



HOW TO READ A  
COMPUTER SCIENCE  
RESEARCH PAPER

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# What is a research paper?

- Academic journals and conference are periodicals in which researchers publish articles on their work.
- Most often these articles discuss recent research.
- Journals and conferences also publish theoretical discussions and articles that critically review already published work.
- Journals and top CS conferences are typically peer-reviewed.
- Common repository for CS papers
  - DBPL: Computer Science Bibliography
    - <https://dblp.uni-trier.de>
  - Google Scholar
    - [scholar.google.com](https://scholar.google.com)

# What is the peer-review process?

Getting published in peer-reviewed (also called “refereed”) venues usually involves three or four steps.

1. Submit an article manuscript for consideration.
2. Editors/Conference Program Chairs will send the submission to other scholars who do similar work and who are qualified to review the article. Generally, editors will send submissions to be reviewed by three other scholars.
3. Editors will evaluate the reviews and decide whether to reject or accept the submission. Usually, the response is either a rejection or an acceptance (contingent on the author making revisions).
4. If the author is asked to make revisions, they are to edit and resubmit the article for another round of reviews. Sometimes the article is accepted at this point and other times authors are asked to make further revisions.
5. Note in CS not all conferences allow revisions.

# What is the purpose of academic articles?

- Scholars write articles **to share their ideas with their peers**, usually within their own academic subdiscipline (e.g., data management, natural language processing, operating systems, ...)
- Articles fall under the realms of:
  - **research reports**: presentation of an original study or studies
  - **literature review articles**: discusses existing research about a problem and suggests paths for future studies
  - **theoretical articles**: discusses existing theories that explain observation, and often proposes new theories or a new perspective on theories
- Because they already share a highly specialized background, they often assume that their readers already understand some of the fundamental knowledge of the field as well as the jargon.
- *Jargon requires on-going attention. I encourage you to battle the jargon!*

# Choosing an article

- When looking through databases and web sources that provide articles, you need to narrow down your list to read.
- Read the title: titles typically reveal the main theory or variables being investigated in the article
  - Keyword search can fail you (see jargon comment plus heterogeneity of vocabulary across sub disciplines)
  - Often you'll need to use navigation to find articles
    - \*Topic based
    - \*Citation based (who cited whom)
- Read the abstract: the abstract will give you more information about the context to see if it relates to your topic
- Consider the reputation of the publication venue

# Reading an academic article

Different things require different reading (e.g., dictionary, novel, textbook); Research articles cannot be read effectively in the same way as other things.

The contents of a research article cannot typically be grasped by a single reading. You have to engage with it several times, but in different ways.

- Step 1: Skim the whole article
- Step 2: Determine your purpose for reading the article
- Step 3: Read specific sections critically to fulfill your purpose

# Step 1: Skimming the article

- Skim reading makes use of a normal convention for structuring writing: placing key information at the beginning of a “chunk” of text, then elaborating on that in the rest of that “chunk”
  - Two types of “chunks”– paragraphs and paper sections
- **1<sup>st</sup> type of chunk: paragraphs.** In non-fiction writing, it is most usual to put the key sentence of the paragraph at beginning, then elaborate on that key sentence.
  - *State, then elaborate*, is the general rule. Because of that, we can usually obtain a good understanding of what an author is saying by reading *only* the first sentence of paragraphs.
  - You may have to force yourself to stop reading after the first sentence, but if the section is relevant to your purpose you will come back to it.
- **2<sup>nd</sup> type of chunk: sections.** In research articles, the articles are broken down into sections, most often abstract, literature review, methods, results, and discussion.
  - As with *paragraphs*, the general rule for *sections* is 'state then elaborate'. So, immediately after the section heading, the first paragraph will generally contain key information for that section.

# Step 1: Skimming the article

- There are two sections that usually are particularly useful in understanding the article.
  - the *Introduction*
  - the *Conclusion*
    - \* Here, an author will generally **end** the section with a paragraph that makes important points. Now we can modify the previous rule:
- For long articles, read fully the first *and* last paragraph of the **Introduction** and the **Conclusion** sections
  - Introduction often ends with a paragraph on **Contributions** which is especially important



## **Step 1: Skimming the article: Review the figures and tables**

- As you skim read through the article, you will have noticed that the text is interrupted by a set of diagrams.
- Diagrams, or figures, are usually intended to display an idea in a way that is easier to see and grasp than is possible with text.
- While skimming, look over any tables you encounter to see what kind of information they are displaying. If the information is relevant to your purpose, you can look at it more closely later.

# Step 1: Skimming the article

Combining the skimming strategies for the two types of “chunks”, in each section you will read the entire first paragraph, then the first sentence in each paragraph after that. For the introduction and conclusion, also read the entire last paragraph. Read the topics of all tables and charts.

# Step 2: Determining purpose

Different purposes for reading articles require attention to different areas.

- Overview of topic
  - Focus on the introduction and conclusion.
- Research ideas
  - Read the introduction and conclusion, looking for further research suggestions in conclusion, then critically read the methods section.
- Planning an experiment
  - Critically read the methods section.
- General knowledge
  - Carefully read the whole article making sure you understand it all.
- Assignment for a course
  - Think about the goal of the assignment. Critically read what you might use to achieve that goal.

# Step 3: Reading critically: Skill

**Treat critical reading as a skill to be developed through practices, such as:**

- Marking and looking up all vocabulary (**acronyms**) and concepts that you are unfamiliar with
- Taking notes of the text's main ideas and adding your own responsive comments
- Talking to others about what you have read
- Relating a given text to others in the syllabus by identifying similar or contrasting themes
- Explaining what the text means to a non-specialist and noting what you would have to add to make it intelligible
  - This will help you to see the underlying, unstated assumptions.
- Asking yourself: “How can I convince my peers/teachers that I understand what this is about?”

# Step 3: Reading critically: Attitude

**Treat critical reading as an attitude towards the communication of ideas.**

- Think of reading an article like hearing someone else's perspective on a specific topic.
- Remain open minded to the fact that your previously held ideas may be wrong.
- Do not make the mistake of thinking that authors are always right.
- Keep in mind that writers of scientific articles are trying persuade you to agree with their ideas.
- Keep in mind the influence both the author's ideological affiliations and biases in writing the article as well as your own in reading the article.
- Remain willing to look up vocabulary and concepts in the article that you are unfamiliar with to expand your knowledge and fully understand the article.

## Step 3: Reading critically: Questions while reading

**...think about the following questions to help you read critically:**

- What is the author's purpose for writing this paper/ conducting this research?
- What are the main points of this text?
- Can you put them in your own words?
- What sorts of examples are used? Are they useful? Can you think of others?
- What factors (ideas, people, things) have been included? Can you think of anything that has been missed out?
- Is a particular bias or framework apparent? Can you tell what 'school of thought' the author belongs to?
- Can you work out the steps of the argument being presented? Do all the steps follow logically?
- Could a different conclusion be drawn from the argument being presented?
- Are the main ideas in the text supported by reliable evidence (well researched, non-emotive, logical)?
- Do you agree or disagree with the author? Why?
- What connections do you see between this and other texts?
- Where does it differ from other texts on the same subject?
- What are the wider implications— —for you, for the discipline?

# Assess the strength/validity of the argument

While continuing to close read for the subtle rhetorical ways in which the writer builds his or her case, use the following questions to help you sort out the building blocks of the writer's argument:

## 1. Evidence

- What evidence does the author offer in support of the position put forth? (Identify all pieces of evidence you find.)
- What is the nature of each piece of supporting evidence? For example, is it based on empirical research, ethical consideration, common knowledge, anecdote?
- How convincing is the evidence? For example, does the research design adequately address the question posed (#1 above)? Are the ethical considerations adequately explored and assessed? Have you read or heard anything on this subject that confirms or challenges the evidence?

## 2. Counter arguments

- What arguments made in opposition to the author's views were described?
- Were these arguments persuasively refuted?
- What evidence was used in the refutation?

## 3. Effectiveness

- What were the strengths of the article?
- Was it difficult to read and understand? If so, why? If not, why not?
- Were you able to follow the moves of the article from thesis to evidence, for example?
- Did the structure of sentences and paragraphs and the overall organization guide you and help you follow the author's intent?
- Did all the material seem relevant to the points made?

# What to look for in each section

By knowing the point of each section, you'll find what you need quickly and without being bogged down by the convoluted language in these research articles.

Scientific articles, particularly research reports, generally contain the following:

- abstract
- introduction
- literature review
- methods
- data
- results
- conclusion
- bibliography



# Abstract

This is the summary of the article. Almost all articles have an abstract. The abstract appears as a short paragraph at the start of the article, sometimes italicized or indented to set itself apart from the rest of the article.

Editors/publishers usually have rules about the structure

*What's important:* The abstract tells you the point of the article. Always read the abstract to make sure the article is suited toward your paper's topic.

# Introduction / Literature Review

The writer's introduction is the first section of the paper. Although not always labeled, it generally introduces the topic, the thesis, and tells readers why the research is important.

*What's important:* Look for the thesis; what's the author trying to prove or show? How do they intend to contribute to their field? Read the first and last paragraph of the introduction; the thesis is oftentimes located there. If you cannot find the thesis in those two places, you may have to scan the whole introduction.

## **Literature Review (or "A Review of the Literature" or "Related Work")**

A literature review looks at past research on the author's thesis. The literature review demonstrates to other researchers that the author is thoroughly acquainted with their topic. It is not always marked as a separate section from the introduction.

*What's important:* If you're still searching for sources for your paper, a literature review can point you to other sources you can use. It can also broadly educate you on this area of research. If you're not looking for more research and you have a good grasp on the material, feel free to skip over this section.

# Literature Review

- Questions:
  - What is the overall purpose of the research?
  - How does the research fit into the context of its field? Is it, for example, attempting to settle a controversy? show the validity of a new technique? open up a new field of inquiry?
  - Do you agree with the author's rationale for studying the question in this way?
  - As you get more sophisticated, consider if any relevant literature is missing.
- Common pitfalls
  - Literature review may copy language and terminology of the referenced paper, and not integrate it with the article
  - A good literature review places existing work in context of the article using the articles terminology and notation.

# Methods

In this section, the author details how they will try to support (or disprove) their thesis.

*What's important:* You should know how the writer obtained their information and explain that in your paper. Did they use a survey? What type of survey? Who did they survey? Or did they do an experiment? What type of experiment? How did they get test subjects?

- Questions:
  - (If an experiment:) How did the researchers manipulate variables in order to test them?
  - Were the measurements appropriate for the questions the researcher was approaching?
  - Often, researchers need to use "indicators" because they cannot measure something directly--for example, using page I/O as a surrogate for performance. Were the measures in this research clearly related to the variables in which the researchers (or you) were interested?
  - Were the measurements appropriate for the questions the researcher was approaching?

# Data

- All the data the author collected or used for their research is located in this section. This is often incorporated in the results section.
- *What's important:* Although it depends on your purpose for reading the article, looking at the data in combination with the results gives you a more unbiased result of their experiment.
- Sometimes, you'll want to skip this section entirely. If you're interested in a specific point of the author's research (and which is unlikely to be covered by the author in the conclusion) or are interested in replicating the research, then you may want to check out the data section.

# (Experimental) Results

The author explains the results of the data.

*What's important:* Like the data section, this section can be skipped over depending on your interests. The conclusion's section should be the final is-my-thesis-right-or-wrong statement, and the conclusion is usually clearer than the results section. If the article's conclusion doesn't satisfy you, *then* you may want to look at the results section.

- Questions
  - What is the one major finding?
  - Are the experiments described in sufficient detail that you feel you can reproduce the results?
  - Did you see patterns or trends in the data that the author did not mention? Were there problems that were not addressed?

# Conclusion / Discussion

The author's summary of the article. The author may also explain whether his or her thesis is correct, the implications, and what other research can be done.

*What's important:* This section is vital. If you use this article as a source, you better know the general outcome of the author's research. It is a good idea to read this section after you read the abstract, then again after reading the rest of the article. Was it proven wrong? Right? Inconclusive? You can always turn to the results section if you can't find the answers you're looking for here. You may also find a suggestion for future research in the discussion of limitation that guides your own project.

- Questions:
  - Do you agree with the conclusions drawn from the data/experiments?
  - Are these conclusions over-generalized or appropriately careful?
  - Are there other factors that could have influenced, or accounted for, the results?
  - What further experiments would you think of to continue the research or to answer remaining questions?

# Bibliography/Works Cited/References

The bibliography is the list of sources the author has used.

*What's important:* If you're in need of more sources, take a glance through the titles of this section. You may find articles you can use in your paper.

Consider the currency and completeness of the references

Is anything missing?



# For this course

- The homework will involve reading and critiquing research articles
- The presentation will required in depth reading and presentation of one article!

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