The difference between popularity and prestige:
Beyond simple metrics

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physica status solidi (Editor)

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The importance of impact

- Why should we care about impact?
- How do we currently measure it?
- What do these metrics *actually* measure?
- Can we do better?

Important remark

- This talk is about metrics and how they compare to each other, but …
- It is important that
  - they be used correctly
  - they be used as a helping tool
  - they *not* be used *exclusively*
- Metrics don‘t kill people. People kill people.

Why the `obsession´?

- Explosive growth of science

Which has lead to:

- Explosion of the publication record
- Specialisation of scientists
- Increased competition amongst
  - Scientists
  - …. and scientific journals

How do we objectively measure scientific output?

- Use of citation metrics is exploding
  - academic departments (hiring decisions)
  - funding agencies
  - …
- Routinely used to
  - evaluate scientific journals
  - make decisions on where to submit
  - Evaluate scientists
- Abused, and (sometimes) misused.

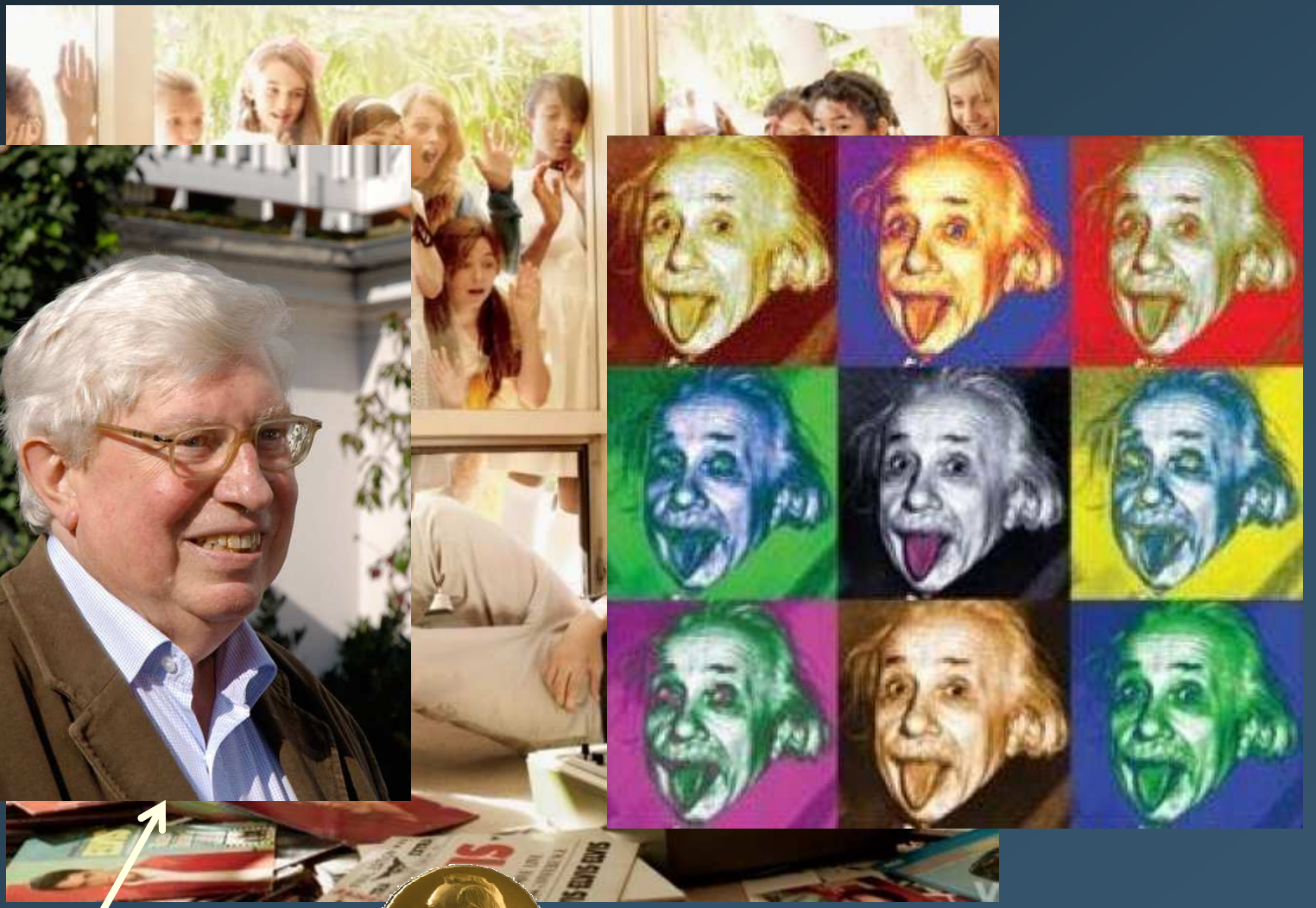
Prestige vs. popularity

Prestige vs. popularity

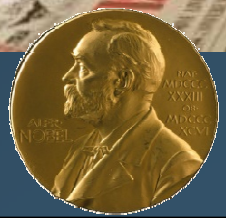
?

Prestige vs. popularity

Prestige vs. popularity



Prof. Dr. Gerhard Ertl



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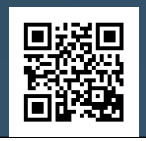
Some metrics

- h-index
- m index
- g-index

- ISI Impact Factor (IF)
- Immediacy index
- Five-year impact factor
- Eigenfactor®
- And more … a LOT more

"A principal component analysis of 39 scientific impact measures",
http://arxiv.org/PS_cache/arxiv/pdf/0902/0902.2183v2.pdf



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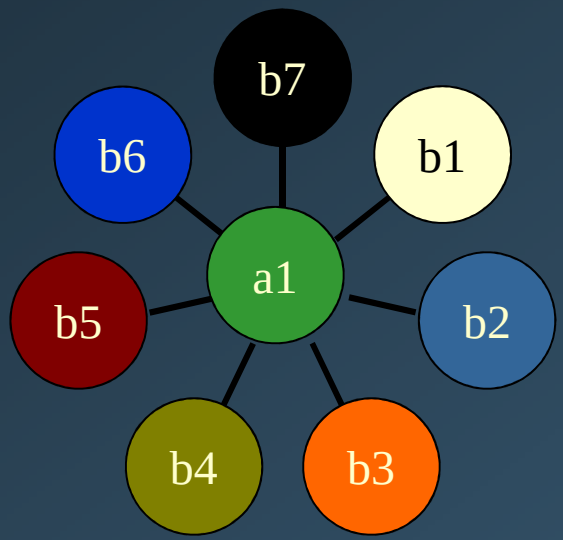
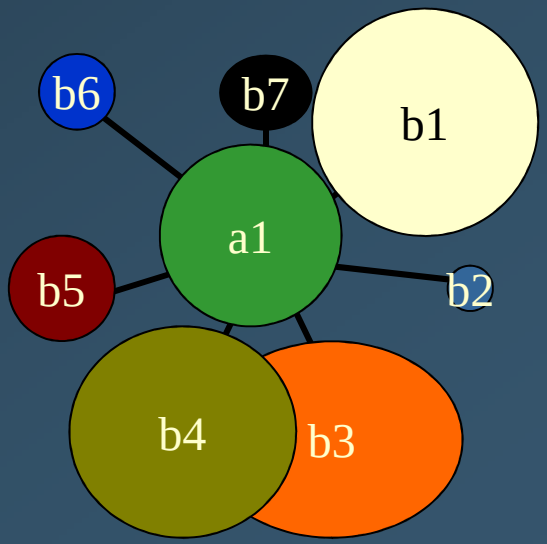
Types of metrics

- Article-level metrics
- Journal metrics (IF, 5-yr IF, eigenfactor)
- Author metrics

More types of metrics

- Popularity metrics
  - -One "man", one vote
  - -Democratic
- Prestige metrics
  - -Graph (or network) based
  - -Meritocratic (?)





A word about statistics

- "Statistics are no substitute for judgment."
- "A statistician can have his head in an oven and his feet in ice, and he will say that on the average he's okay."
- "Most people use statistics the way a drunk uses a lamp post, more for support than enlightenment."
- "There are three types of lies: Lies, Damn Lies, and Statistcs."
- "42.17 % of statistics are made up on the spot."

And now for some statistics:

Citation metrics

Journal Impact Factor (JIF)

The journal impact factor:
Average number of times articles from the journal published in the past two years have been cited in the JCR year.

$$IF_3 = \frac{C_3}{A_1 + A_2}$$

Current uses of the JIF

- Authors; decide where to submit
- Academic departments; hiring decisions
- Funding agencies; award grants
- Publishers; estimate success of journals

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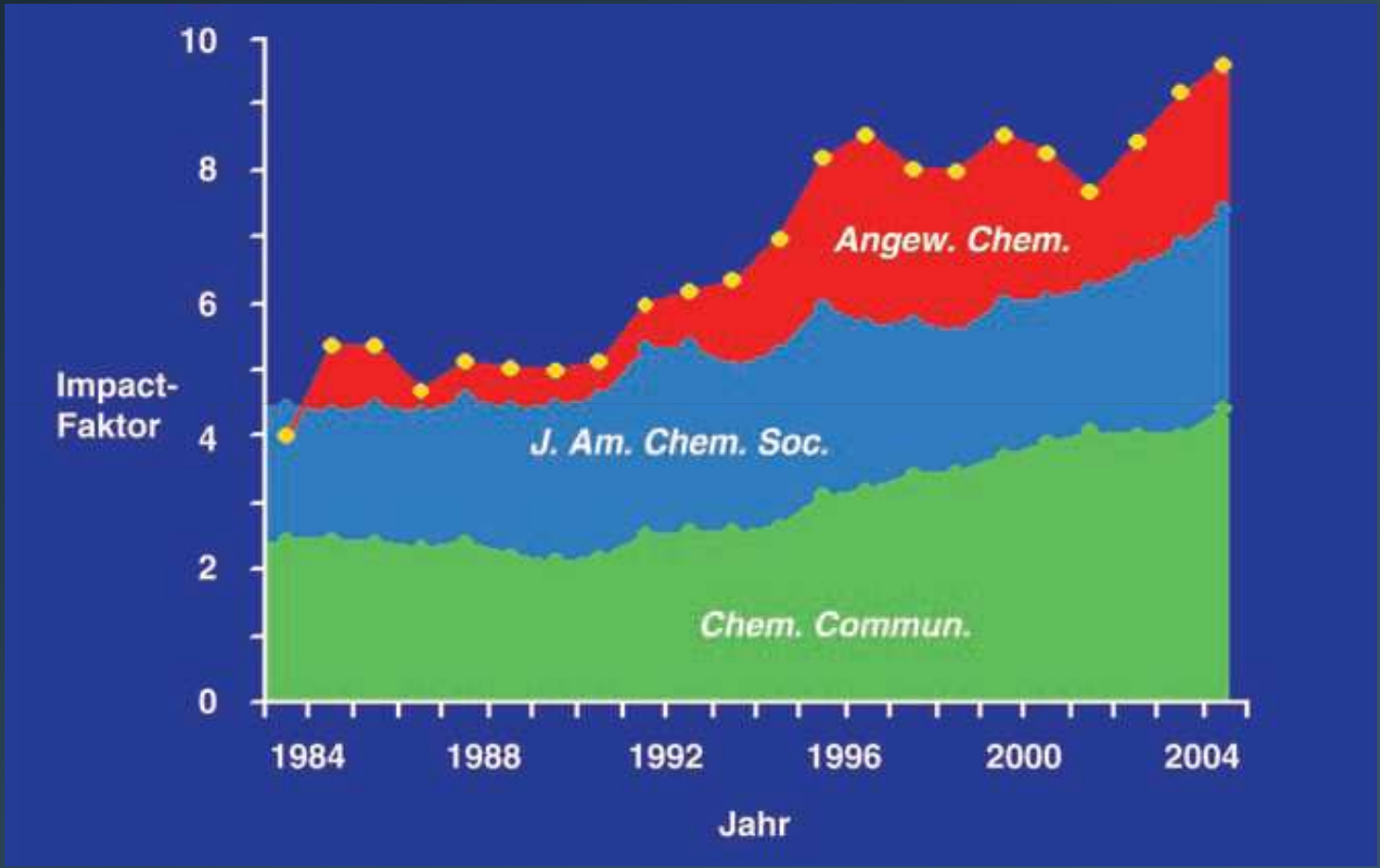
It has problems ...

- It's easy to game
  - Authors: self-citations
  - Unscrupulous editors: directed citations (and other dirty tricks)
- It's not reproducible
  - Based on the JCR, which is proprietary
  - Not necessarily clear what constitutes a "citable item"
- Only covers a limited window
  - 2 or 5 years, but still ...
- Vastly varies from field to field

Impact Factor "inflation"



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Impact Factor – an alternative definition

PhD Comics (8/12/2008): http://www.phdcomics.com/comics.php?f=1108

Outlier or Out-liar? An anecdote

Acta Crystallographica (A)

- Impact Factors in 2008
  - AC-A: 2.051
  - AC-B: 2.341
- Impact Factors in 2009
  - AC-A: 49.926
  - AC-B: 1.801

- Acta Cryst. A was ***not*** removed from the JCR

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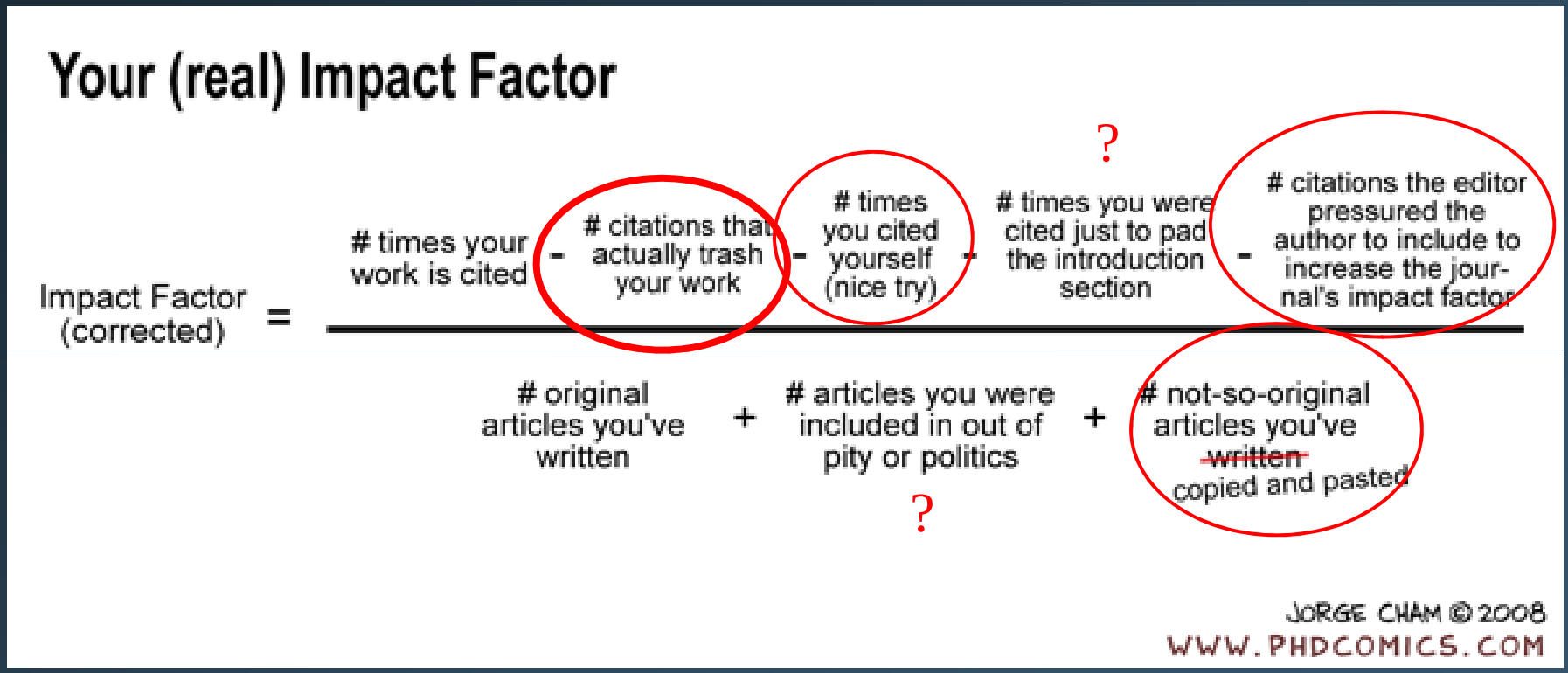
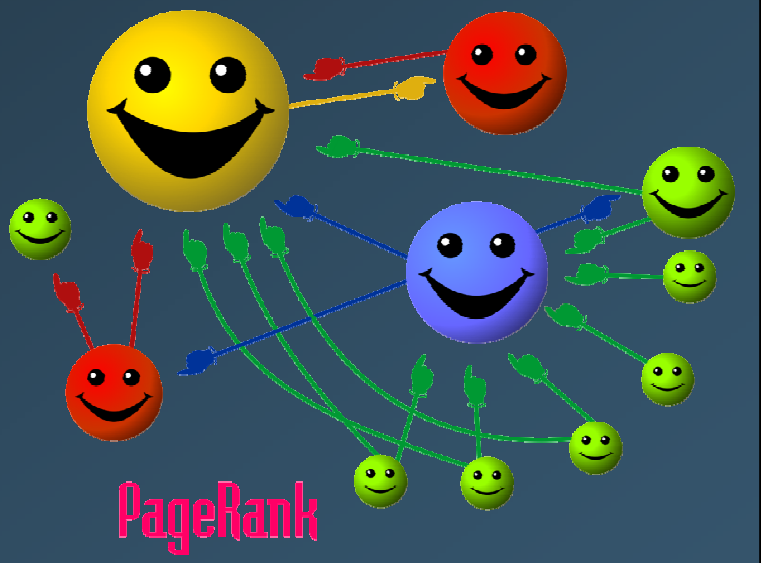
Impact Factor – an alternative definition



PhD Comics (8/12/2008): http://www.phdcomics.com/comics.php?f=1108

Google PageRank

- Algorithm Google uses to rank its search results
- Network-based method
- Takes into account the PR of incoming links
- Measures reputation
- Yes, the size of the smile is $\propto$ to PR



$$PR(p_i) = \frac{1-\alpha}{N} + \alpha \sum_{p_j \in M(p_i)} \frac{PR(p_j)}{L(p_j)}$$

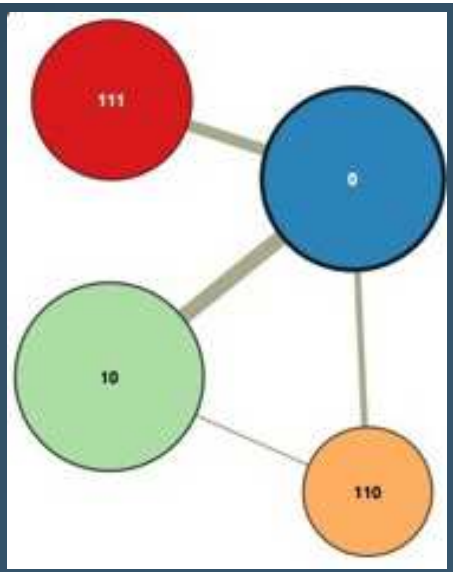
amusing anecdote ...

- In 1941 Wassily W. Leontief (an economist) developed his input-output model
- The model represents a country's economy by sectors that receive and supply resources from and to each other
  - Size of each sector is ∝ to the resources it receives
  - It is weighted by the resources it supplies
  - Familiar? This *is* PageRank
- Leontief was awarded the Nobel Memorial prize in economics for this work in 1973

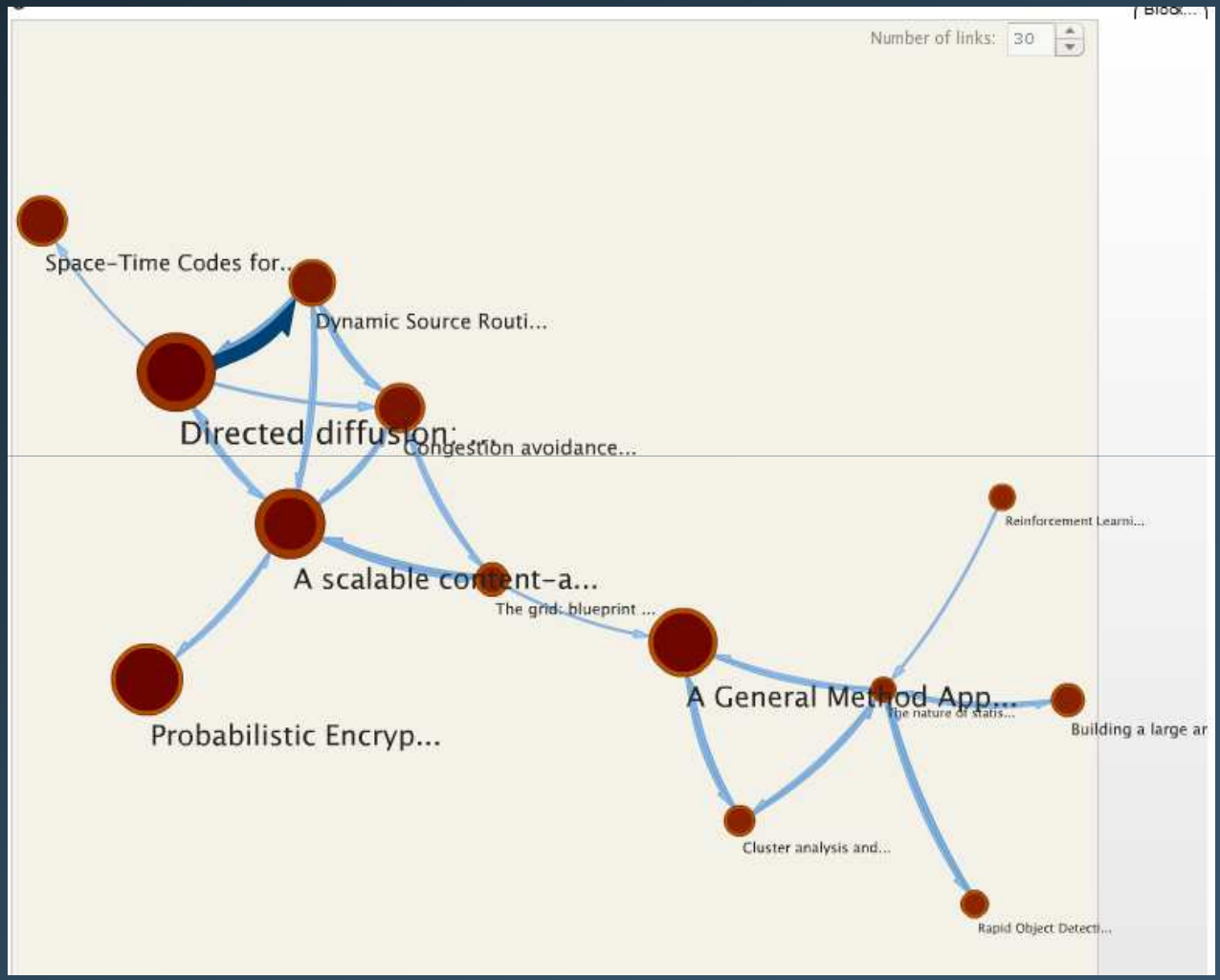
- Even a Nobel prize doesn't guarantee visibility...

Eigenfactor

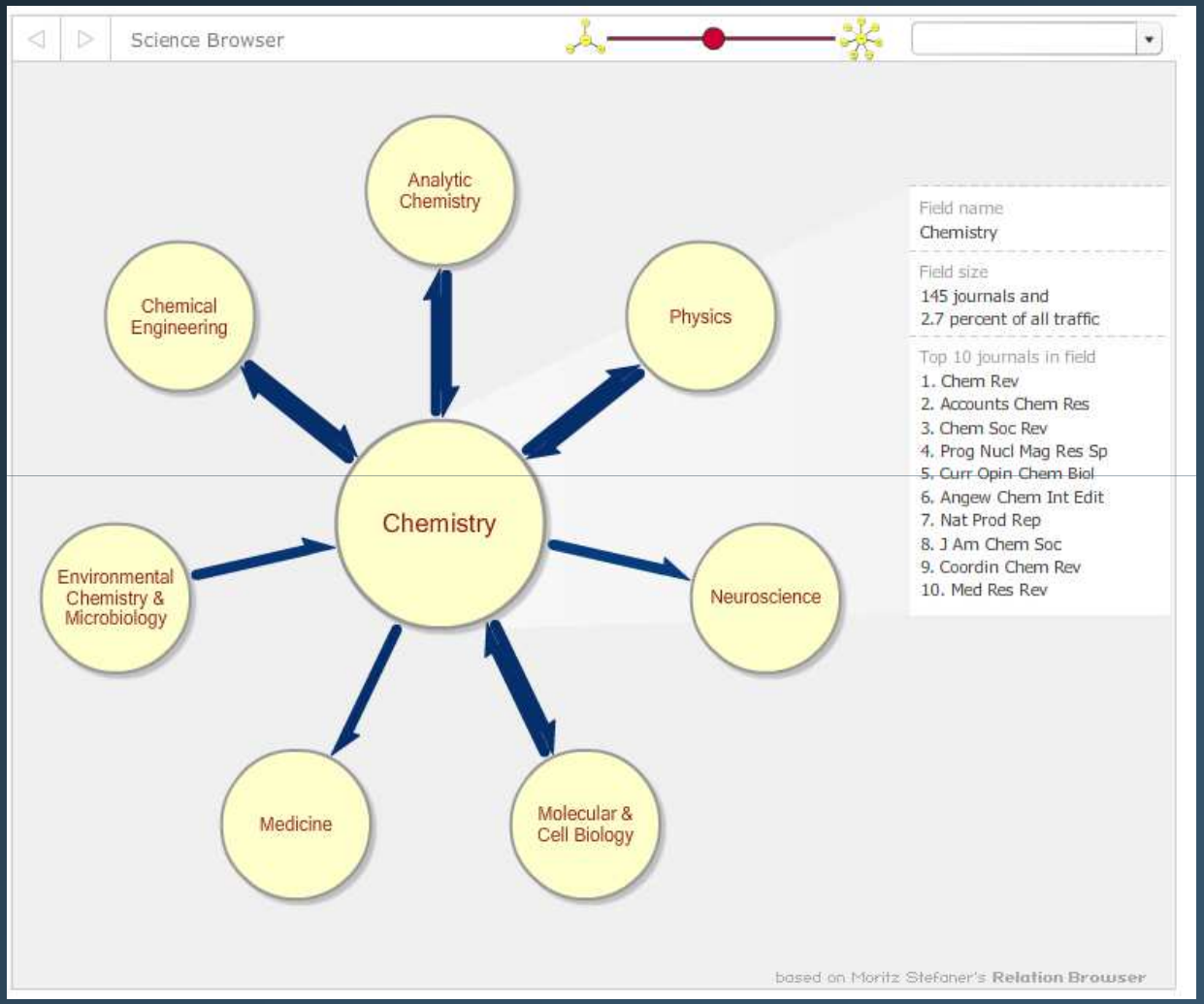
- Inspired by PageRank (same advantages)
- Similarly to PR it assumes a random citation pattern
- An important difference is that links are *weighted*
  - A journal may cite another more than once
  - The more often 2 journals are connected, the thicker the link
- Removes self-citations altogether
  - Of course your work is important, your journal the best … But we don't care so much
  - It is more important what others "think"
  - Harder to game the system



Application of eigenfactor

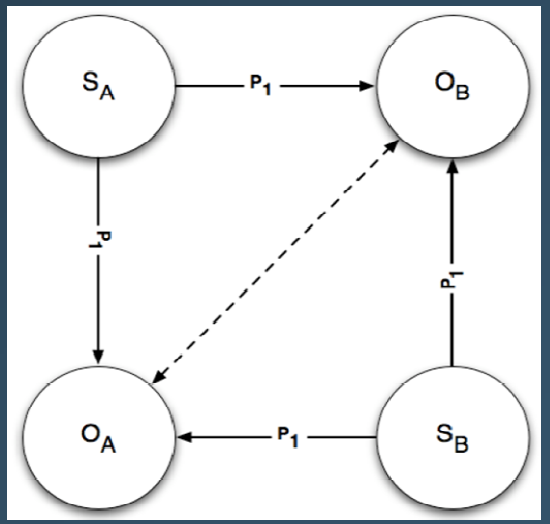


Application of eigenfactor



coRank – here comes the network

- coRank: using co-citations.
- Similar to PR, but goes one level deeper.
- When x cited y, did they also cite z ?
- Stabilizes faster than PR. (9-14 mths)



$$CR(p_i) = \frac{1-\alpha}{N} + \alpha \sum_{cp_j \in M(p_i)} \frac{CR(p_j)}{CL(p_j)}$$

Conclusions

- Many metrics. Most measure popularity: pop-metrics.
- Do not accurately reflect how scientists evaluate each other or science.
- Network-based metrics do a better job.
- Science is the most complex endeavour ever attempted by man. It is also a social, networked activity.
- We should not rely on metrics alone (pop or otherwise) to evaluate science.

Outlook: what's next?

Change is coming ...

- Self-archiving, repositories (Arxiv, PubMed Central, ...)
- Open Access, Open Science
- Science is changing before our eyes, fast
- (Even) more specialised, but also more networked
- Science 2.0 (or 3.0 ?)

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Science 2.97 (?)

- Negative results
  - Journal of Negative Results – Ecology and Evolutionary Biology
  - Journal of Negative Results in Biomedicine
- Open data
  - That computer code you spent half your PhD developing
  - That trick you did to get the %*@! STM to scan
- Alternative journals
  - Open research Computation
- Smallest publishable item no longer a scientific paper
  - Blogs, tweets
  - Lab notebook

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References (not exhaustive)

Papers

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- D. Tarrant, *A Study of Early Indication Citation Metrics*. PhD thesis, University of Southampton.
- D. Colquhoun, *Nature* **423**, 479 (2003) |

Websites

- http://www.eigenfactor.org
- *Article-Level Metrics Information*, http://goo.gl/Wb7MT

Blogs

- http://cameronneylon.net/
- http://scholarlykitchen.sspnet.org

Thank you for your attention!

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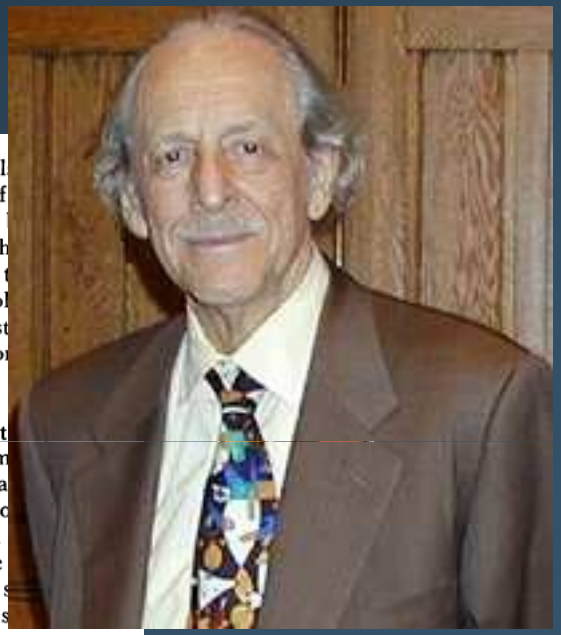
Journal Impact Factor (JIF)

Devised by **Eugene Garfield**, founder of ISI (Chairman Emeritus of Thomson Scientific)



Citation Inde

A New D

Mr. Garfield is a documentation consultant with offices at 1530 Spring Garden St., Philadelphia 1, Pa.

1955 SCIENCE, VOL. 122

"The uncritical citation of disputed data by a writer, whether it be deliberate or not, is a serious matter. Of course, knowingly propagandizing unsubstantiated claims is particularly abhorrent, but just as many naive students may be swayed by unfounded assertions presented by a writer who is unaware of the criticisms. Buried in scholarly journals, critical notes are increasingly likely to be overlooked with the passage of time, while the studies to which they pertain, having been reported more widely, are apt to be rediscovered." (*1*)

In this paper I propose a bibliographic system for science literature that can approach to subject control of the literature of science. By virtue of its different construction, it tends to bring together material that would never be collated by the usual subject indexing. It is best described as an association-of-ideas index, and it gives the reader as much leeway as he requires. Suggestiveness through association-of-ideas is offered by conventional subject indexes but only within the limits of a particular subject heading.

If one considers the book as the macro unit of thought and the periodical article the micro unit of thought, then the citation index in some respects deals in the submicro or molecular unit of thought. It is here that most indexes are inade-

case. Classified indexes are al
ent upon a subject analysis of
articles and, at best, offer us
new types of bibliographic too
help to span the gap between
approach of those who create
—that is, authors—and the
proach of the scientist who s
mation.

Since 1873 the legal profession has been provided with an invaluable research tool known as *Shepard's Citations*, published by Shepard's Citations, Inc., Colorado Springs, Colo. (*2*). A citation index is published for court cases in the 48 states as well as for cases in Federal courts. Briefly, the Shepard citation system is a listing of individual American court cases, each case being followed by a complete history, written in a simple code. Under each case is given a record of the publications that have *referred* to the case, the other court decisions that

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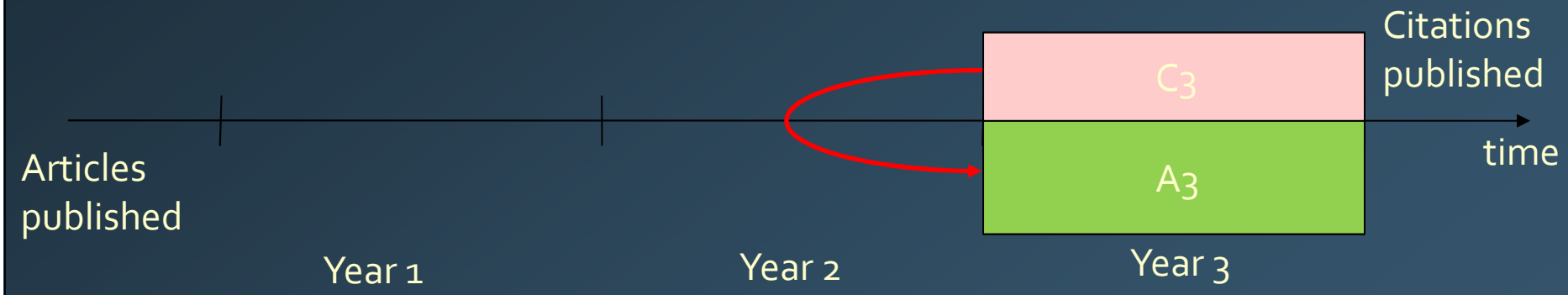
Journal Immediacy Index

The immediacy index is the average number of times an article is cited in the year it is published. The immediacy index is calculated by dividing the number of **citations to articles published in a given year** by the number of **articles published in that year**.



$$IF_3 = \frac{C_3}{A_3}$$

Some popular author metrics

popularity

- *h*-index
  - *Your h* index is *h* if *h* of your papers have at least *h* citations.
- *m*-index (or *m*-quotient)
  - $m = h/n$, with *n* number of active years
- *g*-index
  - Given a set of articles ranked in decreasing order of their citation number, the g-index is the largest number such that the top g articles received (together) at least g^2 citations.
- *i10*-index (prominently featured on Google Citations)

…