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# Efficient Reading of Papers in Engineering and Technology

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資訊工程系



# What do we mean by a research work?

- Contains novel research results or review of existing results
- **Classifications:**
  - **Master Thesis, Ph.D. Dissertation, Technical report**
  - **Paper, article--Journal**
    - Peer review by one or more referees
    - Undergo a series of reviews, edits and re-submissions
    - The process may take a few months to some years
  - **Paper, article -- Conference proceedings**

## Reasons for reading a research paper

- ⊙ Review for a conference or a (class) presentation
- ⊙ Keep yourself up-to-date for a field
- ⊙ Doing a literature survey of a new field
- ⊙ Try to get an overview quickly (interest)

 *but, reading research papers efficiently is a challenge.*

- ∴
  - ✦ Written in a very condensed style
  - ✦ Page limitations
  - ✦ For intended readers (know the field already)
  - ✦ Your time is limited
  - ✦ Other ...
- ∴ ✓ *need a **special approach** (say, **Yes.**)*

# How a typical paper is put together?

- ④ ***Paper structure***: Abstract, Introduction, Background study (Related works to some degree), Proposed method/model, Analytical/Simulated /Experimental results, Discussion, Comparisons, Conclusion(and future work), Acknowledgment, Appendix (proof), References.
- ④ Likely *repetitive* contents (in abstract, introduction, conclusion, and main body of the paper) from different levels of details and perspectives
- ∴ To read the paper “*out-of-order*,” “*skipping*” or “*skimming*” *over* certain sections may be needed.

## What you want to have answered by reading? (1/3)

### Ⓢ What are *motivations* for this work?

- People problem or technical problem? the motivation and statement of the problem are distilled into a **research question** that can be addressed

### Ⓢ What is the proposed *solution*? hypothesis or idea.

- *Why is it believed that this solution will work, and be better than previous solutions? How the solution is achieved?*

### Ⓢ What is the work's *evaluation* of the proposed solution?

- An idea alone is usually not adequate for publication. What argument, implementation, and/or experiment makes the case for the value of the ideas? What benefits or problems are identified?



## What you want to have answered by reading? (2/3)

### ④ **What is your analysis of the identified problem, idea and evaluation?**

- Is this a good idea? What flaws do you perceive in the work? What are the most interesting points made? What are the most controversial ideas or points made?
- For work that has *practical* implications, you also want to ask: *Is this really going to work, who would want it, what it will take to give it to them, and when might it become a reality?*

### ④ **What are the *contributions*?**

- Include: ideas, software, experimental techniques, or an area survey.

## What you want to have answered by reading? (3/3)

### ⊙ **What are *future directions* for this research?**

- What ideas did you come up with while reading the paper?
- Sometimes these may be identified as shortcomings or other critiques in the current work.

### ⊙ **What questions are you left with?**

- What questions would you like to raise in an open discussion of the work? What do you find confusing or difficult to understand? (take time to *list them all and force yourself to think more deeply about the work*)

### ⊙ **What is your take-away message from this paper?**

- Sum up the main implication of the paper from your perspective, for quick reviewing and refreshing your memory. It also forces you to try to identify the essence of the work.

# How do you read a paper currently?

- ⊙ Print out the paper (But now, hard copy → *pdf* file(s))
- ⊙ Prepare pencil, marker, note, . . .
- ⊙ Find a quiet place, prepare coffee or tea, cigarette, . . .
- ⊙ Calm down yourself and START reading
- ⊙ After ten minutes, you will be . . .

. . . z z z z z z z z Z Z Z Z

## ⊙ Suggestion:

- Take a few minutes to skim the paper quickly, noting basics like section headings, figures, and the like. **Not to understand it but to get an overview.**
- Decide what to read:
  - Read for *breadth* – *build a framework/get an roughly idea*
  - Read for *depth* – *challenge what you read*



# Recomm. → Three-pass approach

- ② Pass 1 : (**glance**) – get the *overview/survey* of new field
  - quick scan to get a general idea (*bird's-eye view*) of the paper
- ② Pass 2 : (**breadth**) – determine if further reading or not
  - grasp the paper content (greater care than pass 1 did), but not the details (e.g. proof)
  - Jot down the key points or make comments in the margins
- ② Pass 3 : (**depth**) – when it is really need to read
  - (fully) understand the paper in depth (especially for a reviewer or if the work closely related to yours)
  - (even) *virtually re-implement* the paper → recreate to identify the paper's idea and its hidden failings and assumptions

# Pass-1 reading

1. Carefully read the **title**, **abstract**, and **introduction**
2. Read the section and subsection **headings**, but ignore everything else
3. Read the **conclusion**
4. Glance over the references and ticking off those you've read

© Then, check **5C's** below to see if the paper is worth reading

1. **Category** – (paper's type) analysis, research prototype?
2. **Context** – basis, other related papers?
3. **Correctness\*** – assumptions valid? appropriateness
4. **Contributions** – any useful points?
5. **Clarity** – well written?

(10 minutes done)

## Pass-2 reading ✓

1. Look carefully at the tables, **figures** and diagrams. Read the definitions and **theorems**. Highlight major points. Read the paper **section by section** for comprehension.
2. Skim and mark *relevant unread references* for further reading (a good way to learn more about background)

### 🕒 **After pass-2, you should be able to**

- Grasp the paper's **content**
- **Summarize** the main thrust with supporting events

### ➡ **If you still don't get it, then**

- Set the paper aside (if won't bother your career), *or*
- Return to it later (e.g. after reading background), *or*
- Preserve and go on to the third pass.

# Pass -3 reading

**1. To identify and challenge every assumption (Is it reasonable?)**

**2. Examine the methods**

- measurement appropriate? Explain what they observed? Were simulation/experiment/test carried out in a standard way?

**3. Examine the results, discussion, and statistics**

- Are the major findings statistically significant? Did they do proper statistically tests and error analysis? Are there other factors that could have influenced, or accounted for, the results? Were there problems not addressed (missing part)?

**4. Examine the conclusions**

- Logically from the observations? Contributions/results as claimed? (enough) Evidences supporting?

**5. Reflection and criticism.** To be able to identify its strong and weak points. How you can apply their approaches/results?

## (What if) Too many words don't recognize you?

- ④ Underlining/highlighting every word and phrase you don't understand. Don't worry if there are a lot of underlinings; (if) you're still not trying to make sense of the article. Then
  - Look up simple words and phrases – be refer to resource (dictionary) of appropriate field
  - Get an understanding from the context in which it is used. But be careful – since it might not mean what you think
  - Flag these words or phrase as belonging to one of the major concepts of the paper. (look at the correlation/connection to a topic or the sentences before and after)
- ④ *See reference* (3-page “**Reading English books**”)

# A few hints on paper writing/construction

- © Title
- © Abstract
- © Introduction
- © Results
- © Discussion
- © Conclusions
- © References

## ◆ A *paper* should

- Focus on describing the results in sufficient details to establish their validity
- Identifies the novel aspects of the results, i.e., what new knowledge is reported and what makes it non-obvious;
- Identifies the significance of the results, i.e. what improvements and impact do they suggest.

# Title

- A *label*, not a sentence
- Announce the subject simply and directly
- Short (6 ~ 14 words) but specific
- Remove waste words such as “study on” or “investigation on”, etc.
- No abbreviations/formula/jargon  
(Avoid all but the most readily understood abbreviations)
- Re-read your introduction and conclusion, and examine key words/phrases for possible title.

## Abstract

Ⓢ An abstract must be a fully self-contained, capsule description of the paper. Should not exceed 200 to 250 (<500) words.\*

### Ⓢ DO

- State the subject and **objective/purpose** of the *study or investigation*
- Describe(or just give) the method(s) used
- Summarize the results obtained
- State the principle results
- Provide recommendation (if any)

### Ⓢ DON'T

- Background of the study, containing references, math.
- Details discussion or explanation of the methods
- Administrative details (e.g., how the study was undertaken)
- Any information not appear in the paper
- \* Most parts of the *Abstract* should be in the *past* tense



# Checklist of Abstract (1/3)

*(when more space allowed (extended abstract) or for on-line publication)*

- ⊙ Abstracts have always served the function of "*selling*" your work and "*convincing*" the reader to keep reading the rest of paper.
- ⊙ **Motivation:**
  - *Why do we care* about the problem and the results?
    - If the problem isn't obviously "interesting" it might be better to put *motivation* first;
    - but if your work is incremental progress on a problem that is widely recognized as important, then it is probably better to put the *problem statement* first (if readers already understand the importance of problem) to indicate which piece of the larger problem you are breaking off to work on
  - Include the importance of your work, the difficulty of the area, and the impact it might have if successful.

## Checklist of Abstract (2/3)

### @ Problem statement:

- What *problem* are you trying to solve?
- What is the *scope* of your work (a generalized approach, or for a specific situation)? Be careful not to use too much jargon.

### @ Approach:

- *How did you go about solving* or making progress on the problem?
- Did you use simulation, analytic models, prototype construction, or analysis of field data?
- What important *variables* did you control, ignore, or measure?

### @ Results:

- *What's the answer?* Put the result there, in numbers, e.g. on how many percent faster, cheaper, smaller, or otherwise better than something else.

## Checklist of Abstract (3/3)

- Be concrete and precise. Avoid vague, hand-waving results such as "very", "small", or "significant." If you must be vague, you are only given license to do so when you can talk about orders-of-magnitude improvement.

### Ⓢ **Conclusions:**

- *What are the implications of your answer?* Is it going to change the world (unlikely), be a significant "win", be a nice hack, or simply serve as a road sign indicating that this path is a waste of time (all of the previous results are useful).
- Are your results *general*, potentially generalizable, or specific to a particular case?

Ref: [Philip Koopman](http://www.ece.cmu.edu/~koopman/essays/abstract.html) **How to Write an Abstract**  
<http://www.ece.cmu.edu/~koopman/essays/abstract.html>

# Introduction

- ④ Gives general information before getting into the body of your writing
  - States the *subject* ~ including brief history (previous works and drawbacks), define terms related to subject (for unfamiliar readers)
  - States the *purpose* ~ using topic sentence to describe why you are writing (reflecting what you did)
  - States the *scope* ~ telling little/limited details (e.g. say this is a survey) brief and simple (but not the same words appears in *Abstract*)
  - State the *development of the subject* ~ giving a basis for the reader to anticipate how the subject will be presented and how you arrive your conclusions

## Introduction(cont'd)

- Structure (suggestions by technical writing books):
  - ✓ The last sentence of the first paragraph states what you intended to do.
  - ✓ The last paragraph states what you did or the organization of the paper.
  - ✓ \* The last sentence of the Introduction states the conclusion.
  - ✓ \* Most in the *present* tense

## A good introduction is fairly formulaic (1/5)

- ② The following outline can be varied. All of the points below need to be covered in an introduction, and in most papers, you don't need to cover anything more in an introduction.
- ② **Paragraph 1: Motivation**
  - At a high level, what is the problem area you are working in and why is it important?
  - It is important to set the larger context here. Why is the problem of interest and importance to the larger community?

## A good paper introduction is fairly formulaic (2/5)

Ⓢ **Paragraph 2:** What is the specific problem considered in this paper?

- This paragraph narrows down the topic area of the paper. In the first paragraph you have established general context and importance. Here you establish *specific* context and background.

Ⓢ **Paragraph 3:**

- "In this paper, we show that ...". This is the key paragraph in the intro. - you summarize, in one paragraph, what are the main contributions of your paper given the context you have established in paragraphs 1 and 2. What is the general approach taken? Why are the specific results significant?

## A good paper introduction is fairly formulaic (3/5)

### Ⓢ Paragraph 3 (cont'd):

- This paragraph must be really really good. If you can't "*sell*" your work at a high level in a paragraph in the intro, then you are in trouble.
- You should think about how to structure this one or two paragraph summary of what your paper is all about. If there are two or three main results, then you might consider itemizing them with bullets or in text (e.g., "First, ...").
- If the results fall broadly into two categories, you can bring out that distinction here. For example, "Our results are both theoretical and applied in nature. (two sentences follow, one each on theory and application)"



## A good paper introduction is fairly formulaic (4/5)

### ⊙ Paragraph 4:

- At a high level what others have done, and what are the differences in what you are doing?
- Keep above at a high level only, you can refer to a future section where specific details and differences will be given. But it is important for the reader to know at a high level, what is new about this work compared to other work in the area.

### ⊙ Paragraph 5:

- "The remainder of this paper is structured as follows..."  
Give the reader a roadmap for the rest of the paper.
- Avoid redundant phrasing, "In Section 2, In section 3, ...  
In Section 4, ... " etc.

## A good paper introduction is fairly formulaic (5/5)

### 🌀 A few general tips:

- Don't spend a lot of time into the introduction telling the reader about what you don't do in the paper. Be clear about what you do do, but don't dwell here on what you don't do.
- Does each paragraph have a *theme sentence* that sets the stage for the entire paragraph? Are the sentences and topics in the paragraph all related to each other?
- Do all of your tenses match up in a paragraph?

(By Henning Schulzrinne, also contributed by Jim Kurose, U. mass.)

<http://www.cs.columbia.edu/~hgs/etc/intro-style.html>

# Results

- ② Most important but may be the *shortest part* (showing your contribution or new knowledge/discovery by formula, tables, or figures)
- ② Present representative data (evidence); don't mix with Discussion
- ② \* Write your present work in the *past* tense (since it is not supposed to be an established knowledge until it has been published.)

# Discussion

- ② The hardest section to write
- ② Must contains logical argument and avoids summarizing your results in the Discussion (just mention that).
- ② Not a restatement of your problem or your result; no repeated statements
- ② Don't justify the practicality of your research
- ② Don't fill up space by listing topics for further research
- ② End your Discussion when you have finished being analytical and interpretive.
- ② \* Use the *present* tense to describe what people published; use the *past* tense to describe what you did.

# Conclusions

- Ⓢ Need precise wording
- Ⓢ The important conclusion should be states THREE times by different phrases in Abstract, Introduction, and Conclusion, respectively.
- Ⓢ Don't repeat the words. Rephrase it.
- Ⓢ Must be consistent with what the Introduction states that the report/paper would examine (its purpose) and how it would do so (its method).
- Ⓢ Structure:
  - Brief statement of *purpose*
  - *Findings* based on methods specified in Introduction
  - Restatement of scope and its *implications*

# References

- ② List the title, author(s), originate of the documents/books/papers you or readers may refer to.
- ② The format is publication-dependent.
- ② In general, the readers are referred to (cite) the reference papers/books in the text with the notation [1] or [3-5] and those references are listed in the References in the form of : (FYI)

- [1] Nektaria Efthymiou, Yim Fun Hu, and Ray E. Sheriff, “Performance of Intersegment Handover Protocols in an Integrated Space/Terrestrial-UMTS Environment,” *IEEE Transaction on Vehicular Technology*, vol. 47, no. 4, pp. 1179-1199, Nov. 1998.
- [2] C. Brusaw et al., *Handbook of Technical Writing*, 4<sup>th</sup> ed., St. Martin’s Press: New York, 1993.
- [3] John C. Hodges et al., *Harbrace College Handbook*, 12<sup>th</sup> ed., Harcourt Brace College Publishers, 1994.

## References

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- ④ Michaelson, Herbert, *How to Write & Publish Engineering Papers and Reports*, Oryx Press, 1990. (check for new version)
- ④ William Strunk Jr., *The Elements of style* , <http://www.bartleby.com/141/>
- ④ Gerald J. Alred, Charles T. Brusaw, and Walter E. Oliu, *The Handbook of Technical Writing, Seventh Edition*, St. Martin’s press, New York.



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感謝聆聽，敬請指教

