STRUCTURING OPERATING SYSTEMS LITERATURE
FOR THE GRADUATE COURSE

J. R. Metzner

Computer Science Department

University of Missouri - Rolla

Rolla, Missouri 65401

This document contains several groups of bibliographic citations which are used in the graduate-level course entitled, "Advanced Operating Systems". The course is largely based upon journal literature in this area and is organized about two major goals. The first is to acquaint the student with the flavor and substance of research and development in Operating Systems. The second aim addresses a range of skills which are applicable to many subject areas. It may be loosely described by the phrase, "Learning to use the literature," and involves extracting the import from an article, experiencing the benefits of group inquiry, and putting the material in perspective. The long-range benefit here lies in convincing the student that he can indeed use the professional literature to bring his understanding of a subject area up to "the state of the discipline".

The conduct of the course is designed to put these skills to use as they develop. Material in the first half of the course is presented by the instructor, initially in an explicit lecture style but evolving to that of a loosely guided group discussion. In the second half of the course, the papers are presented by the students. Because teaching is seldom a subject of graduate training, the students are encouraged to gain experience with a variety of pedagogic methods and devices. In addition to covering the material of their assigned papers, the student presenters may pose exercises, give quizzes, distribute supplementary handouts, or conduct recitations.

There is a prerequisite course in Operating Systems, so the student is presumed to be acquainted with the workings of contemporary, large-scale operating systems. Any one of the introductory texts cited in the bibliographic section for books (in this document) would provide adequate background for this course. Topical coverage begins with overview material; "bottom-line" diagnostic and evaluative techniques from Rosen's book establish a context for viewing systems in the whole while presenting material often omitted from introductory courses. Then, the papers listed under the heading, "Pass One Papers" are presented in that order, commencing with a survey article providing a historical perspective with which to view the remaining works. The articles for student presentation are listed under the heading, "Closer-Look Sampler".

It is a challenging task to so organize the literature in an emerging area like Operating Systems that a series of selected readings can be arranged to constitute a coherent tour rather than a random sampling. The diversity of subject matter and the uneven pace among divers developments renders a chronological ordering unsatisfying. Splitting the area into ten or twelve categories, as *Computing Reviews* does, yields a disquieting frequency of cross-referencing and "coin toss" decisions about which aspect of a work to consider dominant and classify under. For example, a paper on modeling input/output activity could be grouped with those on Performance as easily as those on File Systems Management. The high incidence of such ambiguity in this subject's literature suggested the multi dimensional classification scheme outlined below.

10

The first of the three classifications, Topical Focus, is organized about the tasks and activities typical of operating systems. It follows the lines of division often used when dealing with these complex systems, separating into the managements of processes, resources, and communications. The second classification is termed Major Thrust and is intended to capture the viewpoint from which the topic is addressed. The main divisions here separate works describing a particular operating system from those treating the design of operating systems in some generality and from those whose subject is the analysis of existing or contemplated systems. The final classification, Treatment, is included to serve as an annotation which can help in the selection of items appropriate to a student's deeper inquiry. This categorization is a judgement call on whether, for example, the author's treatment of a topic is primarily technical or primarily conceptual.

The categorization used here is really hierarchical in structure so that a work can be classified at any one of several levels of specificity. The categorical structure for Treatments is shown in Figure 1 in the form of a tree. The number of levels employed in such a structure is really open-ended, depending mainly upon the need to finely divide the literature and the extent to which its individual works confine themselves to narrow topics, aspects, and standpoints. What's especially handy is the freedom to categorize at nodes above the leaves when a work is somewhat general or could well be assigned to more than one leaf.
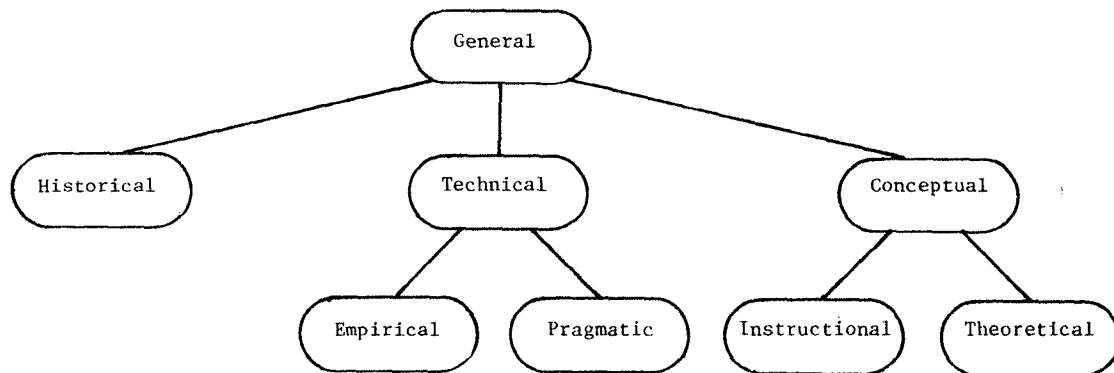
TREATMENT CATEGORY TREE

FIGURE 1

There are other advantages of an hierarchical categorization. The number of levels employed can be chosen to suit the size of the corpus of literature being classified and finer divisions can be added to any leaf later, as they become apparent. It is also hoped that the changes which arise over a span of time as the field grows and matures would tend to affect the more detailed levels and thus have minimal impact upon categorizations already done. The fine-grained categorizations which could be added at the leaves are more subjective and difficult to draw distinctions among, so the individual researcher may wish to affix a personal layer to familiar categories.

The advantage used in the organization of these collections is that a preorder traversal of a category tree encounters general nodes before their more specific dependants and that leaves appended to the same node are encountered consecutively. This type of traversal yields a somewhat coherent ordering; a preorder traversal of the Topical Focus attributes of the Pass One Papers formed the basis for their order of treatment.

0	PM Process Management	SCH Scheduling	Deadlocks Optimal Scheduling Command & Control Langs.
		SYN Synchronization	Concurrency Mutual Exclusion Locks & Signals
Overall Operating System	RM Resource Management	MEM Memory Management	Allocation/Deallocation Secondary Storage Segmentation & Paging Virtual Memory
		CXT Context Management	Context Switching Fault Isolation Backout & Checkout Virtual Machines
	CM Communications Management	FLS File Systems	Directory Structures File Services DBMS
		COM Communications Services	Interprocess Messages Network Communications Distributed Data Bases
		SEC Security	Access Control Security Kernel Encription/Decription

CATEGORIES OF TOPICAL FOCUS

FIGURE 2

Figure 2 displays that tree-structured categorization in tabular form. The
letter codes in the boxes of the first three levels are used to annotate the
fuller listings which follow. A fourth level of leaves is suggested in the figure
to help explain the meanings of the terms at the higher nodes, but is not used
here—divisions that specific would be appropriate only for far larger biblio-
graphic or retrieval efforts. The Major Thrust categories are presented in this
form in Figure 3 and, for completeness, those of Treatment are tabluated in
Figure 4.

In the categorically organized listings that follow, each citation is an-
notated with a three-part descriptor of the form <TF, MT, T> in which;
  TF is the letter code of the Topical Focus categorization,
  MT is the letter code of the Major Thrust categorization,
  T is the letter code of the Treatment categorization.
Since these listings are intended to assist students in starting purposive del-
vings, both topical and thrust listings are given. The listings are organized
by three traversals of the Topical Focus and Major Thrust categories except that
those items so general as to be classified at the root nodes are omitted. Many
of the citations are assigned to the root node in only one classification and
thus appear in only one listing. Those works of greater specificity appear in
both listings.

These listings are not intended to be complete in any sense. Citations are
included when the work is judged significant and suitable to the purposes of
students seeking to explore further.

B	DE	ORG Organization	Nucleus/Primitives Hierarchical Structure Features
Broad Overview	Design	ENV Environment	Real Time Distributed System Multiprogramming Multiprocessing
		PHL Philosophy	Process-Based Systems Message-Based Systems Object-Based Systems
	SD System or Topical Description	REP Report	
		MAN Manual	
		BIB Bibliography	
	AN Analysis	MOD Modeling	Queueing Theory Operational Analysis Stochastic Analysis Simulation
		MSR Measurement	Probes Monitoring Accounting

CATEGORIES OF MAJOR THRUST

FIGURE 3

G	HS Historical	
General	TN Technical	EMP Empirical
		PRG Pragmatic
	CO Conceptual	INS Instructional
		THR Theoretical

CATEGORIES OF TREATMENT

FIGURE 4

13

BOOKS

BRINCH HANSEN, P., *Operating System Principles,* Prentice-Hall, 1973.

CHANDY, K. M. and REISER, M., eds., *Computer Performance,* North-Holland, 1977.

COFFMAN, E. G. and DENNING, P. J., *Operating Systems Theory,* Prentice-Hall, 1973.

DRUMMOND, M. E., *Evaluation and Measurement Techniques for Digital Computers,* Prentice-Hall, 1973.

GOOS, G. and HARTMANIS, J., eds., *Lecture Notes in Computer Sciences: 16, Operating Systems,* Springer-Verlag, 1974.

HABERMANN, A. N., *Introduction to Operating System Design,* Science Research Associates, 1976.

HELLERMAN, H. and CONROY, T. F., *Computer System Performance,* McGraw-Hill, 1975.

LORIN, H. and DEITEL, H. M., *Operating Systems,* Addison-Wesley, 1981.

MADNICK, S. E. and DONOVAN, J. J., *Operating Systems,* McGraw-Hill, 1974.

ROSEN, S., *Lectures on the Measurement and Evaluation of the Performance of Computing Systems,* Society for Industrial and Applied Mathematics, Philadelphia, PA, 1976.

SAUER, C. H. and CHANDY, K. M., *Computer Systems Performance Modeling,* Prentice-Hall, 1981.

SHAW, A. C., *The Logical Design of Operating Systems,* Prentice-Hall, 1974.

SPIRN, J. R., *Program Behavior: Models and Measurements,* Elsevier, 1977.

SVOBODOVA, L., *Computer Performance Measurement and Evaluation Methods: Analysis and Applications,* Elsevier, 1976.

PASS ONE PAPERS

ROSIN, R. F., "Supervisory and Monitor Systems", *Computing Surveys,* 1:37-54, (March, 1969).

LAMPSON, B. W., "A Scheduling Philosophy for Multiprocessing Systems", *CACM,* 11:347-360, (May, 1968).

HABERMANN, A. N., "Prevention of System Deadlocks", *CACM,* 12:373-377,385, (July, 1969).

DIJKSTRA, E. W., "Solution of a Problem in Concurrent Programming Control", *CACM,* 8:569, (September, 1965).

DENNIS, J. B., "Segmentation and the Design of Multiprogrammed Computer Systems", *JACM,* 12:589-602, (October, 1965).

PARMELEE, R. P., PETERSON, T. I., TILLMAN, C. C. and HATFIELD, D. J., "Virtual Storage and Virtual Machine Concepts", *IBM Systems J.,* 11:99-130, (1972).

MADNICK, S. E. and ALSOP, J. W., "A Modular Approach to File System Design", *Proc. AFIPS SJCC,* 34:1-13, (1969).

WALDEN, D. C., "A System for Interprocess Communication in a Resource Sharing Computer Network", *CACM,* 15:221-230, (April, 1972).

BRINCH HANSEN, P., "The Nucleus of a Multiprogramming System", *CACM*, 13:238-241, 250, (April, 1970).

RITCHIE, D. M. and THOMPSON, K., "The UNIX Time-Sharing System", *CACM*, 17:365-375, (July, 1974).

CLOSER-LOOK SAMPLER

FABRY, R. S., "Capability Based Addressing", *CACM*, 17:403-411, (July, 1974).

SCHROEDER, M. D., CLARK, D. D., and SALTZER, J. H., "Multics Kernel Design Project", *Operating Systems Review*, 11:No. 5:43-56, (November, 1977).

GIFFORD, D. K., "Cryptographic Sealing for Information Secrecy and Authentication", *CACM*, 25:274-286, (April, 1982).

HOARE, C. A. R., "Monitors: An Operating System Structuring Concept", *CACM*, 17:549-557, (October, 1974).

HOARE, C. A. R., "Communicating Sequential Processes", *CACM*, 21:666-677, (August, 1978).

LAMPORT, L., "Time, Clocks, and the Ordering of Events in a Distributed System", *CACM*, 21:558-565, (July, 1978).

STURGIS, H., MITCHELL, J. and ISRAEL, J., "Issues in the Design and Use of a Distributed File System", *Operating Systems Review*, 14:No. 3:55-69, (July, 1980).

LAUER, H. C. and NEEDHAM, R. M., "On the Duality of Operating System Structures", *Proc. Second International Symp. on Operating Systems*, IRIA, (1978).

DIJKSTRA, E. W., "The Structure of the 'THE'-Multiprogramming System", *CACM*, 11:341-346, (May, 1968).

RASHID, R. F. and ROBERTSON, G. G., "Accent: A Communication Oriented Network Operating System Kernel", *Operating Systems Review*, 15:No. 5:64-75, (December, 1981).

LAZOWSKA, E. D., et. al., "The Architecture of the Eden System", *Operating Systems Review*, 15:No. 5:148-159, (December, 1981).

TAFT, S. T., "An Object-Based Virtual Operating System for the Ada Programming Support Environment", *Operating Systems Review*, 16:No. 1:14-25, (January, 1982).

SHERMAN, S. W., BASKETT, F., and BROWNE, J. C., "Trace-Driven Modeling and Analysis of CPU Scheduling in a Multiprogramming System", *CACM*, 15:1063-1069, (December, 1972).

DENNING, P. J., "The Working Set Model for Program Behavior", *CACM*, 11:323-333, (May, 1968).

BROWNE, J. C., et. al, "Hierarchical Techniques for the Development of Realistic Models of Complex Computer Systems", *Proc. IEEE*, 63:966-975, (June, 1975).

TEOREY, T. J. and PINKERTON, T. B., "A Comparative Analysis of Disk Scheduling Policies", *CACM*, 15:177-184, (March, 1972).

BARD, Y., "A Model of Shared DASD and Multipathing", *CACM*, 23:564-572, (October, 1980).

TOPICAL GROUPING

PROCESS MANAGEMENT

PINKERTON, T. B., "Performance Monitoring in a Time-Sharing System", *CACM*, 12: 608-610, (November, 1969). <PM,MSR,PRG>

BASKETT, F., CHANDY, K. M., MUNTZ, R. R., and PALACIOS, F. G., "Open, Closed, and Mixed Networks of Queues with Different Classes of Customers", *JACM*, 22: 248-260, (April, 1975). <PM,MOD,THR>

NUTT, G. J., "Tutorial: Computer System Monitors", *Computer*, 8:No. 11:51-61, (November, 1975). <PM,MSR,INS>

KEEDY, J. L., "On Structuring Operating Systems with Monitors", *Australian Computer J.*, 10:23-27, (February, 1978). <PM,ORG,G>

Scheduling

LAMPSON, B. W., "A Scheduling Philosophy for Multiprocessing Systems", *CACM*, 11:347-360, (May, 1968). <SCH,PHL,CO>

HABERMANN, A. N., "Prevention of System Deadlocks", *CACM*, 12:373-377,385, (July, 1969). <SCH,AN,THR>

SHERMAN, S. W., BASKETT, F., and BROWNE, J. C., "Trace-Driven Modeling and Analysis of CPU Scheduling in a Multiprogramming System", *CACM*, 15:1063-1069, (December, 1972). <SCH,AN,EMP>

BRICE, R. S. and BROWNE, J. C., "Feedback Coupled Resource Allocation Policies in the Multiprogramming-Multiprocessor Computer System", *CACM*, 21:678-686, (August, 1978). <SCH,MOD,TN>

NEWTON, G., "Deadlock Prevention, Detection, and Resolution: An Annotated Bibliography", *Operating Systems Review*, 13:No. 2:33-44, (April, 1979). <SCH,BIB,INS>

BOKHARI, S. H., "Dual Processor Scheduling with Dynamic Reassignment", *IEEE-TSE*, 5:341-349, (July, 1979). <SCH,MOD,TH>

LOMET, D. B., "Subsystems of Processes with Deadlock Avoidance", *IEEE-TSE*, 6:297-304, (May, 1980). <SCH,ORG,THR>

OBERMARCK, R., "Distributed Deadlock Detection Algorithm", *ACM Trans. on Database Systems*, 7:187-208, (June, 1982). <SCH,ENV,PRG>

Synchronization

DIJKSTRA, E. W., "Solution of a Problem in Concurrent Programming Control", *CACM*, 8:569, (September, 1965). <SYN,ENV,THR>

BAER, J. L., "A Survey of Some Theoretical Aspects of Multiprocessing", *Computing Surveys*, 5:31-80, (March, 1973). <SYN,ENV,CO>

LISTER, A. M. and MAYNARD, K. J., "An Implementation of Monitors", *Software-Practice & Experience*, 6:377-385, (1976). <SYN,REP,PRG>

LOMET, D. B., "Process Structuring, Synchronization, and Recovery Using Atomic Actions", *Operating Systems Review*, 11:No. 2:128-137, (April, 1977). <SYN,PHL,G>

LAMPORT, L., "Time, Clocks, and the Ordering of Events in a Distributed System", *CACM*, 21:558-565, (July, 1978). <SYN,ENV,THR>

HOARE, C. A. R., "Communicating Sequential Processes", *CACM*, 21:666-677, (August, 1978). <SYN,ORG,PRG>

REED, D. P., and KANODIA, R. K., "Synchronization with Event Counts and Sequences", *CACM*, 22:115-123, (February, 1979). <SYN,ORG,PRG>

SCHNEIDER, F. B., "Synchronization in Distributed Programs", *ACM Trans. Programming Langs. & Systems*, 4:125-148, (April, 1982). <SYN,ENV,THR>

RESOURCE MANAGEMENT

DALEY, R, C. and DENNIS, J. B., "Virtual Memory, Processes, and Sharing in MULTICS", *CACM*, 11:306-312, (May, 1968). <RM,SD,G>

PARMELEE, R. P., PETERSON, T. I., TILLMAN, C. C., and HATFIELD, D. J., "Virtual Storage and Virtual Machine Concepts", *IBM Systems J.*, 11:99-130, (1972). <RM,DE,G>

LYNCH, H. W. and PAGE, J. B., "OS/VS2 Release Two Systems Resources Manager", *IBM Systems J.*, 13:274-291, (1974). <RM,SD,INS>

Memory Management

DENNIS, J. B., "Segmentation and the Design of Multiprogrammed Computer Systems", *JACM*, 12:589-602, (October, 1965). <MEM,DE,PRG>

BELADY, L. A., "A Study of Replacement Algorithms for Virtual Storage Computers", *IBM Systems J.*, 5:78-101, (1966). <MEM,MOD,TN>

LIPTAY, J. S., "Structural Aspects of the System/360 Model 85:II The Cache", *IBM Systems J.*, 7:15-21, (1968). <MEM,AN,EMP>

DENNING, P. J., "The Working Set Model for Program Behavior", *CACM*, 11:323-333, (May, 1968). <MEM,MOD,THR>

BELADY, L. A., NELSON, R. A., and SHEDLER, G. S., "An Anomaly in the Space-Time Characteristics of Certain Programs Running in Paging Machines", *CACM*, 12:349-353, (June, 1969). <MEM,AN,G>

BATSON, A., JU, S-M., and WOOD, D. C., "Measurements of Segment Size", *CACM*, 13:155-159, (March, 1970). <MEM,MSR,EMP>

HATFIELD, D. J. and GERALD, J., "Program Restructuring for Virtual Memory", *IBM Systems J.*, 10:168-192, (1971). <MEM,MSR,PRG>

HATFIELD, D. J., "Experiments on Page Size, Program Access Patterns, and Virtual Memory Performance", *IBM J. Research and Development*, 16:58-66, (1972). <MEM,MSR,PRG>

DENNING, P. J. and SCHWARTZ, S. C., "Properties of the Working Set Model", *CACM*, 15:191-198, (March, 1972). <MEM,MOD,THR>

AUSLANDER, M. A. and JAFFE, J. F., "Functional Structure of IBM Virtual Storage Operating Systems--Part I: Influences of Dynamic Address Translation on Operating System Technology", *IBM Systems J.*, 12:368-381, (1973). <MEM,SD,HS>

BOYSE, J. W., "Execution Characteristics of Programs in a Page-on-Demand System", *CACM*, 17:192-196, (April, 1974). <MEM,MSR,EMP>

CHOW, W.-M. and CHIU, W. W., "An Analysis of Swapping Policies in Virtual Storage Systems", *IEEE-TSE*, 3:150-156, (March, 1977). <MEM,MOD,PRG>

SMITH, A. J., "Bibliography on Paging and Related Topics", *Operating Systems Review*, 12:No. 4:39-56, (October, 1978). <MEM,BIB,G>

DENNING, P. J., "Working Sets Past and Present", *IEEE-TSE*, 6:64-84, (January, 1980). <MEM,MOD,HS>

Context Management

MEYER, R. A. and SEAWRIGHT, L. M., "A Virtual Machine Time Sharing System", *IBM Systems J.*, 9:199-218, (1970). <CXT,SD,INS>

BUZEN, J. P. and GAGLIARDI, U. O., "The Evolution of Virtual Machine Architecture", *Proc. AFIPS NCC*, 42:291-301, (1973). <CXT,SD,HS>

FABRY, R. S., "Capability Based Addressing", *CACM*, 17:403-411, (July, 1974). <CXT,DE,TN>

TONIK, A. B., "Bibliography on Checkpoint, Restart, and Recovery Papers", *Performance Evaluation Review*, 5:No. 2:100-104, (April, 1976). <CXT,BIB,INS>

COMMUNICATIONS MANAGEMENT

BAGLEY, J. D., FLOTO, E. R., HSIEH, S. C. and WATSON, V., "Sharing Data and Services in a Virtual Machine System", *Operating Systems Review*, 9:No. 5: 82-88, (November, 1975). <CM,SD,PRG>

SALTZER, J. H., "Research Problems of Decentralized Systems with Largely Autonomous Nodes", *Operating Systems Review*, 12:No. 1:43-52, (January, 1978). <CM,ENV,CO>

SILBERSCHATZ, A., "Port Directed Communication", *Computer J.*, 24:78-82, (February, 1981). <CM,DE,CO>

File Systems

MADNICK, S. E. and ALSOP, J. W., "A Modular Approach to File System Design", *Proc. AFIPS SJCC*, 34:1-13, (1969). <FLS,ORG,TN>

TEOREY, T. J. and PINKERTON, T. B., "A Comparative Analysis of Disk Scheduling Policies", *CACM*, 15:177-184, (March, 1972). <FLS,MOD,PRG>

BUZEN, J. P., "I/O Subsystem Architecture", *Proc. IEEE*, 63:871-879, (June, 1975) <FLS,DE,TN>

WILHELM, N. C., "An Anomaly in Disk Scheduling: A Comparison of FCFS and SSTF Seek Scheduling Using an Empirical Model for Disk Accesses", *CACM*, 19:13-17, (January, 1976). <FLS,MOD,PRG>

WILHELM, N. C., "A General Model for the Performance of Disk Systems", *JACM*, 24: 14-31, (January, 1977). <FLS,MOD,THR>

BARD, Y., "A Model of Shared DASD and Multipathing", *CACM*, 23:564-572, (October, 1980). <FLS,MOD,TN>

SMITH, A. J., "Bibliography on File and I/O System Optimization and Related Topics", *Operating Systems Review*, 15:No. 4:39-54, (October, 1981). <FLS,BIB,G>

BAILEY, K. A. and OLIVER, G. J., "User Defined Files", *Operating Systems Review*, 15:No. 4:75-81, (October, 1981). <FLS,DE,G>

SATYANARAYANAN, M., "A Study of File Sizes and Functional Lifetimes", *Operating Systems Review*, 15:No. 5:96-108, (December, 1981). <FLS,MSR,EMP>

Communications Services

WALDEN, D. C., "A System for Interprocess Communication in a Resource Sharing Computer Network", *CACM*, 15:221-230, (April, 1972). <COM,ENV,TN>

STURGIS, H., MITCHELL, J. and ISRAEL, J., "Issues in the Design and Use of a Distributed File System", *Operating Systems Review*, 14:No. 3:55-69, (July, 1980). <COM,ENV,TN>

SPECTOR, A. Z., "Performing Remote Operations Efficiently on a Local Computer Network", *CACM*, 25:246-260, (April, 1982). <COM,SD,TN>

BIRRELL, A. D., LEVIN, R., NEEDHAM, R. M. and SCHROEDER, M. D., "Grapevine: An Exercise in Distributed Computing", *CACM*, 25:260-274, (April, 1982). <COM,SD,TN>

Security

LAMPSON, B. W., "Dynamic Protection Structures", *Proc. AFIPS FJCC*, 35:27-38, (1969). <SEC,SD,PRG>

COHEN, E. and JEFFERSON, D., "Protection in the Hydra Operating System", *Operating Systems Rev.*, 9:No. 5:141-160, (November, 1975). <SEC,SD,PRG>

ATTANASIO, C. R., MARKSTEIN, P. W., and PHILLIPS, R. J., "Penetrating an Operating System: A Study of VM/370 Integrity", *IBM Systems J.*, 15:102-116, (1976). <SEC,REP,G>

GAINES, R. S. and SHAPIRO, N. Z., "Some Security Principles and Their Application to Computer Security", *Operating Systems Review*, 12:No. 3:19-28, (July, 1978). <SEC,B,CO>

MCGRAW, J. R., and ANDREWS, G. R., "Access Control in Parallel Programs", *IEEE-TSE*, 5:1-9, (January, 1979). <SEC,B,CO>

GIFFORD, D. K., "Cryptographic Sealing for Information Secrecy and Authentication", *CACM*, 25:274-286, (April, 1982). <SEC,DE,CO>

MAJOR THRUST GROUPING

DESIGN

DENNIS, J. B., "Segmentation and the Design of Multiprogrammed Computer Systems", *JACM*, 12:589-602, (October, 1965). <MEM,DE,PRG>

PARMELEE, R. P., PETERSON, T. I., TILLMAN, C. C., and HATFIELD, D. J., "Virtual Storage and Virtual Machine Concepts", *IBM Systems J.*, 11:99-130, (1972). <RM,DE,G>

FABRY, R. S., "Capability Based Addressing", *CACM*, 17:403-411, (July, 1974). <CXT,DE,TN>

BUZEN, J. P., "I/O Subsystem Architecture", *Proc. IEEE*, 63:871-879, (June, 1975). <FLS,DE,TN>

LAMPSON, B. W. and STURGIS, H. E., "Reflections on an Operating System Design", *CACM*, 19:251-265, (May, 1976). <O,DE,G>

SCHROEDER, M. D., CLARK, D. D., and SALTZER, J. H., "Multics Kernel Design Project", *Operating Systems Review*, 11:No. 5:43-56, (November, 1977). <O,DE,PRG>

MOHAN, C., "Survey of Recent Operating Systems Research, Designs and Implementations", *Operating Systems Review*, 12:No. 1:53-89, (January, 1978). <O,DE,INS>

ENSLOW, P. H., "Languages for Operating Systems Description, Design and Implementation", *Proc. AFIPS NCC*, 48:29-37, (1979). <O,DE,INS>

SILBERSCHATZ, A., "Port Directed Communication", *Computer J.*, 24:78-82, (February, 1981). <CM,DE,CO>

BAILEY, K. A. and OLIVER, G. J., "User Defined Files", *Operating Systems Review*, 15:No. 4:75-81, (October, 1981). <FLS,DE,G>

GIFFORD, D. K., "Cryptographic Sealing for Information Secrecy and Authentication", *CACM*, 25:274-286, (April, 1982). <SEC,DE,CO>

Organization

MADNICK, S. E. and ALSOP, J. W., "A Modular Approach to File System Design", *Proc. AFIPS SJCC*, 34:1-13, (1969). <FLS,ORG,TN>

BRINCH HANSEN, P., "The Nucleus of a Multiprogramming System", *CACM*, 13:238-241, 250, (April, 1970). <O,ORG,PRG>

HOARE, C. A. R., "Monitors: An Operating System Structuring Concept", *CACM*, 17:549-557, (October, 1974). <O,ORG,CO>

HABERMANN, A. N., FLON, L., and COOPRIDER, L., "Modularization and Hierarchy in a Family of Operating Systems", *CACM*, 19:266-272, (May, 1976). <O,ORG,PRG>

KEEDY, J. L., "On Structuring Operating Systems With Monitors", *Australian Computer J.*, 10:23-27, (February, 1978). <PM,ORG,G>

GOULLON, H., ISLE, R., and LOHR, K.-P., "Dynamic Restructuring in an Experimental Operating System", *IEEE-TSE*, 4:298-307, (July, 1978). <O,ORG,G>

HOARE, C. A. R., "Communicating Sequential Processes", *CACM*, 21:666-677, (August, 1978). <SYN,ORG,PRG>

REED, D. P. and KANODIA, R. K., "Synchronization with Event Counts and Sequences", *CACM*, 22:115-123, (February, 1979). <SYN,ORG,PRG>

LOMET, D. B., "Subsystems of Processes with Deadlock Avoidance", *IEEE-TSE*, 6:297-304, (May, 1980). <SCH,ORG,THR>

CROWLEY, C., "The Design and Implementation of New UNIX Kernel", *Proc. AFIPS NCC*, 265-271, (1981). <O,ORG,PRG>

Environment

DIJKSTRA, E. W., "Solution of a Problem in Concurrent Programming Control", *CACM*, 8:569, (September, 1965). <SYN,ENV,THR>

DENNIS, J. B. and VAN HORN, E. C., "Programming Semantics for Multiprogrammed Environments", *CACM*, 9:143-155, (March, 1966). <O,ENV,CO>

WALDEN, D. C., "A System for Interprocess Communication in a Resource Sharing Computer Network", *CACM*, 15:221-230, (April, 1972). <COM,ENV,TN>

BAER, J. L., "A Survey of Some Theoretical Aspects of Multiprocessing", *Computing Surveys*, 5:31-80, (March, 1973). <SYN,ENV,CO>

SALTZER, J. H., "Research Problems of Decentralized Systems with Largely Autonomous Nodes", *Operating Systems Review*, 12:No. 1:43-52, (January, 1978). <CM,ENV,CO>

LAMPORT, L., "Time, Clocks, and the Ordering of Events in a Distributed System", *CACM*, 21:558-565, (July, 1978). <SYN,ENV,THR>

STURGIS, H., MITCHELL, J., and ISRAEL, J., "Issues in the Design and Use of a Distributed File System", *Operating Systems Review*, 14:No. 3:55-69, (July, 1980). <COM,ENV,TN>

SCHNEIDER, F. B., "Synchronization in Distributed Programs", *ACM Trans. Programming Langs. & Systems*, 4:125-148, (April, 1982). <SYN,ENV,THR>

OBERMARCK, R., "Distributed Deadlock Detection Algorithm", *ACM Trans. on Database Systems*, 7:187-208, (June, 1982). <SCH,ENV,PRG>

Philosophy

LAMPSON, B. W., "A Scheduling Philosophy for Multiprocessing Systems", *CACM*, 11:347-360, (May, 1968). <SCH,PHL,CO>

LOMET, D. B., "Process Structuring, Synchronization, and Recovery Using Atomic Actions", *Operating Systems Review*, 11:No. 2:128-137, (April, 1977). <SYN,PHL,G>

LAUER, H. C. and NEEDHAM, R. M., "On the Duality of Operating System Structures", *Proc. Second International Symp. on Operating Systems*, IRIA, (1978). <O,PHL,THR>

SYSTEM OR TOPICAL DESCRIPTION

DALEY, R. C. and DENNIS, J. B., "Virtual Memory, Processes, and Sharing in MULTICS", *CACM*, 11:306-312, (May, 1968). <RM,SD,G>

LAMPSON, B. W., "Dynamic Protection Structures", *Proc. AFIPS FJCC*, 35:27-38, (1969). <SEC,SD,PRG>

MEYER, R. A. and SEAWRIGHT, L. M., "A Virtual Machine Time Sharing System", *IBM Systems J.*, 9:199-218, (1970). <CXT,SD,INS>

BUZEN, J. P. and GAGLIARDI, U. O., "The Evolution of Virtual Machine Architecture", *Proc. AFIPS NCC*, 42:291-301, (1973). <CXT,SD,HS>

AUSLANDER, M. A. and JAFFE, J. F., "Functional Structure of IBM Virtual Storage Operating Systems—Part I: Influences of Dynamic Address Translation on Operating System Technology", *IBM Systems J.*, 12:368-381, (1973). <MEM,SD,HS>

SCHERR, A. L., "Functional Structure of IBM Virtual Storage Operating Systems—Part II: OS/VS-2 Concepts & Philosophies", *IBM Syst J*, 12:382-400, (1973). <O,SD,CO>

RITCHIE, D. M. and THOMPSON, K., "The UNIX Time-Sharing System", *CACM*, 17:365-375, (July, 1974). <O,SD,INS>

LYNCH, H. W. and PAGE, J. B., "OS/VS2 Release Two Systems Resources Manager", *IBM Systems J.*, 13:274-291, (1974). <RM,SD,INS>

BAGLEY, J. D., FLOTO, E. R., HSIEH, S. C., and WATSON, V., "Sharing Data and Services in a Virtual Machine System", *Operating Systems Review*, 9:No. 5: 82-88, (November, 1975). <CM,SD,PRG>

COHEN, E. and JEFFERSON, D., "Protection in the Hydra Operating System", *Operating Systems Review*, 9:No. 5:141-160, (November, 1975). <SEC,SD,PRG>

RAIMONDI, D. L., et. al., "LABS/7--A Distributed Real-Time Operating System", *IBM Syst. J.*, 15:81-101, (1976). <O,SD,INS>

WEIZER, N., "A History of Operating Systems", *Datamation*, 27:No. 1:118-126, (January, 1981). <O,SD,HS>

RASHID, R. F. and ROBERTSON, G. G., "Accent: A Communication Oriented Network Operating System Kernel", *Operating Systems Review*, 15:No. 5:64-75, (December, 1981). <O,SD,TN>

LAZOWSKA, E. D., et. al, "The Architecture of the Eden System", *Operating Systems Review*, 15:No. 5:148-159, (December, 1981). <O,SD,G>

TAFT, S. T., "An Object-Based Virtual Operating System for the Ada Programming Support Environment", *Operating Systems Review*, 16:No. 1:14-25, (January, 1982). <O,SD/PHL,G>

SPECTOR, A. Z., "Performing Remote Operations Efficiently on a Local Computer Network", *CACM*, 25:246-260, (April, 1982). <COM,SD,TN>

BIRRELL, A. D., LEVIN, R., NEEDHAM, R. M., and SCHROEDER, M.D., "Grapevine: An Exercise in Distributed Computing", *CACM*, 25:260-274, (April, 1982). <COM,SD,TN>

Report

DIJKSTRA, E. W., "The Structure of the 'THE'-Multiprogramming System", *CACM*, 11:341-346, (May, 1968). <O,REP,EMP>

BRINCH HANSEN, P., "Testing a Multiprogramming System", *Software-Practice & Experience*, 3:145-150, (1973). <O,REP,PRG>

ATTANASIO, C. R., MARKSTEIN, P. W., and PHILLIPS, R. J., "Penetrating an Operating System: A Study of VM/370 Integrity", *IBM Systems J.*, 15:102-116, (1976). <SEC,REP,G>

LISTER, A. M. and MAYNARD, K. J., "An Implementation of Monitors", *Software-Practice & Experience*, 6:377-385, (1976). <SYN,REP,PRG>

Bibliography

AGAJANIAN, A. H., "A Bibliography on System Performance Evaluation", *Computer*, 8:No. 11: - , (November, 1975). <O,BIB,G>

TONIK, A. B., "Bibliography on Checkpoint, Restart, and Recovery Papers", *Performance Evaluation Review*, 5:No. 2:100-104, (April, 1976). <CXT,BIB,INS>

SMITH, A. J., "Bibliography on Paging and Related Topics", *Operating Systems Review*, 12:No. 4:39-56, (October, 1978). <MEM,BIB,G>

NEWTON, G., "Deadlock Prevention, Detection, and Resolution: An Annotated Bibliography", *Operating Systems Review*, 13:No. 2:33-44, (April, 1979). <SCH,BIB,INS>

SMITH, A. J., "Bibliography on File and I/O System Optimization and Related Topics", *Operating Systems Review*, 15:No. 4:39-54, (October, 1981). <FLS,BIB,G>

ANALYSIS

LIPTAY, J. S., "Structural Aspects of the System/360 Model 85: II The Cache", *IBM Systems J.*, 7:15-21, (1968). <MEM,AN,EMP>

BELADY, L. A., NELSON, R. A., and SHEDLER, G. S., "An Anomaly in the Space-Time Characteristics of Certain Programs Running in Paging Machines", *CACM*, 12:349-353, (June, 1969). <MEM,AN,G>

HABERMANN, A. N., "Prevention of System Deadlocks", *CACM*, 12:373-377,385, (July, 1969). <SCH,AN,THR>

SHERMAN, S. W., BASKETT, F., and BROWNE, J. C., "Trace-Driven Modeling and Analysis of CPU Scheduling in a Multiprogramming System", *CACM*, 15:1063-1069, (December, 1972). <SCH,AN,EMP>

WILKES, M. V., "The Dynamics of Paging", *Computer J.*, 16:4-9, (January, 1973). <O,PHL,CO>

CHIU, W. W., DUMONT, D., and WOOD, R., "Performance Analysis of a Multiprogrammed Computer System", *IBM J. of Research and Development*, 19:263-271, (May, 1975). <O,AN,TN>

Modeling

BELADY, L. A., "A Study of Replacement Algorithms for Virtual Storage Computers", *IBM Systems J.*, <u>5</u>:78-101, (1966). <MEM,MOD,TN>

DENNING, P. J., "The Working Set Model for Program Behavior", *CACM*, <u>11</u>:323-333, (May, 1968). <MEM,MOD,THR>

TEOREY, T. J. and PINKERTON, T. B., "A Comparative Analysis of Disk Scheduling Policies", *CACM*, <u>15</u>:177-184, (March, 1972). <FLS,MOD,PRG>

DENNING, P. J. and SCHWARTZ, S. C., "Properties of the Working Set Model", *CACM*, <u>15</u>:191-198, (March, 1972). <MEM,MOD,THR>

LYNCH, W. C., "Operating System Performance", *CACM*, <u>15</u>:579-585, (July, 1972). <O,MOD,G>

SREENIVASAN, K. and KLEINMAN, A. J., "On the Construction of a Representative Synthetic Workload", *CACM*, <u>17</u>:127-133, (March, 1974). <O,MOD,TN>

BASKETT, F., CHANDY, K. M., MUNTZ, R. R., and PALACIOS, F. G., "Open, Closed, and Mixed Networks of Queues with Different Classes of Customers", *JACM*, <u>22</u>:248-260, (April, 1975). <PM,MOD,THR>

BROWNE, J. C., et. al., "Hierarchical Techniques for the Development of Realistic Models of Complex Computer Systems", *Proc. IEEE*, <u>63</u>:966-975, (June, 1975). <O,MOD,TN>

WILHELM, N. C., "An Anomaly in Disk Scheduling: A Comparison of FCFS and SSTF Seek Scheduling Using an Empirical Model for Disk Accesses", *CACM*, <u>19</u>:13-17, (January, 1976). <FLS,MOD,PRG>

WILHELM, N. C., "A General Model for the Performance of Disk Systems", *JACM*, <u>24</u>:14-31, (January, 1977). <FLS,MOD,THR>

CHOW, W.-M. and CHIU, W. W., "An Analysis of Swapping Policies in Virtual Storage Systems", *IEEE-TSE*, <u>3</u>:150-156, (March, 1977). <MEM,MOD,PRG>

BRICE, R. S. and BROWNE, J. C., "Feedback Coupled Resource Allocation Policies in the Multiprogramming-Multiprocessor Computer System", *CACM*, <u>21</u>:678-686, (August, 1978). <SCH,MOD,TN>

TOWSLEY, D. F., CHANDY, K. M., and BROWNE, J. C., "Models for Parallel Processing Within Programs: Application to CPU:I/O and I/O:I/O Overlap", *CACM*, <u>21</u>:821-831, (October, 1978). <O,MOD,TN>

BOKHARI, S. H., "Dual Processor Scheduling with Dynamic Reassignment", *IEEE-TSE*, <u>5</u>:341-349, (July, 1979). <SCH,MOD,TH>

DENNING, P. J., "Working Sets Past and Present", *IEEE-TSE*, <u>6</u>:64-84, (January, 1980). <MEM,MOD,HS>

KRITZINGER, P. S., KRZESINSKI, A. E., and TEUNISSEN, P., "Incorporating System Overhead in Queueing Network Models", *IEEE-TSE*, <u>6</u>:381-390, (July, 1980). <O,MOD,TN>

BARD, Y., "A Model of Shared DASD and Multipathing", *CACM*, <u>23</u>:564-572, (October, 1980). <FLS,MOD,TN>

SAUER, C. H., "Approximate Solution of Queueing Networks with Simultaneous Resource Possession", *IBM J. Research & Development,* 25:894-903, (November, 1981). <O,MOD,TH>

Measurement

PINKERTON, T. B., "Performance Monitoring in a Time-Sharing System", *CACM,* 12:608-610, (November, 1969). <PM,MSR,PRG>

BATSON, A., JU, S.-M., and WOOD, D. C., "Measurements of Segment Size", *CACM,* 13:155-159, (March, 1970). <MEM,MSR,EMP>

HATFIELD, D. J. and GERALD, J., "Program Restructuring for Virtual Memory", *IBM Systems J.,* 10:168-192, (1971). <MEM,MSR,PRG>

HATFIELD, D. J., "Experiments on Page Size, Program Access Patterns, and Virtual Memory Performance", *IBM J. Research and Development,* 16:58-66, (1972). <MEM,MSR,PRG>

HUGHES, J. and CRONSHAW, D., "On Using a Hardware Monitor as an Intelligent Peripheral", *Performance Eval. Review,* 2:No. 4:3-19, (December, 1973). <O,MSR,TN>

BOYSE, J. W., "Execution Characteristics of Programs in a Page-on-Demand System", *CACM,* 17:192-196, (April, 1974). <MEM,MSR,EMP>

NUTT, G. J., "Tutorial: Computer System Monitors", *Computer,* 8:No. 11:51-61, (November, 1975). <PM,MSR,INS>

SATYANARAYANAN, M., "A Study of File Sizes and Functional Lifetimes", *Operating Systems Review,* 15:No. 5:96-108, (December, 1981). <FLS,MSR,EMP>