So You Want To Review A Paper...

Andrea Arpaci-Dusseau and Remzi Arpaci-Dusseau

1 Introduction

Well-done reviews are the bedrock of a good research community. Hence, your task as a reviewer is of critical importance. In this article, we discuss some things you should keep in mind when reviewing, based on our experience with the process (both as reviewers and recipients of reviews).

The single major point we make is that **a good review takes time** – time to read the paper (perhaps more than once), time to take notes and think about the paper, and finally time to write the review. Hence, plan ahead and don't wait until the last minute. If you are a last-minute type of person, at least try to *read* the paper ahead of time; this will let your thoughts about the paper mature before you go to write it up. Writing the review at the last minute is somewhat more forgivable.

2 Paper Submission And Review

Research is performed. Papers are written. Papers are submitted to conferences. Some papers get in, most don't. What happens during this process to determine which papers are accepted?

When a paper is submitted to a conference, a group of experts in the field known as the *program committee* (the PC), headed by a *program chair*, get together to decide each paper's fate – whether it gets into the conference or not. The PC members and chair will each have reviewed some subset of the papers submitted, and, in addition, have sought help in reviewing some other papers. This is likely where you come into the picture, as one of the "external" reviewers. The PC then discusses each paper and determines a single bit outcome for each one – whether it should be accepted or rejected.

3 Goals For Your Review

You should keep the main points of the review in mind when writing your review. Reviewing is a process that has two major goals:

- **Information for the program committee.** When writing a review, most of what you do is aimed at influencing the decision of the program committee. Should this paper be presented at the conference or not? The more information the PC has, the better decisions it makes.

- **Feedback for the authors.** The other audience for your review is of course the authors. Whether a paper is accepted or rejected, the written feedback from reviews helps the authors to make a better paper.

Hence, you should keep these two major audiences in mind when writing your review. What are you saying that will be useful to someone making a decision about this paper? What are you saying that is useful feedback to the authors?

4 What You Are Evaluating

In writing a paper review, one should always remember what you are evaluating: *whether the research contribution of a paper is significant enough to warrant publication*. Of course, what is "significant enough" is a judgment call, one you have to make based on experience with other work in field. However, we can break this down a bit further into the following four axes of evaluation:

- **New ideas.** What are the new ideas in the paper? Are they big new ideas that will generate many follow-on papers and interest? Are they likely to have a real impact? Is the problem being solved well motivated? Good systems papers solve real problems and do so with interesting and new ideas – ideas that change how you think about building systems.

- **Method and approach.** What did they do? Did they build a new system to demonstrate their ideas? Or did they use simulation or modeling? In the systems community, papers that describe real systems (or prototypes) are likely to be more well-received.

- **Evaluation.** How did they evaluate their system or idea? Was their experimentation rigorous? Did they make the points they claim to make? Do they tell you enough to be able to reproduce what they did? Good systems papers usually have a serious empirical evaluation component.

- **Writing.** How well written is their paper? Are the main points clear? Is the paper well organized? And so forth.

Not all of the axes are equally important. Most likely you will place emphasis on the new ideas generated by a paper – forgiving (for example) a poor evaluation if the ideas are highly interesting. Similarly, if all aspects of a paper are outstanding except for the writing, it is likely forgivable. Realize the exact balance is up to you – what do you think is important in a good systems paper?

5 Figuring Out What To Say

Reviewing can be difficult. Often you will feel as though you don't know all of the related work (though that isn't a good excuse for a poorly-done review). You may have trouble generating interesting and relevant things to say about the paper. Finally, you may also feel as if you don't know whether to reject or accept a paper. In this section, we present some tips for generating a good review.

- **Read the paper carefully.** The first step to a good review is of course to read the paper.
- **Look for good ideas.** In the process of reviewing, it is easy to get into the mindset of simply looking for flaws with which you can reject the paper. Don't forget to look for good ideas (however big or small).
- **Look for flaws.** All papers have them. You need to find them. You also need to categorize them; which are so major that they lead you to reject the paper?
- **Take notes while you read.** Have a sheet of paper handy to take down some notes, or minimally do so on paper. Don't assume you will remember all of the points you think of while reading.
- **Organize your notes.** Look for common things that occurred to you while reading. Are there consistent flaws in the methodology? Does the description of the system confuse you or contradict itself? The basic idea is to spend some time thinking about the paper while not reading – and hopefully to gain new insights on the merits or problems of the paper.
- **Sleep on it.** Best if you can read the paper, take notes and think about it a bit, and then be away from it for a while (*e.g.*, a day). Then, come back and write the review. This serves two main purposes. First, it lets you think about it in the background, which often generates new insights or comments. Second, it dampens your emotional reaction to the paper (*e.g.*, "This darn paper stinks!"), leading to a more rational review.
- **Be willing to read the paper again.** Sometimes all of the ideas and points of a paper don't come across in a single read. Hence, you should be willing to go back and read the paper again, to see if you missed anything. This is particularly true for dense (but perhaps worthwhile) papers.
- **Write the review.** Finally, you've got to get it all together and write the review.

6 Writing Your Review

The written review is a document of your effort in reviewing. Hence, make sure to write the review carefully and clearly – there is little point in going through the effort a review requires if you don't do a good job when writing it.

Here is the structure of a typical review:

- **Summary.** Start with a one paragraph summary of the paper. A colleague of yours should be able to read this and understand what the paper is about.
- **Recommendation.** One paragraph which clearly states what you think the outcome of this paper should be (accept/reject) and some backup sentences informing the program committee why you think so. If it's an accept, list the most interesting contributions that the paper makes. If it's a reject, list the major reasons for rejection.
- **Strong points.** Summarize the major strong points of the paper. One paragraph per major strong point is good, *e.g.*, "The paper presents an excellent and new idea for disk scheduling: to reorder requests so as to lower the average disk service time. (more description here)"
- **Major weak points.** Summarize the major weak points of the paper. Again, you should be thinking one paragraph per major weak point.
- **Minor points (nits).** Finally, write down your lesser points about the paper, *e.g.*, "page 3: graph 6 is hard to read." Types of things to include here are things about formatting, readability, writing, etc. They can also be technical points, but lesser ones. Note that these can be positive too (*e.g.*, "I liked graph 6 a lot – nice job!").

Your reviews should be substantial – a page or two or even three if you really get going. One paragraph is not acceptable and is the hallmark of a poorly-done review. One sentence is even worse. We had the fortune of receiving a one-sentence review before: "This paper is about an idea that is obvious – so obvious that perhaps no one has

bothered to write it down." The other reviewers liked it, but this reviewer killed it. However, we received no useful feedback (other than the fact that the reviewer thought the paper was obvious).

7 The Numbers Game

One last part of your review is the numerical grading component. Each conference has a different set of criteria, based on the whims of the program chair. Here is an example (from the SOSP '03 review form):

- **Originality and Insightfulness:** 1 (Not original) .. 5 (Wow)
- **Validation and Thoroughness**: 1 (Not credible) .. 5 (Beyond reasonable doubt)
- **Importance of topic:** 1 (Not important) .. 5 (Burning issue)
- **Presentation and clarity:** 1 (dense, impenetrable) .. 5 (lucid, eloquent)
- **Review confidence:** 1 (could be way off) .. 5 (I really know this stuff)
- **Overall score**: 1 (definite reject) to 5 (award quality)

These numbers matter! So fill them in carefully, and make sure they are in alignment with your review. Why do they matter? Simply put, the program committee will use some formula (based on the numbers above) to "rank" the papers in some way (the exact formula is different each time and reflects the biases of the program chair or committee). The committee will then use this ranking to help determine which papers are accepted. Uniformly good numbers do not guarantee acceptance, but they sure help – so think through the numerics as carefully as you do the rest of your review.

One aspect to always be honest about is the "review confidence" indicator – if you are not an expert in an area, say so. This number is often used in the ranking computation to lessen the effects of less knowledgeable reviews. That said, if you really know what you are talking about, don't hesitate to say so – sometimes (whether you want to believe it or not), *you* are the expert!

8 Other Things To Keep In Mind

- **Put yourself in the place of the author.** This is the "golden rule" of paper reviewing – before you send in your review, read it over as if you were the author of the paper. This is of particular importance when you are rejecting a paper. Does the review give you good feedback in order to make your paper better? If it recommends rejection, do you understand why? Does the tone of the review seem constructive? (*i.e.*, does it make you feel bad as a researcher, as a writer, as a human being?) Realize that a reject can be quite helpful and instructive for authors – indeed, there are many reviews which substantially shaped and contributed to papers of ours in the past.

- **Ambivalence is useless.** A common mistake made by newcomers to review is to sit on the fence. Sitting on the fence is nearly useless – after all, the program committee needs to make a binary (yes/no) decision, and they are looking for your help. Hence, in 95% of the papers you review, you should try to come to a simple yes or no decision. Note that this doesn't mean that you should make an ignorant, uninformed, or rash decision – rather, it means that the responsibility for coming to a decision is in your hands.

- **Most papers get rejected.** Another common mistake is to be too lenient, particularly once you start thinking about helpful tip number 1 above. Recall that most papers get rejected – in good conferences, up to 90% of submitted papers get the big NO from the committee. Hence, given a random sample, when you are reviewing, it is highly likely the paper you are reviewing will be rejected.

- **Reviews are venue-relative.** One thing you should realize is that not all conferences are equally good – and hence, your reviews should take this into account, at least somewhat. For example, in systems the most prestigious conference is SOSP – papers you review for SOSP should be excellent (or nearly so) along all axes of evaluation. A reasonably prestigious conference is the USENIX Annual Technical Conference, and in reviewing papers for it, you might be somewhat more forgiving if a paper is missing some aspect (*e.g.*, a really good evaluation). However, if you are to err, the best thing to do is to *always keep your standards high* – it is better to reject an OK paper than to accept one that you think is flawed because you think the conference is sub-par too.

- **Related work is your responsibility.** If you are reviewing a paper, it is your responsibility to know enough to review the paper. Hence, you may have to read some related work to see if the work makes a real contribution. Yes, this can be a lot of work! But the alternative is not acceptable – in the end, someone has to be able to judge whether the paper is different than related work, and that someone is you.

- **Short reviews are not (usually) acceptable.** As we stated above, longer, more thorough reviews, are always preferred. Indeed, if you are a graduate student, we will go ahead and say they are a must. However, if a paper is so poorly done as to not merit real consideration, it is acceptable to simply say so and be done with it – if the authors have not put in the work to make it worth your time to read, there is no reason for you to put in the work to help make their paper better.

- **Realize that some things can be fixed during shepherding.** Most systems papers are shepherded – meaning that a person (the "shepherd") will be assigned to make sure some things about the accepted paper get fixed before the final version is submitted. Hence, when reviewing, realize that some things about the paper will be fixable, *e.g.*, the writing, or even perhaps a single missing experiment. However, do *not* assume substantial changes will take place between the submitted and final versions.

- **Most comments you make should be author-visible.** Many review forms have a section that says: "comments to the program committee" (not to be seen by the authors). Use this sparingly if at all, for highly unusual comments (*e.g.*, "this author has plagiarized work in the past, so ..."). Virtually all of your feedback should be visible to the authors unless one of these special circumstances arises.

- **Journal reviews are a little different.** Most of this document is about reviewing conference papers, as conferences are the most important publishing target in systems (and Computer Science as a whole). In reviewing journal papers, realize that there a few differences. First, journal reviews tend to be even longer than conference reviews, so put in the time and really get into the details. Second, there is a better opportunity for a cycle of improvement, *i.e.*, you can suggest changes and recommend that the paper be accepted pending those changes; then the authors will make the changes and you will see the revised version. Third, there is no program committee. The similar role is served by the editor or editorial board.

9 An Example

Here is an example of a paper review that we did.

(ask Andrea or Remzi for some).

Acknowledgments

Provide feedback and become famous through your inclusion in this mighty acknowledgments section!

10 Conclusions

Good reviews make for good research communities. We have described some things to consider when writing a paper review. The most important thing to remember is that well-done reviews are hard to do and take time – don't feel bad if you are struggling, and plan ahead to ensure that you have the time to do the authors justice.