JOURNAL PREFERENCE OF COMPUTER SCIENTISTS: A BIBLIOMETRIC STUDY BASED ON *MALAYSIAN JOURNAL OF COMPUTER SCIENCE*

B K Sen[*]
Wee Siu Hiang[**]

Introduction

We are living in an age when more or less every human activity has been pervaded by a small device called a computer. In the human civilisation possibly no device has influenced civilisation so much in so short a period as this particular device. Even fifty years ago it was possibly beyond the wildest dream of human beings that within less than half a century a gigantic brain called Internet will hold almost the entire knowledge humans have ever generated!

The growth rate of literature in the field of computer science is possibly the highest among all other fields of knowledge. It can be seen from Table 1 that in 1966 *Computer and Control Abstracts* [1] recorded only 2,817 entries, and in 1990 it has recorded a whooping 75, 537 entries, an increase of about twenty-seven times. Compared to that the growth rate of electrical and electronics literature has not even been four times [Table 2]

Table 1- Growth of Computer Literature (1966 - 1990)

Year	Number of Abstracts
1966	2,817
1971	24,644
1976	31,857
1981	36,889
1986	57,854
1990	75,537

Source: *Computer & Control Abstracts* 1966 - 1990

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[*] Professor, Department of Library & Information Science, University of Malaya, Malaysia.
[**] MLIS Program, Faculty of Computer Science & Information Technology, University of Malaya, Malaysia.

Table 2 - Growth of Electrical & Electronics Literature (1967 - 1991)

Year	Number of Abstracts
1967	24,039
1971	39,968
1976	51,178
1981	53,861
1986	71,170
1991	81,393

Source: *Electrical and Electronics Abstracts* 1967 – 1991[2]

As in most fields of science, the research papers in computer science are also by and large multi-authored. The five issues of *Malaysian Journal of Computer Science* [3]used for the study contains 49 articles contributed by eighty-four authors. ON an average, one article has been contributed by 1.7 authors. Taking this as a clue we may assume that at present there will be well above 100,000 researchers in the field of computer science. The research output of these individuals has led to the phenomenal growth of journals in the field. The research journals on computer science publishing in the field in English language alone is likely to be more than 200.

The tremendous growth of a subject obviously leads to specialisations. The field of computer science is also no exception. The common specialisations that can be encountered today are -Artificial Intelligence; Computer Communications; Compilers and Operating Systems; Computer-Aided Design, Learning and Manufacturing; Computer Architecture, Computer Graphics: Computer Security and Recovery; Image Processing and Pattern Recognition: Information Systems and Databases; Microprocessors and Interfaces; Multimedia; Programming Languages and Algorithm; Software Engineering and CASE Tools, and so on. The enormity of literature in a field obliges a researcher to restrict his field of study to a narrow specialisation. This, in turn, restricts the number of journals which a researcher normally browse through or read to keep himself abreast of the development. This study aims to find out the journals that the computer specialists normally use for their professional attainments.

Definition of Terms

Journal preference - The term journal preference can have two different connotations: (i) the journals wherein the researchers of a discipline prefer to place their papers; and (ii) the journals which the researchers of a discipline usually consults to keep themselves abreast of the latest developments in the field to conduct research, write research communications, and so on. . In this article the term has been used in its second sense.

Methodology

For conducting the study five recent issues of *Malaysian Journal of Computer Science* i.e. issue numbers 1 and 2 of 1996 and of 1997, and issue number 1 of 1998 were used [3], to collect the data. The following steps were undertaken to conduct the study.

Step 1: Scanning the References Section of each article to mark the journal citations

Step 2: Entering the data in tabular form using Word 97

Step 3: While entering data it was observed that uniformity has not been maintained in the rendition of titles of journals in the References section of the articles. Different abbreviations were noticed for the same title. In certain cases the titles were incomplete. Hence it was decided to convert abbreviated titles as well as incomplete titles into the complete titles. This task involved guessing the complete title and then checking the title with *Ulrich's Plus* [4]. This alone did not help in all the cases because the titles which have ceased or undergone changes were not available in *Ulrich's Plus*.[4]. Hence, the library catalogues had to be checked using Internet. Once the job is complete, the next step was taken.

Step 4: The abbreviated and incomplete titles were modified to their full form in the computer.

Step 5: The titles were then sorted according to alphabetical order. This brought all like titles together. As the number of titles occurring more than once was not very high, they were simply counted and the number was typed under frequency. The titles that got repeated because of their multiple occurrences were erased. This provided us the Table 3.

Table 3 – List of Cited Periodicals

Serial No.	Periodicals	Frequency
1	Accounting Organisations and Society	1
2	ACM Computing Surveys	1
3	ACM Transactions on Computer Systems	1
4	ACM Transactions on Database Systems	4
5	ACM Transactions on Graphics	1
6	Acta Informatica	1
7	Acta Psychologica	1
8	Advances in Fuzzy Set Theory and Applications	3
9	Advances in Human-Computer Interaction	1
10	AI Ch E Journal	1
11	AI Expert	2
12	AI Magazine	1
13	Akron Law Review	1
14	American Journal of Computational Linguistics	2
15	American Journal of Psychology	1
16	American Psychologist	1
17	Artificial Intelligence	1
18	Australian Computer Journal	1
19	Biological Cybernetics	2
20	Bit	2
21	British Telecom Technology Journal	1
22	Byte	2
23	Byte Magazine	2
24	Child Development	3
25	Cognitive Psychology	1
26	Columbia Journal of Transnational Law	1
27	Columbia Law Review	1
28	Communications of the ACM	9
29	Communications on Pure and Applied Mathematics	1
30	Communications Week	1
31	Computer Aided Design	2
32	Computer Communications	10
33	Computer Journal	4
34	Computer Network & ISDN Systems	7
35	Computers and Law	1
36	Computers and Security	5
37	Computers in Education	1

38	Computing & Control Engineering Journal	1
39	Cybernetica	2
40	Data and Knowledge Engineering	1
41	Data Communications	1
42	Database Engineering	1
43	Datamation	4
44	Decision Sciences	1
45	Design Studies	1
46	Dr. Dobb's Journal	2
47	EDI Forum	1
48	EDP Audit Control and Security Newsletter	1
49	Electronics Letters	1
50	European Journal of Information Systems	1
51	Europhysics Letters	2
52	Expert Systems	1
53	Formal Methods in System Design	1
54	Fuzzy Sets and Systems	18
55	IBM Systems Journal	1
56	IEE Transactions on Computers	1
57	IEEE Communications Magazine	1
58	IEEE Computational Science and Engineering	1
59	IEEE Computer	4
60	IEEE Computer Graphics and Applications	2
61	IEEE Database Engineering	1
62	IEEE Digest	1
63	IEEE Expert Intelligent Systems and Their Applications	4
64	IEEE Journal on Selected Areas of Communication	4
65	IEEE Network	1
66	IEEE on Knowledge & Data Engineering	2
67	IEEE Software	3
68	IEEE Spectrum	2
69	IEEE Transactions on Circuit Theory	1
70	IEEE Transactions on Communications	2
71	IEEE Transactions on Pattern Analysis & Machine Intelligence	3
72	IEEE Transactions on Acoustics, Speech and Signal Processing	1
73	IEEE Transactions on Computers	8
74	IEEE Transactions on Image Processing	1
75	IEEE Transactions on Information Theory	1
76	IEEE Transactions on Neural Networks	2
77	IEEE Transactions on Signal Processing	1

78	IEEE Transactions on Software Engineering	19
79	IEEE Transactions Systems, Man and Cybernetics	8
80	IEEE/ACM Transactions on Networking	4
81	IEEE/OSA Journal of Lightwave Technology	1
82	IEICE Transactions Fundamentals	1
83	Ind. Eng. Chemical. Process Des. Development	1
84	Information & Control	1
85	Information and Management	9
86	Information and Software Technology	11
87	Information Management and Computer Security	1
88	Information Processing and Management	1
89	Information Science	3
90	Information Systems	5
91	Information Systems Journal	1
92	Information Systems Research	1
93	International Journal of Computer Applications in Technology	2
94	International Journal of Computer Mathematics	5
95	International Journal of Control	3
96	International Journal of Expert System	2
97	International Journal of High Speed Computing	1
98	International Journal of Information Management	1
99	International Journal of Intelligent System in Accounting	1
100	International Journal of Intelligent Systems	1
101	International Journal of Management Science	1
102	International Journal of Man-Machine Studies	3
103	International Journal of Modelling and Simulation	2
104	International Journal of Network Management	2
105	International Journal of Systems Science	1
106	Internet Journal of Circuit Theory	1
107	Internet Research and Experiment	1
108	IS Audit and Control Journal	2
109	Journal of Computational Physics	1
110	Journal de Physique. France	1
111	Journal of Accounting and EDP	1
112	Journal of Child Language	2
113	Journal of Computing Systems & Science	1
114	Journal of Experimental Psychology	3
115	Journal of Fluid Mechanics	1
116	Journal of General Psychology	1
117	Journal of Information Science	2

118	Journal of Information Science and Engineering	1
119	Journal of Information Systems Management	1
120	Journal of Information Technology	2
121	Journal of Lightwave Technology	1
122	*Journal of Mathematical Analysis and Applications*	1
123	Journal of Mathematical Psychology	1
124	Journal of Microcomputer Applications	1
125	Journal of Operations Society	1
126	Journal of Physics. A: Mathematical and General	1
127	Journal of Software Maintenance: Research & Practices	1
128	Journal of Systems Management	11
129	Journal of Systems & Software	1
130	Journal of the ACM	4
131	Journal of the American Society of Information Science	1
132	Jurnal Teknologi	1
133	Jurnal Teknologi Maklumat	1
134	KISS Review	1
135	Knowledge Engineering Review	2
136	Lingua	1
137	Machine Intelligence	1
138	Malaysian Journal of Computer Science	7
139	Malaysian Journal of Science	1
140	Management Information System Quarterly	2
141	Management Science	1
142	Mathematical System Theory	1
143	Mathematics and Computers in Simulation	1
144	Mathematics of Computation	1
145	Mathematics of Control. Signal and Systems	1
146	Merrill-Palmer Quarterly	1
147	Microprocessing & Microprogramming	5
148	Mind	1
149	MIS Quarterly	3
150	Monographs of the Society for Research in Child Development	1
151	Neural Computation	1
152	Neural Networks	1
153	New Zealand Journal of Computing	1
154	Operations Research	2
155	Organisation Science	1
156	Parallel Computing	2
157	Pattern Recognition	3

158	PC Week	1
159	Perception	1
160	Perception & Psychophysics	2
161	Pertanika Journal of Science and Technology	1
162	Physical Review - A	1
163	Physics Letters - A	1
164	Physics Review Letters	1
165	Proc IEE – Part D	1
166	Proceedings of IEEE	5
167	Proceedings of the National Academy of Sciences of the United States of America	2
168	Psychological Bulletin	1
169	Psychological Research	1
170	Psychological Review	1
171	Scientific American	1
172	Singapore National Academy of Science Journal	1
173	Software Engineering	1
174	Software Engineering Journal	2
175	Yearbook of Law, Computers and Technology	1
176	Zeitschrift fuer Physikalische Chemie	1

In all, the list contains 176 journals. Apart from computer science the list also contains periodicals devoted to a number of other subjects as can be seen from Table 4

Table 4 – Subject Distribution of non-Computer Science Journals Cited

Subject	Number of Journals	Serial Nos. (*vide* Table 3)
Psychology	13	7, 15, 16, 25, 114, 116, 123, 148, 160, 161, 168, 169, 170
Information Science	10	6, 84, 85, 87, 88, 89, 98, 117, 118, 131
Mathematics	9	29, 94, 112, 123, 126, 142, 143, 144, 145
Systems Science	8	53, 55, 105, 119, 128, 129, 142, 145
Physics	7	51, 109, 110, 126, 163, 164, 165
Communications	6	30, 32, 57, 64, 70, 145
Electricity & Electronics	5	48, 62, 68, 165, 166
Law	4	13, 26, 27, 75
Science	5	139, 155, 168, 171, 172
Accounting	3	1, 79,111
Child Study	3	24, 112, 150

Information Technology	3	86, 120, 133
Linguistics	3	14, 42, 136
Management Information System (MIS)	3	85, 104, 149
Management Science	3	85, 101, 141
Technology	3	93, 132, 175
Networks [excludes Neural Networks]	3	15, 80, 104
Circuit Theory	2	69, 106
Design	2	31, 45
Fuzzy Set	2	8, 54
Lightwave Technology	2	81, 121
Modeling & Simulation	2	103, 143
Operations Research	2	125, 154
Ergonomics	2	9, 102
Acoustics	1	72
Chemical Engineering	1	10
Decision Science	1	44
Fluid Mechanics	1	115
Industrial Engineering	1	83
Information Theory	1	75
Internet	1	107
Physical Chemistry	1	176
Science & Technology	1	161
Signal Processing	1	72
Telecommunications	1	21
Education	1	37

It may be seen from Table 4 that the computer scientists use not only computer science journals but also journals from a number of other disciplines. Publishing articles in the journals of broader disciplines is but a common practice with the scientists in the world. As such, we find articles practically from all scientific disciplines in journals like *Nature, Science, Scientific American,* and *Proceedings of the National Academy of Sciences of the United States of America.* The computer scientists being no exception to the rule also publish papers in journals on broad disciplines and draw materials from them whenever necessary. This phenomenon provides the explanation for the appearance in Table 4 of five journals devoted to science, three each to information technology and technology, and one to *science and technology in general. The application of computer has become*

more or less universal. As such there is nothing surprising that articles on computer application will appear in journals on chemical engineering, industrial engineering , design, education, and so on. In addition to this we find there are quite a number of other areas apart from computer science and its numerous subdisciplines, which are becoming related to computer science in some way or the other. This is what we intend to examine here. In Table 4 psychology tops the list followed by information science, mathematics, systems science, physics, communications, law, linguistics and so on. Let us examine the subjects one by one.

Psychology – We have in the Table as many as 13 journals devoted to psychology. How the human brain stores unimaginable amount of data and retrieves the necessary information in most cases almost in no time? As the need grows for storing more and more data in the memory devices, processing of this huge reservoir of data in the most efficient way, and retrieving the desired information in quickest possible time is becoming more and more demanding. As a result, computer scientists are trying to understand the mechanism of the wonderful mass lying within our scull called the brain. Hence, so much dependence on psychology

Information Science – The information science journals in the Table total ten. The demarcation line between the two subjects is continuously becoming thinner and thinner. Why this is so can be realised from the fact that some of the objectives such as fast processing, storing, retrieval and dissemination of information; development of efficient information systems; creation of databases; and building up of information networks of various complexities and dimensions are all common to both the disciplines. As such, it becomes almost axiomatic that computer scientists will be consulting journals on information science to glean necessary materials for their research. and discovery of virgin areas awaiting computer applications.

Mathematics and Physics - In Table 4 we find that there are nine journals on mathematics and two on fuzzy sets totalling eleven in all. Similarly, we have seven journals on physics, five on electricity and electronics, two on circuit theory, and one each on fluid mechanics and acoustics totalling sixteen in all. In a sample of 176 journals we find that as many as twenty-seven journals (15%) are devoted to these two broad subjects. We should not forget that computer science has grown up as an offspring of physics,

mathematics, and logic. Boolean algebra being the bridge between the last two. Hence, it can be easily explained that it will be heavily dependent on these two subjects and their subdisciplines.

Systems Science – The tally of this new discipline is found to be eight. The technique of system analysis as a component of efficient management finds application in numerous activities in industries, public administration, and other areas. It now acts as a pillar on which the computer application and the necessary software development in any field depends. The study of systems in variegated environments and their the application of system analysis in diverse fields have given rise to the new discipline called *systems science*. No wonder, it has also found its own niche in computer science.

Communications – Apart from six journals on communications, there are three journals on networks, and one journal each on information theory, Internet, signal processing, and telecommunications which add up to thirteen. The number itself is indicative of the extent of closeness between communication and computer science. It is to be noted that both the subjects together form the backbone of information technology. Doubtless, with the advent of computer science, the field of communication has possibly been most affected and thereby developed in leaps and bounds. The faultless operation of telephone switching systems; development of Internet, Intranet and Extranet; alongside LAN, MAN, and WAN; deft handling of equipment in many phases of radio and television broadcasts; transmission of written materials and graphics with lightning speed; launching of communication satellites and their operation and many other communication activities are all due to the happy communion between the two. Hence, the citation of communication science journals is quite natural in computer science articles.

Law – As many as four journals on law have figured in the Table. Law is also a subject which pervades all human activities. In computer science, intellectual property right is a big issue and its infringement in any way brings one within the jurisdiction of law. Computer software piracy is rampant in the world. Pirated CD ROMs available in the market may surpass the legal ones. The relentless competition in the computer market for supremacy are obliging firms to take steps which may not always be

legal in the truest sense of the term. Illegal entry into databases, mutilation or alteration of data by hackers have become a commonplace phenomenon in today's world. Computer crime today is but a common term. An Internet search with the key term *computer crime* employing Hotbot search engine on 3rd September 1998 resulted in 10632 hits. This itself shows the enormity of the problem. All these amply justify the appearance of four legal journals in the Table

Accounting -The computer has made the complicated task of extensive accounting, billing as well as inventory control not only simple but also flawless. It is, therefore, no wonder that computer scientists will be drawing materials from the journals on accounting and related disciplines to develop more powerful and efficient systems to take care of accounting in various organisations

Child Study - In the quest for artificial intelligence computer scientists have started to look at the child from a new angle. How a child gains knowledge from his or her environment and becomes more and more intelligent as he or she grows? Often the comparison of child's intelligence, reasoning capability, etc. with those of a computer provides useful clue to understand the limitations of computer designs, softwares, etc. Here lies the importance of the subject in computer science.

Linguistics – Recognition of handwriting by computers, in other words, pattern recognition, machine translation, etc. have occasioned the study of languages by computer scientists. As a result, linguistics has gained great importance in computer science.

Management Science – We have encountered three journals on management science, three on management information system, two each on ergonomics and operations research, and one on decision science in this study. In all , the journals number eleven, not a small number. This clearly shows the application of computer in management is quite substantial.

Conclusion

This small study provides good indication as to the fact that subscribing computer science journals alone for researchers and specialists on computer

science may not meet all their informational requirements. The librarians will have to look for periodicals befitting to the needs of computer specialists working in an institution, and thereby may have to transgress the arena of computer science in collection building for the benefit of computer professionals.

Acknowledgement

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    The article has been used to draw materials for describing relationship of computer
    science with several subjects.