Bibliometric Evaluation of Computer Science – Problems and Pitfalls

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Abstract. We first discuss some general issues of bibliometric evaluation, in particular its increasing popularity and the different purposes it is being used for. ETH Zurich then serves as an example to show how apparently small changes in the model and the definition of bibliometric measures can greatly influence the ranking position of a research institution in popular ranking lists such as the "Times Higher Education Ranking".

We further present several evidences which show that the well-known ISI Science Citation Index (or "Web of Science") has a very low coverage of Computer Science, and that it doesn't clearly distinct Computer Science from related but different areas such as Communications Engineering, Signal Processing, or Computational Sciences. The list of the "250 Mostly Cited Computer Science Researchers" that is proudly displayed in the Internet is therefore seriously flawed, as is the SCOPUS "Top 20 Cited Articles in Computer Science". This is important, because almost all bibliometric evaluations are based on the ISI database or the SCOPUS database. We also cite research results which prove that in Computer Science the majority of published papers appear in conference proceedings, and that the top-cited conferences and workshops are as significant as journals with respect to citation counts. This is critical because contrary to other disciplines (such as Physics), in Computer Science a conference paper may very well be a final product in itself which is not republished in a journal – the classical citation indices (such as ISI or SCOPUS) have a rather low coverage of conference proceedings, however.

Different research fields differ largely in their citation culture – for example in life sciences, research papers get on the average 6 times more citations than papers in Mathematics. Since Computer Science is rather heterogeneous, with applications in many different areas, it is impossible to define a universal and fair bibliometric measure that encompasses all subfields.

Because institutional rankings based on bibliometric measures correlate only very weakly with rankings based on peer review or on procured third party money, it is questionable whether bibliometry deserves indeed such a high significance as is often assumed. This is even more true for very simple indicators such as the "h index" applied to evaluate individual researchers. We critically discuss the h index that is gaining much importance and is now becoming a crucial and even decisive factor in many evaluation committees and appointment committees. A recent report [17] characterizes this attitude nicely as follows: "Using the impact factor alone is like using weight alone to judge a person's health".

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ETH Zurich

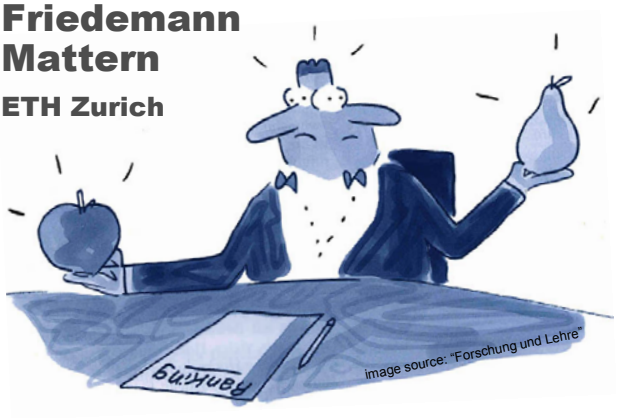
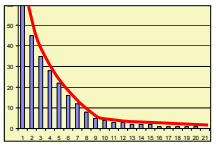


image source: "Forschung und Lehre"

European Computer Science Summit – ECSS 2008, 9-10 Oct. 2008, Zurich

Bibliometry?

- Counting of publications and citations
  - measuring the output and the impact of scientific research



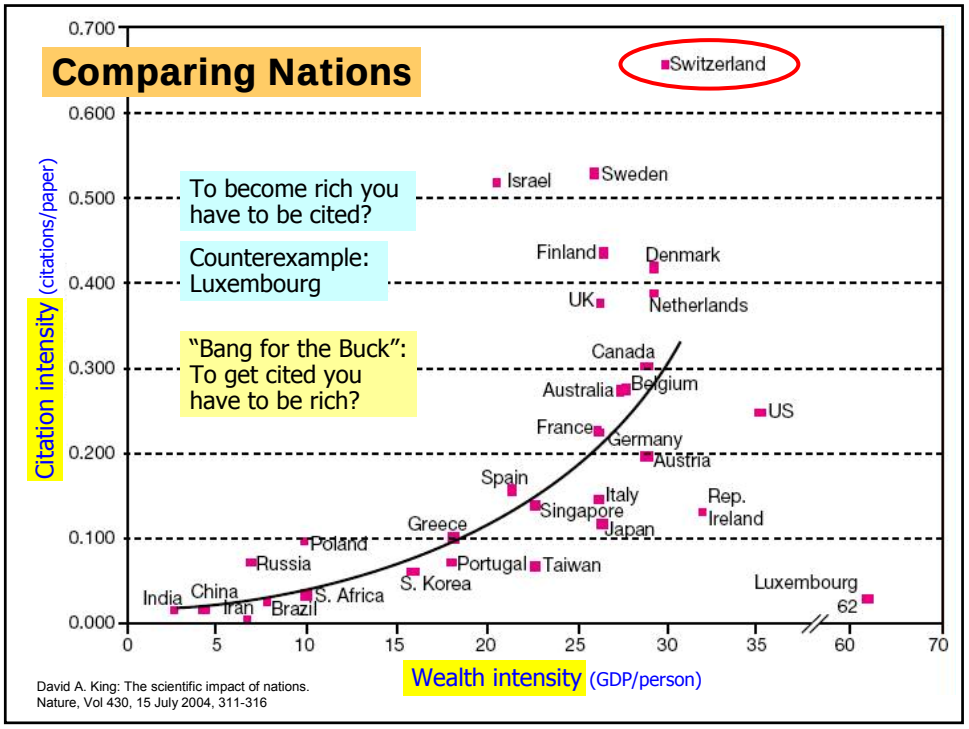
- Evaluating and ranking people and institutions

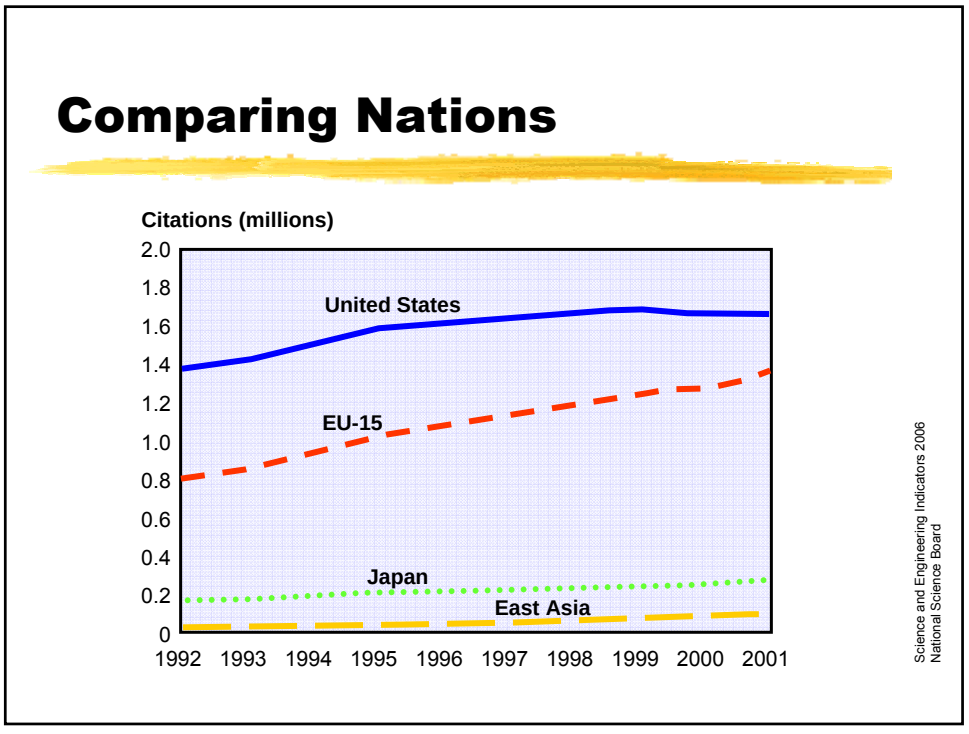
Bibliometry Has Become Popular

- Politics and the public want to have simple indicators
  - transparency
- "You can't manage what you can't measure"
  - measure quantity → measure of research quality?
- Alternative to peer review
  - mistrust in "subjective" experts
  - bibliometric evaluation is cheaper

Bibliometry is Being Used

- to evaluate and compare
  - Nations
  - Institutions
  - Disciplines
  - People


Comparing Nations
Switzerland
To become rich you have to be cited?
Counterexample: Luxembourg
"Bang for the Buck": To get cited you have to be rich?
Citation intensity (citations/paper)
Wealth intensity (GDP/person)
0.700
0.600
0.500
0.400
0.300
0.200
0.100
0.000
0
5
10
15
20
25
30
35
60
70
Israel
Sweden
Finland
Denmark
UK
Netherlands
Canada
Australia
Belgium
US
France
Germany
Austria
Spain
Italy
Singapore
Japan
Rep. Ireland
Greece
Poland
Russia
Portugal
Taiwan
S. Korea
India
China
Iran
Brazil
S. Africa
Luxembourg
62
David A. King: The scientific impact of nations.
Nature, Vol 430, 15 July 2004, 311-316


Comparing Nations
Citations (millions)
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
United States
EU-15
Japan
East Asia
Science and Engineering Indicators 2006
National Science Board

Computer Science 2001-2003 Articles Cited in the Year 2005

- All ("ISI journals"): US: 36.1% EU: 31.6%
- 99th citation percentile: US: 69.3% EU: 16.6%

Interpretation: In Computer Science, US research has higher influence than EU research

Science and Engineering Indicators 2008
National Science Board

THE WORLD'S TOP 200 UNIVERSITIES

The Times Higher Education

Comparing Institutions

2005 RANK	2004 RANK	NAME	COUNTRY	PEER REVIEW SCORE (40%)	RECRUITER REVIEW (10%)	INT'L FACU (5%)
1	1	Harvard University	US	100	100	17
2	3	Massachusetts Institute of Technology	US	84	87	12
3	6	Cambridge University	UK	96	73	65
4	5	Oxford University	UK	93	70	58
5	7	Stanford University	US	78	95	10
6	2	University of California, Berkeley	US	95	62	7
7	8	Yale University	US	71	43	52
8	4	California Institute of Technology	US	48	2	27
9	9	Princeton University	US	69	32	22
10	27	Ecole Polytechnique	France	37	17	47
11=	52	Duke University	US	36	79	24
11=	11	London School of Economics	UK	43	86	99
13	14	Imperial College London	UK	59	15	63
14	23	Cornell University	US	56	71	11
15	17	Beijing University	China	71	37	7
16	12	Tokyo University	Japan	73	2	2
17=	20	University of California, San Francisco	US	24	0	4
17=	13	University of Chicago	US	52	47	29
19	22	Melbourne University	Australia	66	27	53
20	19	Columbia University	US	56	36	11
21	10	ETH Zurich	Switzerland	49	7	98

THE WORLD'S TOP 200 UNIVERSITIES

The Times Higher Education

Comparing Institutions

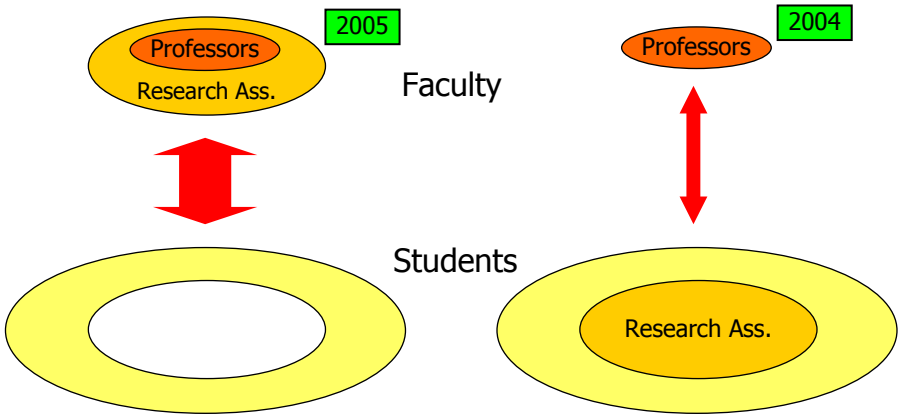
2005 RANK	2004 RANK	NAME
1	1	Harvard University
2	3	Massachusetts Institute of Technology
3	6	Cambridge University
4	5	Oxford University
5	7	Stanford University
6	2	University of California, Berkeley
7	8	Yale University
8	4	California Institute of Technology
9	9	Princeton University
10	27	Ecole Polytechnique
11=	52	Duke University
11=	11	London School of Economics
13	14	Imperial College London
14	23	Cornell University
15	17	Beijing University
16	12	Tokyo University
17=	20	University of California, San Francisco
17=	13	University of Chicago
19	22	Melbourne University
20	19	Columbia University
21	10	ETH Zurich

CITATIONS/FACULTY SCORE (20%)

ETH Rank in the Specific Citations per Faculty Indicator

- 2004: Rank 3 (ETH was called „citations champion")
- 2005: Rank 71
- 2006: Rank 24
- 2007: Rank 120

What are ETH Research Assistants? PhD Students or Faculty Members?



- 377 Professors, 3606 research assistants

ETH Rank in the Specific Citations per Faculty Indicator

- 2004: Rank 3 (ETH is called „citations champion")
- 2005: Rank 71
- 2006: Rank 24 → 2007: Rank 120

- Faculty: head count → full time equivalent
- Publications: ISI DB, 5 years window → Scopus DB, 10 years window

➔ Global ranking position of ETH Zurich down to **42**

A Letter by Our President

ETH
Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

Der Präsident
Prof. Dr. Ernst Hafen
ETH Zürich

An die Vorsteherin und
an die Vorsteher der Departemente
der ETH Zürich

Zürich, 28. September 2006 / UH

Bibliometrische Analyse zur ETH Zürich: Abschluss

- Bibliometrische Indikatoren werden in vielen Rankings eingesetzt. Da sich die bibliometrischen Analysen z. Zt. primär auf die so genannte ‚ISI-World' konzentrieren, ist es für die ETH wichtig, ihre Forschungsresultate möglichst in diesen Journals sichtbar zu machen. Daher rufe ich Sie auf, die Publikationsmöglichkeiten in den ‚ISI-Journals' intensiv zu nutzen. An den DIALOG-Gesprächen mit dem ETH-Rat im Mai war die Studie ebenfalls ein Thema, wobei der Präsident des ETH Rats die Bedeutung dieser Resultate bei internationalen Vergleichen betonte.

Die bibliometrische Analyse ist ein wichtiges Erfahrungsfeld für den Dialog über Leistungen in Lehre und Forschung, der sich entwickeln muss. Ich danke Ihnen für Ihr Engagement und Ihre Anregungen zu diesem komplexen Thema.

Beste Grüsse

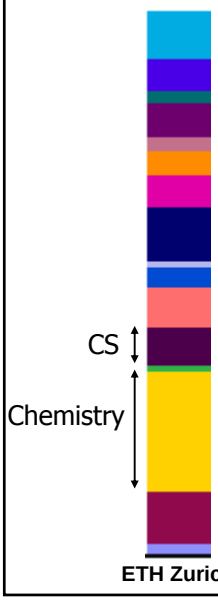
Ernst Hafen

"Bibliometric indicators are used in many rankings. Because bibliometric analysis currently concentrates on the so-called "ISI World", it is important for ETH to make its research results visible in these journals as far as possible. Hence I call upon you to make intense use of the publication opportunities of the ISI journals."

Comparing Disciplines

Based on ISI "highly cited researchers"

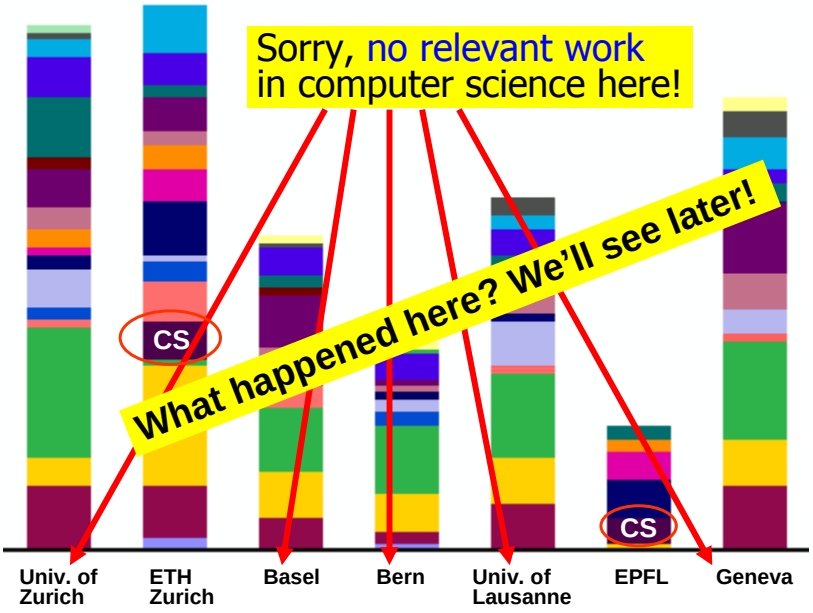
Colorful display of bibliometric data of Swiss Universities in the media



Interpretations in the media:

- At ETH Zurich, chemistry is top
- Computer science is only average

This is nonsense



Bibliometry is Being Used

- to evaluate and compare
  - Nations
  - Institutions ← be careful
  - Disciplines ← be extremely careful
  - People ← not possible (without domain expertise)

Bibliometry is harmful – handle with care!

The ISI Science Citation Index
(or "Web of Science")

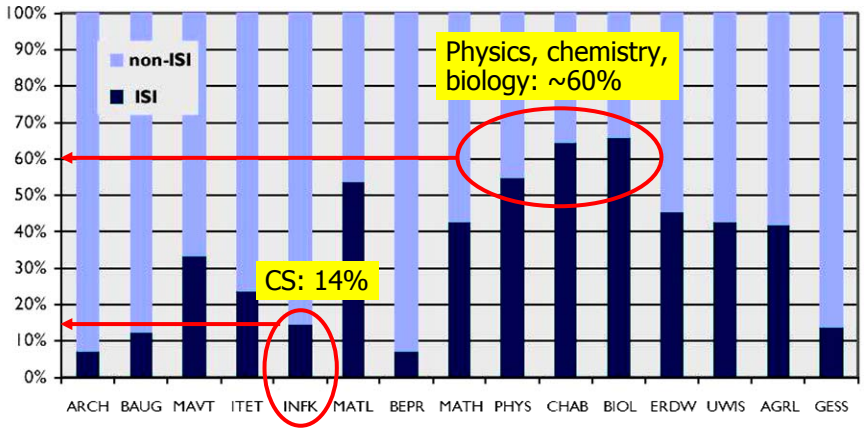
- Most bibliometric evaluations are based on it
  - Institute for Scientific Information
  - now Thomson Reuters (commercial)

- Analyze ~8700 journals (~350 from the "field of CS")
- Only few conference proceedings and books
- Emphasis on natural sciences and life sciences
- Technical sciences are under-represented

- Is the ISI database suitable for CS?

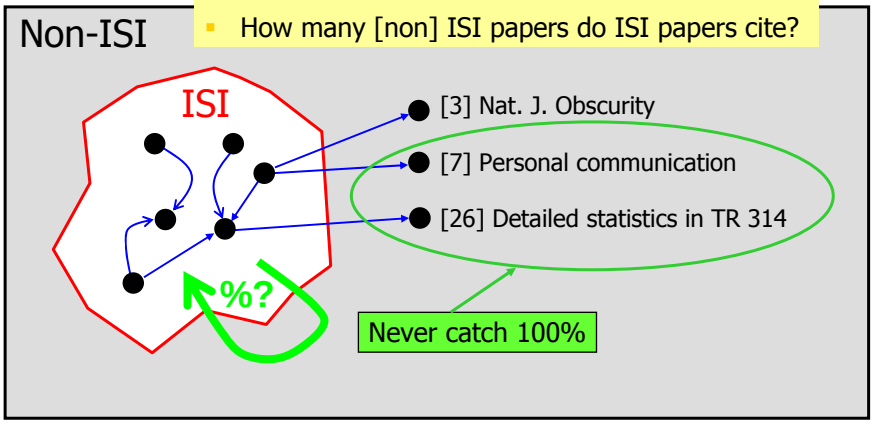
ISI-Coverage is Very Different for Different Disciplines

Analysis of all publications from ETH Zurich in 2003:

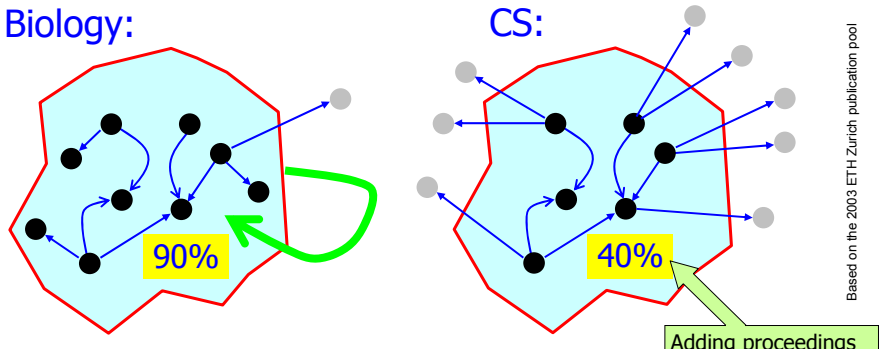


Does ISI Cover At Least All *Relevant* Publications?

- Relevant = cited
- How many [non] ISI papers do ISI papers cite?



ISI Internal Coverage Percentage



- ISI misses more than 50% of all publications considered relevant by the CS-community
  - better in theoretical CS, worse in practical CS
  - "25% of groups had a coverage above 46%, and 25% below 28%" [CWTS study 2007]

Henk F. Moed and Martijn S. Visser: Developing Bibliometric Indicators of Research Performance in Computer Science. CWTS, 2007

How Relevant are Conferences?

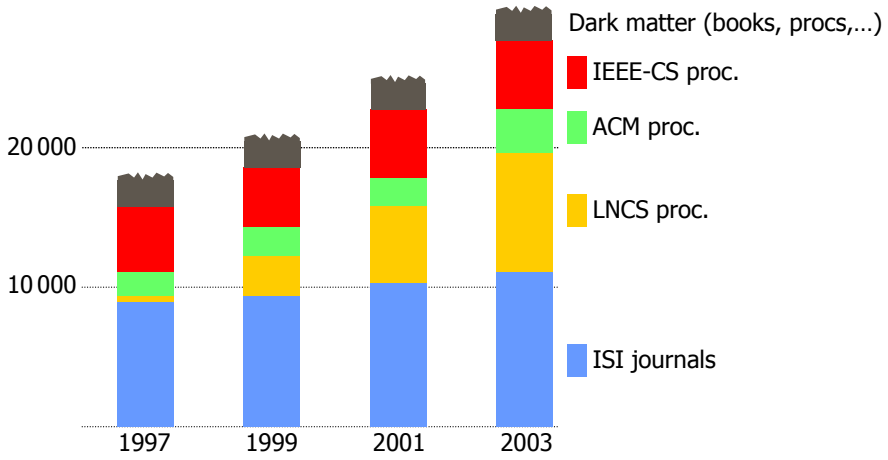
- Conference proceedings are typically not covered by ISI
  → miss of many citations even for journal articles

- Claim: For CS,

  1) the majority of papers appear in conference proceedings

  2) the top-cited conferences and workshops are as significant as journals and have to be considered

Publication Venues of Computer Science Papers



Henk F. Moed and Martijn S. Visser: Developing Bibliometric Indicators of Research Performance in Computer Science: An Exploratory Study. Centre for Science and Technology Studies (CWTS), Leiden University, the Netherlands. Research Report to the Council for Physical Sciences of the Netherlands Organisation for Scientific Research (NWO), Feb. 2007.

Conferences and Workshops

	#venues	#papers (all)	#citations per paper	#papers (top 100 venues)	#citations per paper (top 100 venues)
Journals	471	321 000 35%	5.2	190 000	7.5
Conference / workshop series	2 297	585 000 65%	3.0	167 000	7.3

Data source: MS Libra computer science bibliography search engine, Dec. 2007

Erhard Rahm: Comparing the Scientific Impact of Conference and Journal Publications in Computer Science. Proc. Int. Conf. on Academic Publishing in Europe (APE08), Berlin, 2008

A Small Sample from 2300 CS Conferences / Workshops

Conference	Publications	Citations	Cit/Publ
SIGCOMM	945	33546	35.50
MOBICOM - Mobile Computing and Networking	430	14771	34.35
POPL - Symposium on Principles of Programming Languages	1106	32595	29.47
SIGMOD – Inte. Conf. on Management of Data	2457	53347	21.71
SIGGRAPH – Ann. Conf. on Computer Graphics	3379	59966	17.75
VLDB - Very Large Data Bases	2324	39418	16.96
ECOOP - European Conference on Object-Oriented Programming	504	7881	15.64
STOC - ACM Symposium on Theory of Computing	2427	36113	14.88
WWW - World Wide Web Conference Series	1026	11873	11.57
PODC - Symposium on Principles of Distributed Computing	1064	11930	11.21
FOCS - IEEE Symposium on Foundations of Computer Science	2292	24225	10.57
SODA - Symposium on Discrete Algorithms	1699	14641	8.62
EUROCRYPT - Theory and Application of Cryptographic Techniques	980	7835	7.99
UbiComp - Ubiquitous Computing	246	1843	7.49
MobiSys - Int. Conf. on Mobile Systems, Applications, and Services	88	593	6.74
IJCAI - International Joint Conference on Artificial Intelligence	4520	30435	6.73
ACM SenSys	244	1442	5.91
CHI - Computer Human Interaction	5611	32583	5.81
ICALP - Automata, Languages and Programming	2090	10640	5.09
PARLE - Parallel Architectures and Languages Europe	406	1871	4.61
ISWC - International Symp. on Wearable Computers	361	1430	3.96
SIGOPS European Workshop	376	1462	3.89

Average Cit/Publ is 3.0

Average for journals is 5.2

A Small Sample from 2300 CS Conferences / Workshops

Conference	Publications	Citations	Cit/Publ
ESA - European Symposium on Algorithms	754	2490	3.30
STACS - Symposium on Theoretical Aspects of Computer Science	1207	3956	3.28
Information Processing in Sensor Networks	304	840	2.76
Pervasive Computing	132	348	2.64
SWAT - Scandinavian Workshop on Algorithm Theory	373	983	2.64
ALENEX - Algorithm Engineering & Experimentation	122	294	2.41
Symposium on Graph Drawing	639	1531	2.40
IFIP World Computer Congress	2785	4401	1.58
KI - German Conference on Artificial Intelligence	878	1281	1.46
WG - Workshop on Graph-Theoretic Concepts in Computer Science	681	953	1.40
EWSN	73	102	1.40
IEEE Percom	432	554	1.28
ICDCS – Int. Conf. on Distributed Computing Systems	864	703	0.81
HICSS - Hawaii International Conference on System Sciences	6527	5268	0.81
EUROMICRO	918	537	0.58
European Symposium on Ambient Intelligence	70	39	0.56
ICALT – Int. Conf. on Advanced Learning Technologies	1544	172	0.11
Artificial Intelligence and Soft Computing	140	8	0.06
Wirtschaftsinformatik	195	6	0.03
Fuzzy Systems and Knowledge Discovery	661	14	0.02
IFIP TC3/WG3.1 Publications	221	4	0.02
IASTED Int. Conf. on Communication Systems and Networks	52	0	0.00

Very large quality spectrum

Conferences and Workshops

- In CS a conference paper may very well be a final product in itself
  - therefore, researchers may not seek to have their conference papers published in journals
  - contrary to other disciplines such as Physics!

→ Conference proceedings must not be excluded
  - be aware of variance in quality: "there are more highly cited but also more poorly cited proceedings volumes than there are annual journal volumes" [CWTS study 2007]

The 250 Mostly Cited CS Researchers (According to ISI)

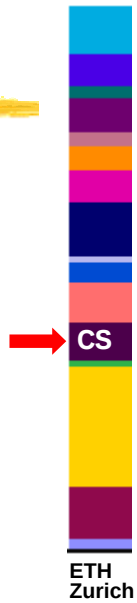
"Scientist rankings in computer science"

1. HIGGINS, DG
2. FUCHS, R
3. BLEASBY, AJ
4. BILLETER, M
5. KORADI, R
6. WUTHRICH, K
7. SJOSTRAND, T
8. EVANS, SV
9. WAS, Z
10. SEYMOUR, MH
11. JADACH, S
12. OVERBEEK, R
13. WEBBER, BR
14. ABBIENDI, G
15. KNOWLES, IG
16. …

Whom do you recognize?

1. Desmond G. Higgins: Empirical estimation of the reliability of ribosomal RNA alignments
2. Rainer Fuchs: Predicting protein function: a versatile tool for the Apple Macintosh
3. Alan J. Bleasby: Information Resources for the Bioinformatician

This is CS in the ISI sense!



ETH Zurich

www.isihighlycited.com

Mostly Cited European Computer Science Researchers (ISI)

- Abiteboul, Serge
- Aulin, Tor M.
- Balbo, Gianfranco
- Benedetto, Sergio
- Bergstra, Jan A.
- Biglieri, Ezio
- Binnig, Gerd K.
- Broy, Manfred
- Büttiker, Markus
- Caceci, Marco S.
- Chlamtac, Imrich
- Courcelle, Bruno
- De Nicola, Rocco
- Du Croz, Jeremy
- Dubois, Didier
- Duff, Iain Spencer
- Engelfriet, Joost
- Ferrari, Domenico
- Flajolet, Philippe
- Girard, Jean Yves
- Gottlob, Georg
- Hagenauer, Joachim
- Hammarling, Sven
- Hennessy, Matthew
- Henzinger, Thomas
- Hoare, C. Anthony R.
- Klop, Jan Willem
- Lovasz, László
- Lupas Scheiterer, R.
- Mallat, Stéphane G.
- Marsan, Marco Ajmone
- Mehlhorn, Kurt
- Milner, Robin
- Montanari, Ugo
- Montorsi, Guido
- Overmars, Mark H.
- Parrow, Joachim
- Polydoros, Andreas
- Prade, Henri
- Pradhan, Dhiraj K.
- Rohrer, Heinrich
- Roscoe, A. William
- Rozenberg, Grzegorz
- Schöning, Uwe
- Ungerboeck, Gottfried
- van Leeuwen, Jan
- Vuillemin, Jean
- Walker, David

Mostly Cited European Computer Science Researchers (ISI)

- Abiteboul, Serge
- Aulin, Tor M.
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- Mehlhorn, Kurt
- Milner, Robin
- Montanari, Ugo
- Montorsi, Guido
- Overmars, Mark H.
- Rohrer, Heinrich
- Schöning, Uwe
- Walker, David

Digital Phase Modulation

Digital Transmission Theory

Principles of Digital Transmission: With Wireless Applications

Scanning tunneling microscope (IBM Patent)

Mesoscopic Capacitors: A Statistical Analysis (Physical Review Letters, 1996)

Fitting curves to data (Byte, 1984)

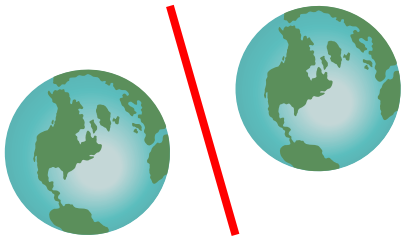
A Wavelet Tour of Signal Processing

CS

Turing Award – the Last 10 Years

- 2007 Edmund Clarke } „highly
- 2007 Allen Emerson } cited“
- 2007 Joseph Sifakis
- 2006 Frances Allen
- 2005 Peter Naur
- 2004 Vinton G. Cerf
- 2004 Robert E. Kahn
- 2003 Alan Kay
- 2002 Leonard M. Adleman
- 2002 Adi Shamir
- 2002 Ronald L. Rivest
- 2001 Kristen Nygaard
- 2001 Ole-Johan Dahl
- 2000 Andrew Chi-Chih Yao
- 1999 Frederick P. Brooks
- 1998 James Gray

Almost disjoint from the 250 highly cited ISI CS researchers!



ISI Database is ~~Irrelevant for~~ Harmful to CS

- Wrong definition of CS
  - ~ computational science, signal processing,…
- Low coverage
  - e.g., very few conference proceedings
- Yields nonsense results

► But almost all bibliometric evaluations are based on the ISI database!

The Shanghai Ranking

"Academic Ranking of World Universities"

Criteria	Indicator	Weight
Quality of Education	Alumni of an institution winning Nobel Prizes and Fields Medals	10%
Quality of Faculty	Staff of an institution winning Nobel Prizes and Fields Medals	20%
	Highly cited researchers in 21 broad subject categories	20%
Research Output	Articles published in Nature and Science	20%
	Articles in Science Citation Index-expanded, Social Science Citation Index	20%

Not much one can do about that

ISI

ISI

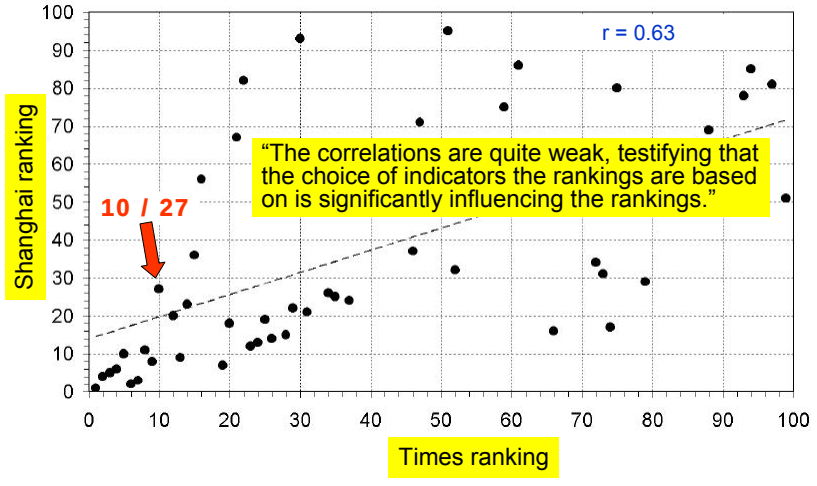
Peter Lee (CMU): Science and Nature – Where's the Computing Research?

"There isn't much computing research in the major core-science publications. I took a quick scan over the past 5 issues of Science and Nature. Over those issues, in Science one sees 35 research articles and reports in the biology and medical science areas, 14 in chemistry/materials, 10 in earth and atmospheric sciences, 5 in astronomy and astrophysics, and several in physics, psychology, and archeology. Only one article in computer science! In Nature, the situation is even more stark. In the last 5 issues we see 11 research articles in biology, 2 in chemistry, 1 in astrophysics, and 1 in psychology. None in computer science." www.cccblog.org Sep 12, 2008

Why should we care about this?

- In the eyes of the natural sciences, we cannot be taken serious
- Image of CS, particularly in the lay public, is a concern
- Science, Nature,... generate news in the more mainstream press

Correlations Shanghai / Times Ranking



Tibor Braun, Ildikó Dióspatonyi, Erika Zádor, Sándor Zsindely: Journal gatekeepers indicator-based top universities of the world. of Europe and of 29 countries - A pilot study Scientometrics, Vol. 71, No. 2 (2007) 155-178

Other Bibliometric Databases?

- SCOPUS: Citation data base from Elsevier
  ~ 15000 journals
  ~ 500 conference proceedings

SCOPUS: Top 20 Cited Articles in Computer Science (2004 – 2008)

Bio	1. MEGA3: Integrated software for Molecular Evolutionary Genetics Analysis and sequence alignment. Kumar, S. (2004), Briefings in bioinformatics, Vol 5, Issue 2, pp 150-163. Cited by: 4,386
Vision	2. Distinctive image features from scale-invariant keypoints. Lowe, D.G. (2004), International Journal of Computer Vision, Vol 60, Issue 2, pp 91-110. Cited by: 1,748
Bio	3. Haploview: Analysis and visualization of LD and haplotype maps. Barrett, J.C. (2005), Bioinformatics, Vol 21, Issue 2, pp 263-265. Cited by: 1,546
Comm	4. Cooperative diversity in wireless networks: Efficient protocols and outage behavior. Laneman, J.N. (2004), IEEE Transactions on Information Theory, Vol 50, Issue 12, pp 3062-3080. Cited by: 1,113
Comm	5. Cognitive radio: Brain-empowered wireless communications. Haykin, S. (2005), IEEE Journal on Selected Areas in Communications, Vol 23, Issue 2, pp 201-220. Cited by: 565
Vision	6. Robust Real-Time Face Detection. Viola, P. (2004), International Journal of Computer Vision, Vol 57, Issue 2, pp 137-154. Cited by: 497
Vision	7. Image quality assessment: From error visibility to structural similarity. Wang, Z. (2004), IEEE Transactions on Image Processing, Vol 13, Issue 4, pp 600-612. Cited by: 472
Comm	8. Medium access control with coordinated adaptive sleeping for wireless sensor networks. Ye, W. (2004), IEEE/ACM Transactions on Networking, Vol 12, Issue 3, pp 493-506. Cited by: 397
Bio	9. The Jalview Java alignment. Editor Clamp, M. (2004), Bioinformatics, Vol 20, Issue 3, pp 426-427. Cited by: 360
Comm	10. Fading relay channels: Performance limits and space-time signal design. Nabar, R.U. (2004), IEEE Journal on Selected Areas in Communications, Vol 22, Issue 6, pp 1099-1109. Cited by: 358

SCOPUS: Top 20 Cited Articles in Computer Science (2004 – 2008)

85% are on the border to other disciplines

Comm	11. Wireless mesh networks: A survey. Akyildiz, I.F. (2005), Computer Networks, Vol 47, Issue 4, pp 445-487. Cited by: 352
Core	12. Tapestry: A resilient global-scale overlay for service deployment. Zhao, B.Y. (2004), IEEE Journal on Selected Areas in Communications, Vol 22, Issue 1, pp 41-53. Cite[illegible]2
Vision	13. Scale & affine invariant interest point detectors. Mikolajczyk, K. (20[illegible]onal Journal of Computer Vision, Vol 60, Issue 1, pp 63-86. Cited by: 326
Core	14. QoS-aware middleware for Web services composition[illegible]004), IEEE Transactions on Software Engineering, Vol 30, Issue 5, pp 311-327[illegible]
Bio	15. FatiGO: A web tool for finding significa[illegible]s of Gene Ontology terms with groups of genes. Al-Shahrour, F. (2004), Bioinf[illegible] 20, Issue 4, pp 578-580. Cited by: 301
Vision	16. Two-Dimensional PCA: A [illegible]ach to Appearance-Based Face Representation and Recognition. Yang, J. ([illegible]rans. Pattern Analysis and Machine Intelligence, Vol 26, Issue 1, pp 131-137. [illegible]
Core	17. Basic c[illegible]d taxonomy of dependable and secure computing. Avižienis, A. (2004), IEEE Transaction[illegible]n Dependable and Secure Computing, Vol 1, Issue 1, pp 11-33. Cited by: 285
Comm	18. Relay-based deployment concepts for wireless and mobile broadband radio. Pabst, R. (2004), IEEE Communications Magazine, Vol 42, Issue 9, pp 80-89. Cited by: 280
Comm	19. Zero-forcing methods for downlink spatial multiplexing in multiuser MIMO channels. Spencer, Q.H. (2004), IEEE Transactions on Signal Processing, Vol 52, Issue 2, pp 461-471. Cited by: 275
Vision	20. A performance evaluation of local descriptors. Mikolajczyk, K. (2005), IEEE Transactions on Pattern Analysis and Machine Intelligence, Vol 27, Issue 10, pp 1615-1630. Cited by: 273

Other Bibliometric Databases?

- Google Scholar and Citeseer
  - very popular, easy to use
  - online tools like "publish or perish" are based on it
- But what exactly do they count, and what do the counts reflect?
  - citations from theses of master students?
  - citations from web pages that are no publications?

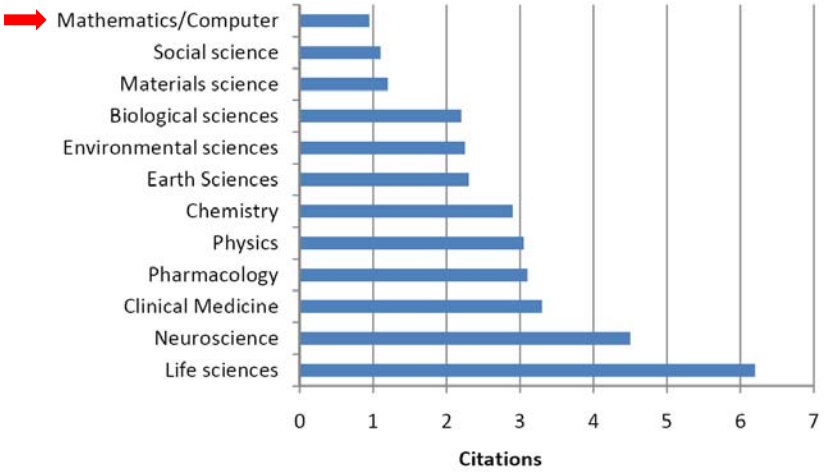
Year	Recipient	# Cit.	Rank
1984	Niklaus Wirth	946	1245
1985	Richard M. Karp	4951	24
1986	John Hopcroft	4542	34
1986	Robert Tarjan	6525	7
1987	John Cocke	1074	1017
1988	Ivan Sutherland	663	2152
1989	William (Velvel) Kahan	413	3973
1990	Fernando J. Corbato'	34	∞
1991	Robin Milner	7900	4
1992	Butler W. Lampson	1643	471
1993	Juris Hartmanis	742	1817
1993	Richard E. Stearns	380	4434
1994	Edward Feigenbaum	363	4684
1994	Raj Reddy	270	6703
1995	Manuel Blum	1704	442
1996	Amir Pnueli	5212	19
1997	Douglas Engelbart	113	∞
1998	James Gray	3945	50
1999	Frederick P. Brooks, Jr.	908	1332
2000	Andrew Chi-Chih Yao	2019	304
2001	Ole-Johan Dahl	505	3094
2001	Kristen Nygaard	498	3161
2002	Ronald L. Rivest	6930	5
2002	Adi Shamir	3492	76
2002	Leonard M. Adleman	1746	418

Citation ranking of the Turing award recipients according to Citeseer

→ Esteem of the community does not correlate with # of citations

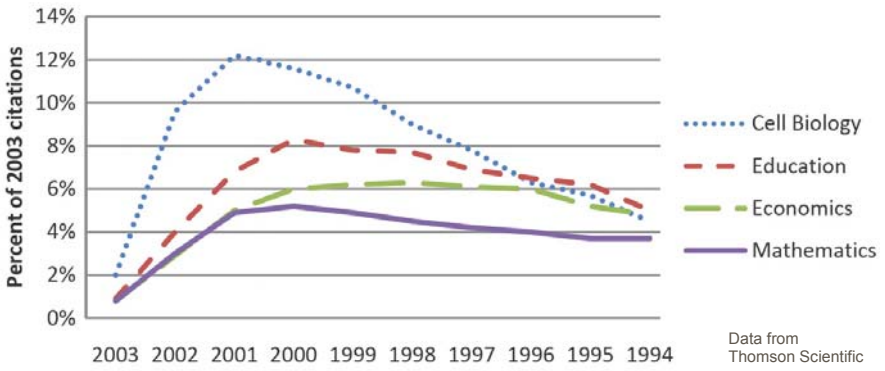
Dror G. Feitelson and Uri Yovel: Predictive Ranking of Computer Scientists Using CiteSeer Data, May 2003

Differences of Disciplines – Average Citations per Article



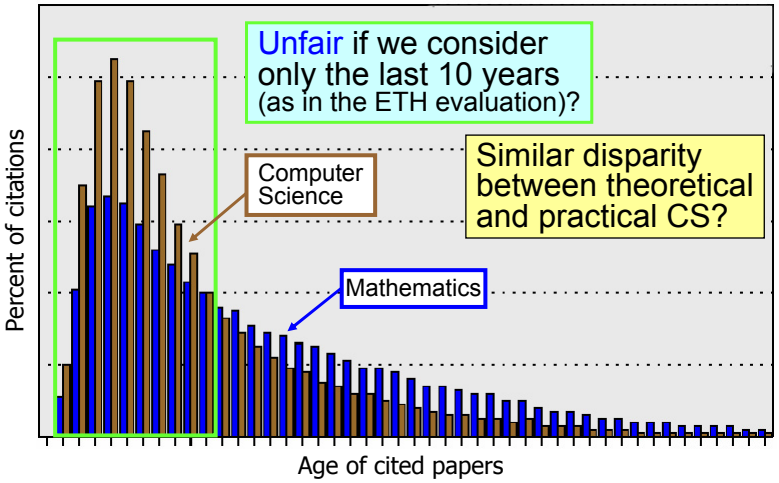
M. Amin, M. Mabe: Impact factor: use and abuse. Perspectives in Publishing, No. 1, October 2000, pp. 1-6

Age Distribution of Citations for Different Fields



The International Council for Industrial and Applied Mathematics, the Mathematical Union and the Institute for Mathematical Statistics: "Citation Statistics", June 2008

Cultural Differences Between CS and Mathematics



Silke Göbel: Untersuchungen zur Mathematikliteratur in verschiedenen Datenbanken, www.math.tu-berlin.de/ftrech/misc/datenb.ps

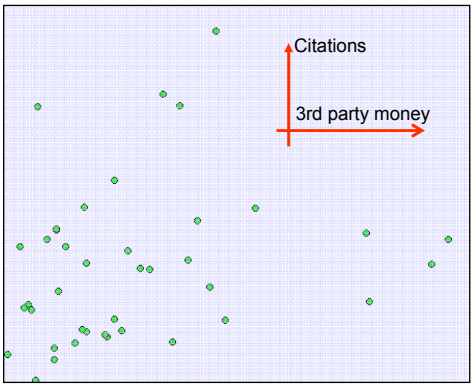
Heterogeneity

- Different disciplines have different citation cultures
- CS is rather heterogeneous
  - practice vs. theory
  - small and exotic areas vs. popular areas
  - very different "cultures" in different sub-fields

Impossible to have a universal measure for CS alone

Are Citations a Good Measure?

Consider third party money/scholar vs. citations/faculty for whole CS Departments at German Universities



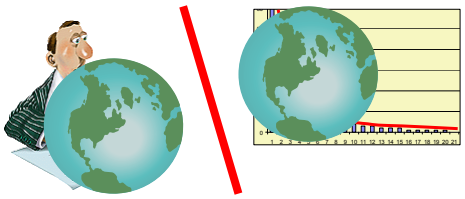
Corr.coeff. = 0.23

Consequences if two sensible performance measures are only weakly correlated?

See: Bernhard Nebel: Ranking? Informatik-Spektrum 4:24, pp. 234-249, Aug. 2001

Are Citations a Good Measure?

- Rank correlations of 0.22 between the peer evaluation based quality rating of Netherlands computer science groups and citation impact indicators of their papers
  - Peer rating of 42 academic computer science groups in the Netherlands in 2003 (QANU)
  - ISI database plus conference proceedings from ACM, LNCS, IEEE



Henk F. Moed and Martijn S. Visser: Developing Bibliometric Indicators of Research Performance in Computer Science. CWTS, 2007

Are Citations a Good Measure?

„15 Reasons Why Authors Cite the Work of Others"
(Weinstock, 1971):

- giving credit for related work
- providing background reading
- paying homage to pioneers
- identifying methodology
- identifying the original publication describing an eponymic concept
- correcting / criticizing the work of others
- disputing priority claims of others
- …

If there are very different reasons for citations – is it then sensible to count them?

Wrong Credits?

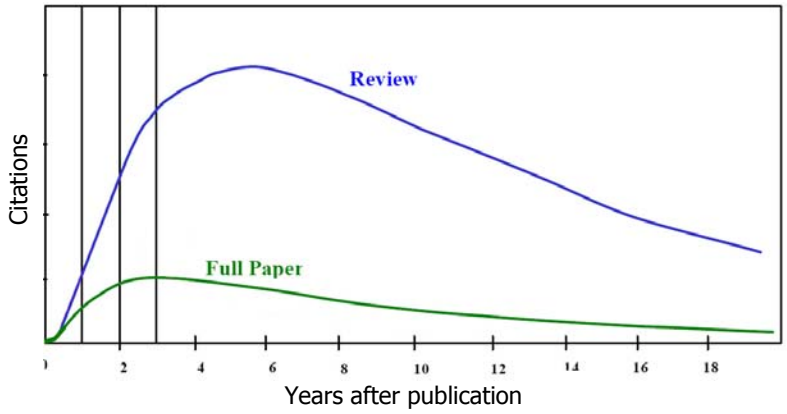
- Sometimes, someone else earns the lion's share of citations
- Example: the important concept of NP-completeness was introduced by Stephen Cook:

  Stephen A Cook: The complexity of theorem-proving procedures. Proc. Third Annual ACM Symp. on Theory of Computing, 1971
  cited by: 2581

- But much more often this work is cited:

  MR Garey, DS Johnson: Computers and Intractability: A Guide to the Theory of NP-completeness. 1979
  cited by: 21087

Review and Survey Papers Versus Research Papers



M. Amin, M. Mabe: Impact factor: use and abuse. Perspectives in Publishing, No. 1, October 2000, pp. 1-6

Self-Citations Boost Papers (and Careers)

- 11% of all citations are self-citations
  - analysis based on 64,842 publications and 692,455 citations
- Each additional self-citation increases the number of citations from others
  - by ~ 1 after 1 year
  - by ~ 3 after 5 years
  - by ~ 3.65 after 10 years

Self-citation may therefore account directly or indirectly for more than half of all citations after 10 years

- There is no penalty – the effect of self-citation remains positive even for very high rates of self-citation

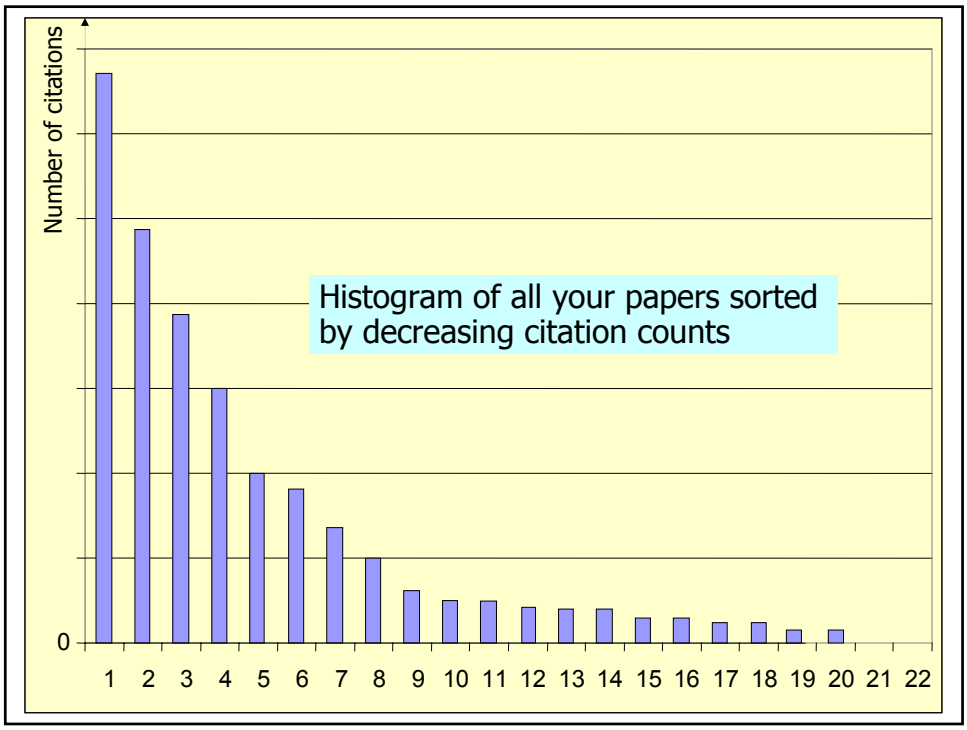
James H. Fowler, Dag W. Aksne: Does self-citation pay? Scientometrics, Vol. 72, No. 3 (2007) 427-43

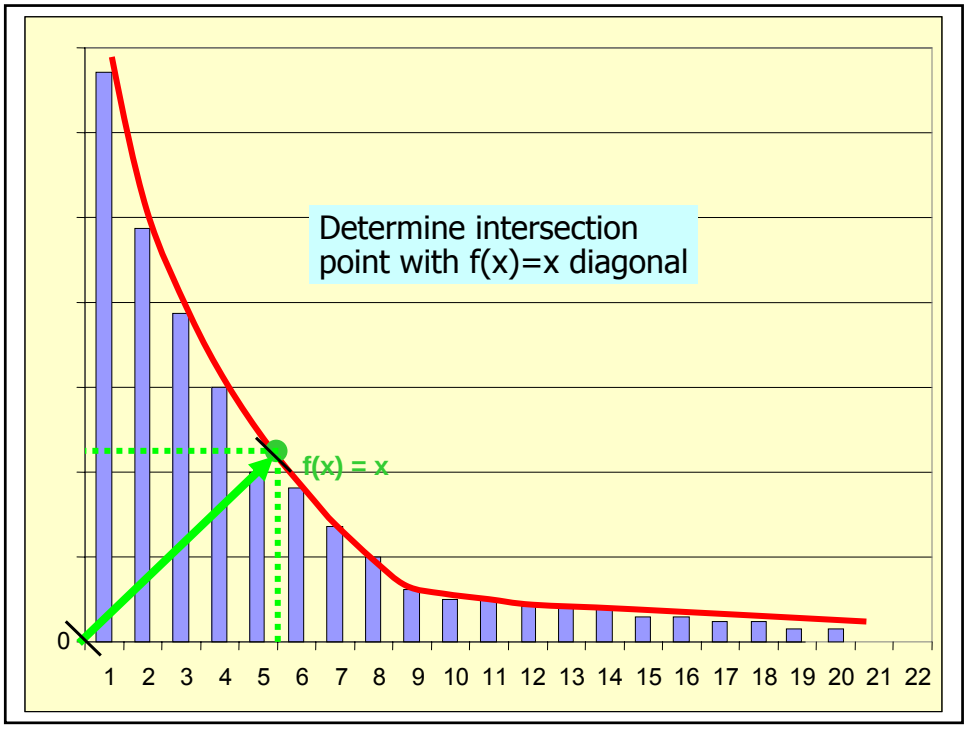
How to Increase Your Bibliometric Values

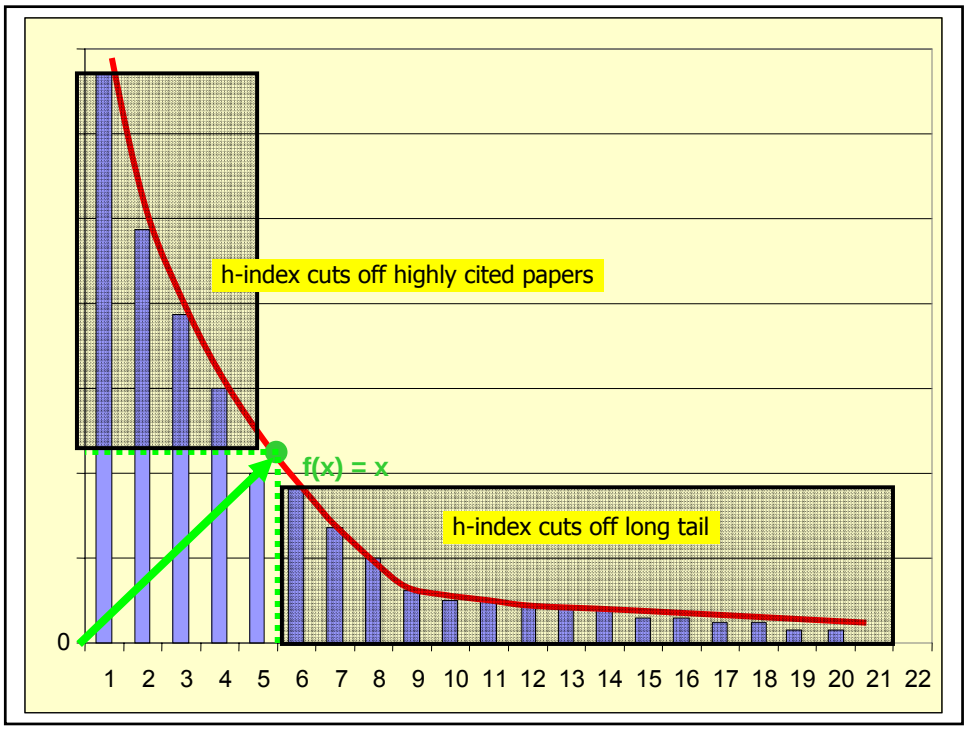
- Write your name on papers by your PhD students
- Ignore your publisher's copyright: put your paper online
- Work in a popular area so that many others can cite you
- Write survey papers, not research papers
- Never change your established research area
- Avoid innovative and new (but risky) projects
- Chose catchy titles for your papers
- Emphasize quantity instead of quality
- Do not lose valuable time, avoid events like this one
- Concentrate on paper production, not good teaching
- Heavily cite your own (and your friend's) papers
- Never publish more than a single "Least Publishable Unit"
- Cannibalize your old papers: refurbish and republish them

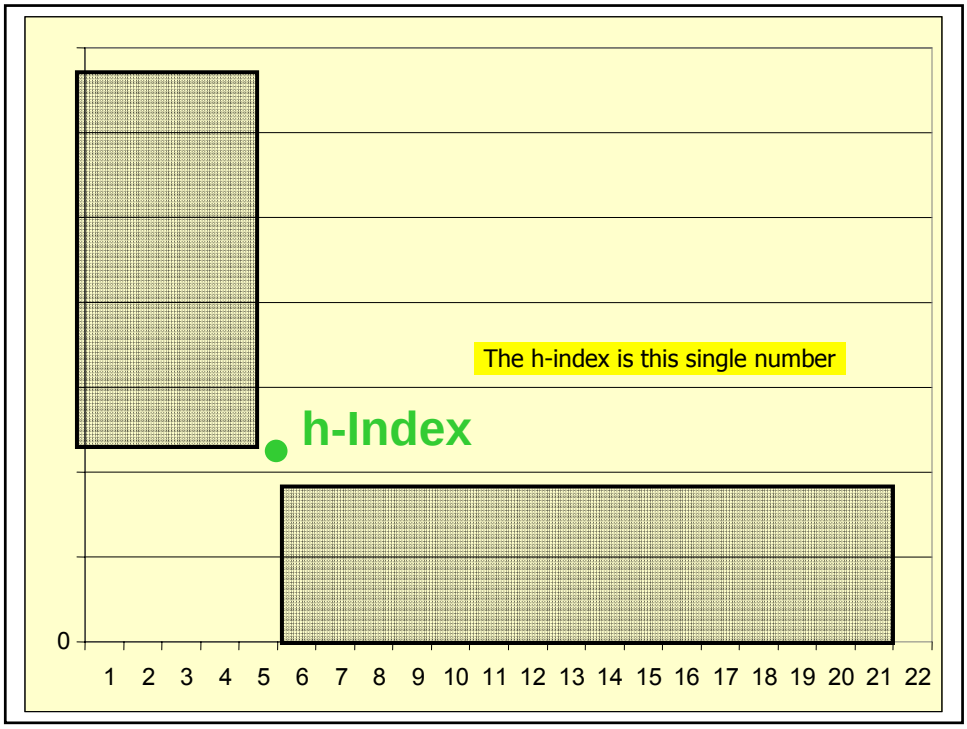
The “h-index”

- Has become very popular
- “The number of papers with citation number higher or equal to h”
- Example: h=23, if 23 papers have at least 23 citations




Determine intersection
point with f(x)=x diagonal
f(x) = x
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22


h-index cuts off highly cited papers
f(x) = x
h-index cuts off long tail
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22



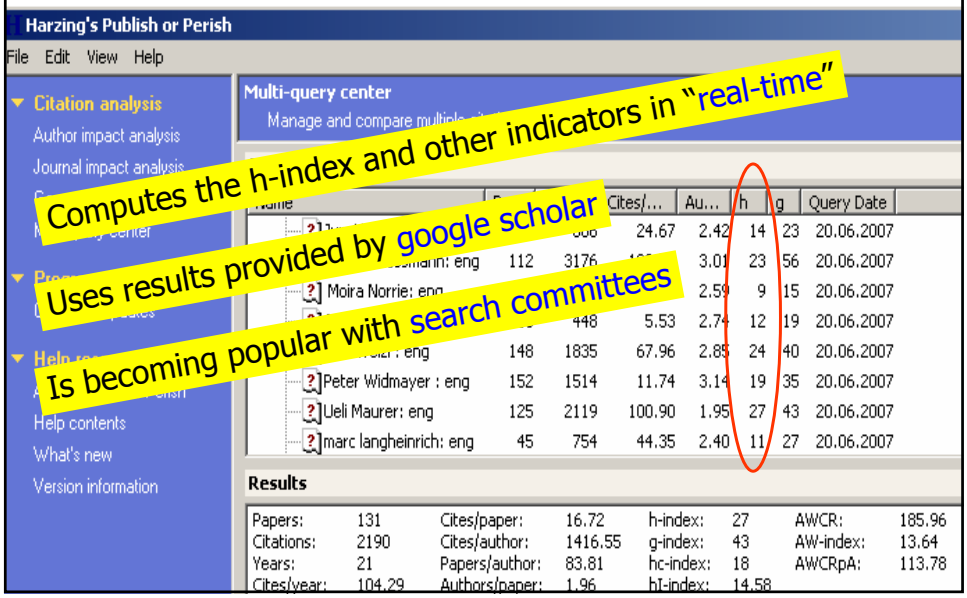
On the h-index

- "I argue that two individuals with similar h are comparable in terms of their overall scientific impact, even if their total number of papers or their total number of citations is very different." [Jorge Hirsch]

- "If your second-most cited publication has 50 citations, it makes no difference for the h-index whether the first has 51 or 10,000." [Bertrand Meyer]

Comparing People

"Publish or Perish" Online Tool



[redacted]
Appointments Committee

Be cited
„~~Publish~~ or perish"

Expert's evaluation of applicants for Professorship in [redacted]

most important criteria, in general terms, must be the impact of the scientific output of the candidates. This has traditionally been measured using the number of publications

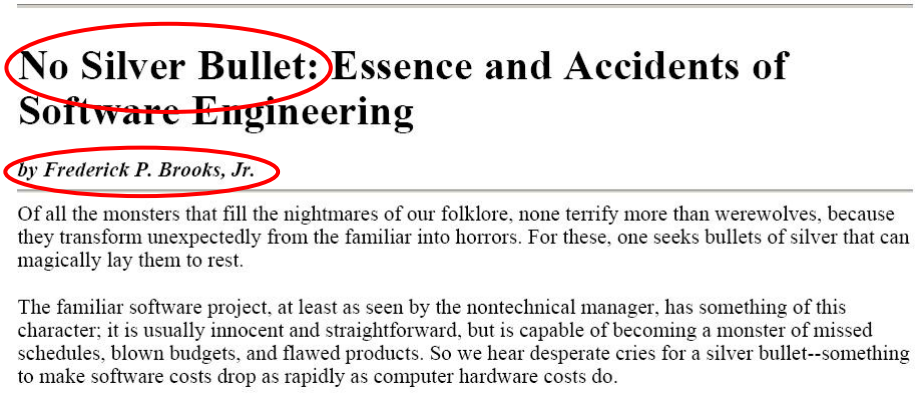
A fairly recent, useful measure for evaluating impact is the so-called h-index. A scholar has an index of h if he or she has published h papers each of which has been cited by others

The following table lists the number of citations of the most influential publication (with most citations) from each applicant, as well as the h-index of each applicant. The numbers are based on a Google Scholar search on [redacted]

Candidate	Citations for top paper	h-index
[redacted]	29	8
[redacted]	51	6
[redacted]	42	8

Although the differences are not huge, the group of top candidates emerges clearly:

Check Candidate „Bullet“



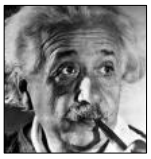
No Silver Bullet: Essence and Accidents of Software Engineering

by Frederick P. Brooks, Jr.

Of all the monsters that fill the nightmares of our folklore, none terrify more than werewolves, because they transform unexpectedly from the familiar into horrors. For these, one seeks bullets of silver that can magically lay them to rest.

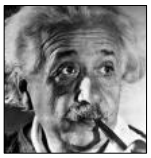
The familiar software project, at least as seen by the nontechnical manager, has something of this character; it is usually innocent and straightforward, but is capable of becoming a monster of missed schedules, blown budgets, and flawed products. So we hear desperate cries for a silver bullet--something to make software costs drop as rapidly as computer hardware costs do.

How I Became Einstein's Co-Author



NEC ResearchIndex Find: Einstein and Mattern Documents Citations

How I Became Einstein's Co-Author



NEC ResearchIndex Find: Einstein and Mattern Documents Citations

Searching for **einstein and mattern**.
Restrict to: Header Title field Order by: Citations Introductory Usage Date Hits:

Order: citations weighted by year.

Zur Evaluation der Informatik mittels bibliometrischer.. - Einstein.. (Correct)
…Analyse Nicht alles was zhlt, kann gezhlt werden, und nicht alles was gezhlt werden kann, zhlt!
Albert **Einstein**, Friedemann **Mattern**, ETH Zurich, Switzerland

The „Einstein & Mattern“ Paper

22 Informatik_Spektrum_25_Februar_2002

Zur Evaluation der Informatik mittels bibliometrischer Analyse

Nicht alles was zählt, kann gezählt werden, und nicht alles was gezählt werden kann, zählt! Albert Einstein

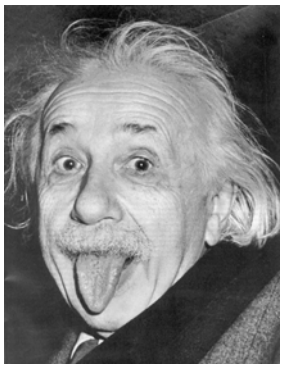
Friedemann Mattern

Zur Bewertung von Forschungsinstitutionen oder einzelnen Wissenschaftlern werden zunehmend bibliometrische Analysen eingesetzt.

Unter einer bibliometrischen Analyse wird die statistische Auswertung wissenschaftlicher Publi- vereinbarung (welche nachprüfbare Leistungsindikatoren zwingend nach sich zieht – „you can't manage what you can't measure“) bis hin zur Erkenntnis, dass im Zeitalter der Globalisierung eine

Not everything that can be counted counts, and not everything that counts can be counted.

Albert Einstein



"Using the impact factor alone is like using weight alone to judge a person's health"

"Ranking people is not the same as ranking their papers"

www.mathunion.org/fileadmin/IMU/Report/CitationStatistics.pdf June 2008

Joint Committee on Quantitative Assessment of Research

Citation Statistics

A report from the International Mathematical Union (IMU) in cooperation with the International Council of Industrial and Applied Mathematics (ICIAM) and the Institute of Mathematical Statistics (IMS)

The report is written from a mathematical perspective and strongly cautions against the over-reliance on citation statistics such as the impact factor and h-index. These are often promoted because of the belief in their accuracy, objectivity, and simplicity, but these beliefs are unfounded.

www.mathunion.org/fileadmin/IMU/Report/CitationStatistics.pdf June 2008

The „Report“ on Numbers

- “The lure of simple numbers seems to overcome common sense and good judgment.”
- “Numbers are not inherently superior to sound judgments. We should not discard peer review merely because it is sometimes flawed by bias.”

“Stop the Numbers Game”, CACM, Nov. 2007

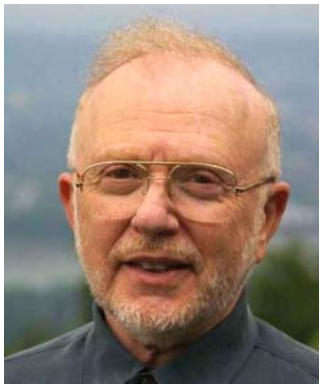
I am offended by discussions that imply that the journal is there to serve the authors rather than the readers. […]

Academics with large groups, who often spend little time with each student but put their name on all of their students’ papers, will rank above those who work intensively with a few students. […]

Researchers who apply the “copy, paste, disguise” paradigm to publish the same ideas in many conferences and journals will score higher than those who write only when they have new ideas or results to report. […]

Those who want to see computer science progress and contribute to the society that pays for it must object to rating-by-counting schemes every time they see one being applied.

David Parnas



Papers:	266	Authors/paper:	2.13
Citations:	4229	h-index:	31
Cites/paper:	15.90	g-index:	62

Source: “Publish or Perish”, Sep 2008

References

[1] David Adam: Citation analysis – The counting house. Nature, Vol. 415, 14 Feb 2002, 726-729

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[16] National Science Board: Science and Engineering Indicators 2008. National Science Foundation, Arlington (VA), 2008

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