Bibliometric Evaluation of Computer Science – Problems and Pitfalls
Friedemann Mattern
Institute for Pervasive Computing, Department of Computer Science, ETH Zurich
mattern@inf.ethz.ch
European Computer Science Summit 2008 (ECSS 2008)

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”.
Bibliometric Evaluation of Computer Science – Problems and Pitfalls

Friedemann Mattern
ETH 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

Wealth intensity (GDP/person)

Citation intensity (citations/paper)

“Bang for the Buck”: To get cited you have to be rich?

To become rich you have to be cited?

Counterexample: Luxembourg


Comparing Nations

Citations (millions)

United States

EU-15

Japan

East Asia

Science and Engineering Indicators 2006
National Science Board

F. Mattern, ETH Zurich, 2008
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.

THE WORLD’S TOP 200 UNIVERSITIES
The Times Higher Education

Comparing Institutions

<table>
<thead>
<tr>
<th>Rank</th>
<th>Name</th>
<th>Country</th>
<th>2009 Rank</th>
<th>2008 Rank</th>
<th>Research Score</th>
<th>Impact</th>
<th>NTU- Advisor</th>
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<tbody>
<tr>
<td>1</td>
<td>Harvard University</td>
<td>US</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>17</td>
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<tr>
<td>2</td>
<td>Massachusetts Institute of Technology</td>
<td>US</td>
<td>84</td>
<td>87</td>
<td>87</td>
<td>84</td>
<td>12</td>
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<td>3-6</td>
<td>Cambridge University, Oxford University</td>
<td>UK</td>
<td>96, 73, 65</td>
<td>96, 73, 65</td>
<td>96, 73, 65</td>
<td>96, 73, 65</td>
<td>96, 73, 65</td>
</tr>
<tr>
<td>7-10</td>
<td>Stanford University, University of California, Berkeley</td>
<td>US</td>
<td>78, 95, 10</td>
<td>78, 95, 10</td>
<td>78, 95, 10</td>
<td>78, 95, 10</td>
<td>78, 95, 10</td>
</tr>
<tr>
<td>11-15</td>
<td>Yale University, California Institute of Technology</td>
<td>US</td>
<td>71</td>
<td>43</td>
<td>43</td>
<td>71</td>
<td>52</td>
</tr>
<tr>
<td>21-27</td>
<td>Ecole Polytechnique, University of Cambridge</td>
<td>France</td>
<td>37, 17, 47</td>
<td>37, 17, 47</td>
<td>37, 17, 47</td>
<td>37, 17, 47</td>
<td>37, 17, 47</td>
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F. Mattern, ETH Zurich, 2008
Comparing Institutions

<table>
<thead>
<tr>
<th>Rank</th>
<th>Year</th>
<th>Name</th>
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<tr>
<td>1</td>
<td>2004</td>
<td>Harvard University</td>
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<td>2004</td>
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<tr>
<td>4</td>
<td>2004</td>
<td>Oxford University</td>
</tr>
<tr>
<td>5</td>
<td>2004</td>
<td>Stanford University</td>
</tr>
<tr>
<td>6</td>
<td>2004</td>
<td>University of California, Berkeley</td>
</tr>
<tr>
<td>7</td>
<td>2004</td>
<td>Yale University</td>
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<td>8</td>
<td>2004</td>
<td>California Institute of Technology</td>
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<td>9</td>
<td>2004</td>
<td>Princeton University</td>
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<td>10</td>
<td>2004</td>
<td>Ecole Polytechnique</td>
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<td>2004</td>
<td>Duke University</td>
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<td>2004</td>
<td>London School of Economics</td>
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<tr>
<td>13</td>
<td>2004</td>
<td>Imperial College London</td>
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<tr>
<td>14</td>
<td>2004</td>
<td>Cornell University</td>
</tr>
<tr>
<td>15</td>
<td>2004</td>
<td>Beijing University</td>
</tr>
<tr>
<td>16</td>
<td>2004</td>
<td>Tokyo University</td>
</tr>
<tr>
<td>17</td>
<td>2004</td>
<td>University of California, San Francisco</td>
</tr>
<tr>
<td>17</td>
<td>2004</td>
<td>University of Chicago</td>
</tr>
<tr>
<td>19</td>
<td>2004</td>
<td>Melbourne University</td>
</tr>
<tr>
<td>20</td>
<td>2004</td>
<td>Columbia University</td>
</tr>
<tr>
<td>21</td>
<td>2004</td>
<td>ETH Zurich</td>
</tr>
</tbody>
</table>

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

"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

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
Sorry, no relevant work in computer science here!

What happened here? We’ll see later!

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? 

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ISI-Coverage is Very Different for Different Disciplines

Analysis of all publications from ETH Zurich in 2003:

![Graph showing ISI coverage for different disciplines](image-url)
Does ISI Cover At Least All Relevant Publications?

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

Non-ISI

[7] Personal communication
[26] Detailed statistics in TR 314

ISI

Never catch 100%


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]

Biology: 90%
CS: 40%

Adding proceedings from ACM, IEEE-CS, and LNCS yields 51%

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

# Conferences and Workshops

<table>
<thead>
<tr>
<th></th>
<th>#venues</th>
<th>#papers (all)</th>
<th>citations per paper</th>
<th>#papers (top 100 venues)</th>
<th>#citations per paper (top 100 venues)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Journals</td>
<td>471</td>
<td>321 000</td>
<td>5.2</td>
<td>190 000</td>
<td>7.5</td>
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<tr>
<td>Conference / workshop series</td>
<td>2 297</td>
<td>585 000</td>
<td>3.0</td>
<td>167 000</td>
<td>7.3</td>
</tr>
</tbody>
</table>

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


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## A Small Sample from 2300 CS Conferences / Workshops

<table>
<thead>
<tr>
<th>Conference</th>
<th>Publications</th>
<th>Citations</th>
<th>Cit/Publ</th>
</tr>
</thead>
<tbody>
<tr>
<td>SIGCOMM</td>
<td>945</td>
<td>33546</td>
<td>35.50</td>
</tr>
<tr>
<td>MOBICOM - Mobile Computing and Networking</td>
<td>430</td>
<td>14771</td>
<td>34.35</td>
</tr>
<tr>
<td>POPL - Symposium on Principles of Programming Languages</td>
<td>1106</td>
<td>32595</td>
<td>29.47</td>
</tr>
<tr>
<td>SIGMOD – Inte. Conf. on Management of Data</td>
<td>2457</td>
<td>53347</td>
<td>21.71</td>
</tr>
<tr>
<td>SIGGRAPH – Ann. Conf. on Computer Graphics</td>
<td>3379</td>
<td>59966</td>
<td>17.75</td>
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<tr>
<td>VLDB - Very Large Data Bases</td>
<td>2324</td>
<td>39418</td>
<td>16.96</td>
</tr>
<tr>
<td>ECOOP - European Conference on Object-Oriented Programming</td>
<td>504</td>
<td>7881</td>
<td>15.64</td>
</tr>
<tr>
<td>STOC - ACM Symposium on Theory of Computing</td>
<td>2427</td>
<td>36113</td>
<td>14.88</td>
</tr>
<tr>
<td>WWW - World Wide Web Conference Series</td>
<td>1026</td>
<td>11873</td>
<td>11.57</td>
</tr>
<tr>
<td>PODC - Symposium on Principles of Distributed Computing</td>
<td>1064</td>
<td>11930</td>
<td>11.21</td>
</tr>
<tr>
<td>FOCS - IEEE Symposium on Foundations of Computer Science</td>
<td>2292</td>
<td>24225</td>
<td>10.57</td>
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<tr>
<td>SODA - Symposium on Discrete Algorithms</td>
<td>1699</td>
<td>14641</td>
<td>8.62</td>
</tr>
<tr>
<td>EUROCRYPT - Theory and Application of Cryptographic Techniques</td>
<td>980</td>
<td>7835</td>
<td>7.99</td>
</tr>
<tr>
<td>UbiComp - Ubiquitous Computing</td>
<td>246</td>
<td>1843</td>
<td>7.49</td>
</tr>
<tr>
<td>MobiSys - Int. Conf. on Mobile Systems, Applications, and Services</td>
<td>88</td>
<td>593</td>
<td>6.74</td>
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<tr>
<td>IJCAI - International Joint Conference on Artificial Intelligence</td>
<td>4520</td>
<td>30435</td>
<td>6.73</td>
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<tr>
<td>ACM SenSys</td>
<td>244</td>
<td>1442</td>
<td>5.91</td>
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<tr>
<td>CHI - Computer Human Interaction</td>
<td>5611</td>
<td>32583</td>
<td>5.81</td>
</tr>
<tr>
<td>ICALP - Automata, Languages and Programming</td>
<td>2090</td>
<td>10640</td>
<td>5.09</td>
</tr>
<tr>
<td>PARLE - Parallel Architectures and Languages Europe</td>
<td>406</td>
<td>1871</td>
<td>4.61</td>
</tr>
<tr>
<td>ISWC - International Symp. on Wearable Computers</td>
<td>361</td>
<td>1430</td>
<td>3.96</td>
</tr>
<tr>
<td>STGOPS European Workshop</td>
<td>376</td>
<td>1462</td>
<td>3.89</td>
</tr>
</tbody>
</table>
A Small Sample from 2300 CS Conferences / Workshops

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

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]

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
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?

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!

www.isihighlycited.com

Mostly Cited European Computer Science Researchers (ISI)

- Abiteboul, Serge
- Aulin, Tor M.
- Balbo, Gianfranco
- Benedetto, Sergio
- Bergstra, Jan A.
- Biglieri, Elio
- Binnig, Gerd K.
- Broy, Manfred
- Büttiker, Markus
- Caceci, Marco S.
- Chlamtac, Imrich
- Courcelle, Bruno
- De Nicola, Rocco
- De 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, Laszlo
- Lupas Scheiterer, R.
- Mallat, Stephane 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.
Balbo, Gianfranco
Benedetto, Sergio
Bergstra, Jan A.
Biglieri, Elio
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

Digital Phase Modulation
Digital Transmission Theory
Principles of Digital Transmission: With Wireless Applications
Scanning tunneling microscope (IBM Patent)
A Wavelet Tour of Signal Processing

Milner, Robin
Montanari, Ugo
Montorsi, Guido
Overmars, Mark H.
Andreas
Romers
Thomas
Sven
Jean Yves
Andreas
Sven
Prade
Rohrer, Heinrich
Henzinger, Thomas
Rohrer, Heinrich
Schöning, Uwe
Gottfried
Walker, David

Turing Award – the Last 10 Years

2007 Edmund Clarke
2007 Allen Emerson
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!
Harmful to
ISI Database is Irrelevant for 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”

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

Not much one can do about that
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.” [source]

Why should we care about this?
- In the eyes of the natural sciences, we cannot be taken seriously
- Image of CS, particularly in the lay public, is a concern
- Science, Nature,... generate news in the more mainstream press

Correlations
Shanghai / Times Ranking

"The correlations are quite weak, testifying that the choice of indicators the rankings are based on is significantly influencing the rankings."
Other Bibliometric Databases?

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

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


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

<table>
<thead>
<tr>
<th>Rank</th>
<th>Title</th>
<th>Authors</th>
<th>Journal/Conference</th>
<th>Year</th>
<th>Pages/Volume</th>
<th>Cited by</th>
</tr>
</thead>
</table>

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

Esteem of the community does not correlate with # of citations

Differences of Disciplines – Average Citations per Article

Mathematics/Computer Science
Social science
Materials science
Biological sciences
Environmental sciences
Earth Sciences
Chemistry
Physics
Pharmacology
Clinical Medicine
Neuroscience
Life sciences

0 1 2 3 4 5 6 7
Citations
Age Distribution of Citations for Different Fields

Data from Thomson Scientific

Cultural Differences Between CS and Mathematics

Unfair if we consider only the last 10 years (as in the ETH evaluation)?

Similar disparity between theoretical and practical CS?

F. Mattern, ETH Zurich, 2008
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?

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

...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:
  
  *cited by: 2581*

- But much more often this work is cited:

  *cited by: 21087*

---

**Review and Survey Papers Versus Research Papers**

![Graph showing citations over years after publication for review and full paper papers.](image-url)

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

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

- $f(x) = x$

h-index cuts off highly cited papers

h-index cuts off long tail
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

Computes the h-index and other indicators in "real-time"

Uses results provided by google scholar

Is becoming popular with search committees

**Appointments Committee**

Expert's evaluation of applicants for Professorship in

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

<table>
<thead>
<tr>
<th>Candidate</th>
<th>Citations for top paper</th>
<th>h-index</th>
</tr>
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<tbody>
<tr>
<td></td>
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<tr>
<td></td>
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<td>8</td>
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<td></td>
<td>51</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>42</td>
<td>8</td>
</tr>
</tbody>
</table>

Although the differences are not huge, the group of top candidates emerges clearly:
Check Candidate „Bullet“

Bullet
N Bullet
D Bullet
D Design
N Boulanger

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

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 zählt, kann gezählt werden, und nicht alles was gezählt werden kann, zählt!

Albert Einstein, Friedemann Mattern, ETH Zurich, Switzerland
The „Einstein & Mattern“ Paper

Zur Evaluation der Informatik mittels bibliometrischer Analyse

Not alles was zählt, kann gezählt werden, und nicht alles was gezählt werden kann, zählt! Albert Einstein

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


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.

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: 4.1
Citations: 4329 h-index: 31
Cites/paper: 15.90 g-index: 62
Source: “Publish or Perish”, Sep 2008
References

[10] Lokman I. Meho, Yvonne Rogers: Citation Counting, Citation Ranking, and h-Index of Human-Computer Interaction Researchers: A Comparison between Scopus and Web of Science. Journal of the American Society for Information Science and Technology. Vol. 59, No. 11, Sep. 2008, 1711-1726