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SOME DATA AND OBSERVATIONS ON RESEARCH PUBLICATION

- a. NUMERICAL COMPUTATION
- b. PROGRAMMING LANGUAGES AND SYSTEMS

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ABSTRACT

This report contains extensive data on the level of research publications in refereed journals for two areas in Computer Science: Numerical Computation and Programming Languages and Systems. It is concluded that the research output in Numerical Computation is about 5 times that in Programming Languages and Systems (as measured by refereed research articles.) Some less complete data on the number of conferences is also presented which suggests the number of conferences in numerical computations substantially exceeds that of Programming Languages and Systems. Some comparisons are made with data derived from Computing Reviews. The data is for 1973 and 1974.

SOME DATA AND OBSERVATIONS ON RESEARCH PUBLICATION

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I. OBJECTIVES AND CONCLUSIONS

The objective of this study is to measure the level of research activity and output in two areas of Computer Science: Numerical Computation and Programming Languages and Systems. The principal measurement made is of refereed research articles that appeared in 1973 and 1974. Some may believe that this does not accurately reflect research activity and output, but most students of scientific publication believe this to be as accurate a measurement as any available. Some less complete data on conferences held was obtained and is discussed below.

The principal conclusion of this study is that there is about 5 times as much research in Numerical Computation as there is in Programming Languages and Systems. This does not correspond to the experience or folklore in the Computer Science community and the reason for this is as follows: The bulk of the research in Numerical Computation is done by people outside the Computer Science community. The "numerical analysis" and "mathematical software" specialists in Computer Science are primarily oriented toward theoretical and general analysis. The others are either in the scientific and engineering disciplines or (to a lesser extent) in mathematics or statistics. On the other hand, almost everyone who publishes research in Programming Languages and Systems is identified with Computer Science (we include here the Computer Science branch of Electrical Engineering).

The procedure for obtaining this data was as follows: Definitions of the two areas were made and given to a person knowledgeable and experienced in mathematics, computer science and engineering computation. He then systematically went through the libraries of Purdue University collecting raw data (given later) of the form

- Journal Name - Number of pages and papers for 1973 and for 1974
- Percentage of papers in each area for each year
- Journal volume number for 1974.

In general, one would say that the definitions were interpreted narrowly. For example, the Journal of Computational Physics is estimated to have 28% of its papers as research in Numerical Computation whereas some would automatically classify this as 100% numerical computations. Likewise the journal Software is estimated to have 48% of its papers in Programming Languages and Systems. Part of the reason for this narrowness is that some evidence of originality was required in order for a paper to be counted. Papers which merely applied known methods and ideas from these two areas were not counted as research in these two areas. Almost all foreign language journals were not considered.

The data for conferences is less complete. Note that the principal Computer Science conferences (Nat. Computer Conf., Nat. ACM Conf. and IFIP 1974 Congress) are included with the refereed journals. A list of conferences (besides regular meetings of organizations) is given for 1974 and the data is taken from the information in Comm. ACM, SIGNUM Newsletter and Notices Amer. Math. Soc. The coverage

is thus rather incomplete of conferences in numerical computation mainly attended by people outside the mathematics and computer science communities.

The data obtained is summarized in the following table.

	YEARLY RATES		
	Measured	Estimated Actual	Computing Reviews Measurement
NUMERICAL COMPUTATION			
Refereed Publications	804	950	186 (=20%)
Conferences Held	31	60	"
PROG. LANGUAGES & SYSTEMS			
Refereed Publications	166	180	108 (=60%)
Conferences Held	12	15	"

Table 1. Yearly rates for refereed research publications and conferences held in two areas. The measured data is given along with an estimate of actual rates and the rates that one derives from the coverage of Computing Reviews. The percentages on the right are for the ratio of Computing Reviews to Estimated Actual.

The Computing Reviews measurement is derived from "A pilot analysis of Computer Science publication activity as reflected in ACM Computing Reviews" by Bruce Gilchrist, Columbia University, Jan. 1976. This study covers the 22 month period of Jan. 1973 through Oct. 1974.

Data was also obtained for three conference proceedings which are standard outlets for research in Programming and Systems. They are (with average yearly rates) the IFIP Congress (19 papers), the National Computer Conference (16 papers) and the ACM Conference (13 papers). These conferences have a negligible (2.5%) impact on the total publications in Numerical Computation, but they would increase the Programming and Systems output by 29%. This would lower the ratio of research in these two areas to 4 to 1, but this move is clearly biased in favor of Programming and Systems. The assessment of papers in conference proceedings is complicated by the wide variation in standards and nature of the conferences.

II. DATA ON NUMERICAL COMPUTATION RESEARCH

The primary reason for presenting the complete data set is to allow the reader to judge for himself the definition used for "Numerical Computation Research". He can select one of the journals listed and compare his judgement with the data actually used.

The definition of Numerical Computation Research used is as follows:

The contents of Numerische Mathematik and SIAM J. Numerical Analysis are included completely. Number theory, group theory and similar areas are excluded, but mathematical software is otherwise included. Application papers must involve the solution of some new numerical computation problem or the presentation of a new numerical method in order to be included.

The nine leading Numerical Computation journals (by number of papers) are, in order, with yearly rates:

USSR Computer Math.-Physics	110
SIAM J. Num. Anal.	90
Operations Research	90
Mathematics of Computation	67
J. Optimization Theory	45
Numerische Mathematik	40
Numerical Meth. in Engr.	25
Mathematical Programming	22
Computers and Structures	20

A list of 31 Conferences on topics in Numerical Computation is given below.

CONFERENCES IN NUMERICAL COMPUTATION IN 1974

NUM. METH OPTIMIZATION ,NFL
 GEOMETRIC DESIGN ,SALT LAKE CITY
 AUTOMATIC CONTROL ,MILWAUKEE
 FINITE ELEMENT METHODS ,MADISON
 MATHEMATICAL PROGRAMMING ,MADISON
 ITERATIVE METHODS ,PITTSBURG
 METHODS FOR ORD. DIFF. EQS. ,STOCKHOLM
 DIGITAL FILTERS AND ALGORITHMS ,STOCKHOLM
 OPTICAL COMPUTATIONS ,ZURICH
 MODELING AND SIMULATION ,PITTSBURG
 MATHEMATICAL PROGRAMMING ,ROME
 MATHEMATICAL SOFTWARE ,LAFAYETTE
 OPTIMIZATION AND APPROXIMATION METH ,ATLANTA
 NUMER. SOL. ORD. DIFF. EQS. ,COLLEGE PARK
 STRUCTURAL MECH. SOFTWARE ,COLLEGE PARK
 DESIGN AUTOMATION ,DENVER
 NUMER. METH. FLUID MECH. ,BOULDER
 NUMER. SOL. ORD. DIFF. EQS. ,OBERWOLFACH
 SATELLITE DYNAMICS ,SAN PAULI
 NUMERICAL ANALYSIS ,DUBLIN
 CIVIL ENGR. COMPUTATION ,ATLANTA
 COMP. METH. NONLINEAR MECH. ,AUSTIN
 COMPUTATIONAL STATISTICS ,VIENNA
 MATHEMATICAL PROGRAMMING ,MONTREAL
 FIELD SIMULATION ,LONDON
 DISCRETE SYSTEMS ,RIGA
 BUILDING DESIGN ,LONDON
 NUMER. METH. PARALLEL PROC. ,LANGLEY
 FORTRAN PREPROCESSORS FOR NUMER. COMP. ,PASADENA
 NUMER. METH. FOR GRAPH PROBLEMS ,OBERWOLFACH
 COMPUTER AIDED DESIGN ,TOULOUSE

Data for 1973 from the same sources is similar in size and composition.

III. DATA ON RESEARCH IN PROGRAMMING LANGUAGES AND SYSTEMS

The definition used here is:

The following topics are included: Operating Systems, Programming Languages, Compilers, Assemblers, Interpreters, Data Structures (of a concrete nature), Scheduling of processors or memory. Excluded are papers which are in Business Data Processing, Artificial Intelligence, Information Retrieval, Hardware, Formal Grammars and Languages.

The nine leading Programming Languages and Systems journals (by number of papers) are, in order with yearly rates:

Comm. ACM	42
IEEE Trans. Computers	18
Software	16
Acta Informatica	12
J. ACM	12
IBM Systems J.	11
J. Computer and System Sci.	11
Computer J.	8
Australian Computer J.	7
Computing Surveys	6

We note that yearly rate for the National Computer Conference is about 16 papers and for the ACM Conference is about 13 papers.

A list of 12 conferences on topics in Programming and Systems is given below.

VERY HIGH LEVEL LANGUAGE SYMPOSIUM, SANTA MONICA
 INTERNATIONAL SYMPOSIUM ON PROGRAMMING, PARIS
 REGIONAL CONFERENCE ON PROGRAMMING METHODOLOGY, ALBUQUERQUE
 SYMPOSIUM ON THE SIMULATION OF COMPUTER SYSTEMS, MARYLAND
 INTERNATIONAL SYMPOSIUM ON OPERATING SYSTEMS, FRANCE
 OPERATING SYSTEMS FESTIVAL, AMHERST
 PRINCETON CONFERENCE ON INFORMATION SCIENCES ^ SYSTEMS, PRINCETON
 ALGOL 68 CONFERENCE, WINNIPEG, CANADA
 SECOND COLLOQUIUM ON AUTOMATA, LANGUAGES ^ PROGRAMMING, W. GERMANY
 SAGAMORE COMPUTER CONFERENCE ON PARALLEL PROCESSING
 IEEE 1974 INTERNATIONAL SYMPOSIUM ON INFORMATION THEORY, NOTRE DAME
 THIRD TEXAS CONFERENCE ON COMPUTING SYSTEMS, AUSTIN

Data for 1973 from the same sources is similar in size and composition.

The tabulation of the data on refereed research publication in Programming and Systems is given below.

SOFTWARE JOURNALS

NAME OF JOURNAL	Y-1973		Y-1974		PERCENT		VOL. NO. 1974
	PAGES	PAPERS	PAGES	PAPERS	1973	1974	
ACM	457	84	753	124	6	17	
ACM JOURNAL	708	51	696	63	14	20	21
ACTA INFORMATICA	392	23	385	25	61	40	4
AFIPS	311	148	1036	122	8	16	
ANNUAL REVIEW AUTO PROG	266	5			80		7
APPLIED INFORMATICS	553	66	560	72	5	4	15
ARTIFICIAL INTELLIGENCE			419	14		14	5
AUSTRALIAN COMPUTER JOURNAL	140	11	188	21	9	33	4-5
BIT	496	49	484	32	6	9	14
COMPUTER JOURNAL	385	61	384	59	26	13	17
COMMUNICATIONS OF THE ACM	786	109	723	102	40	41	17
COMPUTING SURVEYS	245	8	321	13	13	46	5-6
IEEE TRANS ON COMPUTERS	1143	142	1330	101	9	18	23(1-2)
IBM RES AND DEVEL	551	42	604	47	10	6	18
IFIP CONGRESS 74			1092	214		26	
IBM SYSTEMS JOURNAL	417	20	360	16	30	68	13
INFORMATION SCIENCES	659	44	735	39	2	0	7,8
INTER OF COMPUTER MATH	98	7	305	16	14	6	4
J COMPUTER AND SYSTEM SCI	622	36	806	44	10	26	8-10
MANAGEMENT INFORMATICS	293	59	295	46	0	0	3
SIAM JOURNAL ON COMPUTING	318	26	326	26	9	12	3
SIMULATION			406	31		6	22-23
SOFTWARE	411	33	415	35	52	45	4

The tabulation of the data on refereed research publication in Numerical Computation is given below.

NUMERICAL COMPUTATION JOURNALS

NAME OF JOURNAL	Y-1973		Y-1974		PERCENT		VO. NO. 1974
	PAGES	PAPERS	PAGES	PAPERS	1973	1974	
ACM	457	84	753	124	3	6	
ACTA INFORMATICA	393	23	395	25	61	40	4
AFIPS	811	148	1056	122	0	0	
AERUATIONES MATHEMATICAE	320	33	320	57	9	12	9-12
AMERICAN STATISTICS	1032	176	1064	166	16	20	69
APPLICABLE ANALYSIS	305	19	267	23	42	35	4
ANGEWANDTE INFORMATIK	553	66	560	72	16	4	16
APPLIED MATH AND OPTIM			192	8		38	1
AUSTRALIAN COMPUTERS JOURNAL	140	11	188	21	18	10	4-5
BIT	496	49	484	32	49	50	14
CALCOLO	372	17	510	33	82	36	11
COMMUNICATIONS ACM	786	109	728	102	11	16	17
CONG OF PURE AND APPLIED MATH	858	33	809	32	6	16	27
COMPUTER JOURNAL	385	61	394	59	11	12	17
COMPUTING	401	31	389	20	52	70	13
COMPUTING SURVEYS	240	8	321	13	13	0	5-6
COMPUTER PHYSICS	864	74	845	58	24	26	7-8
COMPUTERS AND STRUCTURES	1482	79	1313	66	20	30	4(1-3)
ECONOMETRICA	1214	67	1131	79	4	5	42(1-2)
IEEE TRANSACTIONS ON COMPUTERS	1143	142	1330	101	4	6	23(1-2)
IBM J OF RES AND DEVEL	551	42	604	47	2	2	18
IFIP CONGRESS 74			1092	214		21	
INFORMATION SCIENCES	373	27	366	20	0	0	7-8
INST MATH AND ITS APPLIC	737	70	792	72	51	38	13-14
INT J COMPUTER MATHEMATICS	98	7	305	16	57	25	4
COMP METH APPL MECH AND ENG	371	19	774	39	63	41	4-3
JOURNAL OF ACM	708	51	696	63	24	13	21
JOURNAL OF APPROX THEORY	1201	102	1200	114	28	30	10-13
J OF COMPUTATIONAL PHYSICS	1301	100	1354	77	26	30	14-15
J OF ENGINEERING MATHEMATICS	288	27	351	29	11	7	8
JOURNAL OF FLUID MECHANICS			4121	214		5	62-66
J OF MULTIVARIANT ANALYSIS	500	33	500	36	15	19	5
J OF OPTIM THEORY AND APPLIC	1306	91	1327	89	42	51	13-14
MATHEMATICS OF COMPUTATION	939	81	1169	91	75	74	28
MATHEMATICAL SCIENCES	750	43	1122	76	2	9	19-21
MATHEMATICAL PROGRAMMING	744	41	765	41	39	59	5-8
METRON	364	23			22		31
NUMERISCHE MATHEMATIK	427	42	513	38	100	100	22-23
NUMER METH IN ENGINEERING	585	45	925	68	45	40	8
OPERATION RESEARCH	1323	112	1311	88	30	19	21(1-2)
PHYSICS OF FLUIDS	2374	290	2315	258	1	2	17(1-3)
QUARTELLY OF APPLIED	543	33	494	33	9	21	31
MANAGEMENT SCI MATHEMATICS	366	95	1497	124	5	11	21(1-2)
SIAM J APPL MATHEMATICS	1321	136	1467	130	4	7	26-27
SIAM JOURNAL OF COMPUTING	318	26	326	26	0	12	3
SIAM JOURNAL OF CONTROL	676	53	778	60	9	5	12
SIAM J NUMERICAL ANALYSIS	552	92	1206	90	100	100	11
SIAM REVIEW	809	28	592	24	21	29	16
SIMULATION			406	31		14	22-23
STUDIES IN APPLIED MATHEMATICS	377	25	317	20	4	5	53
U.S.S.R COMP MATH & PHYSICS	2023	137	1555	106	100	100	14(1-2)
NAVAL LOGISTICS QUARTELY	313	61			13		20
UTILITAS MATHEMATICA	654	45	686	48	7	2	5-6
ZEITSCHRIFT FUR ANGEWANDTE MATHEMATIK UND PHYSICS	808	117	828	105	12	12	54

