How to write a paper?

Reference: CS211@UCLA, by Prof. Songwu Lu; with slight revision

A nice paper structure

Example: a 12-page paper

- Abstract (1/8~1/4 page)
- Introduction section (1 page)
- Background section (0.5~0.75 page)
- Design section (3.5 page)
- Implementation section (1 page)
- Evaluation section (3.5 page)
- Discussion section (0.75 page)
- Related work section (0.5~0.75 page)
- Conclusion section (0.25~0.5 page)

What you have in mind before writing your paper?

- Does it solve an important problem?
- What is the novelty?
  - formulating a new problem?
  - proposing new solutions?
  - presenting new evaluation methods/techniques?
  - The work is not incremental!
- Relevance of the work
  - On a hot problem in a hot area
  - Or, the first one in this area, and can stimulate a lot of follow-up work even though the solution is still rough

- Readers learn something they did not know before

Introduction

- A few key questions to answer
  - The problem statement: what exact problem it is solving?
  - The importance of the problem: why it is worth the effort to solve it
  - Challenges for the problem: there are many problems to solve, why is this one difficult to solve?
  - Current solutions: what are the limitations of current solutions and motivate the proposed one?
  - New idea & technique of the solution: why is the solution different?
  - Performance summary: how good is the solution based on the experimental/analytical evaluation?
  - Main contributions of the paper (optional): simple recap and main points for the reader to carry home
  - Structure of the paper: what each of the remaining sections in the paper talks about

Background

- Provide brief intro. to people not working in the area
  - State from the standpoint of the problem, NOT general tutorial about the area
  - No copy from the literature (or even your previous writeup)
- Models used
- Assumptions made
  - Every paper makes assumptions, it is fine
  - Try to explain why the assumptions are not strong, give cases why the assumptions are realistic in practice
  - Spell out the issues not addressed in the paper, which are out of the scope of the work
    - No one expects a paper to solve all the problems

Design

- Provide a brief overview of the solution at the beginning
  - Key ideas or principles
- For each component of the solution, clearly elaborate
  - What the issues/challenges to address?
  - How the solution component works?
  - Why choose such a solution approach?
  - There are many ways to address the same issue, why this one? Provides cons and pros for this one

- Novelty, novelty, novelty!
  - Explain why the solution is different, not necessarily better
  - Tell readers why it is different from the related work in brief terms when describing each component of the solution

Implementation

Required for a system work

- What are the challenges for the implementation of the design, if any exists?
- How does it address each challenge in the implementation?

- What are the software/hardware platforms for the implementation?

- Complexity of the implementation?
  - E.g., lines of codes
  - Hacking tricks
  - Does it work with other existing software/hardware platforms?
  - If not, is it easy to export it to these platforms?

Evaluation

- To show quantitatively how good the solution is
  - Corresponding to the design
- Describe the testing scenarios
  - What devices used, the supporting environment, etc.
- Describe the analytical results
  - Spell out the assumptions and conditions for the analysis
  - explain figures, tables, bar charts, etc.
    - Tell the readers the % improvement, the gains etc. Do not expect the readers to get such numbers by themselves from the figures, etc.
- Share the insights why the solution provides better results
- For those results worse than the existing solutions, explain why they are so
  - It is okay to share negative results, as long as they are explained why; provide some justification if possible
- Micro-benchmark vs. system evaluation
  - Evaluation for single design component
- (optional) a short summary of the performance results
  - The main items for the readers to take home

Discussion (optional)

- This section basically serves as the storage room for the work
- If there are messy issues, state here
  - Not in the design section, which may distract the readers from your main idea
- If there are straightforward extensions of the solution, state here
- If there are unaddressed, but important issues, discuss here
  - They are basically the loopholes of the work, argue them here
- If there are suggestions/improvements to the current solutions, state here
  - These are items that authors do not have time to evaluate and test out

Related Work

- Main point to make: the work is significantly different from all the existing solutions!
  - Not necessarily better
  - It is not incremental, which extends the existing ones a little bit
- Novelty of the problem: one of the following
  - formulated a NEW problem in this paper!
  - identified NEW issues to an existing problem
- Novelty of the solution
  - The idea explored in this paper is completely different from all others in the literature
  - used new techniques borrowed from other areas or fields
    - No one has done so, I'm the first one
- Novelty of the evaluation
  - used new analysis/experimental methods that no one has used before
- Stay at the level as high as possible: the contribution is major, not minor improvements (no need to comment on the detailed level)
  - Do not discuss the novelty of each component of the solution, only the main idea of the solution
    - Component novelty is described in the design section already, not here

Conclusion

- Brief recap of the problem solved, and the solution proposed in this paper
- Articulate the importance of the solution
  - Is it applicable to other areas or problems?
  - Does it explore new design principles/philosophies that offer new ways to solve many other problems?
- Share insights gained and lessons learned
  - What are the new positive insights gained?
    - E.g., certain ideas really work
  - What are the negative lessons learned?
    - E.g., complex solutions give only marginal improvement
    - E.g., certain ideas proposed in the literature do not work at all in the tested scenarios
- Ongoing/future work (optional)
  - One or two sentences are enough
  - Not too much, otherwise, the paper sounds work-in-progress that reviewers can reject easily!

Alternative structure

- Sometimes, the related work section can appear as the 2nd section right after the introduction section
  - When to use it? The work builds significantly on the existing ones
  - merge the background with the related work in a single section
    - Provide the tutorial to your design section
  - Downside of this layout: this may make the paper sound incremental, and the novelty is limited