Reading Papers

General questions to ask to help you read papers efficiently

1) **Is the paper worth your time?** Read carefully title, and abstract – max. 5 minutes

2) **What is the paper about?** Scan the paper to understand the big picture (e.g., paper's structure, research question, key message) – max. 15 minutes

3) **What do you want to get from the paper?** Ask yourself what is of interests to you in the paper. Are you interested in the method? In the quantitative results? In the discussion? If you are interested in technical info or specific results and are familiar with the field, go directly to the section. If you are not familiar with the field, read the paper carefully

4) **What problem is the study trying to solve and how?** When reading the paper carefully, start with the intro to ensure you understand the research gap. Usually the beginning of the intro is general and could be read quickly if this is not your first paper in the field. Then, read the method section to grasp the rationale of the method. Note the questions, comments, or needs for clarification along the way. Search for a quick explanation of these terms but don't forget to come back to the initial paper, it is easy to get lost into the ocean of papers.

5) **What are the messages of the paper?** Read carefully the results and discussion section to understand the messages of the paper, the way they are conveyed.

6) **What are the limitations of the paper?** Once you have read the paper carefully, read again with a critical perspective: are they any issues in the method? In the data? In the discussion? What are the critical elements of the study?

Tips for Reading Papers

For Engineering/ Biophysics

- Always read the abstract first to see what their problem is and what their conclusion was

  - We are many times drawn to a paper by its title, but the title may not accurately present the data

- Read through the figures the most, as they tend to tell the complete story the most accurately

  - Figures tend to have the most complete descriptions of data, and many journals tend to have multi-panelled figure sets, and good articles can tell the full story through just the figure set

- Read the conclusion/discussion carefully – in many papers, the research goal of the introduction may not have been fully met, so you'll need to consider if it just means that the work is incomplete and future steps need to be done, or maybe the experimental setup of the work is not well founded for future steps

  - This is useful when figuring out what has been done in literature already, and whether you should follow their methodology or not

- Be aware of statistical significance!

    o Many papers in biology, due to the nature of the work generally taking longer/being harder to replicate, may have authors draw stronger conclusions than they should from their data

    o Be aware of "tricks" authors sometimes use when representing their data: low number of repeats, standard error vs standard deviation representation, independent variable axis being scaled to show changes that may actually be small

- If a paper is heavy in mathematical derivations, or loosely goes over them, read the SI

- Having two copies of a paper open can be useful for reading

    o For example, having the paper open on your computer to look at figures while you have a printed copy to simultaneously look at the body text

    o This is more necessary when you are taking a deep dive into one paper

For Clinical

- Papers are generally concise with a standardized structure, and therefore are straight forward to parse given familiarity with journal. Typically, one major contribution per paper.

Suggested reading order:

1. Abstract (and Central figure if available)
    a. Retrospective or prospective study
2. Last paragraph of intro
3. Conclusion
4. Figures and Tables
5. First paragraph of discussion
6. Methods
    a. Identify population: inclusion and exclusion criteria, source of data
    b. Modeling approach: refer to appendix if needed
7. Discussion
8. Limitations
9. Introduction
    a. If new to the area, read first

For Engineering

- Papers tend to be stylized, with unstandardized structure. Multiple contributions can be in one paper. Papers tend to pre-emptively list learning objectives before reading and target during reading:

    o Review of Literature

    o Learning methods/model

        ▪ Formulation
        ▪ Validation
        ▪ Proofs

- o Results
  - Increase in performance
  - Management takeaways

Reading order

1. Abstract (skim, unstructured abstracts)
2. Last section of introduction
   a. Specifically look for summary of contributions section
3. Conclusion
4. Look for sections containing learning objectives:
   a. Related literature
      i. If new to the area – read in depth to understand lay of the land
      ii. Flow diagram explaining system
   b. Model/Methods
      i. Model formulation, description, diagrams
         1. Typically, more than one model in paper, identify the version of interest
      ii. Proofs (appendix)
      iii. Means of validating methodological approach
   c. Results:
      i. Computational experiments results
         1. Figures and Tables
      ii. Look for results following implementation if available