How to read a Paper

Information Systems and Machine Learning Lab (ISMLL)

Carlotta Schatten

Outline

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How to read a paper

- Like novel or newspaper stories, scientific articles needs to be read differently.
- Since they are not books designed for students sometimes they are not self contained and requires some research to be fully understood.
- Understand a paper for a researcher means to be able to implement the described algorithm.

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How to read a paper

- Skim
- Re–read
- Analyze
- Summarize

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Skim

First get the "Big picture" by reading the title, abstract, and introduction carefully: this will tell you the major findings and why they matter.

- Quickly scan the article without taking notes: focus on headings and subheadings
- Note the publishing date and conference/journal
- Note terms and parts you don't understand.
  Only with the bigger picture you will understand how much it is necessary to investigate something.

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Re-read

Read the article again, asking yourself questions such as:

- What problems is the study trying to solve?
- Are findings well supported by evidence?
- Is the study repeatable? (i.e. is the article self contained?)
- If you do not understand take some time to find a brief explanation of what you are not understanding (one-two sentences).
- Is the paper innovative?

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Interpret

- Examine graphs and tables carefully
- Try to interpret data first before looking at captions
- When reading the discussion and results look after key issues and new findings
- Make sure you have distinguished the main points. If not go over the text again.

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Summarize

- Take notes and underline key points: it improves reading
- Decide what part of the paper needs to be expanded and how much.

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Common paper structure

- Abstract
- Introduction
- State of the art
- Algorithms explanation
- Experiments
- Conclusions and future work
- References

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Let's take this paper as an example:

"Huang, S., Wang, S., Liu, T. Y., Ma, J., Chen, Z., and Veijalainen, J. (2015, August). **Listwise Collaborative Filtering.** In Proceedings of the 38th International ACM SIGIR Conference on Research and Development in Information Retrieval (pp. 343-352). ACM."

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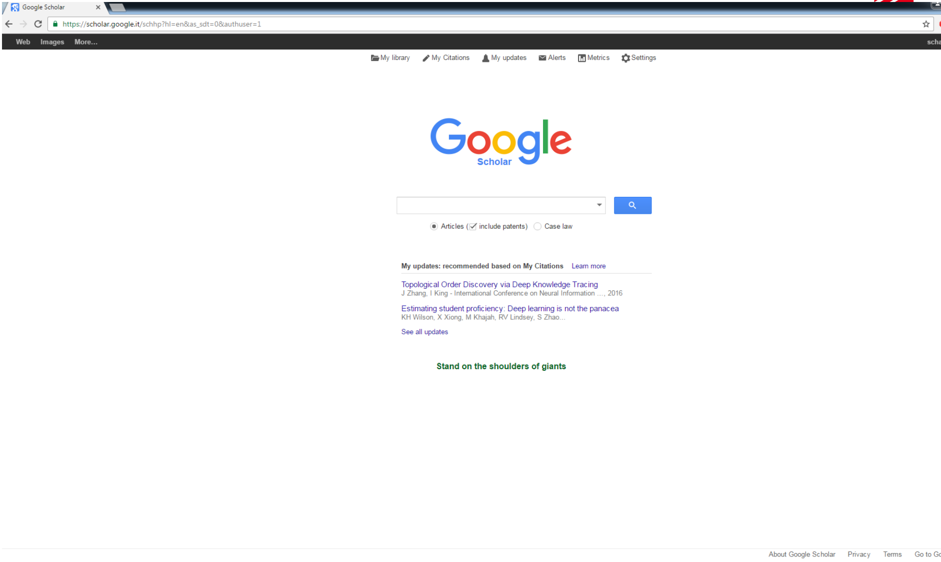
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Topological Order Discovery via Deep Knowledge Tracing
J Zhang, I King - International Conference on Neural Information ..., 2016
Estimating student proficiency: Deep learning is not the panacea
KH Wilson, X Xiong, M Khajah, RV Lindsey, S Zhao...
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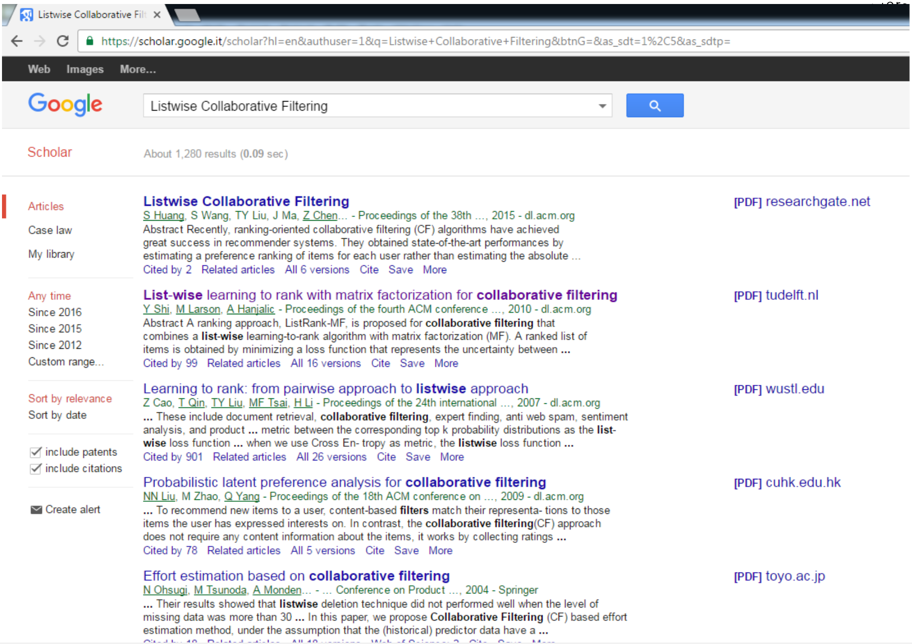
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Abstract

- Brief introduction to the topic
- Brief introduction to paper achievements
- Brief summary of the experiments

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Introduction

- Introduction to the topic
- Introduction of the main concepts
- Introduction of the main state of the art methods
- **State of the art limitations**
- **Hypotheses**
- **Contributions**

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The Importance of Hypotheses

- It is not enough to describe some new technique or system, some claim about it must be stated and evaluated
- In experimental research, hypotheses typically take one of these two forms:
  - Technique/system X automates task Y for the first time
  - Technique/system X automates task Y better, along some dimension, than each of its rivals
- In theoretical papers, the hypotheses are the statements of theorems and the supporting evidence is their proofs

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The Importance of Hypotheses

Technique/system X automates task Y better, along some dimension, than each of its rivals, where the dimensions are typically:

- **Behavior:** X has a higher success rate or produces better quality outputs than Y
- **Coverage:** X is applicable to a wider range of examples then Y
- **Efficiency:** X is faster or uses less space then Y
- **Dependability:** X is more reliable, safe or secure than its rivals
- **Maintainability:** X is easier to adapt and extend than its rivals
- **Usability:** Users find X easier to use than its rivals

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State of the art / Related work

- Is a broad and shallow account of the field, which helps to place the contribution of the paper in context
- What are the rival approaches?
- What are the drawbacks of each?
  - One sentence per method. Is it clear enough?
- How has the battle between different approaches progressed?
- What are the major outstanding problems?

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Algorithm Explanation

- First the authors introduce the algorithm from which they derived the new algorithm
- Then, the new algorithm is explained
- Contains:
  - Formulas
  - Pseudo code

Algorithm 1: The ListCF Algorithm

Input: An item set I, a user set U, and a rating matrix $R \in \mathbb{R}^{M \times N}$. A set of rated items $I_u \subseteq I$ by each user $u \in U$. The maximal number of iterations $maxIteration$ and error threshold ϵ.

Output: A ranking $\hat{\tau}_u$ of items for each user $u \in U$.

```
for u ∈ U do
    for v ∈ U and u ≠ v do
        P_u, P_v ← TopKProDist(I_u, I_v, R)          /* Eq.1 */
        sim(u, v) ← Similarity(P_u, P_v)             /* Eq.2 */
    end
    N_u ← SelectNeighbors({sim(u, v)}_{v∈U/u})
end
for u ∈ U do
    t = 1
    repeat
        ε = 0
        Initialize(φ_u^0)
        for g ∈ G_k^{T_u} do
            φ_{u,g}^t ← Update(N_u, sim, R)          /* Eq.8 */
            ε += sqrt(Σ (φ_{u,g}^t − φ_{u,g}^{t−1})^2)
        end
        t ← t + 1
    until t > maxIteration or ε < ϵ;
    for t ∈ T_u do
        P(t) ← Aggregation({φ_{u,g}}_{g∈G_k^{T_u}})
    end
    τ̂_u ← Ordering({P(t)}_{t∈T_u})
end
```

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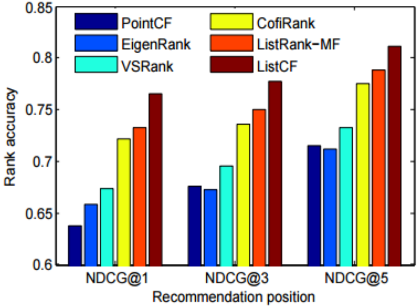
Experiments

- **Dataset Explanation**
  - What are the available information?
  - What are the available statistics? E.g. number of users, items, sparsity etc.
- **Evaluation protocol**
  - How is the error of the algorithm computed?
  - Are there any other quantitative success measures?
- **Experiments**
  - Are the results statistically significant?

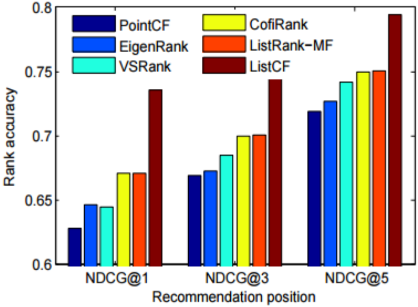
20162017/How to Read a Paper/fig/datasetcharacteristics.png

Table 2: Statistics on the three datasets.

	Movielens-1M	EachMovie	Netflix
#users	6,040	36,656	429,584
#items	3,952	1,623	17,770
#ratings	1,000,209	2,580,222	99,884,940
#ratings/user	165.6	70.4	232.5
#ratings/item	253.1	1589.8	5621.0
sparsity	93.7%	95.7%	98.7%



(a) Movielens-1M



(b) EachMovie

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Conclusions

- Repeats the contributions pointing out specifically how the paper addressed it
- Include future works

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Finding additional material

- If you don't understand something..
- This is not a book, it happens...
  - Try to pose yourself a specific questions
  - Look online

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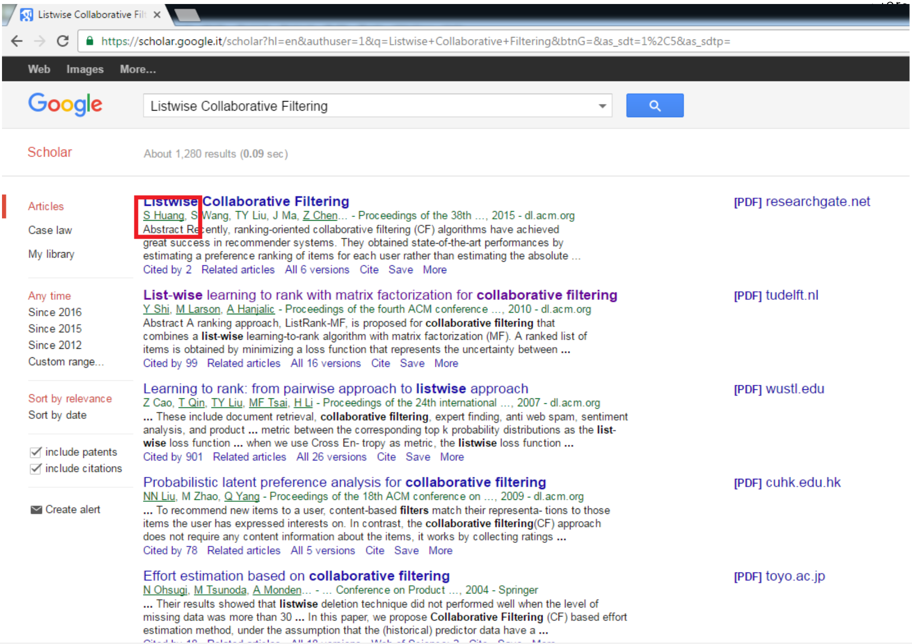
Finding additional material

- A book explaining the algorithms
- A PhD thesis
- Tutorials
- Highly related state of the art papers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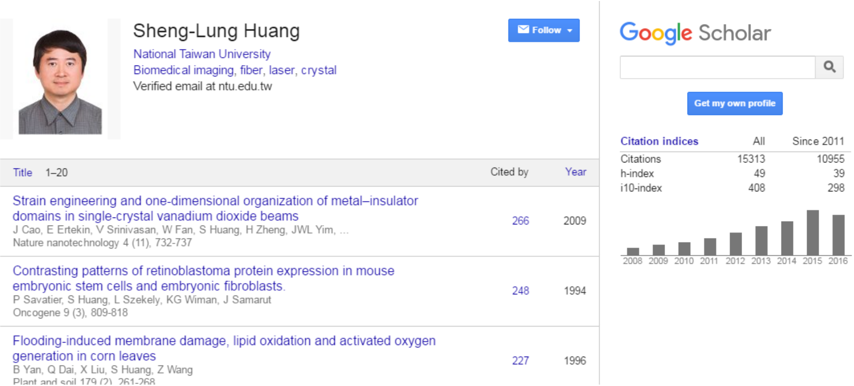
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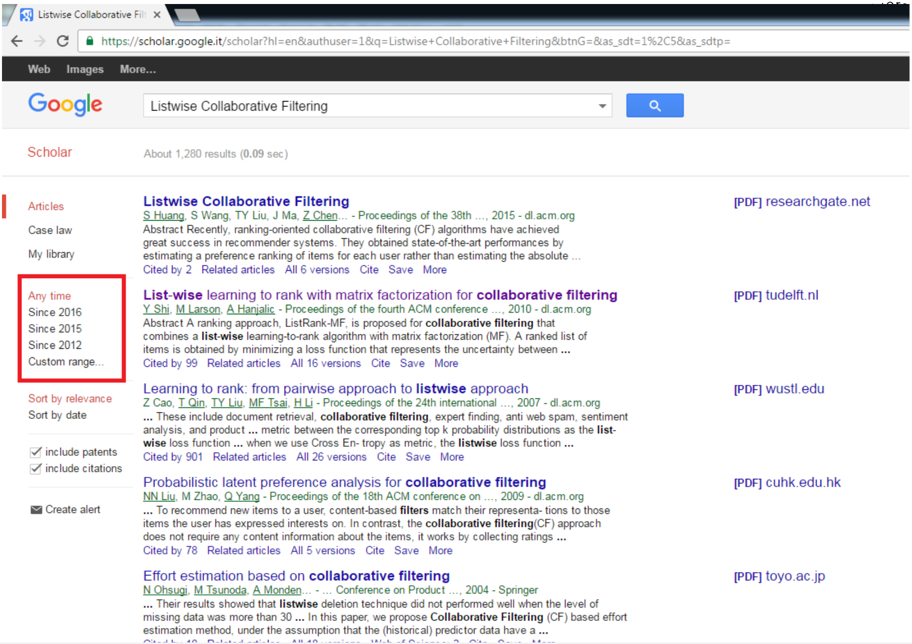
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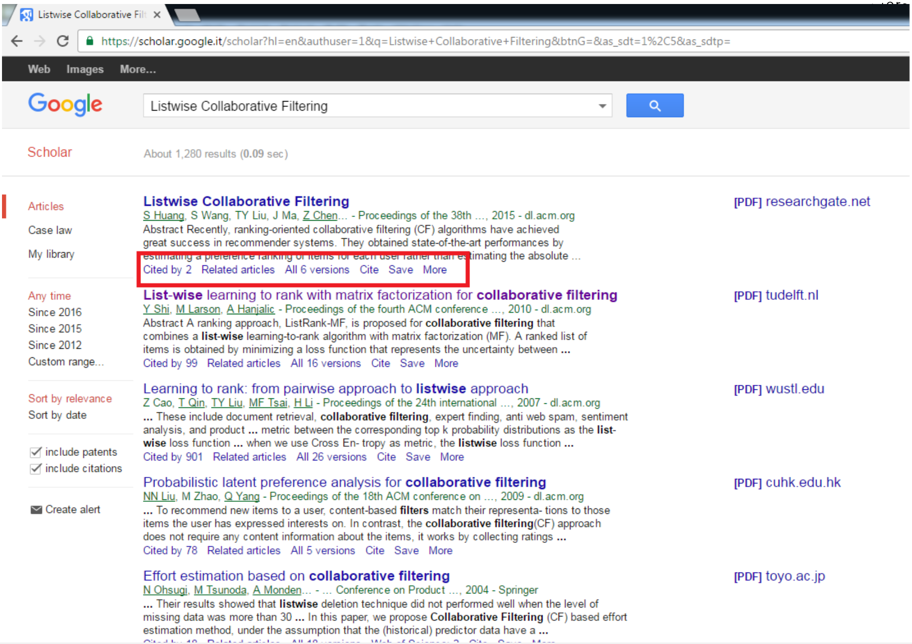
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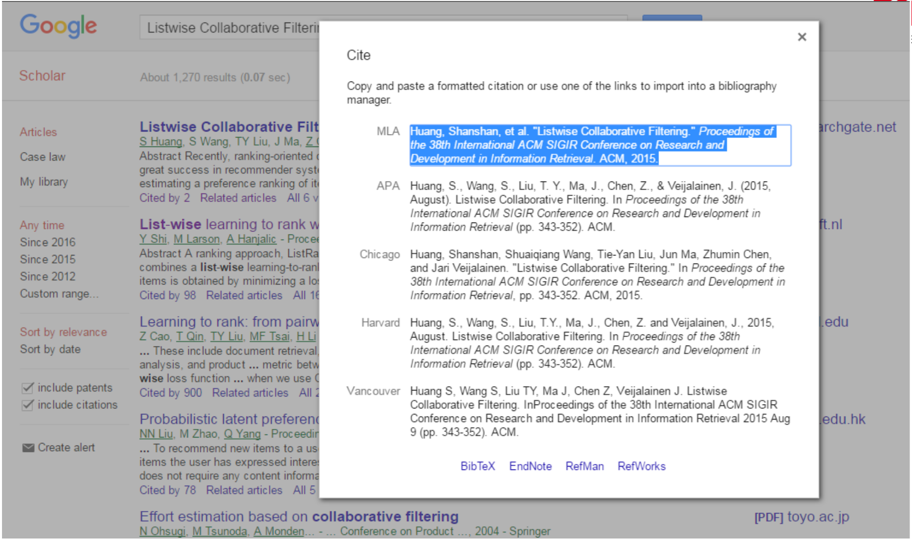
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