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Citation-Based Journal Rankings for AI Research

A Business Perspective

Chun Hung Cheng, Clyde W. Holsapple, and Anita Lee

■ A significant and growing area of business-computing research is concerned with AI. Knowledge about which journals are the most influential forums for disseminating AI research is important for business school faculty, students, administrators, and librarians. To date, there has been only one study attempting to rank AI journals from a business-computing perspective. It used a subjective methodology, surveying opinions of business faculty about a prespecified list of 30 journals. Here, we report the results of a more objective study. We conducted a citation analysis covering a time period of 5 years to compile 15,600 citations to 1,244 different journals. Based on these data, the journals are ranked in two ways involving the magnitude and the duration of scientific impact each has had in the field of AI.

AI research has been striving for the past four decades to increase the intelligence displayed by computing systems. Today, there are many distinct subfields within AI—natural language processing, speech recognition and synthesis, pattern recognition and computer vision, robotics, knowledge representation, machine learning, fuzzy logic, and expert systems, to mention a few. Each attempts to automate specific aspects of human intelligence, and each is relevant to business research and practice. This relevance cuts across several business fields but is particularly pronounced for the field of business-computing systems, which has a growing intersection with the AI field. Nearly 400 faculty listed in the 1992 MISRC/McGraw-Hill directory identify an AI area as a research specialization (DeGross, Davis, and Littlefield 1992). Courses dealing with AI topics have become commonplace in business school curricula.

A recent special issue of *Communications of the ACM* on commercial and industrial applications of AI provides a timely depiction of the dramatic effects of AI research in business computing (CACM 1994). AI business applications today span the realms of manufacturing, finance, and management, employing such technologies as knowledge-based systems, vision systems, automatic speech recognition, microelectromechanical systems, fuzzy logic, neural networks, and genetic or evolutionary algorithms. Consumer products are now measured in machine intelligence quotients. Companies such as Digital, IBM, and DuPont have ongoing efforts in developing AI applications to solve complex real-world problems, improve productivity, and achieve strategic competitiveness. Many regard AI as the next wave in the ongoing computing revolution (Dutta 1993).

To stay at the forefront of this revolution, a guide to the latest and most influential scientific developments in AI is critical. The purpose of this article is to offer such a guide for researchers and practitioners who operate on the cusp of the AI and business-computing fields. We do so by developing objective rankings of journals that have the greatest impact on AI research. The rankings are based on an extensive citation analysis. Because the citation base is determined from a survey of business school faculty about the quality of AI journals, the rankings have a definite business orientation. The results reported here are of practical interest to business-computing researchers contemplating where to submit their own AI research. They are of interest to both faculty and students who need to allocate their limited time to reading among a

Field of Interest	Basis of Analysis	Purpose
AI	References made to papers published in *Artificial Intelligence* from 1970–1991	To identify 50 most influential papers in AI (Bobrow 1993)
Business computing	Over 25,000 citations from 5 base journals covering a time period from 1987–1991	To rank business-computing journals (Holsapple et al. 1993)
Decision support systems (DSS)	Publishing records in DSS-related areas from 32 U.S. institutions examined	To identify the most-influential contributors and the leading U.S. universities in DSS-related research (Eom and Lee 1993)
Management information systems (MIS)	References from an MIS literature-review article in 1988	To identify a core of MIS journals (Cooper, Blair, and Pao 1993)

Table 1. Citation Studies Published in 1993 for AI and Business-Computing Research.

host of journals. They are of interest to university administrators who need an objective way to gauge the AI outlets in which their faculty members publish. They are of interest to business school librarians who need a way to assess what AI journals are most important to include in their collections.

We begin with a brief review of studies related to ranking journals that publish AI research. Next, details of the citation-analysis methodology are described. Findings from this analysis are then presented. Results based on both unnormalized and normalized citation scores are reported. They are compared with a previously reported subjective ranking, showing that our objective rankings yield some major differences from the earlier work. A concluding discussion accentuates insights gained from this study.

Related Studies

The ranking of journals has long been undertaken as a means to gauge journal quality and influence (Garfield 1979). Our literature review reveals only one prior attempt to rank AI journals. In 1992, Gupta (1994) surveyed the opinions of 111 AACSB accredited business faculty about the academic quality and reputation of 30 journals she identified as publishing AI research. Each respondent rated each of these journals on a scale of 1 (low quality) to 4 (top quality). Journals were then ranked according to a weighted-average score derived from the respondents' ratings. Gupta grouped the ranked journals into three categories of roughly comparable size that she called top, medium, and low, reflecting the weighted-average scores.

Gupta also reported a recognition factor for each of the 30 journals. This recognition factor is the percentage of the 111 respondents who were sufficiently familiar with the journal to rate it on the 1 to 4 scale. These recognition factors ranged from 89 to 20. She argued that journals of relatively recent vintage generally have had less time to be recognized. Accordingly, she developed two additional rankings. The first ranking had the 12 journals with recognition factors above 50 percent based on their ranked weighted-average scores. The second ranking listed the remaining journals on the same basis. The intent of this dual-ranking approach was to overcome bias introduced by the age differences of the journals.

Gupta's study is a pioneering effort at assessing the quality and impact of various journals on AI research from a business perspective. However, it has some notable limitations. First, respondents were given the task of rating a prespecified list of 30 journals. Are these the 30 most influential journals for AI research, or are important journals omitted? Second, the study is strictly subjective. The opinions of business school faculty are, of course, important. However, do they accurately reflect the actual relative influences of AI journals? Third, the longevity of a journal might well impact the recognition it garners. However, is a 50-percent recognition factor an appropriate cutoff for partitioning journals into two rankings, and might not a single ranking that is normalized to adjust for longevity be more useful? The research reported in this article addresses all three of these concerns.

One other related study produced rankings of journals based on their relative impacts on expert system research (Cheng, Holsapple, and Lee 1995). Although this study was objective,

expert systems form only one segment of the AI field. Thus, its results are of interest to those focusing on expert systems, but they could be expected to differ from the broader AI study reported here—and indeed they do.

Citation Analysis

In the interest of objectivity, our ranking is established through an extensive study of citation patterns existing in a base set of AI articles. This methodology is known as *citation analysis*, the merits of which are put forth by Cooper, Blair, and Pao (1993):

> Citation analysis is an unobtrusive way to judge the influence of research within the research community. Such analyses do not require cooperation of respondents and thus are not prone to many of the biases associated with eliciting researcher perceptions and the noise which can be introduced due to multiple perceptions of influence criteria.

Reported studies in 1993 using citation analysis for various purposes in AI and business fields are summarized in table 1.

Regardless of how citation analysis is administered, the identification of a base set of articles related to the subject under study is crucial. It is important that the base set of articles be representative of the best work in the subject area and that the inclusion-exclusion of articles be immune from researcher judgments or bias. In this study, the base set of articles is collected from six AI journals, covering the period from 1989 to 1993. In assembling this citation base, we exercised no judgment in choosing the specific AI journals or selecting specific articles from them. The journals were effectively chosen by the business faculty responding to Gupta's survey. All articles in these journals during the five-year period were included in the base set of articles.

To identify the base journals, we established three criteria: (1) the journal must have a clear and exclusive AI focus, as indicated by its stated editorial scope; (2) it must not be perceived by business faculty as having a relatively low academic quality; and (3) it must have a recognition factor at least half as large as the maximum for all journals satisfying the first two criteria. The first criterion permits us to avoid deciding whether a specific article has sufficient AI content for inclusion in the base set of articles. This decision is made by the journals' editors. The second criterion ensures that on the whole, articles in the base set are perceived by business faculty as being of sound quality. The third criterion gives a base set of articles that are not obscure from a business faculty perspective.

Table 2 provides details behind the identification of base journals based on these criteria: *Artificial Intelligence, AI Magazine, Expert Systems, Expert Systems with Applications, IEEE Expert,* and *IEEE Transactions on Pattern Analysis and Machine Intelligence*. The table shows all 19 journals that meet the second criterion. Of these, five were eliminated because of the first criterion. They have a computing focus that includes but also goes beyond AI. Of the remaining journals, *IEEE Expert* and *AI Magazine* had the maximum recognition factor (at 86 percent). The other four base journals were all recognized at more than half this rate. The result is a substantial set of base articles that we contend is representative of what business faculty regard as quality research in the AI field.

General Findings

The base set of 1,519 articles yielded 36,420 citations to books, proceedings, and 1,224 different journals in their combined reference lists. This data set is compiled from all volumes of the base journals from 1989 to 1993, including a special issue of *AI Magazine* in 1990. The 36,420 citations do not include references to working papers, personal communications, presentations, and non-English articles. A tabulation of citation distributions by year is shown in table 3. The 15,600 journal citations consistently dominate the distribution every year with no major variations.

Notable differences in citation patterns are found across base journals, as shown in table 4. First, *AI Magazine* has a lower percentage of citations to journal articles (28 percent) than any of the other base journals. In contrast, *IEEE Transactions on Pattern Analysis and Machine Intelligence* is the only base journal having over 50 percent of its citations to journals. Second, more than 39 percent of the 15,600 total citations to journal articles are from *IEEE Transactions on Pattern Analysis and Machine Intelligence,* which has nearly 10 times the number of journal citations found in either *Expert Systems* or *AI Magazine*. It has nearly double the number of articles published in *Artificial Intelligence* and roughly matches the total number of articles appearing in the other four base journals combined. These major differences lead us to rankings of journals based not on citation counts but rather on citation scores that adjust for the imbalances among base journals' contributions to the base set of AI articles.

Citation analysis is an unobtrusive way to judge the influence of research within the research community.

Journal Name	Recognition Factor	Rank	Focus
Communications of the ACM	89	Top	Computing
IEEE Expert	86	Medium	AI
AI Magazine	86	Medium	AI
IEEE Transactions on Knowledge and Data Engineering	72	Top	Computing
Decision Support Systems	68	Top	Computing
IEEE Transactions on Systems, Man, and Cybernetics	64	Top	Computing
International Journal of Man-Machine Studies	60	Top	Computing
IEEE Transactions on Pattern Analysis and Machine Intelligence	60	Top	AI
Artificial Intelligence	58	Top	AI
Expert Systems with Applications	53	Medium	AI
Expert Systems	44	Medium	AI
Applied Artificial Intelligence	41	Medium	AI
International Journal of Expert Systems: Research and Applications	38	Medium	AI
Heuristics: Journal of Knowledge Engineering	37	Medium	AI
International Journal of Intelligent Systems	36	Medium	AI
Machine Learning	35	Top	AI
Knowledge Acquisition	32	Medium	AI
Journal of Automated Reasoning	28	Medium	AI
Applied Intelligence	24	Medium	AI

Table 2. Identifying a Set of Base Journals.

	1989	1990	1991	1992	1993
No. of Articles	241	294	337	315	332
Total Citations	5565	7394	8086	8072	7303
Total Journal Citations	2591	3038	3353	3506	3112
Average No. of Journal Citations/Article	10.8	10.3	9.9	11.1	9.4
Journal Citations (%)	46	41	42	44	43
Book Citations (%)	22	27	28	24	24
Proceedings Citations (%)	23	24	23	25	26
Technical Report and Thesis (%)	9	8	7	7	7

Table 3. Distribution of Citations by Base Years.

A Ranking Based on Citation Score

The relatively large number of articles published by *IEEE Transactions on Pattern Analysis and Machine Intelligence* in the past five years suggests that if raw citation counts are used as a basis for ranking, results will be dominated by the citation pattern of *IEEE Transactions on Pattern Analysis and Machine Intelligence* articles. Consequently, we adjust the raw citation counts a journal receives by the number of articles in the base journal citing it, as follows:

Let i = a base year, i = 1, …, 5.

j = a base journal, j = 1, …, 6.

k = a journal referenced by the base set of articles, k = 1, …, 1224.

S_k = the citation score of journal k.

C_{ijk} = the number of citations received by journal k from base journal j in base year i.

n_{ij} = the number of articles published by base journal j in base year i.

The 1224 different journals are then ranked

	AI[1]	AIM[2]	ES[3]	ESWA[4]	IE[5]	ITPAMI[6]	Total
No. of Articles	312	105	85	235	181	601	1,519
Total Citations	9,525	2,747	1,864	5,081	2,529	14,674	36,420
Total Journal Citations	3,292	764	784	2,218	957	7,585	15,600
Average No. of Journal Citations/Article	10.55	7.28	9.22	9.44	5.29	12.62	10.27
Journal Citations (%)	35	28	42	44	38	52	43
Book Citations (%)	28	28	34	31	28	19	25
Proceedings Citations (%)	27	30	19	20	26	23	24
Technical Report and Thesis	11	14	5	5	8	6	8

1. AI = *Artificial Intelligence.*
2. AIM = *AI Magazine.*
3. ES = *Expert Systems.*
4. ESWA = *Expert Systems with Applications.*
5. IE = *IEEE Expert.*
6. ITPAMI = *IEEE Transactions on Pattern Analysis and Machine Intelligence.*

Table 4. Distribution of Citations by Base Journals.

$$S_k = \sum_{i=1}^{5} \sum_{j=1}^{6} \frac{C_{ijk}}{n_{ij}} \times 100$$

by their citation scores: S_1, …, S_{1224}.

Only the top 5 percent of journals ranked by the citation score (that is, 62) are listed in table 5. It is unrealistic and not very useful to attempt reporting the ranks of over 1000 journals. Besides, the 62 journals shown in table 5 represent over 70 percent of all journal article citations. It is interesting to see that half our base journals represent the top three: *Artificial Intelligence, IEEE Transactions on Pattern Analysis and Machine Intelligence,* and *AI Magazine.* Five of them are in the top 10, and all are in the top 25. Half the top 10 journals have a strict AI focus. The other half of the top 10 journals have a broader editorial scope that includes other fields of computing in addition to AI.

A Ranking Based on a Normalized Score

Journals that have been published over a longer period have a greater opportunity to be cited. To offset bias introduced by the age differences of the journals, we followed the approach used in two earlier citation studies to obtain a normalized ranking (Cheng, Holsapple, and Lee 1995; Holsapple et al. 1994). In arriving at a normalized ranking, the beginning year of publication of each journal is obtained from *Ulrich's International Periodicals Directory* (1993). The citation score is normalized by dividing the cumulative score for each journal by the total number of years the journal has been in print during the period 1979 through 1992. In doing so, we assume that the scientific impact from a journal's article in its field of study cannot last much longer than a decade. That is, few citations appearing in 1989 articles would be to articles published before 1979. This assumption is reasonable because AI is a rapidly growing and changing field. In addition, we assume that few 1993 publications cite other journal articles published in 1993. Thus, the period for normalization only goes through 1992.

A ranking based on normalized citation scores is given in table 6. The column labeled *differential* indicates the relative shift in ranking under normalization. A positive differential for a journal means that it is ranked higher under the normalized scheme as opposed to the previous unnormalized scheme. This indicator represents relatively young, up-and-coming journals for influencing AI research.

There are some substantial differences between the two rankings shown in tables 5 and 6. First, despite a drop in ranking for *AI Magazine,* all the 6 base journals are among the 10 most influential journals for AI after normalization. Second, with normalization, 11 journals rise from below the 5-percent reporting cutoff: (1) *Neural Computation;* (2) *Neural Networks;* (3) *AI Communications;* (4) *Complex Systems;* (5) *AI in Medicine;* (6) *IEEE Transactions on Knowledge and Data Engineering;* (7) *Applied AI;* (8) *International Journal of Approximate Reasoning;* (9) *Knowledge-Based Systems;* (10) *International Journal of Expert Systems;* and (11) *AI for Engineering Design, Analysis, and Manufacturing.* All these journals began publication after 1986, and nearly all have a clear AI focus. Third, 11 journals drop below the 5-percent cutoff after normalization: (1) *Scientific American,* (2) *Journal of the Operational Research Society,* (3) *SIAM Journal on Computing,* (4) *Fuzzy Sets and Systems,* (5) *European Journal of Operations Research,* (6) *Computer Journal,* (7) *Methods of Information in Medicine,* (8) *Computers*

Rank	Journal Name	Score
1	*Artificial Intelligence*	4147.3
2	*IEEE Transactions on Pattern Analysis and Machine Intelligence*	1805.2
3	*AI Magazine*	950.3
4	*Communications of the ACM*	797.2
5	*Computer Vision, Graphics, and Image Processing*	796.4
6	*International Journal of Man-Machine Studies*	581.8
7	*Expert Systems*	569.3
8	*IEEE Transactions on Systems, Man, and Cybernetics*	565.2
9	*Cognitive Science*	513.7
10	*IEEE Expert*	512.4
11	*Machine Learning*	480.8
12	*IEEE Computer*	358.1
13	*Journal of the ACM*	300.2
14	*IEEE Transactions on Software Engineering*	277.8
15	*Pattern Recognition*	271.2
16	*IEEE Transactions on Computers*	225.2
17	*Computational Intelligence*	223.2
18	*AI Expert*	205.2
19	*ACM Computing Surveys*	194.9
20	*International Journal of Computer Vision*	194.6
21	*Management Science*	187.1
22	*Journal of Automated Reasoning*	174.2
23	*International Journal of Robotics Research*	173.1
24	*IEEE Transactions on Robotics and Automation*	171.0
25	*Expert Systems with Applications*	169.6
26	*Biological Cybernetics*	162.6
27	*IEEE Transactions on Signal Processing*	150.2
28	*Journal of the Optical Society of America*	143.3
29	*Science*	138.1
30	*Psychological Review*	133.8

Table 5. Ranking of AI Journals by Citation Scores.

and Chemical Engineering, (9) *Information Processing Letters,* (10) *Journal of the American Statistics Association,* and (11) *Journal of Experimental Psychology.* All these journals began publication before 1979, and most have a broader focus than just AI.

A Comparison of Rankings

Although important differences are found between the unnormalized and the normalized methods, disparities are also observed when these two objective rankings are compared to Gupta's subjective ranking. As shown in table 7, the only ranks that remain unchanged are for the top two AI journals: (1) *Artificial Intelligence* and (2) *IEEE Transactions on Pattern Analysis and Machine Intelligence*. Other than these two journals, more than half the top 5 percent of journals in our citation analysis are not rated in Gupta's study. We can only speculate what would have been her survey results if they had been included in her prespecified list. Clearly, subjective evaluation of journals' effects on AI is not reflective of the actual citation pattern of the articles in journals rated highly by business faculty. Half the 30 journals ranked in Gupta's study are below the 5-percent cutoff in our unnormalized ranking, and nearly one-third are not among the top 200 journals. In addition, one-third are below the 5-percent cutoff under the normalized rank.

Based on specific journals, the citation patterns clearly suggested that business faculty should pay far more attention to the AI journals *AI Magazine* and *Expert Systems* than they apparently are prone to do. They should also not overlook such journals as *Computer Vision, Graphics, and Image Processing, Cognitive Sciences, Computational Intelligence, International Journal of Computer Vision, SIGART Newsletter,*

Rank	Journal Name	Score
31	*SIGART Newsletter*	124.9
32	*Pattern Recognition Letter*	123.9
33	*IEEE Transactions on Information Theory*	123.7
34	*Nature*	122.7
35	*Journal of the Royal Statistical Society*	114.4
36	*Computational Linguistics*	110.6
37	*Operations Research*	110.1
38	*Information Sciences*	106.6
39	*Knowledge Acquisition*	106.3
40	*Cognitive Psychology*	105.7
41	*Computers and Biomedical Research*	104.6
42	*Machine Intelligence*	101.6
43	*International Journal of Production Research*	98.2
44	*IBM Journal of Research and Development*	94.9
45	*Decision Sciences*	92.9
46	*Scientific American*	88.3
47	*Journal of the Operational Research Society*	85.2
48	*SIAM Journal on Computing*	84.0
49	*Fuzzy Sets and Systems*	82.0
50	*Decision Support Systems*	80.7
51	*Journal of Logic Programming*	78.5
52	*European Journal of Operations Research*	76.8
53	*Computer Journal*	75.5
54	*Image and Vision Computing*	75.1
55	*AI in Engineering*	74.1
56	*Methods of Information in Medicine*	73.8
57	*Computers and Chemical Engineering*	71.4
58	*IEEE Signal Processing*	70.6
59	*Information Processing Letters*	70.1
60	*Journal of the American Statistics Association*	69.8
61	*Journal of Experimental Psychology*	69.0
62	*Knowledge Engineering Review*	66.8

Table 5. Continued.

and *IEEE Computer* as sources (and outlets) for influential AI articles. Conversely, some journals perceived by Gupta's respondents to be of high quality have had little impact from a citation-pattern perspective. For example, *Heuristics* and *Applied Intelligence* have had relatively little impact on the large and representative set of base AI articles derived from Gupta's business faculty respondents.

Conclusions

Objective rankings of journals for AI research (from a business perspective) were developed. The method used was citation analysis. Faculty and students interested in AI can use the results to create prioritized reading lists for staying abreast of developments in the field. To complement external reviews in promotion cases, administrators can use the rankings to objectively assess the quality of research article placements. For researchers, the rankings suggest where to submit articles and give evidence to buttress merit-review cases. For librarians, they provide guidance about what AI journals are most important to have in a business collection.

Some caution should be exercised when applying our results. Just because a journal does not appear near the top of our rankings does not mean that it is not a quality publication. Its editorial scope might be so broad that its impact on AI research is small compared to publications devoted to AI. At the opposite extreme, a journal might be so highly specialized on some topic within the AI field that its im-

Normalized Rank	Unnormalized Rank	Journal Name (year of origin)	Differential
1	1	*Artificial Intelligence (1970)*	0
2	2	*IEEE Transactions on Pattern Analysis and Machine Intelligence (1979)*	0
3	10	*IEEE Expert (1986)*	7
4	3	*AI Magazine (1980)*	–1
5	11	*Machine Learning (1986)*	6
6	7	*Expert Systems (1984)*	1
7	4	*Communications of the ACM (1959)*	–3
8	5	*Computer Vision, Graphics, and Image Processing (1969)*	–3
9	25	*Expert Systems with Applications (1990)*	16
10	6	*International Journal of Man-Machine Studies (1969)*	–4
11	8	*IEEE Transactions on Systems, Man, and Cybernetics (1971)*	–3
12	9	*Cognitive Science (1977)*	–3
13	20	*International Journal of Computer Vision (1987)*	7
14	31	*SIGART Newsletter (1989)*	17
15	18	*AI Expert (1986)*	3
16	17	*Computational Intelligence (1985)*	1
17	39	*Knowledge Acquisition (1989)*	22
18	12	*IEEE Computer (1971)*	–6
19	22	*Journal of Automated Reasoning (1985)*	3
20	13	*Journal of the ACM (1954)*	–7
21	24	*IEEE Transactions on Robotics and Automation (1985)*	3
22	14	*IEEE Transactions on Software Engineering (1975)*	–8
23	15	*Pattern Recognition (1968)*	–8
24	16	*IEEE Transactions on Computers (1968)*	–8
25	23	*International Journal of Robotics Research (1982)*	–2
26	19	*ACM Computing Surveys (1969)*	–7
27	21	*Management Science (1954)*	–6
28	62	*Knowledge Engineering Review (1988)*	34
29	83	*Neural Computation (1989)*	54
30	32	*Pattern Recognition Letter (1983)*	2
31	68	*Neural Networks (1988)*	37

Table 6. Ranking of AI Journals by Normalized Citation Scores.

pact is less than mainstream AI journals. Some journals are simply too new to appear in the rankings. Others might suffer from low circulations (for example, because of high subscription rates or modest promotion). Thus, use of the rankings to identify quality publications near the top should be supplemented, as needed, with quality journals not near the top that are too broad, too narrow, or too new.

Although there is a recent emergence of AI-specific journals in certain disciplinary areas—such as *AI for Engineering Design, Analysis, and Manufacturing; AI in Engineering;* and *AI in Medicine*—there appears to be no established business-computing journal that is devoted to the field of AI. In table 6, the highest-ranked business-computing journal is *Decision Support Systems*, but its scope is not restricted to AI articles. With the introduction of Wiley's *Intelligent Systems for Accounting, Finance, and Management* in 1993, AI research affecting the business community appears to have gained a dedicated channel for dissemination. Although gauging the scientific impacts of journals on AI research has been the main purpose here, as well as identifying trends in AI research, other topics of interest (such as mapping the intellectual development in AI) can be investigated as an extension of the current study.

Normalized Rank	Unnormalized Rank	Journal Name (year of origin)	Differential
32	26	*Biological Cybernetics (1975)*	–6
33	79	*AI Communications (1988)*	46
34	27	*IEEE Transactions on Signal Processing (1951)*	–7
35	55	*AI in Engineering (1986)*	20
36	28	*Journal of the Optical Society of America (1917)*	–8
37	50	*Decision Support Systems (1985)*	13
38	70	*Complex Systems (1987)*	32
39	29	*Science (1880)*	–10
40	30	*Psychological Review (1894)*	–10
41	33	*IEEE Transactions on Information Theory (1963)*	–8
42	34	*Nature (1869)*	–8
43	51	*Journal of Logic Programming (1984)*	8
44	116	*AI in Medicine (1989)*	72
45	117	*IEEE Transactions on Knowledge and Data Engineering (1989)*	72
46	84	*Applied Artificial Intelligence (1987)*	38
47	35	*Journal of the Royal Statistical Society (1838)*	–12
48	36	*Computational Linguistics (1974)*	–12
49	37	*Operations Research (1952)*	–12
50	86	*International Journal of Approximate Reasoning (1987)*	36
51	58	*IEEE Signal Processing (1984)*	7
52	87	*Knowledge-Based Systems (1987)*	35
53	38	*Information Sciences (1969)*	–15
54	88	*International Journal of Expert Systems (1987)*	34
55	40	*Cognitive Psychology (1970)*	–15
56	54	*Image and Vision Computing (1983)*	–2
57	41	*Computers and Biomedical Research (1969)*	–16
58	42	*Machine Intelligence (1967)*	–16
59	43	*International Journal of Production Research (1961)*	–16
60	95	*AI for Engineering Design and Manufacturing (1987)*	35
61	44	*IBM Journal of Research and Development (1957)*	–17
62	45	*Decision Sciences (1970)*	–17

Table 6.Continued.

References

Bobrow, D. G. 1993. Artificial Intelligence in Perspective: A Retrospective on 50 Volumes of the *Artificial Intelligence* Journal. *Artificial Intelligence* 59(1): 5–20.

CACM. 1994. Special Issue on Commercial and Industrial AI. *Communications of the ACM* 37(3): 23–119.

Cheng, C. H.; Holsapple, C. W.; and Lee, A. 1995. Citation-Based Journal Rankings for Expert Systems Research. *Expert Systems* 12(4): 1–10.

Cooper, R. B.; Blair, D.; and Pao, M. 1993. Communicating MIS Research: A Citation Analysis of Journal Influence. *Information Processing and Management* 29(1): 113–127.

DeGross, J. I.; Davis, G. B.; and Littlefield, R. S. 1992. *1992 Directory of Management Information Systems Faculty in the United States and Canada*. New York: MISRC–McGraw-Hill.

Dutta, S. 1993. *Knowledge Processing and Applied Artificial Intelligence*. Jordan Hill, Oxford: Butterworth-Heinemann.

Eom, S. B., and Lee, S. M. 1993. Leading U.S. Universities and Most Influential Contributors in Decision Support Systems Research (1971–1989): A Citation Analysis. *Decision Support Systems* 9(3): 237–244.

Garfield, E. 1979. *Citation Indexing: Its Theory and Application in Science, Technology, and Humanities*. New York: Wiley.

Gupta, U. G. 1994. The Academic Quality of AI Journals and the Role of AI in the MIS Curriculum: Perspectives of Business Faculty. *Expert Systems with Applications* 7(4): 581–588.

Holsapple, C. W.; Johnson, L. E.; Manakyan, H.; and Tanner, J. 1993. A Citation Analysis of Business-Computing Research Journals. *Information and Management* 25(2): 231–244.

Holsapple, C. W.; Johnson, L. E.; Manakyan, H.; and Tanner, J. 1994. Business-Computing Research Journals: A Normalized Citation Analysis. *Journal of*

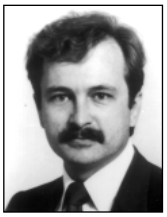
Normalized Rank	Unnormalized Rank	Gupta's Rank	Journal Name
1	1	1	*Artificial Intelligence*
2	2	2	*IEEE Transactions on Pattern Analysis and Machine Intelligence*
3	10	9	*IEEE Expert*
4	3	16	*AI Magazine*
5	11	6	*Machine Learning*
6	7	17	*Expert Systems*
7	4	3	*Communications of the ACM*
8	5	NA	*Computer Vision, Graphics, and Image Processing*
9	25	11	*Expert Systems with Applications*
10	6	8	*International Journal of Man-Machine Studies*
11	8	5	*IEEE Transactions on Systems, Man, and Cybernetics*
12	9	NA	*Cognitive Science*
13	20	NA	*International Journal of Computer Vision*
14	31	NA	*SIGART Newsletter*
15	18	26	*AI Expert*
16	17	NA	*Computational Intelligence*
17	39	18	*Knowledge Acquisition*
18	12	NA	*IEEE Computer*
19	22	13	*Journal of Automated Reasoning*
20	13	NA	*Journal of the ACM*
21	24	NA	*IEEE Transactions on Robotics and Automation*
22	14	NA	*IEEE Transactions on Software Engineering*
23	15	NA	*Pattern Recognition*
24	16	NA	*IEEE Transactions on Computers*
25	23	NA	*International Journal of Robotics Research*
26	19	NA	*ACM Computing Surveys*
27	21	NA	*Management Science*
28	62	25	*Knowledge Engineering Review*
29	83	NA	*Neural Computation*
30	32	NA	*Pattern Recognition Letter*
31	68	NA	*Neural Networks*
32	26	NA	*Biological Cybernetics*
33	79	NA	*AI Communications*
34	27	NA	*IEEE Transactions on Signal Processing*
35	55	NA	*AI in Engineering*

Table 7. Comparison of Journal Rankings for AI Research.

Management Information Systems 11(1): 131–140.

Ulrich. 1993. *Ulrich's International Periodicals Directory,* 32nd ed. New York: Bowker.

Chun Hung Cheng received his Ph.D. in business administration from the University of Iowa in 1990. Prior to joining the Chinese University of Hong Kong, he was an assistant professor at Grand Valley State University and Kentucky State University. His research interests include knowledge-based systems, object-oriented design, distributed computer systems, computer integrated manufacturing, and group technology.



Clyde Holsapple holds the Rosenthal Endowed Chair in Management Information Systems and currently serves as area coordinator of Decision Science and Information Systems at the University of Kentucky. He does teaching and research in decision support systems, knowledge management, expert systems, and organizational computing. His books include *Foundations of Decision Support Systems, Micro Database Management, Business Expert Systems,* and *The Information Jungle.* Hol-

Normalized Rank	Unnormalized Rank	Gupta's Rank	Journal Name
36	28	NA	*Journal of the Optical Society of America*
37	50	7	*Decision Support Systems*
38	70	NA	*Complex Systems*
39	29	NA	*Science*
40	30	NA	*Psychological Review*
41	33	NA	*IEEE Transactions on Information Theory*
42	34	NA	*Nature*
43	51	NA	*Journal of Logic Programming*
44	116	NA	*AI in Medicine*
45	117	4	*IEEE Transactions on Knowledge and Data Engineering*
46	84	14	*Applied Artificial Intelligence*
47	35	NA	*Journal of the Royal Statistical Society*
48	36	NA	*Computational Linguistics*
49	37	NA	*Operations Research*
50	86	NA	*International Journal of Approximate Reasoning*
51	58	NA	*IEEE Signal Processing*
52	87	20	*Knowledge-Based Systems*
53	38	NA	*Information Sciences*
54	88	15	*International Journal of Expert Systems: Research and Applications*
55	40	NA	*Cognitive Psychology*
56	54	NA	*Image and Vision Computing*
57	41	NA	*Computers and Biomedical Research*
58	42	NA	*Machine Intelligence*
59	43	NA	*International Journal of Production Research*
60	95	24	*Artificial Intelligence for Engineering Design: Analysis and Manufacturing*
61	44	NA	*IBM Journal of Research and Development*
62	45	NA	*Decision Sciences*
86	125	12	*International Journal of Intelligent Systems*
NA	827	19	*Applied Intelligence*
NA	414	21	*Artificial Intelligence and Law*
NA	NA	28	*Artificial Intelligence and Society*
NA	NA	29	*Artificial Intelligence Today*
NA	605	22	*Expert Systems for Information Management*
NA	386	10	*Heuristics*
NA	NA	27	*Journal of Artificial Intelligence in Education*
NA	214	30	*PC Artificial Intelligence*
NA	645	23	*Robotics and Computer-Integrated Manufacturing*

NA = Not available.

Table 7. Continued.

sapple is also associate editor of *Management Science* and *Organizational Computing*; area editor for *Decision Support Systems* and cofounder of the International Society for Decision Support Systems. In 1993, he was named computer educator of the year by the International Association for Computer Information Systems.

Anita Lee is an assistant professor in the decision science and information systems area at the University of Kentucky. She received her Ph.D. in business administration from the University of Iowa. Her research interests include AI, machine learning, knowledge-based systems, computer-integrated manufacturing, and group technology. She is also the author of *Knowledge-Based FMS Scheduling: An Artificial Intelligence Perspective.*