Basics Of Scientific Research 3: How to write a scientific research?

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Outline

- Start your scientific research report/ paper
- Paper structure
- Paper formatting
  - Equations
  - Figures and Tables
  - References style
- Plagiarism, readability and consistency

Let's start

- Where to start?
  - Already have documented raw data
  - Previous writing experience, tell a story "a scientific one"
  - Previous projects experience
- Clear writing requires clear organized thinking
- The first draft doesn't have to be perfect!
- Goals:
  - Communicate ideas and experiments
  - Persuade people of the approach
  - Describe experiments and results
  - Allow others to reproduce your results precisely
  - Be honest

Paper Structure: Headings and sub-division

- Title and authors' list
- Abstract
- Key words (optional)
- Introduction
- Mathematical model/ theory
- Methods
- Experimental work
- Results and discussion
- Conclusions and future work
- References
- Appendices
- ….. As specified in the guide for authors …. (For publication)
- Modify section headings and add subsection headings that reflect your subject

This is the order in which they appear in the final paper, not the order in which they are actually written

Headings and subdivisions

- You may make use of “my personally suggested” template https://www.cse.ust.hk/~ni/TR_template_V2.doc
- Don’t bother if you have already developed a good draft!
- Use features of MS word to automatically create and update fields such as: Sections and Subsections, Captions, Table of contents, List of Figures, List of Tables, ….
- Use MS word equation editor and correct symbols

Title

- Identify the main issue of the paper
- Begin with the subject of the paper
- Accurate, unambiguous, specific and complete
- Attract readers

Abstract

- Short and concise (100-200 words)
- States the problem and its significance
- How the research paper addresses this problem
- Key results
- Both are probably the last thing to be written
- No citations, symbols, abbreviations or acronyms, if necessary spell out

Introduction

- Motivation: Why is your research important?, List applications
- General literature review: What is known about the topic?, group studies that share common features
  - you may specify a separate section for literature review.
- Plan: What are your hypotheses?, justify selected methods
- Goal: What are your objectives?
- Explicitly list your contributions
- Paper organization
- Usually gets finalized near finalizing the whole paper

Mathematical Model/ Theory

- Mathematical background required to understand the problem and the proposed solution
- State of the art mathematical models posed for the problem
- State of the art mathematical techniques proposed to solve it, even if you are using heuristic search in your experimental work

Equations and numbering

- Use MS word “Insert equation”
- Write variables in math mode
- Add equation number between brackets
- Use the word “equation” at the start of a sentence only, but in text just use the number [e.g., in (1)],

Methods

- The used techniques, flowchart, pseudo-codes, algorithms, …
- It gives how the mathematical model/theory are implemented

Experimental Work

- Narrow down the focus to your own technical work
- Describe things you have done not only understand
- Algorithms converted to MATLAB codes and run, but don't write the code in this section
- Experiment design, test case scenario, case study
- Define test data, parameters, performance evaluation criteria …

Results and Discussion

- Include simulation results in the form of figures, charts, tables accompanied by explanation and comments within text
- Cross reference:
  - Figure 1 shows …
  - … as shown in Fig. 1
  - …, which can be inferred from the values given in Table 1
  - Table 1 provides …
- Discuss how your data compare or contrast with previous results
- Compare several methods you have applied
- Discuss the significance/implications of the results: your ideas on what they mean

Figures and Tables

- Usually appear *after/close to* the first cross reference and follow a numeric order
- Preferably at the top of the page
- Both a figure and a table have captions with number and concise description
- Preferably, while table caption precedes it, figure caption follows it
- Subfigures
- Accompanied by descriptive comments within the text
- Make sure that graphs are clearly visible and text is readable (Edit figures inside or outside MATLAB/; color, legend, font size, axes limits …)
- Axes labels with quantity, symbol and SI units, if applicable
- Table cells fully described: Rows and columns headings

Conclusions and Future Work: Take Home Messages

- Major findings
- Contributions and limitations
- Recommendations
- Brief discussion on future perspectives and/or application of present work to other disciplines
- Future work ideas

References formatting: a quick guide to IEEE style

- A list of references must be provided at the end of the paper.
- They must all be cited in the text of the document.
- The references should be numbered and ordered sequentially, i.e., in the order they appear in the text.
- The three main parts of a reference are as follows:
  - Authors' names listed as first initial of first name, then full last.
  - Title of article, patent, conference paper, etc., in quotation marks.
  - Title of journal or book in italics.
  - Volume, issue number, pages, year, …

References formatting: more details

- How to Cite References: IEEE Documentation Style https://ieee-dataport.org/sites/default/files/analysis/27/IEEE%20Citation%20Guidelines.pdf

  Or

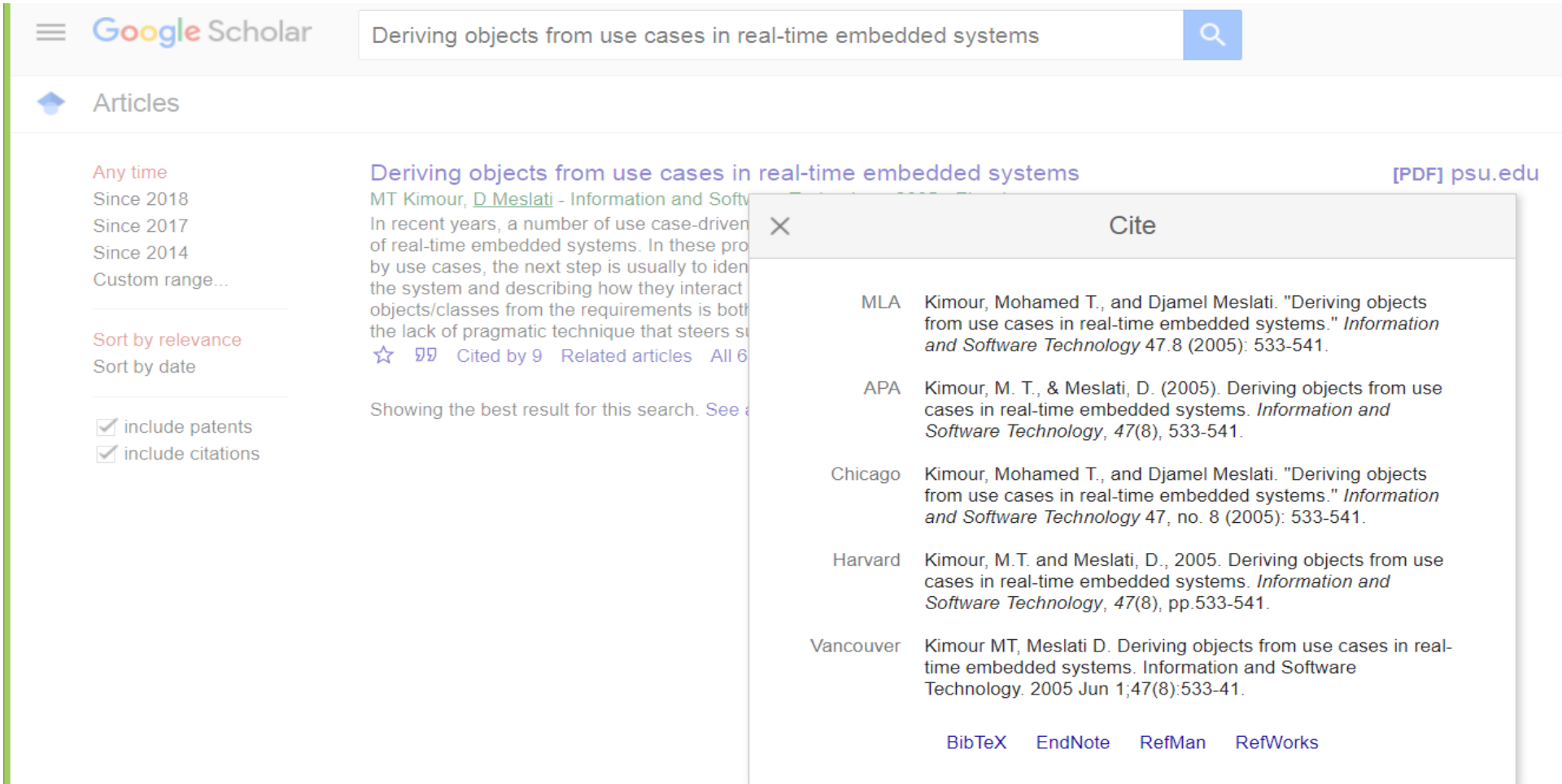
  http://www.ijsst.info/info/IEEE-Citation-StyleGuide.pdf

- For future consideration, google:
  - Referencing and creating a bibliography in MS word
  - References management tools: EndNote, RefMan, RefWorks
  - LaTeX and BibTex …

References formatting: a quick start

- Copy from scholar and modify

[1] M. T. Kimour and D. Meslati, "Deriving objects from use cases in real-time embedded systems," *Information and Software Technology*, vol. 47, no. 8, p. 533, June 2005. [Abstract]. Available: ProQuest, http://www.umi.com/proquest/. [Accessed November 12, 2007].



Citation Within The Text

- **Each reference number should be enclosed in square brackets on the same line as the text, before any punctuation, with a space before the bracket.**
- Examples:
  - ". . .end of the line for my research [13]."
  - "The theory was first put forward in 1987 [1]."
  - "Scholtz [2] has argued. . . ."
  - "For example, see [7]."
  - "Several recent studies [3, 4, 15, 22] have suggested that. . . ."
  - **Note: Authors and dates do not have to be written out after the first reference; use the bracketed number. Also, it is not necessary to write "in reference [2]." Just write "in [2]."**
  - **Do not group all references in a single sentence/paragraph.**
  - The preferred method to cite more than one source at a time is to list each reference in its own brackets, then separate with a comma or dash:
    - [1], [3], [5]
    - [1] – [5]

Finally, add your codes to the last section: Appendix

Codes with comments/
documentation would be excellent

Plagiarism

Plagiarism

- This is the worst thing that can happen to a researcher!
- Deliberate plagiarism is a crime!

Quote or paraphrase

- You can use the exact words if you are making a quote (between quotation marks), otherwise you must summarize/ paraphrase only after those words have filtered through your own understanding of them, then cite the source
- **Quote when:** the specific words of your source matter
- **Paraphrase when:** you are more interested in the findings/data than in how your source expressed them

- The source of any figure you haven't generated by yourself must be cited in its caption

Readability: some common mistakes

- **Acronyms**
  - You **must** write out an acronym the first time you use it in the body of the paper.
  - Write the term first and then put the acronym in parentheses, e.g., Bit Error Rate (BER)
- **Grammar**
  - Singular and plural
- **Punctuation**
- **Spell check**
- **Long statements lacking the verb**
- **Prevailing passive voice versus excess use of “we”, “our”, …**
- **…**

Consistency: Team writing unified

- No blank spaces
- Figures and tables merged within text, not on separate pages, or small figures occupying full page
- Maintain consistency, smoothness and flow
- No repetition
- Each paragraph leads to its subsequent “in the story”
- The magic conjunctions: “In addition, moreover, however, on the other hand, yet, hence, consequently, …”
- Lists, bullets and chronological order: first, then, afterwards, finally

More information about writing

- By practice: Reading and writing
- See the book “How to Write a Good Scientific Paper” by Chris A. Mack

  http://spie.org/samples/9781510619142.pdf

  chapters 1 – 6. The rest focus on publication.
- Google. Find your own guide.
- Discuss with your colleagues, senior students and TAs and revise several times

The importance of proof-reading and editing

- A high percentage of the time spent in writing is actually editing
- Correct errors
- Delete every unnecessary word
- Break down complex sentences
- Use conjunctions
- Rephrase and reconstruct sentences for clarity and flow
- Convert passive into active voice
- Towards the final report: proof-read, break, proof-read, paper and pen, checklist, … stop when necessary

Questions?

Thank you!