elementary subgroups. The whole process is completely automatic. So Unger and I have now computed most of the Atlas character tables using this method (BM and M are the only groups the method cant handle). We found that generally they agree with the Atlas tables as stored in the GAP package. At this point we want to publicise this work and use it to start a debate about the level of confidence mathematicians expect for results produced by computer. It would seem that JCM would have been the ideal forum for such an important discussion.

To summarise, research in computational mathematics (in the sense of exact computation) has led to the discovery of many amazing algorithms which in some cases open up areas of theoretical mathematics to further development (L-functions and the Langlands conjectures, for example). A satisfactory set of journals for the publication of non-numerical computational mathematics has yet to emerge. JCM is one of a handful of journals with the right pedigree and right editorial policies which makes it a journal that we badly need for the continued development of computational mathematics.

I hope that some way can be found to continue the publication of this journal.

Yours faithfully,

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