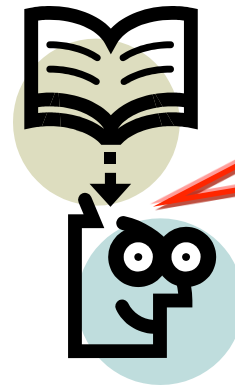# Writing a Research Paper

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This paper is not as terrible as the other junk that I reviewed

We are honored to receive such praise from the all-knowing one

Author

How to impress Prof. Skeptic, the reviewer

# Outline

- Common mistakes

- The writing process

- Organizing the contents

# Common Mistakes

- Plagiarism

- Passive voice

- Typographical errors

- Not explaining your contribution

- Inconsistent results

- Style over substance

# Plagiarism

- Do not steal others' ...
  - Ideas
  - Words
    - Rewrite others' material in your own words, when necessary, and cite the reference
    - Citing a reference does not justify using its words
    - If you must use a short quote from elsewhere, then make it clear by putting it in quotes, and perhaps writing it in italics
      - Cite the reference too
      - Avoid quoting as far as possible
  - Figures
    - Just because it is easy does not make it right
  - Conference management systems have tools (eg, docoloc) to detect plagiarism

# Self Plagiarism

- Don't submit work you have already published
  - If you made improvements to prior work, then clearly identify them in the paper and cite the earlier work
  - Identify any result in the current paper that has already been published

- Don't submit to two venues simultaneously
  - Most conferences and journals prohibit this
  - It may be ok to do this for poster sessions and venues, such as most SIAM conferences, which require just abstracts
  - Ask the program chair, if you have any doubts

- It may be ok to reuse figures and some background material from **your own** prior work
  - But beware of copyright issues

# IEEE Policies

- IEEE PSPB Operations Manual, section 8.2.4
  - Uncredited copying of > 50% of the paper
    - 3-5 year ban; up to life time ban for multiple repeated violations
  - Uncredited copying of 20-50% of the paper
    - 1-3 year ban; up to life time ban for multiple repeated violations
  - Uncredited copying of up to 20% of elements, such as paragraphs, sentences, and illustrations
    - Apology and notice of violation published; 1 year ban for repetition
  - Uncredited **improper** paraphrasing
    - Apology and notice of violation published; 1 year ban for repetition
  - Credited copying of a major portion without clear delineation
    - Apology and notice of violation published; 1 year ban for repetition
  - Not properly citing author's previous work
    - 1 year ban for multiple repeated violations
  - ...

# Passive Voice

- Let passive voice be avoided
  - ... better: 'Avoid using passive voice'
- In judging a paper, it is important for the reviewer to know what you did versus what someone else has done
  - Passive voice makes it easy to avoid mentioning the doer
    - Example: 'The effect of affinity on network bandwidth utilization was studied'
      - Studied by whom?
      - If you studied it, then claim the credit
        - 'We studied the effect of affinity on network bandwidth utilization'
      - If others did, then give them the credit
        - 'Sudheer et. al. [3] studied the effect of affinity on network bandwidth utilization'

# Typographical Errors

- Typographical errors create a bad impression
  - The reviewer may not explicitly reject a paper because of typographical errors, but may sub-consciously decide to reject it
    - Once the reviewer decides to reject a paper, it is very easy for him to come up with technical reasons for rejecting it
  - Reviewers have a heavy work load and would love a paper that is a clear reject, so that they can save themselves some time
    - Don't tempt them with your typographical errors
- It is a sin to have spelling mistakes that could be caught by a spell checker
  - Always spell check the final version to catch errors you might have introduced while correcting another error
- References too should be free of typographical errors
  - Beware of capitalization errors when using bibtex

# More typographical Errors

- Use consistent formatting.

- Common typographical errors
  - Extra blank spaces
  - Missing blank spaces
  - Capitalization errors

- Can you identify three typographical errors on this slide?

Was it accidental, or are they being mean to me?

... as mentioned in Prof. Septic's work [3], ...

# Not Explaining Your Contribution

- Clearly identify your contribution
  - Mention related work by others
  - Mention your related prior work
  - Mention what is new about your current work
    - How does it differ from the above two categories?
    - Under what conditions is your method better?

The significance of this work lies in demonstrating that the Cell has good potential for running intra-Cell MPI applications.

The primary contributions of this work lie in demonstrating the utility of the matrix multiplication approach and also in providing an implementation that is efficient for small DFTs when a GPU is used to accelerate an application running on the host.

# Explain Your Contribution

- Quantify the significance of your work if possible
  - Example: You write -- 'We obtained much better speedup than [3,4] on practical applications on massively parallel machines'



They probably obtained 0.01% improvement using two cores on obscure applications

- Write: 'We obtained 20-30% greater speedup than [3,4] on all HPC Challenge benchmarks on a 1000 node Xeon cluster'

# Inconsistent Results

- Ensure that your results don't contradict each other
  - For example, speedup results should be consistent with timing results
  - Timing results for components of your computation should be consistent with timings for the total computation
    - Ensure that your timer has sufficient resolution for the timing that you are performing

# Unreasonable Results

- Ensure that you results don't contradict theoretical bounds
  - For example, the Gflop/s you obtain cannot exceed the peak performance of the machine that you are using
  - Check your results to make sure that they are reasonable
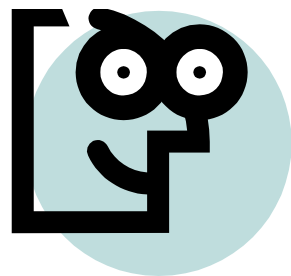
and our algorithm ran at twice the speed of light in vacuum.

# Style Over Substance

- Great language cannot compensate for poor science
  - Use simple, clear language
  - If the reviewer can understand what you have done and why it is important, you have achieved more that most manuscripts do
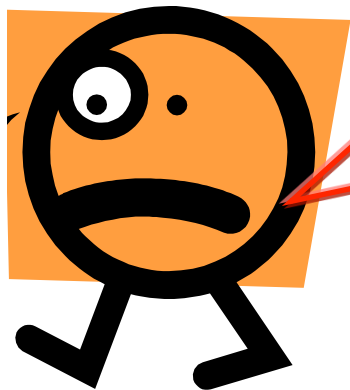
What a terrible disease. I hope I can't get infected by reading about it.

... and the *kurtosis* was ...

# Style Over Substance 2

■ Don't praise your work too much

> The reviewer should praise your work

> You should explain your work and present results that make the reviewer praise your work

Paper Rating

 1  Weak accept
 0  Borderline
-1  Reject
-2  Reject with deep
    contempt  **X**
-3 Reject with
   public ridicule

*I am* God's greatest gift to humanity. How dare they make false claims.

... and our work is God's greatest gift to humanity.

# Style Over Substance 3

- Don't exaggerate the significance of your work
  - It may just irritate the reviewer
  - It is ok to make your work sound exciting
    - You would not be writing about it if you did not find it exciting
    - But, a nice idea does not become 'a new paradigm'
    - A nice result does not become a 'breakthrough'

It looks like they plan to revive the sun dial.

Our solar clock promises to change the course of humanity by eliminating toxic waste, reducing ...

# More on Writing Style

- Avoid technical jargon and explain any that you need to use
  - *If the reviewer does not understand your paper, then he will not accept it*
  - Don't assume that the reviewer has expertise on the specific problem on which you have been working
  - You cannot make your work sound profound by making it hard to understand
    - You just show poor writing skill!

I don't understand this paper. Either I am not the greatest genius the world has ever seen, or this paper is too badly written to be accepted.

What will Prof. Skeptic do?

# The Writing Process

- Why are you writing this paper?
- The writing sequence
  - Decide on the title
  - Write the abstract
  - Write an outline
  - Then refine it, by adding more details
  - Fill in the details
- Check for typographical errors
- Hire someone to improve your writing, if your English is not good

# Why Are You Writing This Paper?

- Which **one** of the following is a valid reason for writing a paper?
  - It will make you famous
  - It will help you get a job
  - It will help you get into a good graduate program
  - You have performed hard work and need to be rewarded with a paper
  - You have something to share with the research community, which will be useful for others to know

In conclusion, we have clearly shown that one can get a good job by publishing in this conference ... oops. Did I really say that?

# Why Are You Writing This Paper? 2

- You have something useful to share
  - Throughout the writing process, keep in mind that your goal is to help the reader by sharing the results of your work
  - Your goal is not to impress the reader about your brilliance or other good qualities
  - Your goal is not to describe all that you have done
    - There are billions of people in the world working very hard
    - The reader does not want to know what every one is doing
    - The reader wants to know that which will help him
    - Everything you write should support the central goal of explaining your useful contribution to the reader

# The Writing Sequence

- **Suggested sequence**
  - Decide on the title
  - Write the abstract
    - Clearly identify your main contribution
  - Write an outline
    - Include entries for each section
    - Include the main points for each section
    - Check if the outline has a good flow
  - Refine the outline
    - Mention the main point for each paragraph
      - Each paragraph should have only one point
      - The sentences in a paragraph should be connected
  - Fill in the details

- **Alternate sequence**
  - Describe your novel contribution and empirical result
  - Write other sections
  - Write the introduction
  - Write the abstract
    - After all, we don't know what our contribution is until we finish the section on empirical results
  - Repeat the above steps, refining your paper, until five minutes before the deadline

- **My criticism**
  - If you cannot first identify your main contribution, why write a paper?
  - In the former sequence, the abstract shows you the focus of the paper
    - This guides you throughout the writing process

# Check For Typographical Errors

- Proofread the manuscript carefully, but just a few times
  - You will stop noticing errors after you proofread the document a few times
  - Have each co-author proofread the document
- Run a spell check before final submission
  - Do this even if you have performed the spell check several times already, and think that you have not made any error since your last spell check

# Organizing the Content

- A common pattern
  - Title
  - Abstract
  - Introduction
  - Related work
  - Your novel contribution
  - Empirical evaluation of your technique
  - Conclusions and future work
  - Bibliography

# Title

- If someone will benefit from reading your paper, then he should want to read your paper after seeing its title
    - Avoid very general or vague titles
        - Example: *'Optimizing Scientific kernels on Emerging Architectures'* is not as useful as *'Optimizing Dense Linear Algebra Kernels on Multicore Processors with Shared Cache'*
    - The title should contain words that people interested in your paper are likely to use in a search

# Abstract

- After reading this, the reviewer should know
  - What problem you are solving
  - Why the problem addressed is important
  - What the basic idea behind your work is
  - How it improves on other work
    - Quantify the improvement from your work

# Abstract 2

- **End the abstract with a sentence clearly identifying the contribution of your work**
  - How will people benefit from your work?
- **After reading the abstract, the reviewer should be excited about your work**
  - He should think, "If they have really accomplished what they have claimed, then I will accept this paper"

# Introduction

- Provide background on the problem
  - Explain what the problem is
  - Explain why it is important
  - Summarize other approaches that people have taken to solve this problem, and their limitations
- Summarize your work and describe its significance
  - Provide a high-level view of your approach and summarize how it improves on previous approaches
  - Summarize your theoretical and empirical results

# Introduction 2

- Give an outline of the rest of the paper
  - You may omit this, if your introduction follows the same sequence of topics as the rest of the paper
    - In this case, refer to the relevant sections in appropriate places in the introduction
    - Example: http://www.cs.fsu.edu/~asriniva/papers/icpp06.pdf
- The beginning of the introduction should catch the attention of the reviewer
  - You should get to your point quickly
    - Example: Don't waste space explaining the importance of multicore processors in a submission to a High Performance Computing conference

# Related Work

- Summarize related work by others and by you
  - Give any limitations of other work which you overcome
  - Don't be too negative about others' work – one of the authors may be the reviewer for your paper
  - Briefly mention how your work differs from others'
    - Examples: You may solve a slightly different problem, you may obtain greater performance, your algorithm may be more general
  - If you have related papers, make sure that you clearly identify how this work differs
    - Do this even for your prior work which is not closely related, if its title will make the reviewer think that it is related

# Related Work 2

- Cite related work that is well respected or which appears in respected venues
  - Example: Improving on results published in *SIAM Journal on Scientific Computing* carries more weight than improving on results published in the *International Journal of Empirical Plagiarism*

# Your Novel Contribution

- Explain your algorithm or software, etc
    - Keep your audience in mind when deciding what to explain and what to assume as known
    - Provide a high level view before providing the details
    - You don't need to reveal your entire span of knowledge; just present what is central to the point that you are trying to make
    - Provide simple examples to illustrate your technique

# Your Novel Contribution 2

- Some tips on writing clearly
  - Use mathematical expressions, if a plain English description will not be easy to understand
    - For example, the second statement below is clearer than the first
      - 'Assume that the sum of the number of rows and columns of the first matrix is greater than the corresponding sum for the second matrix.'
      - 'Let $r_a$ and $r_b$ be the number of rows in matrices A and B respectively, and let $c_a$ and $c_b$ be respective number of columns. Assume $r_a+c_a > r_b+c_b$.'
  - You don't need to define something in one sentence
    - Define complex terminology in multiple sentences if necessary

# Your Novel Contribution 3

- **More tips on writing**
  - Use the same terminology throughout the paper
    - Example: In describing a differential equation solver, if you use the term 'time step' in one location, then don't refer to it as an 'iteration' elsewhere
    - Even if you mention in the paper that you will some times refer to a time step as an iteration, it can still confuse the reader
  - Use a paragraph to explain a crucial point, even if a sentence will suffice
    - An absent minded reviewer can easily miss a few sentences out of the thousands that he will read
    - Alternatively, write it in bold face or italics

# Empirical Evaluation

- **Provide convincing evidence that your technique is good**
  - ➢ Just giving the performance of your technique does not establish this
    - Compare against state of the art implementations
    - Compare against theoretical upper bounds on performance
- **Analyze the results**
  - ➢ Why are the results the way they are?
    - Example: If the parallel efficiency decreases and then increases with the number of processors, then you need to explain why that happens

# Empirical Evaluation 2

- A figure and its caption should have enough information for a reader to understand its implication without referring to the text

- Use different line styles (solid, dashed, etc) to distinguish different lines in a figure
  - Using different colors is not sufficient if a reader prints it in black and white

- Give details of the experimental environment
  - Mention the CPU, OS version, compiler flags, etc
  - Give details of how timing was performed and resolution of the timer

# Conclusions and Future Work

- ## Conclusions
  - Summarize important aspects that make more sense once the rest of the paper has been read
    - If something can be understood earlier, then that point can go in the introduction
    - Repeat any important contribution that you would want an absent minded reviewer to remember
- ## Future work
  - Mention interesting directions to extend this work
  - Don't mention too many things, lest the reviewer think that your work is currently incomplete

# Bibliography

- Give complete citations so that a reader can locate the cited article

- The bibliography section should also be proofread and be free of typographical errors

- As far as possible, cite journals and respectable conferences

  - It is ok to cite technical reports occasionally
  - Avoid citing web pages and informal venues
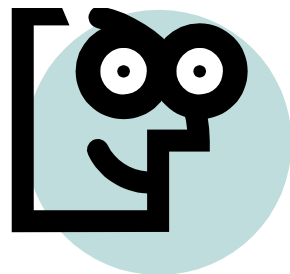
It was established in [5] that ...

5. Gossip heard on bus route 57A, Tallahassee, 15 July 2009, 8 am.

# Appendix

- You can place material that is not central to the flow of your paper here
  - For example, if proofs will distract from the basic idea of your paper, then you may state theorems in the paper and provide the proofs in the appendix
  - Alternatively, you may write a more detailed technical report and cite it in your manuscript
    - However, an appendix is more likely to be read than the technical report

# Life After Rejection

- **The good news**
  - You are still alive
  - Rejection or acceptance probably does not change your life significantly
- **Improve your paper**
  - Read the reviews the moment you get them, and express your outrage to your friends
  - Read the reviews again, calmly, the next day
  - Try to address all the criticisms of the reviewers
    - If the reviewers misunderstood you, then it is your fault for not making yourself clear enough
  - Resubmit the improved paper

# Useful References

- **General writing**
  - ➤ W. White and E.B. Strunk, Elements of Style
    - But see: http://chronicle.com/article/50-Years-of-Stupid-Grammar/25497
  - ➤ URL for original edition: www.bartleby.com/141
- **Technical writing**
  - ➤ SOSP advise
    - ftp://fast.cs.utah.edu/pub/writing-papers.ps
  - ➤ OOPSLA advise
    - www.sigplan.org/oopsla/oopsla96/how93.html
  - ➤ Read best papers of good conferences, such as SC and IPDPS