STAT 572 Critical reading
How to read a research paper

Marina Meilă

Department of Statistics
University of Washington

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Most research papers are organized like this

- Abstract
- Introduction/Motivation: informal problem description, places the problem in context, related work
- Problem formulation
- Methodology/Proposed solution
  - Core method
  - Preprocessing, postprocessing, extensions and variations
- Discussion (placing the work in perspective)
  - related work
- Experiments
  - demonstrate empirically that method works
  - verify provable properties
  - learn about unknown/conjectured properties
  - compare with other methods

  - demonstrate that it can solve real problems

I Get Key points

Read

- Abstract
- **Introduction/Motivation**
- **Problem formulation**
- Methodology/Proposed solution
  - **Core method**
  - Preprocessing, postprocessing, extensions and variations
- Discussion (placing the work in perspective)
  - and related work
- Experiments

Think

- What problem is the paper trying to solve?
- By what method/approach ?
- What is interesting about this method? This should be your **take-home message** from this first reading

II Master the method

Read

- Abstract
- Introduction/Motivation
- Problem formulation
- **Methodology/Proposed solution**
  - **Core method**
  - **Preprocessing, postprocessing, extensions and variations**
- **Discussion (placing the work in perspective)**
  - **related work**
- **Experiments**

Think

- What are all the steps?
- How do algorithms work? How fast? How are/would they be implemented?
- Why do they work? Theory.
- Understand the proofs.

III Put paper in context

Read

- Abstract
- **Introduction/Motivation**
- Problem formulation
- Methodology/Proposed solution
  - Core method
  - Preprocessing, postprocessing, extensions and variations
- **Discussion (placing the work in perspective)**
  - **related work**
- Experiments

Think

- Significance – solves a general, relevant scientific or statistical problem?
- How does it advance the state of the art?
- Originality – how novel, surprising, clever are the solutions?
- Competing methods – what other ways are there to solve this problem?
- How is the new method better/worse than the previous ones (faster, more accurate, different assumptions, fails in different cases)?
- How similar/different is this problem from related problems? Could the new method be extended to other problems?

IV Critique

- Is the theory complete?
- Are the assumptions too strong, or unrealistic?
- How are the free parameters (e.g. regularization parameters, hyperparameters, model selection, stopping conditions of algorithm)?
- Are the authors' claims supported?
- Technical quality – did they solve a hard problem? is there something for you to learn from the solution techniques? are there mistakes?
- Is all relevant literature cited? Are there similarities with other methods that the authors have not mentioned?
- Do the algorithms scale with n? with dimensions, complexity of data?
- Can you think of cases when method will break/be less/more effective?
- Do the experiments support the claims?
- Are the experiments reproducible? (i.e. is there enough information provided to understand what was done?)
- Do the experiments test the method in difficult and varied cases? Do they explore the aspects of the method that are not (completely) predicted by theory?
- Are the comparisons with other methods fair?

For this course

After Step I, skim through the paper, and check the following.

- Is the paper theory-heavy? Does it contain highly technical proofs? How many? What kind of mathematical results are involved?
- Is the paper a follow-up of classic or well-known paper or result? Is it part of a "cluster" of related papers by the same group of authors?
- Are the data sets available? How large are they?
- Get a sense of the computational requirements to reproduce the experiments. How long did they take for the authors?

- In summary, envision your job of "reproducing" this paper. What will be the main challenges?

You will discuss these challenges with one of the instructors in a future meeting.