Understanding the Academic World

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3 Questions to Answer

- Which papers are the most influential in their field?
- Which researchers are more successful?
- Which scientific areas are more promising?

3 Tasks to Accomplish

- Evaluate papers — citation count vs pagerank
- Evaluate authors — h, g, h’ indexes, h_{rwr}
- Evaluate fields — community detection, statistics

Datasets

- 2 datasets:
  - AMiner dataset — 154 million papers
  - Microsoft Academic Graph — 166 million papers
  - 64 million one-to-one matching between them

Data Preparation

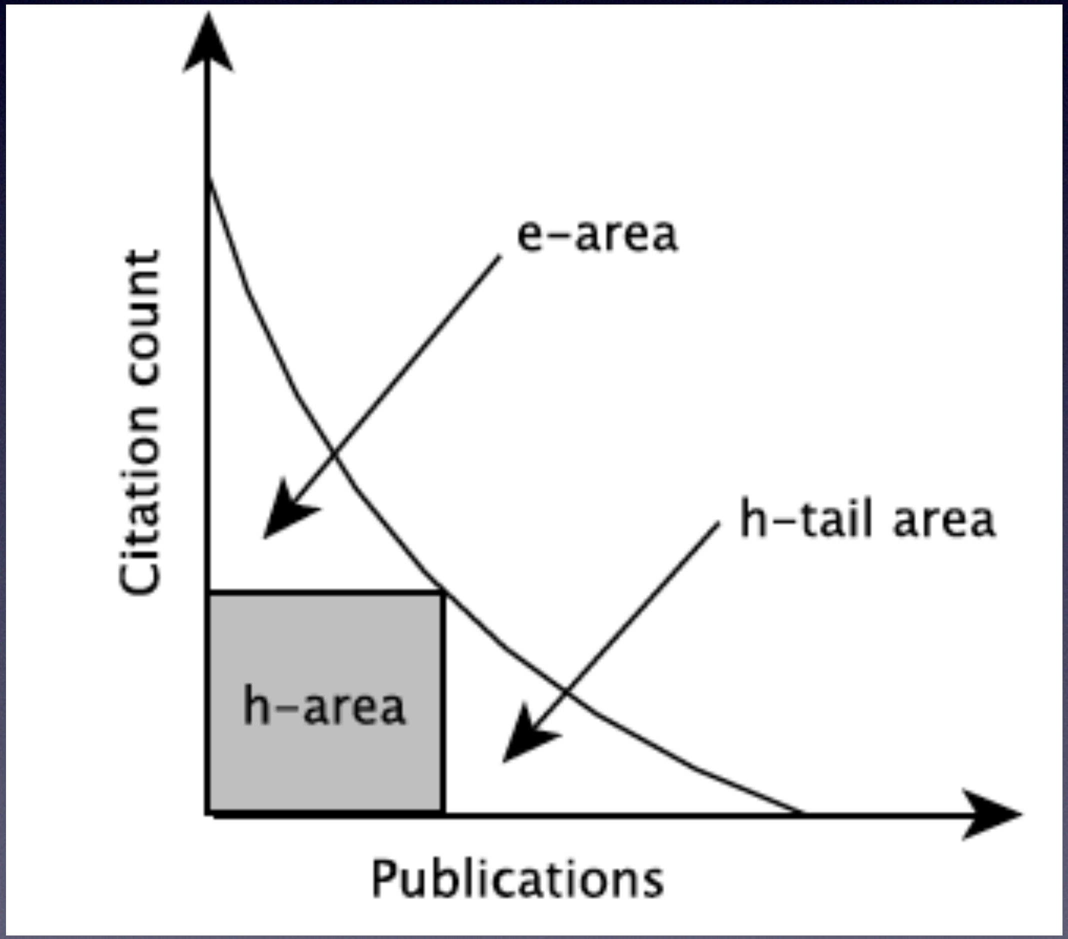
- Filtering necessary attributes — year, authors & affiliations, references, keywords, fields of study
- Constructing CRS (compressed row storage) formatted graphs
  - paper-cites-paper
  - paper-citedby-paper
  - author-writes-paper
  - author-collaborates-author
  - author-cites-author

Evaluating Papers

- Looking at citation counts
  - most current methods use this approach — h-index, g-index, h’-index
- PageRank (based on Random Walk w/ Restarts)
  - a newer approach in literature
  - implemented by another team

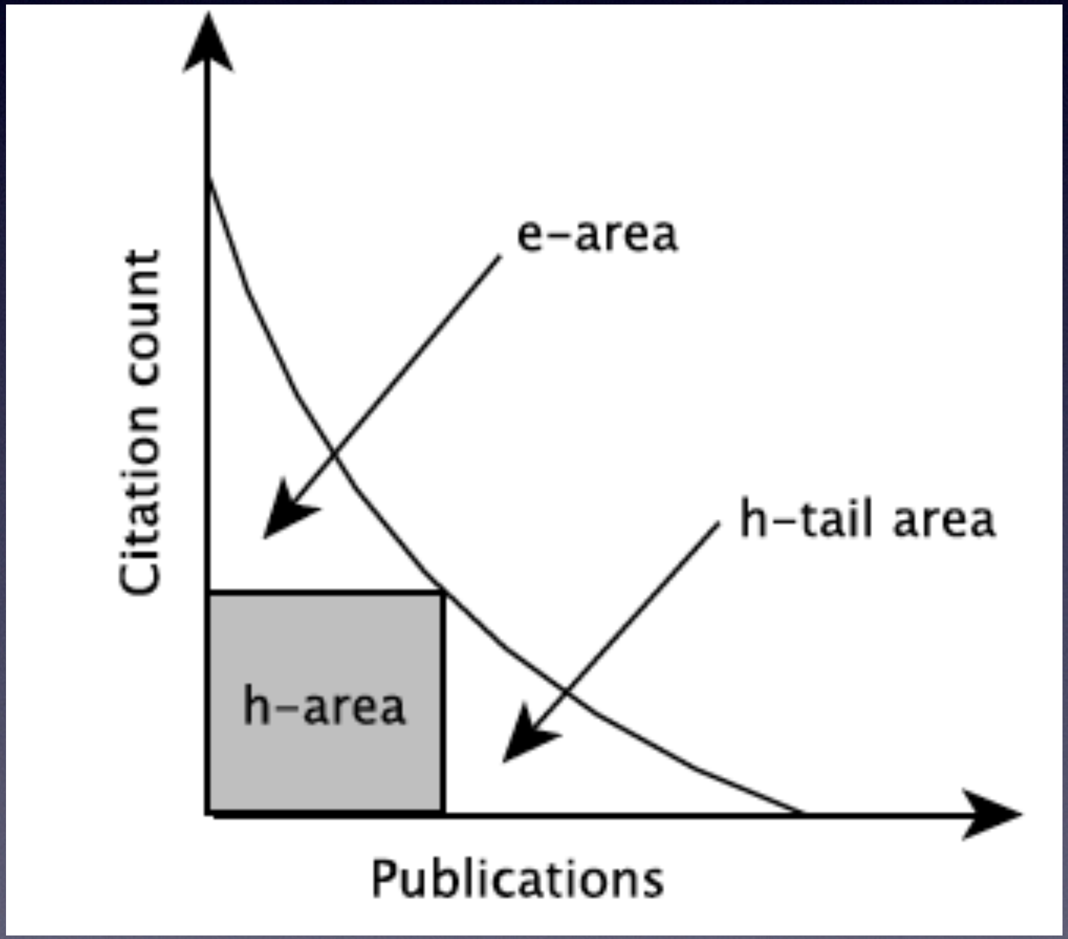
Evaluating Authors

- h-index
  - a researcher has an h-index of h if h of his papers have at least h citations and all of the remaining papers have less than h citations
  - uses only the h-area



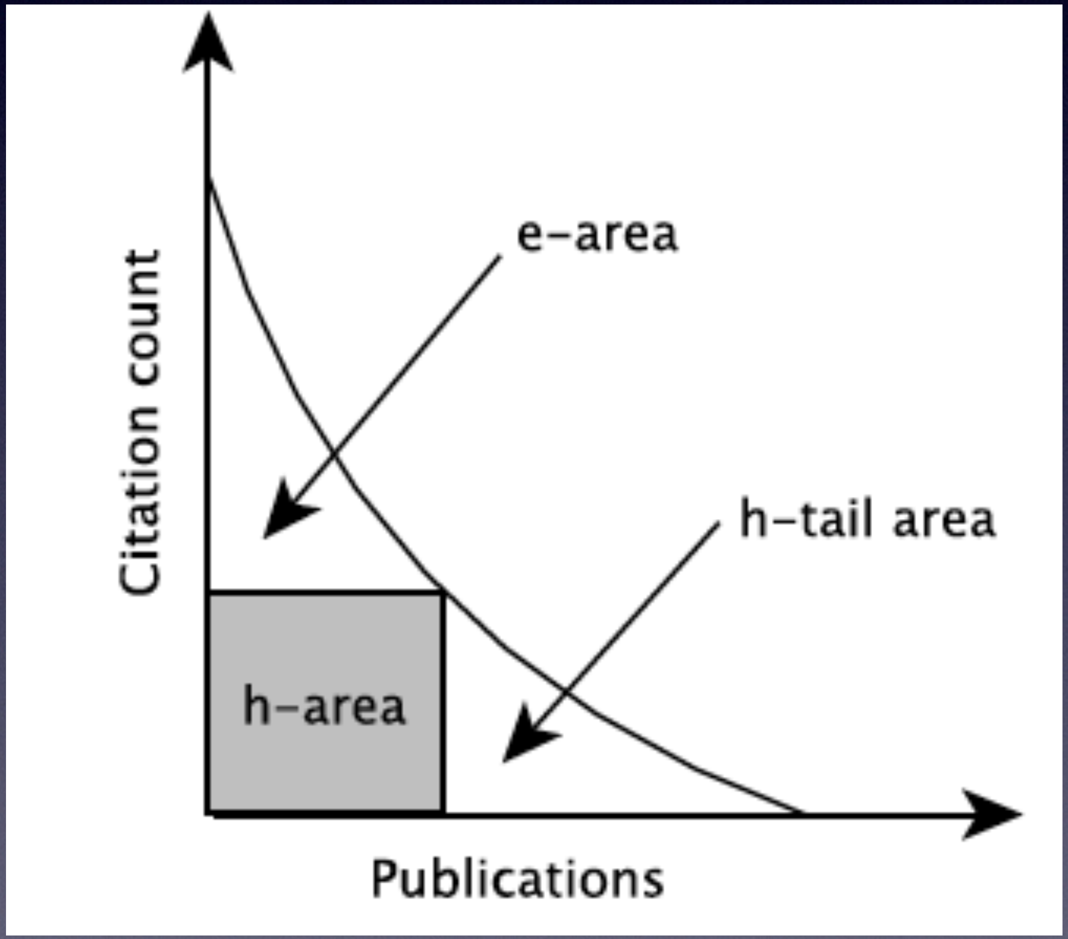
Evaluating Authors

- g-index
  - a researcher has an g-index of g if top g papers have at least g^2 citations in total and top (g+1) papers have less than $(g+1)^2$ citations
  - uses both h-area and e-area



Evaluating Authors

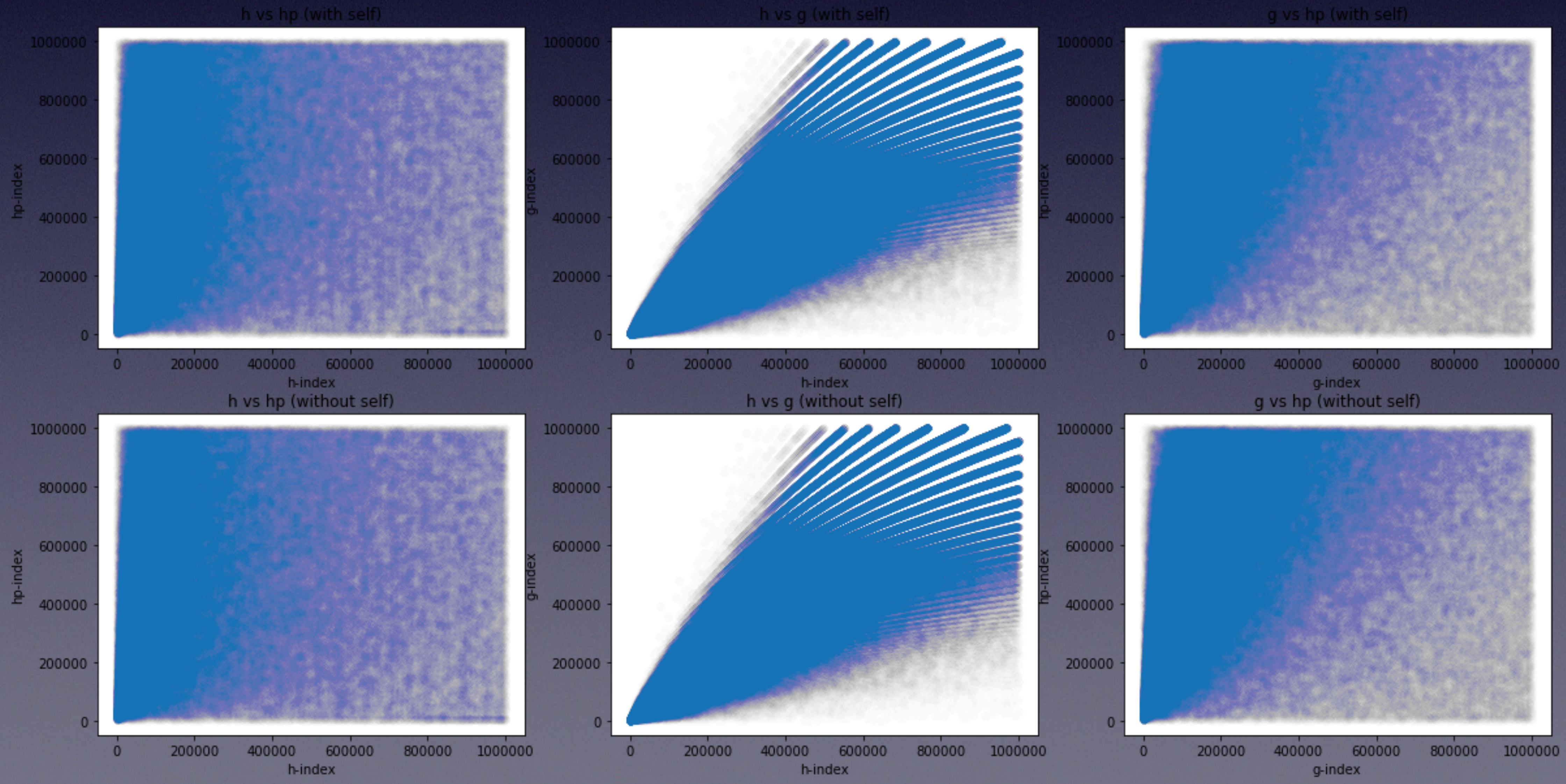
- h'-index
  - a researcher has an h'-index h' = eh/t where h is his h-index, and e and t are the square roots of e-area and h-tail area respectively
  - uses all three areas



Comparing Indexes

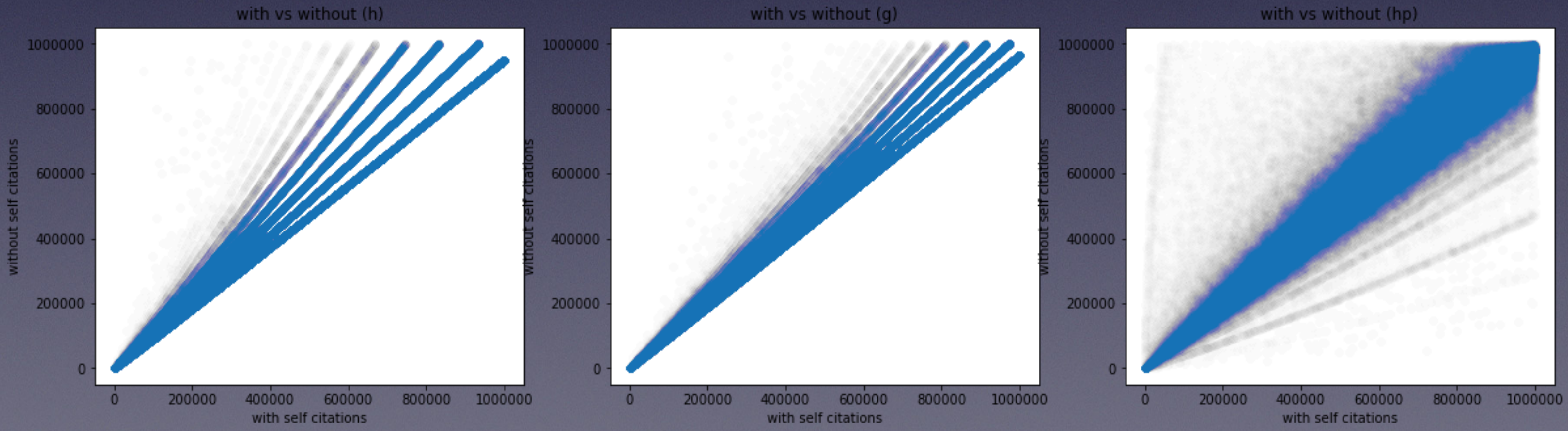
- There are no correlations between h’-index and other indexes.

- However, there is a correlation between h-index and g-index.



Comparing Indexes

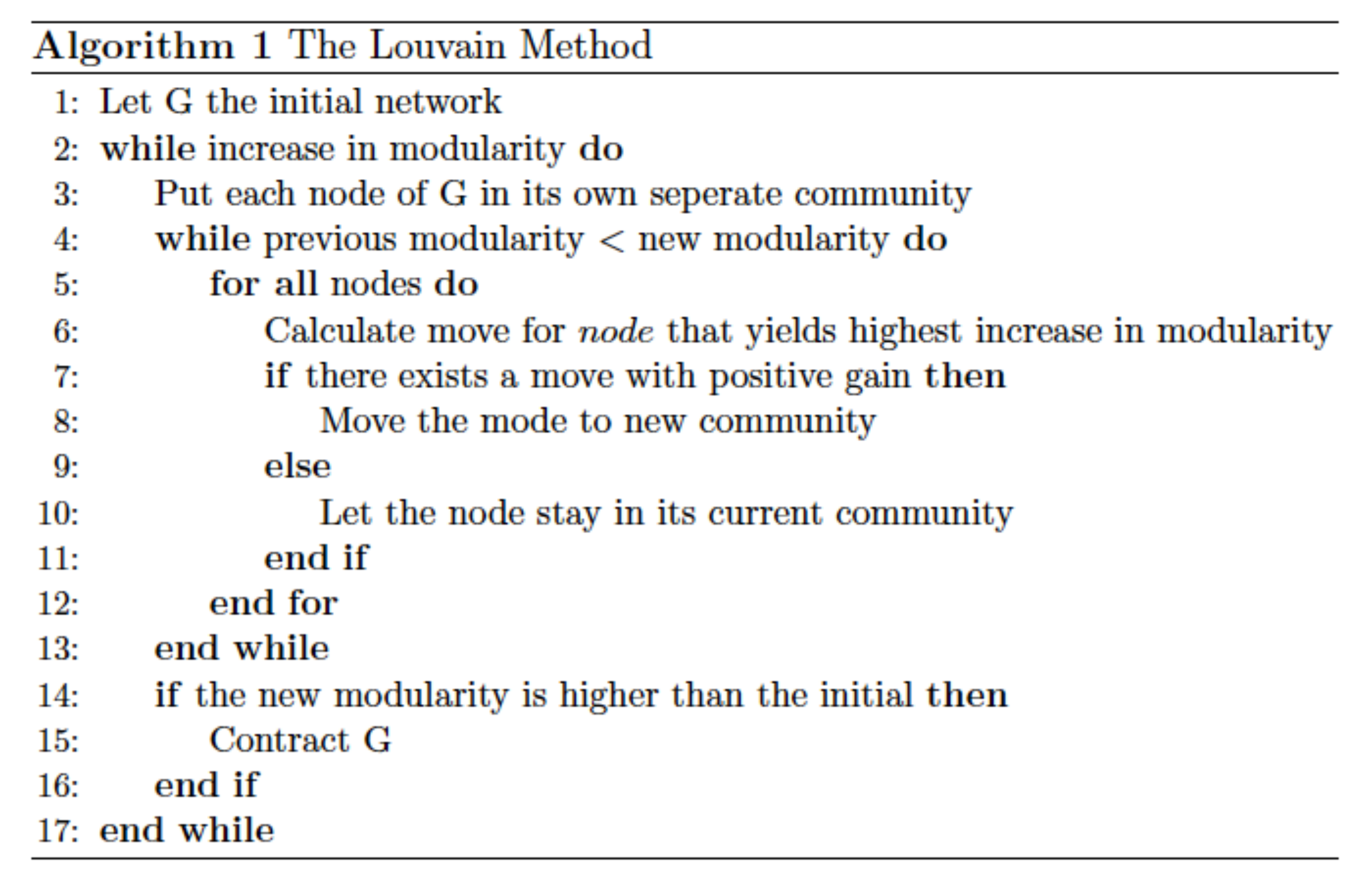
- The effect of self-citations is the most in h’-index.
- This effect is the least in g-index.



Evaluating Fields

- Field identification
    - Community detection — Louvain method
    - Frequency analysis on keywords
    - Word clouds
- Comparison of fields with h-index

Community Detection — Louvain Method



Algorithm 1 The Louvain Method

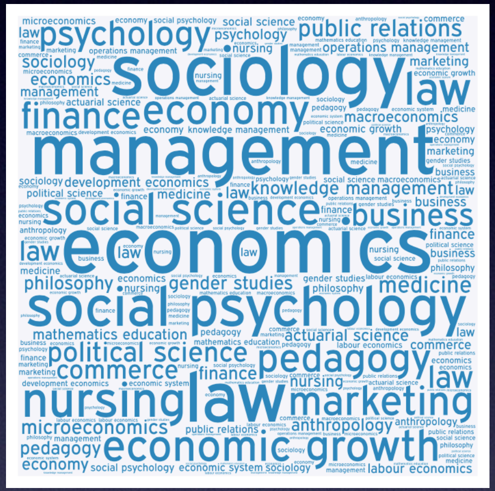
```
Let G the initial network
while increase in modularity do
    Put each node of G in its own seperate community
    while previous modularity $<$ new modularity do
        for all nodes do
            Calculate move for node that yields highest increase in modularity
            if there exists a move with positive gain then
                Move the mode to new community
            else
                Let the node stay in its current community
            end if
        end for
    end while
    if the new modularity is higher than the initial then
        Contract G
    end if
end while
```

(Herman Moyner Lund, 2017)

Frequency Analysis of Keywords

- score = $(\text{freq})^2$ x expected
    - where freq is the frequency of keywords within the community and expected is the expected frequency obtained by the general distribution and the community size

Word Clouds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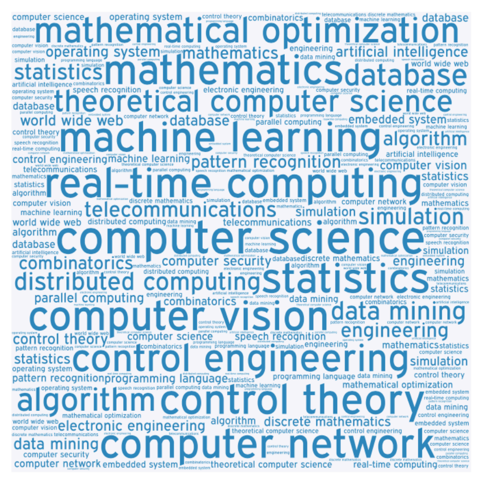
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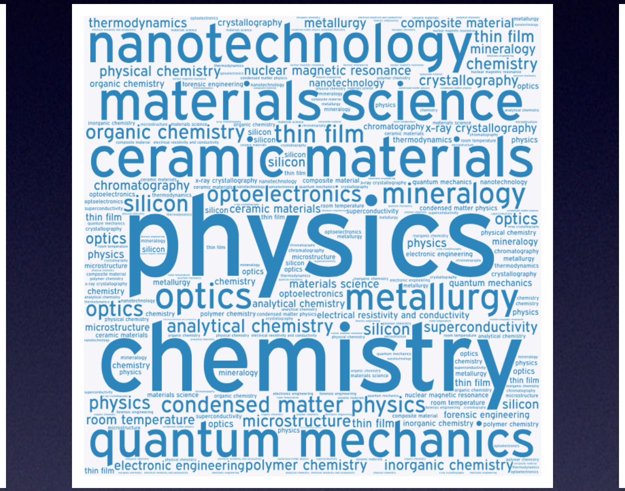
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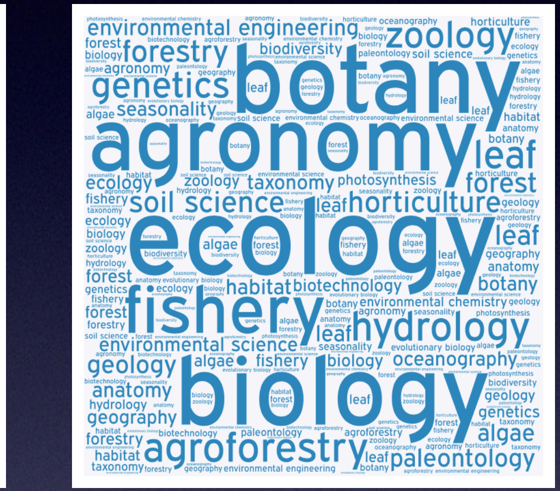
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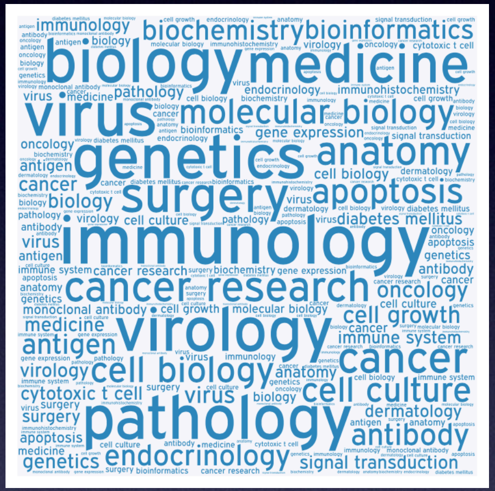
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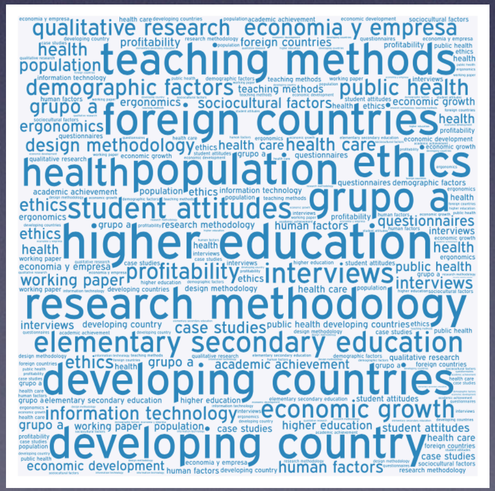
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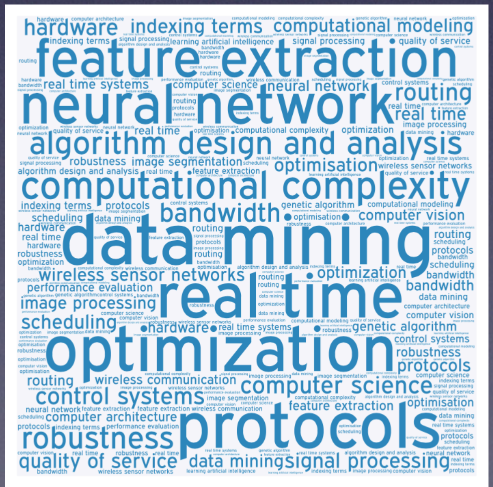
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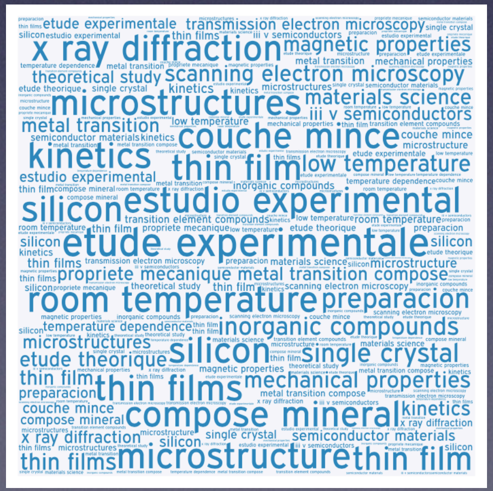
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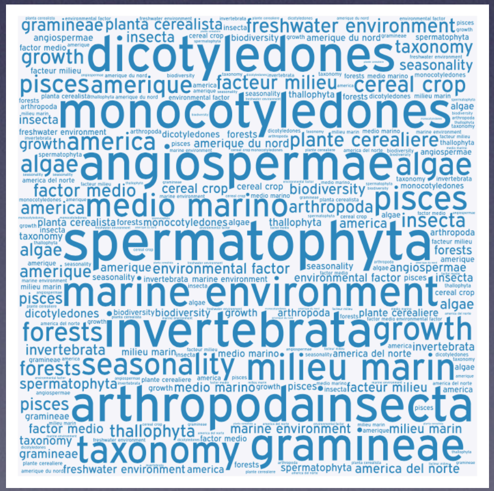
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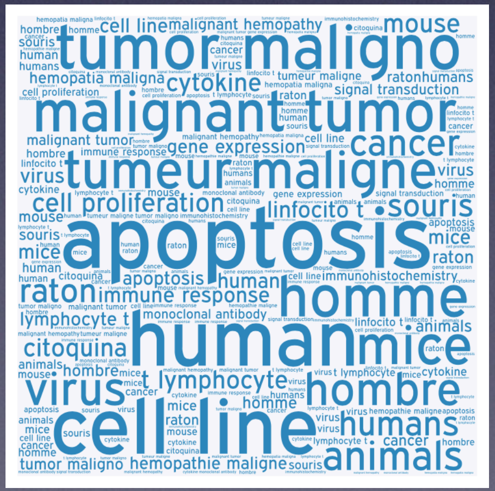
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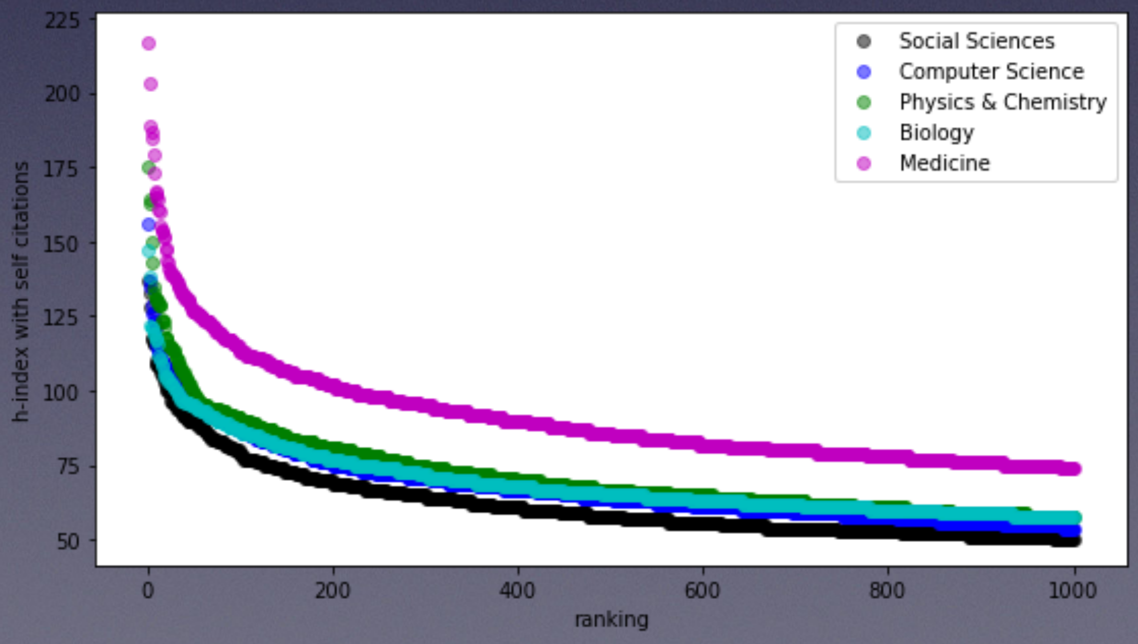
citoquina
lymphocyte
hombre
virus
humans
cell line
animals

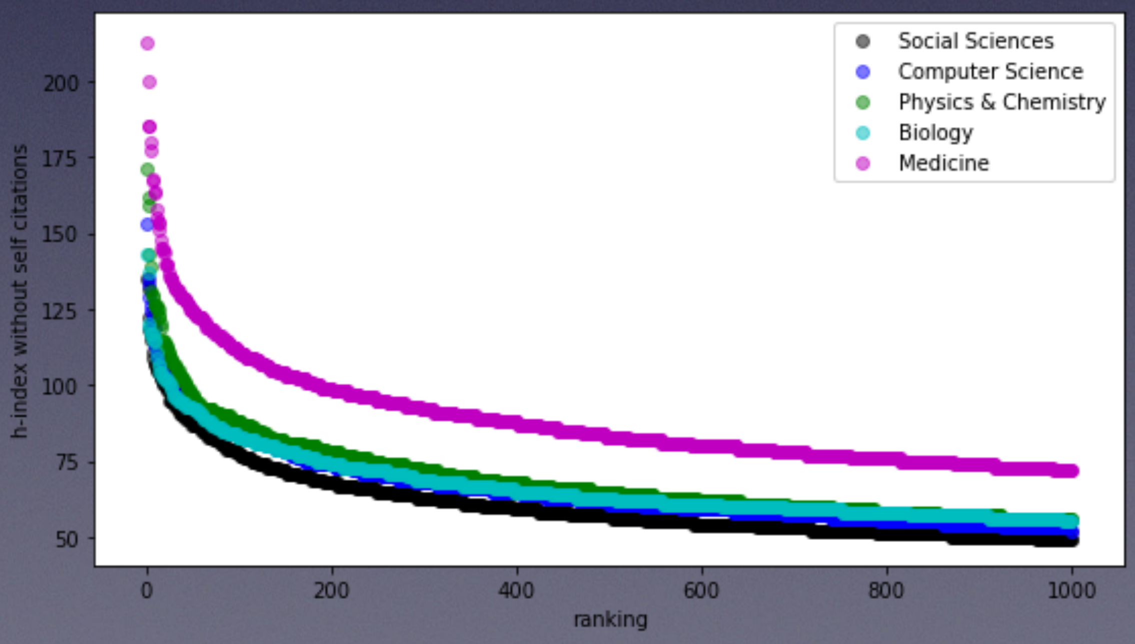
Field Identification

1. Social Sciences
2. Computer Science
3. Physics & Chemistry
4. Biology
5. Medicine

Field Comparison

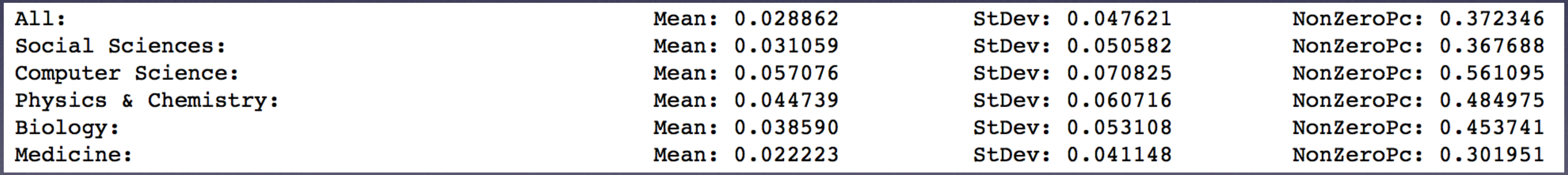
- As seen in the figure, top authors of some fields, e.g. medicine, have much higher h-indexes compared to the top authors of other fields.





Field Comparison

- As seen in the table, of the top 5 fields, self-citation has the most effect in computer science field and the least effect in medicine field.



```
All:                                              Mean: 0.028862          StDev: 0.047621          NonZeroPc: 0.372346
Social Sciences:                                  Mean: 0.031059          StDev: 0.050582          NonZeroPc: 0.367688
Computer Science:                                 Mean: 0.057076          StDev: 0.070825          NonZeroPc: 0.561095
Physics & Chemistry:                              Mean: 0.044739          StDev: 0.060716          NonZeroPc: 0.484975
Biology:                                          Mean: 0.038590          StDev: 0.053108          NonZeroPc: 0.453741
Medicine:                                         Mean: 0.022223          StDev: 0.041148          NonZeroPc: 0.301951
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