# A Guide for New Referees in Theoretical Computer Science*

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Your success as a scientist will in part be measured by the quality of your research publications in high-quality journals and conference proceedings. Of the three classical rhetorical techniques, it is *logos*, rather than *pathos* or *ethos*, which is most commonly associated with scientific publications. In the mathematical sciences the paradigm for publication is to describe the mathematical proofs of propositions in sufficient detail to allow duplication by interested readers. Quality control is achieved by a system of peer review commonly referred to as *refereeing*.

This guide is an attempt to distill the experience of the theoretical computer science community on the subject of refereeing into a convenient form which can be easily distributed to students and other inexperienced referees. Although aimed primarily at theoretical computer scientists, it contains advice which may be relevant to other mathematical sciences. It may also be of some use to new authors who are unfamiliar with the peer review process. However, it must be understood that this is not a guide on how to write papers. Authors who are interested in improving their writing skills can consult the "Further Reading" section.

The main part of this guide is divided into nine sections. The first section describes the Editorial process, the role of the referee within it, and some potential benefits of being a good referee. The second expands on the referee's role in enforcing quality control. The third describes the major categories of research papers. The fourth addresses the difficult subject of ethical behaviour in a referee. The fifth attempts to solve some common dilemmas that new referees may experience. The sixth describes the major categories of referee's reports. The seventh discusses the referee's obligation to improve the technical writing of the paper. The eighth describes the correspondence between the Editor and the referee. The ninth contains pointers to further information on the processes of scientific writing, refereeing, and Editing.



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## What and Why

Although the exact details of the Editorial hierarchy vary from one journal to another, the following idealized description is usually not too far from the truth. Every journal has a set of *Editors*, each of whom is responsible for papers within a certain specialized research area. Each paper submitted to the journal is delegated to an Editor, who selects referees and asks them to report on its merits and shortcomings. Referees are typically selected on the basis of expertise, ability, and performance. The Editor decides, based on his or her professional experience and the referees' reports, whether to accept the paper.

The Editor typically reports to the *Managing Editor* (sometimes called the *Editor-in-Chief*), who is the helmsman of the journal. The tasks of the Managing Editor often include making policy decisions, selecting Editors, acting as an intermediary between the publisher and the Editorial Board, and arbitrating disputes between Editors, authors, and referees. Some popular variants on this hierarchy include multiple Managing Editors, and an extra level of *Associate Editors*.

Your task as a referee is to evaluate the paper and submit to the Editor an anonymous formal report accompanied by a cover letter. The Editor will forward the referees' formal reports anonymously to the author with notification that the paper is either acceptable, acceptable contingent on certain conditions being met, or unacceptable. The audience of the formal report therefore consists of the Editor and the author, who desire the same information but have different perspectives.

It must be emphasized that the referee's task is purely *advisory*. The author bears ultimate responsibility for the correctness and presentation of the results. The Editor bears ultimate responsibility for accepting or rejecting the paper. The referee is expected to express an opinion on whether the results have merits, whether they are likely to be correct, and whether the presentation is adequate. The referee may voluntarily give the author the benefit of his or her expertise in proof-reading, debugging and improving proofs, and technical writing. However, the referee should beware of those who abuse the system by using the referee to perform time-consuming tasks that are the responsibility of the author.

All scientists have an obligation to uphold the standards of their field through careful and ethical refereeing. On a less abstract plane, competent refereeing can carry more concrete rewards.

### *Enhanced Reputation*

Junior referees have a chance to demonstrate their superior qualities to an Editor, who (one may usually assume) is a respected member of the theoretical computer science community. A reputation for being a fair, insightful, thoughtful, and diligent referee can enhance a budding career. Editors are often called upon to write recommendation letters for candidates who seek tenure, promotion, or a new position. They are quite likely to address the candidate's attitude toward refereeing.

### Goodwill from Editors

An Editor is likely to feel obliged to take extra steps to expedite the processing of a paper from a person who is known to be a good referee. A good referee may therefore be rewarded by having his or her papers handled by good referees in a timely fashion.

### Appointment to Editorial Boards

Performance as a referee is often an important factor in the nomination of new members to an Editorial Board. An unreliable referee is unlikely to become a reliable Editor. Membership of an Editorial Board confers, along with extra work and responsibility, considerable status in the community.

### Current Information

It is often said that the referee also has "a finger on the pulse" of the field by being sent journal versions of the latest papers, but this can be much over-rated. New results are usually well-advertised much in advance of the journal submission. Also, it must be remembered that the paper is submitted in confidence.

### More Work

One not-so-appealing consequence of being a good referee is that you will be in demand. However, most Editors will treat their best referees fairly.

## Quality Control

The Editor relies on the referees to help enforce quality control. It is to the advantage of the journal, the author, and the community to have high standards for publication. Desirable attributes for a paper include *correctness*, *significance*, *innovation*, *interest*, *timeliness*, *succinctness*, *accessibility*, *elegance*, *readability*, *style*, and *polish*. A distinction should be drawn between the *results* claimed by the author, the *proofs* of the results that the author has provided, and the *presentation* of the results and the proofs.

### Correctness

*Correctness* is desired of both the results and the proofs. The results may be correct, but the proofs wrong. The principles behind the proofs may be correct, but the author may have made minor technical slips. Halmos [15, 16], speaking of refereeing in the field of pure mathematics, is of the opinion that a referee is in no way required to certify whether a result is correct or incorrect, but need only indicate whether it "smells" right. Some theoretical computer scientists believe that this also applies to our field. In contrast, there are theoretical computer scientists who believe that checking correctness is the principal job of the referee. If a flaw is found, it is important to stress whether you believe the proposition to be true,



and if so, whether it is likely that the proof can be repaired. You are expected to spend some time in error-detection and correction, but you are not expected to do the author's research.

### Significance

The problems solved should be *significant* ones. Significance is sometimes a matter of personal taste, but it is often easy to rule out problems with obvious or trivial solutions, and problems that seem to be chosen by the author because they yield to the line of attack that he or she has chosen. You must be able to defend terms such as "obvious", "trivial", and "simple" if you wish to reject a paper on these grounds.

### Innovation

The results should be original and *innovative*, not trivial extensions or combinations of old results. The proof techniques should be new, or use a novel combination or application of known techniques.

### Interest

It is often not enough for a paper to be technically brilliant. Papers which provide motivation and put their results into a framework in order to develop a theory tend to be more *interesting* than papers which are little more than a litany of deep but obscure theorems. Although non-trivial mathematics plays a significant role in our research, we are in the business of understanding the nature of computation, not enumerating difficult-to-prove theorems about it.

### Timeliness

The appearance of the paper should be *timely*. The results should ideally be motivated by recent interest from the science community in related subject areas. Submission should not be delayed unnecessarily. The author may have been the first person to prove a certain result, but it is not necessarily in the best interests of the journal to publish it after the interest of the community has passed on (perhaps after more fundamental results have been established), or after it has passed into the folk-lore of the field.

### Succinctness

The proofs and the presentation should be *succinct*. The whole of the paper (including, for example, the definitions and explanations) should also be crisp and to the point. Simple proofs should not be obfuscated out of proportion to their true difficulty. Standard proof techniques (for example, cut-and-paste, adversary), which do not have to be spelled out in detail, can be used liberally. However, jargon and hand-waving are not sufficient. The paper must not be made succinct at the cost of accessibility.

### *Accessibility*

It is important that the paper be *accessible* to nonspecialist readers. It should be largely self-contained, and should include careful explanations of basic concepts. References to standard works can be extremely helpful, but they must not be over-used. Standard notation should be utilized wherever possible, but it must be remembered that it may be standard to only a small segment of the community. The technical details of the proofs may only be accessible to experts, but the paper must nonetheless contain something for the casual reader.

### *Elegance*

The proofs should also be *elegant*, that is, intellectually satisfying. One should aim for *The Book Proof*[1]. It should be remembered, however, that this goal is frequently very difficult to obtain, particularly during the initial incubation of the results when the theoretical framework is not well-developed.

### *Readability*

*Readability* is an important but often sadly neglected attribute. The information in the paper should be available to the reader with a minimum of effort. This does not mean that the reader is not expected to be able to fill in some of the details. It would be redundant to fill in every last detail of every proof, since the majority of readers share a "cultural background" of common proof techniques. Both a dearth and an excess of detail can make a paper unreadable.

### *Style*

The manuscript should be written with *style*. That is, it should be well-structured, with flowing prose and scholarly vocabulary and grammar.

### *Polish*

Finally, the paper should be *polished*, that is, it should reflect care taken by the author in all aspects of its preparation.

## A Taxonomy of Research Papers

Most research papers can be described as being either *breakthrough*, *ground-breaking*, *progress*, *reprise*, *tinkering*, *debugging*, or *survey*. The salient points of each category are described below. Our field benefits from high-quality papers in all categories *provided they make a genuine contribution*. Nonetheless, a paper does not have to be published just because the

[1]According to Paul Erdős, God has a Book containing the most perfect proofs of all Theorems. Every mathematician is permitted to look at a single page of *The Book* before he or she is born, and spends his or her life in a struggle to regain that lost perfection.



author has worked hard. You must remember that both rejection and acceptance recommendations require equal justification. Although quality is a matter of individual taste which varies within the community, there are certain accepted norms which become apparent when a large amount of published material is examined. You must ensure that you set personal standards that are neither unrealistically high nor unrealistically low.

### *Breakthrough*

It solves an open problem which has resisted attack by the concerted effort of a substantial part of the community for a considerable period of time. (For example, logarithmic depth sorting networks were thought unlikely until Ajtai, Komlós and Szemerédi [5]).

### *Ground-breaking*

It opens up a field so far not well explored or understood, and lays a firm foundation. (For example, the difficulty of finding locally-optimal solutions to optimization problems was not properly addressed until Johnson, Papadimitriou, and Yannakakis [18]).

### *Progress*

It raises and solves important new open problems, or solves open problems that have recently been posed. Most papers fall into this category.

### *Reprise*

It provides a superior proof of a known result. *Elegance* and *insight* are two important properties that this type of paper must possess. It is expected that the new proof be shorter, easier to understand, more elegant than the original, or illuminate connections and foundational issues that were previously only poorly perceived. (For example, Adleman and Loui [4] provide a direct proof of a result of Hopcroft, Paul and Valiant [17]).

### *Tinkering*

It extends a known result by a more careful but non-obvious analysis. (For example, Parberry and Yan [23] extends a result of Cook, Dwork and Reischuk [7]).

### *Debugging*

It elucidates and repairs a previously undiscovered flaw in published work. The repair may, for example, consist of a corrected proof of the original theorem or one very similar to it, or the proposal and proof of a radically different theorem.

### *Survey*

It surveys and unifies a specialized subject with modern notation, terminology, and proof techniques, often collecting together results which appear in obscure or difficult-to-obtain publications, or are part of the folk-lore of the subject.

## Ethics

Most referees prefer to remain anonymous because it is not always easy to predict how an author will react to a deservedly bad report, however well intentioned and eloquently stated. You must never abuse this privilege by using anonymity as a shield for unethical behaviour. It is difficult to remain completely anonymous. Every writer has a unique style, and idiosyncrasies in philosophy and notation can also help alert the author to your identity. Although referees can breach their anonymity by signing their referees' reports or approaching the author directly, it is not often done in our field. It should be undertaken only with the approval of the Editor.

The referee has great power over the author. A series of bad referees' reports can seriously damage the career of a scientist, or at the least severely damage his or her self-esteem to the point where productivity is reduced. With power comes the ethical responsibility to avoid its abuse. Desirable traits in a referee include *objectivity*, *fairness*, *speed*, *professionalism*, *confidentiality*, *honesty*, and *courtesy*.

### *Objectivity*

You are to judge the paper impartially on its own merits, untainted by personal prejudices and preconceptions. Extraneous issues such as the institution, nationality, fame, and personality of the author must not affect that judgement. Ethical referees do not seek to enhance their reputation at the cost of the author. If you feel that you cannot be objective, you should return the paper to the Editor immediately and explain that you cannot referee properly.

### *Fairness*

You are obligated to give the results a fair hearing rather than reject the paper superficially, particularly if the author espouses a point of view or philosophy which opposes yours or that of a significant fraction of the scientific community. You may encourage the author to mention other points of view (provided your actions are not motivated by mere self-aggrandisement), but a paper should not be rejected merely on the grounds of "misguided philosophy". If you feel that you cannot be fair, you should return the paper to the Editor immediately and explain that you cannot referee properly.

### *Speed*

A good referee completes the task quickly. A long delay in refereeing adds significantly to the other delays inherent in the publication process, such as Editorial time, mail, typesetting,



proofreading, and publication backlog. There is some contention within the community as to how long a referee's report should take. Successful scientists are usually overworked, so some delay is inevitable. Very few members of our community would agree that a referee's report should take less than a month or longer than a year under normal circumstances. Most will agree that a period of three to six months is reasonable, depending on the length and level of difficulty of the paper. A good referee's report takes thought, effort and time, particularly if the paper is long or complicated. Most (but not all) Editors realize that unreasonably short deadlines lead to hurried reports, which are necessarily of less benefit to the author of the paper and the readers of the journal. It is accepted behaviour for a referee to politely refuse an Editor's request if the deadline is unacceptable (either on principle or due to overwork). In this case the paper must be returned with a formal letter indicating the referee's position. It is a service to the Editor to suggest names of others who might be willing to serve instead. If the paper must be returned (for this or any other reason), do so promptly.

### *Professionalism*

A good referee acts in the interests of the author as well as the journal. If the paper is unacceptable, you should explain this firmly, unambiguously and politely. It is to the author's advantage to publish good papers. Bad papers do not enhance an author's reputation, and once published they are permanently on record. If the paper is acceptable, you should try to ensure that the best possible version of it is published. To that end, a list of improvements is almost always part of the referee's report. You can recommend acceptance contingent on these changes, but the Editor is the final arbiter. It is polite to include improvements even if the paper is to be rejected. Whilst many look upon this as a waste of time, it can be of great benefit to the author. Criticism should be specific rather than vague (for example, *which* new references to include, *what* new proof technique to use, *how* the presentation should be changed), constructive rather than destructive. If the specific errors are too numerous to list individually, a few key examples should be chosen from the principal equivalence classes.

### *Confidentiality*

All papers submitted to journals or conferences are submitted in confidence. You must respect the right of the author to confidentiality. This includes use of the results (particularly when the paper is to be rejected), the outcome or projected outcome of the submission, and even the fact that a submission has been made. Whilst it is acceptable to make use of preliminary versions of the results which have appeared elsewhere, the submitted manuscript is sacrosanct until it has been publicly accepted. You are not in competition with the author. If a possible conflict of interest could arise, you should discuss it with the Editor.

### *Honesty*

It is important to be honest about your report and not misrepresent the significance of your opinions. For example, how expert do you perceive yourself to be on the specific topic of the paper? How expert do you perceive yourself to be on the general field of the paper? Do you contribute to the literature regularly, follow it assiduously, maintain a mild interest, or just follow related topics? How closely did you read the paper? Are you sure of the results? Are you sure of the technical detail of the proofs?

### *Courtesy*

You should treat the author with the courtesy due a learned peer. All criticism should be constructive, couched in firm but non-inflammatory tones, and limited to the paper in question. Epithets and personal observations are unforgivable. There is a place for bluntness, but allowances should be made for the possible inexperience of the author while avoiding condescension. Before submitting a finished report, a wise referee asks

*"Would I be embarrassed if this were to appear in print with my name on it?"*

If the answer is "yes", then the report should be rewritten.

## Some Common Dilemmas

The following questions are among those most commonly asked by new referees.

*"How many papers should I be expected to referee per year?"*

A rule of thumb is that a you should do at least as much work for the community as the community does for you. Since journal papers average around two referees each, you should referee about twice as many journal papers as you submit. It is acceptable to weight this with the length and difficulty of the papers and the amount of effort that is put into refereeing. Since a reasonable publication rate is one to three papers per year in refereed journals, a reasonable refereeing load is two to six papers per year. The effort involved in refereeing conference papers is less because the shorter deadlines and length limitations result in more superficial refereeing. Nonetheless, the principle of equal work should be maintained.

*"How much time should I put into a paper?"*

The short answer is "whatever it takes, within reason". A long or complicated paper will take more time than average. Most Editors will take this into account. If this leads to overwork, you should start refusing requests. Sometimes the Editor will send back your returned paper if he or she wants *your* opinion and is willing to tolerate the delay. If you must neglect some of the responsibilities in order to meet a deadline or avoid over-work, the Editor should be notified clearly in the cover letter and report. This is preferable to misleading the Editor into thinking that you have done a thorough job. You are justified in abandoning an excruciatingly badly written paper, or one which has fundamental and probably insurmountable flaws. It is the responsibility of the author to meet certain minimal standards before refereeing can take place. In this case you should make it clear to the Editor exactly how much of the paper you have read.

*"What is the relationship between journal and conference versions of a paper?"*



Technical journals have dual roles: they are an archival medium and a forum for the dissemination of the latest research. Conferences with proceedings fulfil the same two roles, but with more emphasis on dissemination. There is usually a severe limit on the length of the papers that appear in conference proceedings, and they have a less careful refereeing process (papers are judged ruthlessly, and there is typically little or no attempt made to improve them). A journal referee must determine whether a previously published conference version of a paper has fulfilled the archival and forum roles. A journal version of the paper ought to be significantly different from the conference version. Both the technical results and the presentation should be substantially improved. The inclusion of more details is usually a necessary but almost never a sufficient condition for publishing a journal version of a conference paper. A journal version ought to be timely. If the author has delayed submitting the journal version of a paper for a substantial amount of time, you are justified in rejecting it when it has already received adequate attention, particularly when it has become part of the folk-lore of the field (an extreme example is the seminal paper of Cook [8] which has never appeared in a refereed journal). However, you are not equally justified in making the same recommendation when delays in the handling of the paper have had the same result. A delay of six months between publication of the conference proceedings and submission of the journal paper is acceptable, but two years is clearly not. The ACM and IEEE have drafted strict rules about accepting conference papers for their journals.

*"What if I am actively working on the same problems?"*

One of the more serious conflicts of interest occurs when the referee has been working on the same problems as the author. If you have recently proved the same or very similar results, but have not yet written them up, there are a number of options available. Ethically, the right thing to do is to be honest and open. You should ideally consult with the Editor. The approach to be taken will depend upon the exact circumstances, including the relationship between the results (who has the most results, the tighter results, the best proofs, the best presentation), whether the submitted paper has had wide circulation (for instance, in a conference), and the time scales involved. You can choose to either abandon your results, donate them anonymously to the authors, suggest that a note be added along the lines of "these results were independently discovered by ...", or contact the authors and offer to become a co-author of a combined paper (in which case the refereeing must be declined). This is a matter of great delicacy which must be handled carefully by all concerned in order to protect both the author's and the referee's right to confidentiality. If you have already written up your results, and particularly if they have been submitted for publication, then the case for independent discovery has been clearly established. Otherwise, it is not strictly ethical to put aside the submitted paper once you learn that you have competition, and work towards finalizing your results. In the final analysis, it is up to you to decide, perhaps with advice from the Editor, whether you can approach the job of refereeing with a clear conscience.

*"Should I recommend resubmission to a "lesser" journal?"*

Ideally, all journals in theoretical computer science should have the same publication standards. In practice, however, it is well-known that some journals have higher standards than others. It is best for the community if all journals have high standards. You are expected to form standards of your own, and to adhere to them regardless of the particular paper being refereed or the journal to which it is submitted. Whilst you may comment on whether the paper is "good", "excellent", "outstanding", etc., comments to the effect that the paper is not good enough for the journal to which it has been submitted are in bad taste. In particular, the referee should avoid the temptation to tell the author to try a "lesser" journal. It is up to the Editor to determine whether the level of excellence of the paper is sufficient for the journal. The referee may express an opinion in the cover letter. It is generally considered acceptable for the referee to recommend resubmission to another journal for other reasons, such as scope. You may also recommend that the length of the paper be reduced to the point where it is commensurate with the significance of its results, and that the paper be resubmitted to a journal which accepts short publications.

*"Should my recommendation go into the report?"*

There is some difference of opinion in the community as to whether the referee's recommendation should be included in the report, or given confidentially to the Editor in the cover letter only. There are arguments in favour of both sides. If the referee's recommendation is confidential, the Editor has the freedom to make a different decision without further justification to the author. On the other hand, one can argue that the author has a right to the information. Some journals (for example, *SIAM Journal on Computing*) insist that the referee's recommendation remain confidential.

## A Taxonomy of Referee's Reports

Most referees' reports tend to fall into (or close to) one of a small number of categories. The following is adapted from Fischer [10].

### *The Subject is Out of Scope*

The paper is not of the type usually published by the journal. It may not be theoretical enough, or the journal may be a special-purpose one. You should suggest more suitable outlets.

### *The Results are Published Elsewhere*

The key results of the paper have been published elsewhere. The remainder of the paper is not suitable for publication without these results. The referee's report typically consists of one line and a reference. If the new proof has its merits, the author should be encouraged to rewrite the paper as a "reprise" paper.

### *The Problems are at the Level of a Graduate Student Exercise*

The paper contains results which are extremely easy to derive. It should be rejected if the *problem* is genuinely at the level of a Graduate exercise. A wise referee is extremely careful



when making a recommendation of this sort. A *solution* which is at the level of a Graduate exercise is to be lauded, not criticised, if the problem was previously thought to be non-trivial. Many problems which once seemed difficult can now be set as Graduate exercises, because we have the advantage of hind-sight. The initial research which illuminated the problems is not diminished in any way. For example, many $\mathcal{NP}$-completeness proofs are hard to obtain but easy to verify. You must not confuse easy verification of a paper's results with the difficulty of obtaining them. Particular care must be taken with "reprise" and "tinkering" papers.

### *The Results are of Minor Significance*

The only significant results in the paper are a minor extension of previous work. It may be acceptable if its length truly reflects the significance of the results. You can recommend acceptance contingent on the author reducing its length appropriately.

### *The Paper Contains Major Errors*

The paper contains major mistakes which you suspect are insurmountable. You are not expected to spend a large amount of time determining whether the errors can be corrected. This is the author's task. You should express an opinion nonetheless, to give the Editor some idea of whether the paper merits further attention. Unless you have strong feelings to the contrary, you should expend some effort on the rest of the paper, and recommend that the author be invited to repair the breach and resubmit the paper. If you strongly suspect that the problem cannot be surmounted by the techniques used by the author (which is typical, for example, of papers which purport to prove that $\mathcal{P} = \mathcal{NP}$), you may abandon it once the fatal flaw has been located.

### *The Paper is Boring*

The paper is intrinsically uninteresting and lacks motivation. The results, and the methods used to obtain them, are unexciting (perhaps simple but tedious case analysis, or detailed but uninspiring algebraic or arithmetic manipulation). If the paper nonetheless appears to make a genuine contribution, you can recommend that the author condense the tedious material. It can often be replaced with descriptive statements such as "proof by induction" or "a simple but tedious case analysis will show ..." and some hint as to where the difficulty, if any, lies.

### *The Paper has High Density per Unit Progress*

The paper achieves a minor improvement in a previously known result using major machinery. This is not to be confused with a new, elegant technique which has potentially important applications. The significance of the result is too small for the length of the paper. Once again, you can recommend that the author condense the paper if you feel that the results warrant it.

### *The Paper has Poor Exposition*

The author has not done an adequate job of writing up the results. In some cases the writing is so bad that you cannot tell what is in the paper. For example, the model may not be clear, notation may be undefined or abused, and the statements of the theorems (let alone their proofs) very difficult or impossible to understand. Essentially, the research is only partially done. It is more like a preliminary report than a polished paper. The author should be advised to complete the work before the refereeing process can take place.

In other cases you may be able to determine in a reasonable length of time what the results are and whether they are likely to be correct. Even if there are some mistakes in the proofs, the results are probably right, and the proofs contain sensible ideas which can be pushed through. In this case you should state in your report that the paper probably contains something good despite the fact that it is badly done, and recommend that the author be invited to submit a revised version. Your report will typically be long, including specific examples of what needs to be corrected and perhaps suggesting a major reorganization. It is not necessary for you to rewrite portions of the paper. If the revised version is not substantially improved, your subsequent referee's report should be short: "The paper wasn't fixed and my opinion hasn't changed".

### *The Paper is Clearly Acceptable with a Few Minor Changes*

The results and the proofs in the paper are basically sound, but the paper can be improved in minor ways. You should list the improvements that you think are essential, and recommend that the paper be accepted contingent on the author dealing with them to your satisfaction. Perhaps specific paragraphs or definitions need to be clarified or corrected. The paper may need more intuition and descriptive prose. The proof of a theorem may actually give a stronger result than stated. An uninteresting or tedious portion of the paper might be better omitted. You may suggest that the author add a paragraph contrasting a specific result in the paper with a similar result of another author. If it looks like a technique could be used to obtain a stronger result, you can request that the author look into it and either strengthen the result or mention why the apparent extension is unfruitful.

### *The Perfect Paper*

This very seldom happens. The referee's report is typically quite short. Usually a summary and some words of praise are all that is required.

## Technical Writing

Many respected members of the community vehemently object to including technical writing in the tasks expected of a referee. They argue that the referee is usually too busy to cope with such details. This may well be true, but the referee who does not take at least some time over these "details" is doing the author, the journal, and the community a grave disservice. It is sometimes said (particularly by undergraduates) that the details of technical writing



are beneath the notice of a scientist of any worth. The implied contrapositive, that scientists who are concerned with such details are not first rate, has obvious counterexamples. It is the belief of a non-trivial subset of our community, including Knuth [19], that writing skills are a necessary part of the training of a scientist. Poorly written papers do not reflect well on any field. Halmos [14] (reprinted in [25]) is particularly eloquent on this point.

Your evaluation of the paper may include comments on the technical writing issues listed below. Of course, you are not expected to perform the duties of a full-time professional technical writer. In particular, you are justified in returning a paper if it is clear that the author has not adequately proof-read it. It is understood that referees will be reticent about expressing an opinion on the writing skills of the author if they consider their own to be inadequate.

### *Language*

It is to the benefit of the author, the journal, and the community that the paper appear as literate as possible. This includes vocabulary, spelling, and grammar. Although the task of reading an illiterate paper is extremely frustrating, the referee should avoid letting this frustration turn to anger, particularly in the case of papers by authors who are not native speakers of English. English appears to be the dominant language in Computer Science, but it is a fact of life that a large percentage of the productive and significant members of our community have a different first language. You should try to see things from their perspective and do all that is reasonable to assist them.

Misunderstandings are often caused by the fact that American English is different from British English. Authors from many non-English speaking countries may use British English. Whilst many American Editors use Strunk and White [26] as a guide to correct English style, by British standards it is often incorrect or at best misguided. Almost all journals in our field will accept either British or American English. If the journal has no preference, then the referee should not exhibit personal bias. For spelling, Americans abide by *Webster's Dictionary* and the British by the *Oxford English Dictionary*. Spelling ought to be less of an issue now that most authors in our community use word-processors and hence cannot be excused for not availing themselves of the cheap and sophisticated spelling checkers which are readily available.

### *The Passive Voice*

It is customary in our field to use the first-person plural pronoun instead of the passive voice. For example, "we will prove that ..." is used instead of "it will be proved that ...". Injudicious use of the passive voice can make a paper unnecessarily ponderous. The passive voice is still used exclusively in certain other scientific disciplines, despite the fact that it is currently out of vogue with modern proponents of technical writing.

The first-person plural pronoun is used even in singly-authored papers. "We" means "the author and the reader", for example, "we will prove that ..." means "the reader will be able to construct a proof from the description of the author that ...". The first-person singular pronoun is traditionally frowned upon as being unnecessarily arrogant and egocentric.

### *Title and Abstract*

The title of the paper should clearly and succinctly describe the subject of the research. "Cute" but uninformative titles are considered inappropriate, but the occasional pun is tolerable. The Abstract is supposed to communicate the results in the paper to the reader who is too busy (or not interested enough) to read the whole thing, and also serve to tempt the curious reader into reading further. It should be short, including a sentence or two of motivation, a sentence or two of definition, and a short description of the major results. Technical details should be kept to a minimum. It should be specific, choosing "a quadratic time algorithm for the frimfram problem is presented" rather than the less informative "the computational complexity of the frimfram problem is investigated". Since many review publications excerpt only the title and Abstract of a paper, the Abstract must be completely self-contained, accessible to the non-expert, and must remain appealing when read in isolation. For the same reason, it is usually written in the passive voice (as are both examples in this paragraph).

### *Introduction, Notation, and Definitions*

The Introduction should be an expanded version of the Abstract, but not merely a reiteration of it. The Introduction should include a description of the major results in the paper and their significance, and history of earlier work on the subject. The notation should be convenient, intuitive, as "standard" as possible, consistent, concise, and elegant. The definitions should be intuitive, readable, concise, unambiguous, and should indeed be "key" concepts.

### *Figures, Tables, and Examples*

Figures, tables, and examples can be of great assistance to the reader. However, if they are too numerous, too few, or inappropriate, then they can be a great hindrance instead. Figures and tables should be legible, instructive, and adequately labelled and titled. Examples should be detailed enough to illustrate the desired concept, but not to the point of tedium.

### *Bibliography*

The Bibliography should be *correct* (the attributed results must appear in the referenced paper), *accurate* (the right volume and page number, etc.), *up-to-date* (recent breakthroughs and accepted history should be acknowledged), and *accessible* (crucial references should not be to papers that are "in print", or in obscure or out-of-print publications). The reference list should not be over-done. Only papers that are truly relevant should be mentioned. Every paper in the reference list should be referred to at some point in the text.

## Correspondence

The correspondence between Editor and referee usually follows a set pattern.



1. *The Request:*

   The Editor's initial request to the referee will typically be via a form-letter accompanied by a manuscript. The manuscript should be returned if the referee refuses the commission.

2. *The Reply:*

   Some Editors want a formal reply, whilst others are more *laissez faire*. Some include a reply card which is returned by the referee if the commission is accepted.

3. *The Reminder:*

   If, after what the Editor considers to be a reasonable amount of time, no report is received, the referee will receive a reminder that it is overdue.

4. *The Report:*

   The referee submits a formal report accompanied by a cover letter.

5. *The Resubmission:*

   The Editor notifies the author of his or her decision, including anonymous copies of the referees' reports. The author is given a chance to respond, and if the Editor feels it is warranted, resubmit the paper after revision. The Editor may choose to send the revised version of the paper to the referees for a second, and (exceptionally) a third pass.

6. *The Thank-you Note:*

   Once the final decision has been reached, most Editors will acknowledge the referee's effort with a short form-letter expressing gratitude.

7. *The Follow-up:*

   Exceptionally, Editors will notify the referee as to the disposition of the paper, and occasionally provide referees with anonymous copies of the other referees' reports. This is a productive practice which should be encouraged, particularly for novice referees, whether or not the referee has done a good job.

Some of the above correspondence can be carried out by electronic mail, particularly items 2, 3, 6, 7, and occasionally 4. This is a time-saving development which is rapidly becoming more popular. Respondents must realize that electronic mail is very insecure. You must ensure that you neither refer to the authors by name, nor mention the full title of the paper. An abbreviation, acronym, or an anonymous administrative code (if the journal uses one) is preferable. The confidentiality of the paper must be preserved. Although some journals encourage the submission of referees' reports by electronic mail, the referee may put his or her anonymity and the author's confidentiality at risk by doing so.

The referee's report to the Editor is always accompanied by a cover letter, which should contain:

- Your name and address

- The title and authors of the paper, and any bureaucratic code or number that the journal may have assigned to the submission
- Your level of expertise in the specific subject area covered in the paper
- Your level of effort
- A brief summary of your recommendation and justification
- Correspondence that you wish to keep private from the author.

Note that the cover letter is a synopsis; it does not take the place of the formal report. Although the cover letter provides a place for the referee to communicate privately to the Editor, it should not be used to mount a "sneak attack" on the author.

The title and authors of the paper should also appear prominently on the first page of the formal report. The first paragraph should contain a synopsis of the paper and its significance, carefully written for fast comprehension by the Editor. Criticism of the results, the proofs, and the presentation should be separate and clearly delineated. Possible improvements to the results, the proofs and the presentation should be clearly separated from the criticisms. The following information is helpful to the Editor and author.

- A brief synopsis of the paper and its significance.
- (Optionally) Your recommendation.
- Constructive criticism of the results, proofs, and presentation.
- Possible improvements.
- A table of typographical errors.

You should keep in mind when writing the cover letter and formal report that the key points are your recommendation and your justification of it.

## Further Reading

Lock [20] is a scholarly study of peer review in the sciences, concentrating on the medical sciences and those closely related to it. It is particularly invaluable for its bibliography, which we will not attempt to duplicate. Forscher [11] is a useful guide for referees in the classical experimental sciences. Smith [24] is a recently written replacement slanted towards experimental computer science. Knuth, Larrabee, and Roberts [19] contains a section on refereeing. Some unpublished guides have been circulated informally within the computer science community, for example, Gifford [13], and Knuth (reprinted in [19]). Halmos has some sensible advice about refereeing pure mathematics in his "automathography" [15, 16]. Much of it is relevant to theoretical computer science. Bishop [6] is an invaluable guide to the scientific editorial process which deserves scrutiny by Editors, referees, and authors alike.

Technical writing texts abound, but not all are relevant or useful to the mathematical sciences. Knuth, Larrabee, and Roberts have published an invaluable collection of lecture notes on technical writing for mathematicians and theoretical computer scientists [19]. The American Mathematical Society has convened at least two committees charged with providing guidelines for mathematical writing. Their publications [3, 25] are well worth consultation. A book by Day [9] is slanted towards the experimental scientist, but contains some advice which is useful for the mathematical scientist. Advice from other fields (see, for example, [1, 2, 12]) is useful, but one cannot help but notice that the guidelines vary widely from one field to another, and even from one authority to another. Almost all technical writing texts ignore the benefits and problems of word-processing.

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Mike Langston, Editor of *SIGACT News* (acting on a suggestion from Jeff Shallit), was the driving force behind this guide. It would have been the poorer were it not for the outpouring of opinions, suggestions, leads, and constructive criticism from the theoretical computer science community. A great many people responded to a TheoryNet call and individual requests for advice, and read two rough drafts of the manuscript circulated sporadically by mail and a later draft circulated at *FOCS '89*. Their opinions, suggestions, leads, and constructive criticism are greatly appreciated. The respondents include Richard Beigel, Ed Blum, James Burns, Faith Fich, Mike Fischer, William Randolph Franklin, David Gifford, Juris Hartmanis, Stephen Judd, Donald Knuth, Pierre Lescanne, Nick Littlestone, Michael Merritt, Mike Paterson, Joseph O'Rourke, Jan Pachl, David Plaisted, Alejandro Schaffer, Jeff Shallit, Mark Tuttle, Paul Utgoff, Ian Witten, and Paul Young, amongst others who wish to remain anonymous. Inclusion of their names in this list does not necessary imply their complete accord with the material contained in this guide. Of the above, the author is particularly grateful to David Gifford and Donald Knuth for sending manuscripts, and Mike Fischer for permission to adapt his "Taxonomy of Research Papers". As always, the author is grateful to Virginia Holt for her valiant attempts to improve his technical writing skills.

An earlier version of this guide has already appeared in print (Parberry [22, 21]). Since then, a few minor changes have been made in order to improve the clarity of the presentation, and incorporate sensible suggestions from Albert Meyer and Donald Knuth.

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