



Data Base Engineering

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Data Base Engineering**



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Technical Committee on Data Base Engineering

Chairman: Vincent Lum
IBM Research Laboratory
Monterey and Cottle Road
San Jose, CA 95193
(408) 256-7654

Vice-Chairman: Murray Edelberg
Sperry Research Center
100 North Road
Sudbury, MA 01776
(617) 369-4000

Editor: Jane W. S. Liu
Department of Computer Science
University of Illinois
Urbana, IL 61801
(217) 333-0135

Editorial Committee

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Information Sciences
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Gainesville, FL 32611
(904) 392-2371

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Rice University
P. O. Box 1892
Houston, TX 77001
(713) 527-8101

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Yorktown Heights, NY 10598
(914) 945-1721

Carlo A. Zaniolo
Sperry Research Center
100 North Road
Sudburg, MA 01776
(617) 369-4000

Data Base Engineering Bulletin is a quarterly publication of the IEEE Computer Society Technical Committee on Data Base Engineering. Its scope of interest includes: data structures and models, access strategies, access control techniques, data base architecture, data base machines, intelligent front ends, mass storage for very large data bases, distributed data base problems and techniques, data base software design and implementation, data base utilities, etc.

Contribution to the Bulletin is hereby solicited. News items, letters, technical papers, book reviews, meeting previews and summaries, etc., should be sent to the Editor. All letters to the Editor will be considered for publication unless accompanied by a request to the contrary. Technical papers are unrefereed.

Opinions expressed in contributions are those of the individual author rather than the official position of the TC on Data Base Engineering, the IEEE Computer Society, or organizations with which the author may be affiliated.

Membership in Data Base Engineering Technical Committee is open to IEEE Computer Society members, student members, and associate members. (Application form in this issue.)

REVIEW OF OREGON REPORT ON COMPUTING

March 20-22, 1978, Portland, Oregon

S. B. Yao
Purdue University
Lafayette, Indiana

A workshop type meeting with fifty invited computer scientists was held in Portland, Oregon, March 20-22. The meeting addressed contemporary issues of computer systems in an attempt to forecast what problems will be central to computing systems of the next decade. The format of the meeting was unique in that the position papers on a variety of topics were not only formally presented but were also used to guide workshop discussions to produce a report for each area of computing.

Each of the six area workshops were coordinated by a prominent session leader. The six areas included in the meeting were: computer system organization, software engineering, education and training, database systems, personal computing, and basic technology. Of special interest, the papers in the database systems area included logical database design process, distributed database management, data translation and access program conversion, database machines, and data semantics.

The first day of the meeting consisted of closed parallel sessions in which the workshop in each area discussed the position papers, and on the second day, produced an outline of intergrated reports for public presentation. On the third day, the reports were reviewed and criticized by all participates of the meeting.

The meeting succeeded in allowing participates to work together in a workshop environment. However, the idea of a full-participate review of each consolidated report with a view towards the future was not quiet as successful because of widely diversified report topics.

The meeting will publish proceedings (available from IEEE) which will include the revised position papers. The reports (all "blue prints") of the six areas will be published in a special issue of the IEEE Computer Magazine (September 1978).

AN ANNOTATED BIBLIOGRAPHY ON ASSOCIATIVE MEMORY SYSTEMS,
INTELLIGENT MEMORIES AND DATA BASE MACHINES

Mario Jino*
Department of Computer Science
University of Illinois
Urbana, IL 61801

The papers listed in this bibliography constitute a representative sample of literatures describing the past and current research effort in the areas of associative memories, intelligent memories and data base machines. The references have been divided into three sections dealing with associative memory systems, intelligent memories and file processing devices, and data base machines.

I. Associative Memory Systems

In this section, references are simply listed without discussion on their contents. References are divided into two groups: survey and introductory papers, and papers dealing with associative device organization. Papers on hardware implementation and application areas are listed and discussed in the survey papers. In particular, Parhami [I.5] contains an excellent survey on associative memory systems and close to 800 references are listed in Minker [I.3].

A. Survey and Introductory Papers

- [I.1] Campi, A. V., R. M. Dunn, and B. H. Gray, "Content addressable memory system concepts," IEEE Trans. Aerosp. Electron. Syst., vol. AES-1, pp. 168-173, Oct. 1965.
- [I.2] Hanlon, A. G., "Content-addressable and associative memory systems: a survey," IEEE Trans. on Electron. Comp., vol. EC-15, pp. 509-521, Aug. 1966.
- [I.3] Minker, J., "Bibliography 25. An overview of associative or content-addressable memory systems and a KWIC index to the literature: 1956-1970," Computing Reviews, pp. 453-504, Oct. 1971.
- [I.4] Murtha, J. C., "Highly parallel information processing systems," in Advances in Computers, vol. 7, New York, Academic Press, pp. 1-116, 1966.
- [I.5] Parhami, B., "Associative memories and processors: an overview and selected bibliography," Proc. IEEE, vol. 61, pp. 722-730, June 1973.

* Currently on leave from Departamento de Engenharia Eletrica/Eletronica, Faculdade de Engenharia da UNICAMP, C. P. 1170, 13100 - Campinas, SP - BRAZIL.

- [I.6] Thurber, K. J. and R. O. Berge, "Applications of associative processors," *Comput. Des.*, vol. 10, pp. 103-110, Nov. 1971.
- [I.7] Tuttle, G. T., "How to quiz a whole memory at once," *Electronics*, vol. 36, pp. 43-46, Nov. 1963.
- [I.8] Yau, S. S. and H. S. Fung, "Associative processor architecture - a survey," *Proc. 1975 Sagamore Computer Conf. on Parallel Processing*, IEEE Computer Society, pp. 1-14, Aug. 1975.

B. Associative Memory System Organization

References in this subsection are classified into four major categories: fully parallel systems, bit-serial systems, word-serial systems and block-oriented systems.

Fully Parallel Systems

- [I.9] Crane, B. A. and J. A. Githens, "Bulk processing in distributed logic memory," *IEEE Trans. on Electron. Comput.*, vol. EC-14, pp. 186-196, April 1965.
- [I.10] Crane, B. A. and R. R. Laane, "A cryoelectronic distributed logic memory," 1967 SJCC, AFIPS Conf. Proc., pp. 517-524.
- [I.11] Edwards, R. P., "Content-addressable distributed-logic memories," *Proc. IEEE (Corresp.)*, vol. 52, pp. 83-84, Jan. 1964.
- [I.12] Gaines, R. S. and C. Y. Lee, "An improved cell memory," *IEEE Trans. on Electron. Comput. (Short Notes)*, vol. EC-14, pp. 72-75, Feb. 1965.
- [I.13] Lee, C. Y., "Intercommunicating cells, basis for a distributed logic computer," 1962 FJCC, AFIPS Conf. Proc., pp. 130-136.
- [I.14] Lee, C. Y. and M. C. Paul, "A content addressable distributed logic memory with applications to information retrieval," *Proc. IEEE*, vol. 51, pp. 924-932, June 1963.
- [I.15] Lee, C. Y., "Content-addressable and distributed logic memories," in *Applied Automata Theory*, J. T. Tou, Ed., 1968.
- [I.16] Lipovski, G. J., "The architecture of a large associative processor," 1970 SJCC, AFIPS Conf. Proc., pp. 385-396.
- [I.17] Savitt, D. A., H. H. Love, Jr., and R. E. Troop, "ASP: a new concept in language and machine organization," 1967 SJCC, AFIPS Conf. Proc., pp. 87-102.
- [I.18] Spiegelthal, E. S., "A content addressable distributed logic memory with applications to information retrieval," *Proc. IEEE (Corresp.)*, vol. 52, p. 74, Jan. 1964.

Bit-Serial Systems

- [I.19] Batcher, K. E., "Flexible parallel processing and STARAN," in WESCON Tech. Papers (Session 1), Sept. 1972.
- [I.20] Bird, R. M., "An associative memory parallel deltic realization for active sonar signal processing," in Parallel Processor Systems, Technologies, and Applications, L. C. Hobbs et al., Eds., pp. 107-129, 1970.
- [I.21] Chu, Y., "A destructive-readout associative memory," IEEE Trans. on Electron. Comput., vol. EC-14, pp. 600-605, Aug. 1965.
- [I.22] Ewing, R. G. and P. M. Davies, "An associative processor," 1964 FJCC, AFIPS Conf. Proc., pp. 147-158.
- [I.23] Feldman, J. D. and L. C. Fulmer, "RADCAP--an operational parallel processing facility," Proc. ACM Nat'l. Comp. Conf., pp. 7-15, 1974.
- [I.24] Finnila, C. A. and H. H. Love, Jr., "The associative linear array processor," IEEE Trans. on Comput., vol. C-26, pp. 112-125, Feb. 1977.
- [I.25] Fuller, R. H. and R. M. Bird, "An associative parallel processor with application to picture processing," 1965 FJCC, AFIPS Conf. Proc., pp. 105-116.
- [I.26] Fulmer, L. C. and W. C. Meilander, "A modular plated wire associative processor," in IEEE Int. Computer Group Conf. Proc., pp. 325-335, June 1970.
- [I.27] Harding, P. A. and M. W. Rolund, "A 2-1/2D core search memory," 1968 FJCC, AFIPS Conf. Proc., pp. 1213-1218.
- [I.28] Kaplan, A., "A search memory subsystem for a general-purpose computer," 1963 FJCC, AFIPS Conf. Proc., pp. 193-200.
- [I.29] Rudolph, J. A., L. C. Fulmer, and W. C. Meilander, "With associative memory, speed limit is no barrier," Electronics, vol. 43, pp. 96-101, June 1970.
- [I.30] Rudolph, J. A., "A production implementation of an associative array processor: STARAN," 1972 FJCC, AFIPS Conf. Proc., pp. 229-241.
- [I.31] Shooman, W., "Parallel computing with vertical data," Proc. 1960 EJCC, pp. 111-115.
- [I.32] Stone, H. S., "Associative processing for general purpose computers through the use of modified memories," 1968 FJCC, AFIPS Conf. Proc., pp. 949-955.

Word-Serial Systems

- [I.33] Crofut, W. A. and M. R. Sottile, "Design techniques of a delay-line content-addressed memory," IEEE Trans. on Electron. Comput., vol. EC-15, pp. 529-534, Aug. 1966.
- [I.34] King, W. K., "Design of an associative memory," IEEE Trans. on Comput. (Short Notes), vol. C-20, pp. 671-674, June 1971.
- [I.35] Rux, P. T., "A glass delay line content-addressable memory system," IEEE Trans. on Comput., vol. C-18, pp. 512-520, June 1969.

Block-Oriented Systems

- [I.36] Anderson, G. A. and R. Y. Kain, "A content-addressed memory designed for data base applications," Proc. 1976 Int. Conf. on Parallel Processing, pp. 191-195.
- [I.37] Healy, L. D., G. J. Lipovski, and K. L. Doty, "The architecture of a context addressed segment-sequential storage," 1972 FJCC, AFIPS Conf. Proc., pp. 691-701.
- [I.38] Hollander, G. L., "Quasi-random access memory systems," Proc. 1956 EJCC, pp. 128-135.
- [I.39] Lin, C. S., D. C. P. Smith, and J. M. Smith, "The design of a rotating associative memory for relational data base applications," ACM Trans. on Database Syst., vol. 1, pp. 53-65, March 1976.
- [I.40] Minsky, N., "Rotating storage devices as partially associative memories," 1972 FJCC, AFIPS Conf. Proc., pp. 587-595.
- [I.41] Ozkarahan, E. A., S. A. Schuster, and K. C. Smith, "RAP--an associative processor for data base management," Proc. ACM Nat'l. Comp. Conf., pp. 379-387, 1975.
- [I.42] Parhami, B., "A highly parallel computing system for information retrieval," 1972 FJCC, AFIPS Conf. Proc., pp. 681-690.
- [I.43] Parker, J. L., "A logic-per-track retrieval system," IFIP Congress, pp. 711-716, 1971.
- [I.44] Peskin, A. M., "Associative capabilities for mass storage through array organization," 1970 FJCC, AFIPS Conf. Proc., pp. 615-620.
- [I.45] Peskin, A. M., "A logic-in-memory architecture for large-scale-integration technologies," Proc. ACM, pp. 12-25, 1972.
- [I.46] Slotnick, D. L., "Logic per track devices," in Advances in Computers, vol. 10, New York, Academic Press, pp. 291-296, 1970.

II. Intelligent Memories

References in this section deal with the new memory technologies, magnetic bubble memories and charge-coupled devices. These memory techniques offer new promises for the economical realization of intelligent memories. References have been divided into two groups dealing with basic memory operations and file processing devices.

A. Basic Memory Operations

In the four papers listed below, magnetic bubble memory configurations and operations for dynamic data rearrangement are proposed. Beausoleil, Brown, and Phelps [II.1], and Bonyhard and Nelson [II.2], independently developed a model of data rearrangement operations in which only two basic operations, the global shift and the reversed detached shift, are allowed in a data loop. Operations are word or record parallel. Operations in the model developed by Tung, Chen, and Chang [II.3], the bubble ladder, are bit-serial. Four basic operations are allowed in this model, the global shift, the detached shift, the exchange, and the delta exchange. Wong and Yue [II.4] propose an implementation for transposition ordering in bubble lattice files.

- [II.1] Beausoleil, W. F., D. T. Brown, and B. E. Phelps, "Magnetic bubble memory organization," IBM J. Res. Develop., vol. 16, pp. 587-591, Nov. 1972.
- [II.2] Bonyhard, P. I. and T. J. Nelson, "Dynamic data reallocation in bubble memories," Bell Syst. Tech. J., vol. 52, pp. 307-317, Mar. 1973.
- [II.3] Tung, C., T. C. Chen, and H. Chang, "Bubble ladder for information processing," IEEE Trans. on Magn., vol. Mag-11, pp. 1163-1165, Sept. 1975.
- [II.4] Wong, C. K. and P. C. Yue, "Data organization in magnetic bubble lattice files," IBM J. Res. Develop., vol. 20, pp. 576-581, Nov. 1976.

B. File Processing Devices

A variation of the bubble ladder [II.3], the uniform ladder, is proposed by Chen and Tung [II.5] for storage management. Chen, Eswaran, Lum, and Tung [II.6], and Chin and Fok [II.7] discuss the use of the uniform ladder for data sorting. Kluge [II.8] proposes an extension of the idea of the uniform ladder, two-dimensional arrays of shift registers for data file management.

- [II.5] Chen, T. C. and C. Tung, "Storage management operations in linked uniform shift-register loops," IBM J. Res. Develop., vol. 20, pp. 123-131, Mar. 1976.
- [II.6] Chen, T. C., K. P. Eswaran, Y. Y. Lum, and C. Tung, "Simplified odd-even sort using multiple shift-register loops," IBM Technical Report, RJ 1919 (27428), Jan. 1977.

[II.7] Chin, F. and K. S. Fok, "Fast sorting algorithms on multiple shift-register loops," Department of Computing Science, University of Alberta, Edmonton, Alberta, Canada, Oct. 1977.

[II.8] Kluge, W. E., "Data file management in shift register memories," Internat'l. Conf. on Very Large Data Bases, 1977.

Wong and Coppersmith [II.9] discuss the two models of data rearrangement operations ([II.1], [II.2], [II.3]) and develop optimal order of magnitude algorithms for the generation of permutations for both models.

[II.9] Wong, C. K. and D. Coppersmith, "The generation of permutations in magnetic bubble memories," IEEE Trans. on Comput., vol. C-25, March, 1976.

Edelberg and Schissler [II.10] propose an intelligent memory of circulating serial storage loops and distributed processing logic. A new sort algorithm named "gyro sort" is described.

[II.10] Edelberg, M. and L. R. Schissler, "Intelligent memory," Proc. ACM Nat'l. Comput. Conf., pp. 393-400, 1976.

III. Data Base Machines

This section contains references on special purpose hardware to support file processing and data base management functions. References have been divided into three groups containing papers on associative memory systems and data management, data base machines, and suggestions and comments on data base machine architectures.

A. Associative Memory Systems and Data Management

The references listed below deal with the utilization of associative memory systems as components in data base systems. However, these associative memories were not originally designed with data base systems in mind.

[III.1] Berra, P. B., "Some problems in associative processor applications to data base management," Proc. ACM Nat'l. Comput. Conf., pp. 1-5, 1974.

[III.2] Defiore, C. R. and P. B. Berra, "A data management system utilizing an associative memory," Proc. ACM Nat'l. Comput. Conf., pp. 181-185, 1973.

[III.3] Defiore, C. R. and P. B. Berra, "A quantitative analysis of the utilization of associative memories in data management," IEEE Trans. on Comput., vol. C-23, pp. 121-133, Feb. 1974.

[III.4] Defiore, C. R. and N. J. Stillman, "Associative techniques in the solution of data management problems," Proc. ACM Nat'l. Comput. Conf., pp. 28-36, 1971.

- [III.5] Dugan, J. A., R. S. Green, J. Minker, and W. E. Shindle, "A study of the utility of associative memory processors," Proc. ACM Nat'l. Meeting, pp. 347-360, 1966.
- [III.6] Moulder, R., "An implementation of a data management system on an associative processor," Proc. ACM Nat'l. Comput. Conf., pp. 171-176, 1973.

B. Data Base Machines

Four major efforts directed towards the design of systems to support general data structure and basic data base management functions as well as to provide content addressability are described in the following references. CASSM ([I.37], [III.7], [III.9], [III.10]) and RAP([I.41], [III.8]) are intended to be stand alone data base machines. RARES [I.39], on the other hand, is an intelligent storage system designed to perform tuple selection and sorting operations and thus enhance the performance of the query interface to the data base. All three systems were designed to support the relational model. A virtual memory environment for RAP has been proposed [III.8], in order to allow the handling of very large data bases.

- [III.7] Copeland, G. P., G. J. Lipovski, and S. Y. W. Su, "The architecture of CASSM: a cellular system for non-numeric processing," Proc. First Ann. Symp. Comp. Architecture, pp. 121-128, Dec. 1973.
- [III.8] Schuster, S. A., E. A. Ozkarahan, and K. C. Smith, "A virtual memory system for a relational associative processor," Proc. ACM Nat'l. Comput. Conf., pp. 855-862, 1976.
- [III.9] Su, S. Y. W., G. P. Copeland, and G. J. Lipovski, "Retrieval operations and data representations in a context-addressed disc system," Proc. ACM's SIGPLAN and SIGIR Interface Meeting, pp. 144-160, Nov. 1973.
- [III.10] Su, S. Y. W. and G. J. Lipovski, "CASSM: a cellular system for very large databases," Proc. Int. Conf. Very Large Databases, pp. 456-472, Sept. 1975.

The data base computer (DBC) ([III.11] - [III.15]) is intended to be a back end computer capable of handling very large data bases (10^9 bytes or more) and supporting several data base models. In addition, it also provides security and clustering mechanisms making DBC a complete self contained data base management system.

- [III.11] Baum, R. I. and D. K. Hsiao, "A data secure computer architecture," Dig. Papers COMPCON 76, pp. 113-117, Feb. 1976.
- [III.12] Baum, R. J., D. K. Hsiao, and K. Kannan, "The architecture of a data base computer - Part I: concepts and capabilities," The Ohio State University Technical Report OSU-CISRC-TR-76-1, Sept. 1976.

• RESEARCH PROJECT ABSTRACT •

1. NAME OF PROJECT: Natural Language Access to a Large Data Base
2. ORGANIZATION: Coordinated Science Laboratory
University of Illinois
Urbana, IL 61801

Sponsored by: Office of Naval Research
3. PERSONNEL: David L. Waltz
4. KEYWORDS: Natural language, question answering, relational data base, man-machine interaction, computational linguistics
5. DESCRIPTION: A natural language question answering system has been implemented for a large (10^8 bits) relational data base of aircraft flight and maintenance data. The system called PLANES (for Programmed Natural Language Enquiry System) accepts grammatical as well as non-grammatical (e.g. "pidgin English") requests, translates these into formal queries, generates a paraphrase of the request for the user's approval, and returns explicit answers, in graphical form if possible. PLANES also solves pronoun reference and ellipsis problems. The system is now being tested and evaluated with casual users; a new version will be generated to correct problems found. We are also investigating automatic browsing and alerting for our data base.
6. IMPLICATIONS: Production natural language data base front ends should become practical during the next few years. Problems still remain in speed of operation, linguistic coverage of the problem domain, ease of applying system to new data bases, and answering vague or complex questions.
7. REFERENCES: Waltz, D. L., "An English language question-answering system for a large relational data base," to appear in Communications of the ACM, summer 1978.

Waltz, D. L. and Goodman, B. A., "Writing a natural language data base system," Proc. 5th Intl. Joint Conf. on Artificial Intelligence, MIT, Cambridge, MA, Aug. 1977, 144-50.

Waltz, D. L., "Natural language access to a large data base - an engineering approach," Adv. papers 4th Intl. Joint Conf. on Artificial Intelligence, Tbilisi USSR, Sept. 1975, 868-72.

Waltz, D. L. (ed), "Natural language interfaces," SIGART Newsletter, No. 61, Feb. 1977, 16-65.

CALL FOR ABSTRACTS
OF REPORTS, WORKING PAPERS AND THESIS ON
DATA BASE ENGINEERING

Interesting research results and important contributions are often documented in the form of reports, working papers, thesis, technical memoranda and similar documents. Many of these contributions remain unpublished or appear in journals or in conference proceedings at a much later date. For the purpose of fostering a prompt dissemination of technical information, Data Base Engineering will publish the abstracts of unpublished documents dealing with the various aspects of data base technology. The purpose of this service is to publicize the availability of these technical documents not to distribute them. Interested readers must address their request for copies directly to the author(s) or to the issuing organization.

We thereby solicit submission of abstracts for documents conforming to these guidelines:

- The document topic must fall within the scope of interest of Data Base Engineering (see inside cover).
- The document must not have previously appeared in books, journals, or conference proceedings.
- A reasonable number of copies of the document are available and will be mailed on request.

A photo-ready copy containing title, author's name and affiliation, abstract and complete ordering information should be fit into the upper half of a 6.5" x 10.0" page and mailed to the Editor of DBE, Dr. Jane Liu, Department of Computer Science, University of Illinois, Urbana, Illinois 61801. Publication of the abstracts is contingent upon meeting the previous guidelines and upon the available page space.

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• BOOK REVIEW •

"Data Base Systems: A Practical Reference" by Ian Palmer, QED Information Sciences, Inc. (revised 1977, 314 pages, \$25.00).

In this text the author does an excellent job of enumerating basic data base concepts and comparing the various approaches to data base systems at a conceptual level. Among the approaches covered are those espoused by Codasyl, Guide-Share, the Data Independent Accessing Model (DIAM), Hierarchical Model, Relational Model, and Waghorn Model. The role of groups such as the American National Standards Institute (ANSI) and International Standards Organization (ISO) in data base development is also discussed and their appropriate publications referenced. The problems of selecting a data base product, preparing for installation, the conversion period, and performance evaluation are also addressed.

The reader will be more comfortable in reading the text if he is at least familiar with basic operating system and data base terminology. The text is management oriented in that it does not give specific examples of application programs nor does it address the techniques and problems encountered in implementing data base software. An appendix of 84 commercially available data base products is included along with their basic requirements. Case studies pointing out the strengths and weaknesses of some of the more popular commercial products are provided. While many of the diagrams in the text suffer from a lack of accompanying explanation, individuals interested in data base design or a comparison of commercial products should find the text useful.

David S. Burris
University of Southern Mississippi

TC/DBE MEMBERSHIP LIST

March 20, 1978

Russell J. Abbott
Dept. of Computer Science
California State University
Northridge, CA 91324

Larry V. Allen
MD. C-73
Honeywell Information Systems
P.O. Box 6000
Phoenix, AZ 85005

G. V. Amico
Naval Training Equip. Center
Orlando, FL 32813

D. Au
PCS, Inc.
467 Hill 23 Drive
Flint, MI 48504

Charles Bachman
Honeywell Information Systems
200 Smith Street
Waltham, MA 02154

D. Z. Badal
Dept. of Computer Science
UCLA
3436 Boelter Hall
Los Angeles, CA 90024

Jean-Loup Baer
Dept. of Computer Science
University of Washington
FR-35
Seattle, WA 98195

Samuel T. Baker
1310 Stonewall
Murfreesboro, TN 37130

Samuel L. Bailey
Box 226, Rt. 82
Stanfordville, NY 12581

Ann Ellis Bandurski
David W. Taylor Naval Ship
R & D Center
17 North Edison Street
Arlington, VA 22203

Stephen Bankert
Scientific Systems Services
1106 Atlantic Street
Melbourne Beach, FL 32951

Tony M. Barile
Harris Electronic Systems Div.
MS-17-246
P.O. Box 37
Melbourne, FL 32901

A. James Baroody, Jr.
713 Eugenia Avenue
Madison, WI 53705

Frances A. Beason
904 Hooper Road, Apt. 5
Endwell, NY 13760

G. Belford
Dept. of Computer Science
University of Illinois
Urbana, IL 61801

M. S. Berens
System Dev. Corp.
7929 Westpark Drive
McLean, VA 22101

John L. Berg
National Bureau of Standards
TECH A-265
Washington, DC 20234

Herb Berke
Naval Training Equip. Center
N-73
Orlando, FL 32813

P. Bruce Berra
Industrial Engineering and
Operations Research
Syracuse University
441 Link Hall
Syracuse, NY 13210

John G. Bingham
University of South Florida
511 S. Matanzas Avenue
Tampa, FL 33609

M. V. Bhat
Engineering Computing
Pratt & Whitney Aircraft
of Canada
P.O. Box 10
Longueuil, Quebec, CANADA

Timothy S. Bracey
IBM - FSD
201B877
Owego, NY 13827

Ramona J. Briggs
Computer Sciences Corp.
6565 Arlington Blvd.
Falls Church, VA 22046

Robert D. Buehl
R.R. 1
Box 417A
Stone Ridge, NY 12484

Bill Buscher
33 Overlook Avenue
Beacon, NY 12508

G. T. Capraro
USAF/Rome Air Development Center
RADC/RBCT
Griffiss A.F.B.
New York, NY 13441

Robert Carlson
Computer Sciences Department
Northwestern University
Evanston, IL 60201

Walter S. Chambers
Navy, NTEC, Code N-74,
Orlando, FL 32813

Chee-Wai Chan
Dept. 449
Singer-Link Simulation Product Div.
Kirkwood, NY 13901

Cheng-Wen Cheng
Room 4L-409
Bell Laboratories
Warrenville Road
Naperville, IL 60540

L. Cheung
Marquette University
1515 W. Wisconsin Avenue
Milwaukee, WI 53233

Y. H. Chin
Institute of Applied Mathematics
National Tsing-Hua University
Hsinchu, Taiwan
REPUBLIC OF CHINA

Yaohan Chu
Dept. of Computer Science
University of Maryland
College Park, MD 20742

Henry Y. H. Chuang
Dept. of Computer Science
University of Pittsburgh
Pittsburgh, PA 15260

John M. Cianci
347 South Road, Apt. G-14
Poughkeepsie, NY 12601

Billy G. Claybrook
Computer Science Department
VPT and State University
Blacksburg, VA 24061

Mannie R. Connel
Martin Marietta Corp.
P.O. Box 5837, Mp75
Orlando, FL 32805

Daniel S. Connelly
Sperry Research Center
100 North Road,
Sudbury, MA 01776

E. F. Codd
IBM Research Laboratory
Monterey and Cottle Roads
San Jose, CA 95193

Thomas J. Cook
Computer Science Department
Virginia Polytechnic Institute
and State University
Blacksburg, VA 24061

John Czelen
3550 Whitehaven Parkway, N.W.
Washington, DC 20007

Edward W. Davis
Dept. of Electrical Engineering
University of Florida
216 Larsen Hall
Gainesville, FL 32611

Michael L. Davis
R.R. 4 - Box 274
Melbourne, FL 32901

Michael C. Dawson
University of South Florida
8414 El Portal Drive
Tampa, FL 33604

Donald R. Deutsch
National Bureau of Standards
Institute for Computer Sciences
and Technology
TECH A-367
Washington, DC 20234

David Digby
Martin Marietta
450 Cherokee Drive
Orlando, FL 32801

Lorraine Duvall
IIT Research Institute
Box 1355, Branch P.O.
Rome, NY 13440

Murray Edelberg
Sperry Research Center
100 North Road
Sudbury, MA 01776

Sue Eilers
Syracuse University
116 Chinook Drive
Syracuse, NY 13210

Nancy Eiseman
Dept. of Computer Science
and Electrical Engineering
University of Wisconsin
P.O. Box 478
Milwaukee, WI 53201

Roger W. Elliott
Dept. of Computer and
Information Sciences
University of Florida
512 Weil Hall
Gainesville, FL 32611

Ronald L. Enfield
1727 South Charlotte Avenue
San Gabriel, CA 91776

Andrew D. Fairchok
46 Robin Road
Poughkeepsie, NY 12601

Eduardo B. Fernandez
IBM Corp.
Los Angeles Scientific Center
9045 Lincoln Blvd.
Los Angeles, CA 90045

D. Ferrari
CS Division, EECS Dept.
University of California
Berkeley, CA 94720

Edward Feustel
Rice University
P.O. Box 1892
Houston, TX 77001

Dennis W. Fife
Computer Science Section
Systems and Software Division
ICST, U.S. Dept. of Commerce
National Bureau of Standards
Washington, DC 20234

K. S. Fu
School of Electrical Engineering
Purdue University
West Lafayette, IN 47907

Harvey Glass
Dept. of Electrical Engineering
University of South Florida
Tampa, FL 33620

R. Stockton Gaines
Information Science Department
The Rand Corp.
1700 Main Street
Santa Monica, CA 90406

Edward M. Gawlinski
Environmental Protection Agency
26 Federal Plaza, Room 1642
New York, NY 10007

E. Howard Green, Jr.
28 Southview Terrace
San Anselmo, CA 94960

S. P. Ghosh
IBM Research Laboratory
Monterey and Cottle Roads
San Jose, CA 95193

J. M. Grochow
c/o A.M.S.
1515 Wilson Blvd.
Arlington, VA 22209

Leo H. Groner
B/330-75 D/78F
IBM E. Fishkill
Hopewell Jct., NY 12533

Kevin Gross
200 Washington Street
Troy, NY 12180

Michael Hammer
Dept. of Electrical Engineering
M.I.T.
Cambridge, MA 02139

L. D. Healy
Naval Training Equip. Center
Code N74
Orlando, FL 32813

Jerry A. Heath
1431 Boxwood Drive
Blackwood, NJ 08012

Martin Hellman
Dept. of Electrical Engineering
Stanford University
Stanford, CA 94305

Charles B. Hestrom
La Due Road
R.R. 3
Box 369
Hopewell Junction, NY 12533

Gene F. Hoffnagle
6900 Keats Court
Rockville, MD 20855

William L. Honig
Bell Labs, Room 6B327
Naperville & Warrenville Roads
Naperville, IL 60540

Grace M. Hopper
Dept. of the Navy, NPLS, OP-911F
Pentagon BD 770
Washington, DC 20350

Barry House1
Purdue University
Dept. of Computer Science
West Lafayette, IN 47907

David K. Hsiao
Dept. of Computer and Information
Science
The Ohio State University
2036 Neil Avenue Mall
Columbus, OH 43210

Larry G. Hull
Goddard Space Flight Center
Code 533.1
Greenbelt, MD 20771

Antonio Hwang
7 Black Alder Road
Shokan, NY 12481

Keki Irani
Dept. of Computer and Electrical
Engineering
University of Michigan
Ann Arbor, MI 48104

W. C. Janssen
Dept. of Computer Science and
Electrical Engineering
University of Wisconsin
P.O. Box 478
Milwaukee, WI 53201

David K. Jefferson
David W. Taylor Naval Ship
R & D Center
Code 188A
Bethesda, MD 20084

S. Johnston
Dept. of Computer Science
University of Toronto
Rm #331
60 St. George Street
Toronto, Ontario
CANADA M5S 1A7

William G. Joseph
Bishop Moore High School
3512 Fairway Lane
Orlando, FL 32804

Stephen S. Kahng
16A River Terr
Poughkeepsie, NY 12601

Randy H. Katz
University of California
2705 Ridge Road #7
Berkeley, CA 94709

William A. Keller
The UpJohn Co.
7292-25-8
Kalamazoo, MI 49001

Joseph T. Kenny
MS 12/320
Harris Corp. ESD
P.O. Box 37
Melbourne, FL 32901

Douglas S. Kerr
Dept. of Computer and Information
Science
The Ohio State University
2036 Neil Avenue Mall
Columbus, OH 43210

Richard B. Kiebertz
Dept. of Computer Science
State University of New York
Stony Brook, NY 11794

George T. Kirby
Naval Training Equip. Center
110 Pine Tree Lane
Altamonte Springs, FL 32701

Richard H. Krier
Box 146A, RD#2
Vestal, NY 13850

T. L. Kunii
Information Sciences Lab.
University of Tokyo
Tokyo, 113, JAPAN

Yutaka Kuwahara
Hitachi Central Research Lab
2672 Bayshore Frontage Road #703
Mountain View, CA 94043

Larry Kuzma
HQ. AFSC SMR 6
Andrews AFB, MD 20334

Glen G. Langdon, Jr.
IBM Research K54-282
5600 Cottle Road
San Jose, CA 95193

Lee Chin-Hwa
Syracuse University
Electrical and Computer
Engineering Department
Syracuse University
Syracuse, NY 13210

Edward Y. S. Lee
Jet Propulsion Laboratory
MS-168-534
4800 Oak Grove Drive
Pasadena, CA 91103

Ester K. C. Lee
Jet Propulsion Laboratory
171-266
4800 Oak Grove Drive
Pasadena, CA 91103

Philippe G. H. Lehot
Philippe LEHOT Associates
976 Longridge Road
Oakland, CA 97610

David Lefkowitz
The Moore School of Electrical
Engineering
The University of Pennsylvania
Philadelphia, PA 19104

Edward Levinson
Room 2A214
Bell Laboratories
Whippany Road
Whippany, NJ 07981

Alan J. Lidstone
25 Carriage Hill Lane
Poughkeepsie, NY 12603

Wen-Te K. Lin
Sperry Research Center
100 North Road
Sudbury, MA 01776

A. Lind
3291 Dutchtown Road
Saugerties, NY 12477

Charles E. Lindahl
Naval Training Equip. Center
NTEC, Code N-74
Orlando, FL 32813

C. S. Liu
Harris Electronic Systems Div.
P.O. Box 37
Melbourne, FL 32901

Jane W. S. Liu
Dept. of Computer Science
University of Illinois
Urbana, IL 61801

Michael Lockey
USF 1587
University of South Florida
Tampa, FL 33620

Mary E. S. Loomis
University of Arizona
Department of MIS
Econ. 403
Tucson, AZ 85721

Suzanne W. Lore
Florida Technological University
390 Dubsdread Circle
Orlando, FL 32804

Shin-Yee Lu
Syracuse University
Dept. of Electrical Engineering
and Computer Engineering
111 Link Hall
Syracuse, NY 13210

Richard G. Luebke
1841 St. Andrews Plaza
San Jose, CA 95132

James C. Luk
612 Leon Drive
Endicott, NY 13760

Vincent Lum
IBM Research Laboratory
Monterey and Cottle Roads
San Jose, CA 95193

Stuart E. Madnick
Sloan School of Management
M.I.T.
Cambridge, MA 02139

Mary C. Maher
Farm to Market Road
Brewster, NY 10509

Frank Manola
Communications Sciences Division
Naval Research Laboratory
Washington, DC 20375

Giacomo Marini
IBM Scientific Center
Dorsoduro 3228
30123 Venezia
ITALY

Robert Marion
Defense Communications Agency
CCTO/WAD
11440 ISAAC Newton Square North
Reston, VA 22090

Orin E. Marvel
Honeywell Inc.
MS 358/5, R.R. 19
St. Pete, FL 33733

Philip H. Mason
PRIME Computer, Inc.
145 Pennsylvania Avenue
Framingham, MA 01701

Joseph L. Massett
MP 306
Martin Marietta Corp.
Box 5837
Orlando, FL 32808

John K. McCandliss
12164 Wensley Road
Florissant, MO 63033

E. J. McCauley
Aeronutronic Ford Corp., X40
393 Fabian Way
Palo Alto, CA 94303

Donald J. McKenna
Neighborhood Road
Kingston, NY 12401

Dennis McLeod
M.I.T., Laboratory for Computer
Science
545 Technology Square
Cambridge, MA 02139

Peter Meekin
COMPRO Associates
7 Innis Avenue
New Paltz, NY 12561

Jim Mehl
P.O. Box 632
Los Gatos, CA 95030

Donald Mendorf
Martin Marietta Corp.
630 Country Court
Longwood, FL 32750

J. Misra
Computer Science Department
University of Texas
Austin, TX 78712

Patricia L. Monahan
4508 Blue Tee Court
Apartment 77
Lutz, FL 33549

Peter S. Morelli
207 Frey Avenue
Endicott, NY 13760

L. I. Morganstein
E. I. Dupont Company
Engineering Department
Louviens Building
Wilmington, DE 19898

Clement Moy
15 High Court
Poughkeepsie, NY 12603

Barbara Mueller
P.O. Box 459
Pleasant Valley, NY 12569

Dan Nash
Raytheon
GRA-4
Hartwell Road
Bedford, MA 01730

Sham B. Navathe
New York University
40 W. 4th Street
Room 600, Tisch Hall
New York, NY 10003

Philip M. Neches
California Institute of Technology
Dept. of Computer Science 256-80
Pasadena, CA 91125

Peter A. Ng
Dept. of Computer Science
University of Missouri
Math Science Bldg.
Columbia, MO 65201

M. C. Nguyen
Dept. of Computer Science
Concordia University
1455 De Maisonneuve Blvd. W.,
Montreal, Quebec
CANADA H3G 1M8

Sylvia Osborn
University of Western Ontario
Dept. of Computer Science
London, CANADA N6A 5B9

Ronald G. Parsons
MRI Systems Corp.
P.O. Box 9968
Austin, TX 78766

Benjamin W. Patz
Florida Technological University
EECS Dept.
P.O. Box 25000
Orlando, FL 32816

Roger Perrault
Pendell Road
Poughkeepsie, NY 12611

David Pessel
Electrical Engineering Dept.
University of Rochester
Rochester, NY 14627

Wesley D. Peterson
Florida Institute of Technology
636 E. Melbourne Avenue
Melbourne, FL 32901

Charles T. Pierce
Attn: DRSEL-PA-S
Product Assurance Dir.
Ft. Monmouth, NY 07703

James C. T. Pool
Basic Energy Sciences/J-309
Department of Energy
Washington, DC 20545

S. Matthew Prastein
Applied Mathematics Division
Argonne National Laboratory
9700 S. Cass Ave.
Argonne, IL 60439

Noah Prywes
122 Moore D2
University of Pennsylvania
Philadelphia, PA 19174

John J. Purcell
12 Lookout Road
Fishkill, NY 12524

T. Radhakrishnan
Concordia University
Computer Science
1455 De Maisonneuve Blvd. (West)
Montreal, CANADA H3G 1M8

Michael Reggia
Martin Marietta Aerospace
2523 Seabreeze Court
Orlando, FL 32805

John Rich
Neighborhood Road
Kingston, NY 12401

J. S. Riordon
Carleton University
Dept. of Systems Engineering
and Computer Science
Ottawa, Ontario
CANADA K1S 5B6

Daniel J. Rosenkrantz
Computer Science Dept.
1400 Washington Ave.
State University of New York
Albany, NY 12222

John Ryriazoglou
147 Church Avenue
Willowdale, Ontario
CANADA M2N 4G4

B. H. Sams
RCA Laboratories
Princeton, NY 08540

Richard D. Sauer
Florida Institute of Technology
Campus Box 6985
Melbourne, FL 32901

Stewart A. Schuster
Intel. Corp.
1302 N. Mathilda Ave.
Sunnyvale, CA 94086

N. F. Schneidewind
Code 5555
Naval Postgraduate School
Monterey, CA 93940

Harold Schwenk
BGS Systems, Inc.
P.O. Box 128
Lincoln, MA 01773

Michael E. Senko
IBM T. J. Watson Research Center
Yorktown Heights, NY 10598

Gerard P. Shabe
C/o CCTC/WAD
1440 Isacc Newton Square
Reston, VA 22090

Michael D. Shealy
1924 Woodmont Drive
Richmond, VA 23235

Martin L. Shooman
Polytechnic Institute of
New York
Long Island Center
Route 110
Farmingdale, NY 11735

A. Shoshani
System Development Corporation
2500 Colorado Avenue
Santa Monica, CA 90406

James Showalter
110 Frederick Drive
Apalachin, NY 13732

Jitendra Singh
University of South Florida
Electrical Engineering Dept.
Tampa, FL 33620

Ram Singh
66 Miller Drive
Hopewell Junction, NY 12533

Diane C. P. Smith
Computer Science Department
University of Utah
Salt Lake City, UT 84112

Joan Smoot
35 Wurts Street
Kingston, NY 12401

Norman Sondak
Computer Science Department
Worcester Polytechnic Institute
Worcester, MA 01609

Donald H. Springer
1482 Platt Avenue
Milpitas, CA 95035

Mike Stelling
U.S.F.
6415 Midnight Pass Rd.
Apt. #203
Sarasota, FL 33581

Dan Stevens
Box 177
RD2
Hopewell Junction, NY 12533

Michael Stonebraker
EECS Department
549 Evans Hall
University of California
Berkeley, CA 94720

Stanley Y. W. Su
University of Florida
500A Weil Hall
Gainesville, FL 32611

Russell E. Theisen
Martin Marietta Corp.
P.O. Box 5837 MP-140
Orlando, FL 32808

T. C. Ting
School of Information and
Computer Science
Georgia Institute of Technology
Atlanta, GA 30332

Andrew G. Trobia
University of South Florida
13611 N. 20th Street
Tampa, FL 33612

Robert Trueblood
413 Dunton Drive
Blacksburg, VA 24060

M. Tsuchiya
Dept. of Electrical Engineering
University of Hawaii at Manoa
2540 Dole Street
Honolulu, HI 96822

Tom R. Viviano
University of South Florida
1307 E. 127 Ave. Apt. S
Tampa, FL 33612

John C. Wahtera
580 Cinnamon Drive
Satellite Beach, FL 32937

Ted Wasilewski
Hilltop Apts #47
Saugerdes, NY 12477

Anthony I. Wasserman
26 Malta Drive
San Francisco, CA 94131

H. J. Weegenaar
Centraal Beheer
Jachtlaan 105
Apeldoorn NETHERLANDS

Leonard H. Weiner
Computer Science Department
Michigan State University
400 Computer Center
East Lansing, MI 48824

M. C. Welcome
56B Phobella Drive
Poughkeepsie, NY 12603

Jay-Louise Weldon
100 Trinity Place
New York, NY 10006

David L. Wells
University of Wisconsin
Dept. of Electrical Engineering and
Computer Science
P.O. Box 478
Milwaukee, WI 53210

Raymond Wice
University of South Florida
9039C Westchester Cir.
Tampa, FL 33604

Geo Weiderhold
155 Marine Road
Woodside, CA 94062

August Martin Wildeberger
15811 Pinecroft Lane
Bowie, MD 20716

Paul A. Willis
Polytechnic Associates Iac
2824 W. George Mason Rd.
Falls Church, VA 22042

Suzanne R. Witenhafer
University of South Florida
P.O. Box 16000-NC
Temple Terrace, FL 33687

Eugene Wong
Dept. of Electrical Engineering
and Computer Science
University of California
Berkeley, CA 94720

Christopher Wood
IBM Corp.
Los Angeles Scientific Center
9045 Lincoln Blvd.
Los Angeles, CA 90045

Ronald J. Wojtasinski
NASA Kennedy Space Center
IN-MSD-1, J.F. Kennedy Space Center
Orlando, FL 32815

S. B. Yao
Dept. of Computer Science
Purdue University
West Lafayette, IN 47909

Gulsun Yasar
23 Holiday Drive
Woodstock, NY 12498

Stephen S. Yau
Computer Science Department
Northwestern University
Evanston, IL 60201

Benjamin F. Yee
934 Milan Avenue
Endicott, NY 13760

Raymond T. Yeh
Computer Science Department
Painter 3.26
University of Texas at Austin
Austin, TX 78712

A. W. Yonda
12 Sunset Drive
Medway, MA 02053

Kung Nane Yu
13 Miron Drive
Poughkeepsie, NY 12603

Carlo A. Zaniolo
Sperry Research Center
100 North Road
Sudbury, MA 01776

Mel Zimowski
309 Hill Avenue
Edicott, NY 13760

• MEETINGS OF INTEREST •

- ◆ Fourth Illinois Conference on Medical Information Systems
May 11-13, 1978, Urbana-Champaign, Illinois

Sponsor: Regional Health Resource Center, University of Illinois

Contact: Julie Garrett
Regional Health Resource Center
Urbana, IL 61801
(217) 337-2324

- ◆ 1978 SIGMOD International Conference on Management of Data
May 31 - June 2, 1978, Austin, Texas

Sponsor: ACM SIGMOD

General Chairmen: Alfred G. Dale and Neil B. Dale
Department of Computer Science
University of Texas
Austin, TX 78712
(512) 471-4353

- ◆ International Conference on Management of Data
June 29-30, 1978, Milan, Italy

Sponsors: ACM Italian Chapter, etc.

Contact: Dennis Tsichritzis
Computer System Research Group
University of Toronto
CANADA, M5S 1A4

- ◆ International Conference on Data Bases:
Improving Usability and Responsiveness
August 2-4, 1978, Haifa, Israel

Sponsor: Technion in cooperation with ACM

Program Chairman: Ben Shneiderman
Department of Information
Systems Management
University of Maryland
College Park, MD 20742

FOURTH WORKSHOP ON COMPUTER ARCHITECTURE FOR NON-NUMERIC PROCESSING

To Be Held At: Syracuse University Minnowbrook Conference Center
Blue Mountain Lake, New York in the Adirondack
Mountains of New York State (135 miles from Syracuse).

Date of Workshop: August 1 - 4, 1978.

Sponsored By: ACM: SIGARCH, SIGIR, SIGMOD in cooperation with
IEEE-CS: TCARCH, TCDBE, and Syracuse University.

In the past, this Workshop has been a primary avenue for those actively engaged in research and development of a variety of specialized non-numeric systems to present information regarding their current activities and to discuss future directions. To continue this activity, papers on current or proposed work in all areas of computer architecture for non-numeric processing, such as: data communications, information storage and retrieval, data base management, command and control, artificial intelligence, distributed processing, searching and sorting, and text processing have been invited. (See December, 1977 issue of DBE Bulletin.)

General Chairman: P. Bruce Berra, Industrial Engineering and Operations
Research, Syracuse University, Syracuse, New York 13210, (315) 423-2826.

Program Chairman: Lee A. Hollaar, Department of Computer Science,
University of Illinois, Urbana, Illinois 61820, (217) 333-3162.

Program Committee: David K. Hsiao, The Ohio State University; Robert Korfhage,
Southern Methodist University; Glenn L. Langdon, International Business
Machines - San Jose, California; G. Jack Lipovski, University of Texas;
Stewart A. Schuster, University of Toronto.

Publications Chairman: Michael McGill, Information Studies, Syracuse Univer-
sity, Syracuse, New York 13210, (315) 423-4522.

Local Arrangements: Mary Jo Fairbanks, Electrical and Computer Engineering,
Syracuse University, Syracuse, New York 13210, (315) 423-3511.

Registration: There will be no on-site registration for this workshop. Every-
one must pre-register. The total fee for this workshop is \$150. This in-
cludes registration fee (\$30), meals, lodging and use of all Minnowbrook
facilities. A deposit of \$50 is payable with the return of your registration
form. The balance is payable on August 1, 1978. Refunds for cancellation
will be honored until July 15, 1978. Please make checks payable to:
Fourth Workshop on Computer Architecture for Non-Numeric Processing.

REGISTRATION FORM

Fourth Workshop on Computer Architecture for
Non-Numeric Processing, August 1-4, 1978.

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MAIL THIS FORM AND YOUR CHECK TO:

Mary Jo Fairbanks, Dept. of Electrical &
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New York, 13210.

Minnowbrook Conference Center
Blue Mountain Lake, New York

REGISTRATION DEADLINE IS:
July 15, 1978.

PLEASE CHECK ONE:

- Enclosed is \$50 deposit.
 Full payment enclosed \$150.

PLEASE CHECK BELOW:

- I will need transportation
to Minnowbrook from Syracuse.
 Travel arrangements are not
complete. I will notify you.
 I am driving and can take
passengers. Please specify
number ____.

FOURTH INTERNATIONAL CONFERENCE ON VERY LARGE DATA BASES

BERLIN, GERMANY

SEPTEMBER 13-15, 1978

This conference is the fourth in a series. Like its predecessor, the conference is intended to identify areas of general interest for research, development, and applications of data base systems. Its objectives are to promote an understanding of current undertakings, to further the exchange of experience gained in the construction and use of data base systems, and to serve as a forum for future research and development. We are especially interested in high quality papers in the areas of data base design, data base software engineering, distributed data base systems, and the impact of new technologies.

The VLDB conference has been scheduled to coincide with the International Congress of Data Processing. As a result it can be expected that many practitioners will attend the VLDB conference. Thus practically oriented survey and tutorial papers are especially welcome. Intensive debates among practitioners and researchers will be organized.

TOPICS OF INTEREST

Suitable topics include, but are not limited to:

DATA BASE DESIGN

system analysis
requirement specification
logical data base design and
integration

DATA BASE SOFTWARE ENGINEERING

formal specification
design methodology
development tools
verification

DISTRIBUTED DATA BASES

network architecture
resource management
program conversion
data migration

DATA BASE COMPUTER ARCHITECTURE

back end machines
microprocessors
memory organization
storage technologies

DATA SEMANTICS AND MODELING

concepts
formalism
consistency

SYSTEM IMPLEMENTATION

query evaluation
integrity and recovery
concurrent access
access control mechanisms

USER INTERFACE

graphic interface
very high level languages
natural language interface

PERFORMANCE EVALUATION

measurement
monitoring
simulation and analytic modeling

DATA BASE APPLICATIONS

in decision making
in health and environmental
systems
in office automation

MORE INFORMATION AND TRAVEL GRANTS

Suggestions for panel or tutorial sessions should be directed to one of the two program chairmen. Requests for other information should be directed to one of the conference chairmen. It is hoped that some partial travel grants will become available to help support the travel of conference participants.

General Conference Chairman
Dr. Herbert Weber
Hahn-Meitner-Institut
Bereich Datenverarbeitung und Elektronik
Glienicker Str. 100
1000 Berlin 39

European Conference Chairman
Professor Claude Delobel
Computer Laboratory,
University of Grenoble
Boite Postale 53
38041 Grenoble Cedex
Grenoble, FRANCE

U.S. Conference Chairman
Professor Anthony I. Wasserman
Section of Medical Information
Science
University of California
San Francisco, CA 94143

MIMI 77: Proceedings on the International Symposium on Mini and Microcomputers
November 16-18, 1977

Fifty-five papers on hardware, software systems, applications, and education presented by an international group of computer professionals. A sampling of the titles includes: PL/M as a Concurrent High Level Language; Why Multiple Microprocessors; BIGLIO: A Personal Library Information System; and European versus American Philosophy in Microcomputer Based Products.
 Non-members—\$20.00 Members—\$15.00

MICRO-DELCON 78: Proceedings of the Delaware Bay Microcomputer Conference
March 20, 1978 — 72 pp.

Fifteen papers on microcomputers including sessions on: How to Get Started; Systems Organization and New Architecture; Microcomputer Development Tools; Microcomputers in Business; and Case Studies.
 Non-members—\$12.00 Members—\$9.00

INTERNATIONAL CONFERENCE ON VERY LARGE DATA BASES
October 6-8, 1977, Tokyo, Japan

The papers in this conference are intended to promote an understanding of databases which are very large—large in terms of complexity of structure as well as physical size. The papers are a forum for exchange of ideas between users, designers, and researchers of very large databases.
 Non-members—\$25.00 Members—\$18.75

***FIRST ROCKY MOUNTAIN SYMPOSIUM ON MICRO-COMPUTERS: SYSTEMS, SOFTWARE, ARCHITECTURE**
August 31-September 2, 1977 — 310pp.

The Rocky Mountain symposia on microcomputers are organized as a forum for presentation and discussion of basic research in the field of microcomputers. The aim is to encourage a broad base of interaction between the industrial, governmental, and academic communities to provide guidance and feedback (1) for the directions of basic research and (2) for the effective implementation of research achievements. Fourteen papers are included in this first symposium collection.
 Non-members—\$12.00 Members—\$9.00

COMPSAC 77
November 8-11, 1977 — 856pp.

Papers from the first International Conference on Computer Software and Applications—COMPSAC 77. Computer Practitioners, users, and researchers share their ideas, experiences, and requirements for applications software, management techniques, and software development support, including automated techniques. The latest developments in this important, fast-moving field.
 Non-members—\$25.00 Members—\$18.75

***COMPUTER — Volume 10 1977 — Hardbound**
IEEE Computer Society's Monthly magazine.

Tutorial and survey papers providing coverage of the entire range of hardware and software design and application, with each issue focusing on a single major theme, such as, computer networks, computer architecture, small scale computing, and structured programming.
 Non-members—\$36 Members—\$27

***Transactions on Computers Volume C26**
1977 Hardbound

IEEE Computer Society's oldest archival journal. Most cited publication in the Computer Science field. Published monthly. Over 1400 pages in 1977.
 Non-members—\$40 Members—\$30

Proceedings of the Third International Conference on Software Engineering
May 10-12, 1978

The conference is jointly sponsored by the IEEE Computer Society, ACM, and the National Bureau of Standards. The 27 sessions include papers on Microprocessor Software, Language Issues, Software Reliability, and Software Design.
 Non-members—\$20 Members—\$15

Symposium on Computer Architecture

An objective of the symposium is to present the methodologies and languages for representing architectural design within the pragmatics of system evaluation and implementation. Co-sponsored by ACM SIGARCH and the IEEE Computer Society, the conference covers current trends in Special Purpose Processors, Data Base Architectures, Language-Oriented Architectures, Algorithms and Analysis, Reliability, and Recent Advances.

Fifth Annual Symposium on Computer Architecture, April 4-5, 1978. 256 pp.
 Non-members—\$20 Members—\$15

- Fourth Annual Symposium on Computer Architecture, 1977. 210 pp. NM, \$20.00; M, \$15.00
- Third Symposium on Computer Architecture, 1976, 202 pp. NM, \$20.00; M, \$15.00
- Second Symposium on Computer Architecture, 1975, 231 pp. NM, \$20.00; M, \$15.00
- First Symposium on Computer Architecture, 1973, 180 pp. NM, \$20.00; M, \$15.00

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