

H. BUDGET

1. Detailed Budget for First 12-Month Period
2. Budget Estimates for All Years of Support
3. Explanation

SECTION II - PRIVILEGED COMMUNICATION

DETAILED BUDGET FOR FIRST 12-MONTH PERIOD			FROM	THROUGH			
			8 - 1 - 73	7 - 31 - 74			
DESCRIPTION (Itemize)		TIME OR EFFORT %/HRS.	AMOUNT REQUESTED (Omit cents)				
PERSONNEL	NAME		TITLE OF POSITION	SALARY	FRINGE BENEFITS	TOTAL	
	Joshua Lederberg		PRINCIPAL INVESTIGATOR	10	0	0	0
	Edward Feigenbaum		Associate Investigator	10	0	0	0
	Thomas Rindfleisch		SUMEX Facility Head	100			
	Ron Jamtgaard			50	(Details of Salary Budget		
	Gio Wiederhold			90	are submitted in a separate		
	Lee Hundley			100	letter)		
	9 - Systems Programmers			900			
	1 - Applied Mathematician			100			
	2 - Engineers			200			
	3 - Technicians			300			
	3 - Operations Staff			300			
	1 - Secretary			100			
	1 - Administrative Aide			100			
	2 - Grad. Student R.A.'s plus summer help			100			
	Total (24.6 FTE)				375,000	63,750	438,750
CONSULTANT COSTS							2,500
EQUIPMENT Lease of PDP-10 System (Purchase Price--\$1,744,750 less 10% assumed Educational discount plus 5% Calif. Use Tax times DEC lease factor of 2.2% per month=\$36,275/month plus miscellaneous features on hardware to be leased.							435,300*
Purchase graphics station--\$8,000; small machine equipment peripherals \$26,000; communications hardware--\$6,000.							700
							40,000*
SUPPLIES	Office Supplies	4,000	Computer Supplies	6,000			10,000
	Books & Publications	200	Office Telephone	7,000			7,200
	Reproduction Expense	2,500	Technical Services	2,000			4,500
	Engineering Supplies	15,000					15,000
	Postage & Freight	2,500					2,500
TRAVEL	DOMESTIC	5 East, 5 Midwest, 6 West Coast					4,400
	FOREIGN						
PATIENT COSTS (See instructions)							
ALTERATIONS AND RENOVATIONS							
Air conditioning, false flooring, etc., needed for hardware installation.							45,000
OTHER EXPENSES (Itemize) Computer service from SUMCCF							24,000
Maintenance: For PDP-10 System--\$84,600; for service contracts on graphics, peripherals, and communications hardware--\$9,400.							94,000
Communications Costs (Transmission lines and modems)							12,000
Staff Training							2,000
TOTAL DIRECT COST (Enter on Page 1, Item 5)			→				1,137,850
INDIRECT COST (See Instructions)	DATE OF DHEW AGREEMENT:		<input type="checkbox"/> WAIVED <input type="checkbox"/> UNDER NEGOTIATION WITH:				
	_____ % S&W*		_____ % WTDC* <u>pending</u>				
	<u>46</u>						
*IF THIS IS A SPECIAL RATE (e.g. off-site), SO INDICATE.							

SECTION II - PRIVILEGED COMMUNICATION

BUDGET ESTIMATES FOR ALL YEARS OF SUPPORT REQUESTED FROM PUBLIC HEALTH SERVICE DIRECT COSTS ONLY (Omit Cents)							
DESCRIPTION	1ST PERIOD (SAME AS DE- TAILED BUDGET)	ADDITIONAL YEARS SUPPORT REQUESTED (This application only)					
		2ND YEAR	3RD YEAR	4TH YEAR	5TH YEAR	6TH YEAR	7TH YEAR
PERSONNEL COSTS	438,750	464,630	491,990	520,930	551,530		
CONSULTANT COSTS (Include fees, travel, etc.)	2,500	2,500	2,500	2,500	2,500		
EQUIPMENT							
Lease	436,000	436,000	436,000	436,000	436,000		
Maint.	94,000	94,000	160,000	160,000	160,000		
Purchase	40,000	40,000	54,000	64,000	64,000		
SUPPLIES							
Communications	12,000	16,000	16,000	18,000	18,000		
Supplies	39,200	40,000	41,000	42,000	43,000		
TRAVEL							
DOMESTIC	4,400	4,400	4,000	4,200	4,200		
FOREIGN							
PATIENT COSTS							
ALTERATIONS AND RENOVATIONS	45,000	---	---	---	---		
OTHER EXPENSES							
Computer Services	24,000	24,000	24,000	24,000	24,000		
Training	2,000	1,000	1,000	1,000	1,000		
TOTAL DIRECT COSTS	1,137,850	1,222,530	1,230,490	1,272,630	1,304,230		
TOTAL FOR ENTIRE PROPOSED PROJECT PERIOD (Enter on Page 1, Item 4) →					\$ 6,0 ⁶ 7,730		
REMARKS: Justify all costs for the first year for which the need may not be obvious. For future years, justify equipment costs, as well as any significant increases in any other category. If a recurring annual increase in personnel costs is requested, give percentage. (Use continuation page if needed.)							
<ol style="list-style-type: none"> Lease of equipment covers a PDP-10 Computer System. Personnel salaries are increased at 5% per year. Staff benefits are 17% in Year 1 and 1% per year greater in each subsequent year. Alteration and renovation funds of \$45,000 are requested for air conditioning and false floors needed for hardware installation. The PDP-10 maintenance contract will be changed from 12 hours, 5 days per week to 24 hours, 7 days per week in Year 3. This will provide the backup capability needed by the Service System, and -versa. 							

BUDGET ESTIMATES FOR PDP-10 SYSTEM:

	<u>Purchase Price</u>	<u>Monthly Maint. (12 hrs 5 days)</u>
<u>Central Processor</u> KI-10 incl. Operator's Console	\$ 380,000	\$ 555
<u>Memory System</u> 8 x ME10, 8 x 16k words	400,000	1,336
<u>Auxillary Memory System</u> 4 x ME10 and DT04C	225,000	748*
<u>Keyboard Terminals(16)</u> Hardcopy & CET, to be selected (16 x 3K)	48,000	320
<u>Memory Bus Swapping Drum System</u> RM10 B & Controller	83,000	265
<u>Memory Bus Disc System</u> 4 x RP03 Disc & Controller	150,000	826
<u>Input/Output Bus Peripheral System</u> Tape Systems, 3 x TU10, (9x7 track) & 1 DEC TU56 & Controllers	64,850	338
<u>Asynchronous Communication System</u> DC10 System for Keyboard Terminals	37,500	110 (A)
<u>SATELLITE COMPUTERS: Includes intercomputer communications and --</u>		
<u>Multiplexed Memory System</u>		
PDP 11/45 #1: 8K	74,050*	547* (B)
#2: 4K	16,450	195
#3: 4K	16,450	195
#4: 8K (incl. RK11 and RF11 Disc, & PC11 Punch and tape)	56,450	484*
10/11 Interface	70,000	500*
MX10 Memory Multiplexor	4,500	15*
<u>Peripherals</u>	118,000	462*
LP10C Line Printer, CP10A, CR10D Card Punch & Reader		
Sub Totals	<u>1,744,250</u>	<u>6,896</u>
Assume 10% Educational Discount	- 174,425	
Net	1,569,825	(Not including sales tax)
<u>Options:</u>		
1) Memory System(4 x ME10)	200,000	668
2) Terminal Communications(DP11DA's & DP11DC's)	7,900	115 a)
3) Sync Communications System(DC-75)	50,000	250* b)
	<u>257,900</u>	<u>1,033</u>
(Incl. Option 1)	TOTAL \$ 1,769,325	(Not incl. sales tax)

a) Added to A above.

b) Deletes \$7,400 of B above.

3. Explanation

a. Major Assumptions

The five-year budget request has been prepared with the following major assumptions:

- (1) SUMEX will include a PDP-10 KI-10 Processor with 192K words of core plus four PDP-11 satellite processors. Additional "user owned" remote satellites will be attached by collaborators.
- (2) It is assumed that the Medical Center will opt to replace the 360/50 with a PDP-10 for the Service Facility. SUMEX personnel will mount a PL-type language on the PDP-10 in order to provide a transition from the 360/50 for current software.
- (3) A 10% education discount from list price on the PDP-10 has been assumed. A higher discount may be negotiable.
- (4) The staff of SUMEX will evolve from the existing groups which have demonstrated competence in tackling and solving biomedical computing problems.
- (5) University authorization and funding of modifications to existing machine room space are assumed. Detailed and formal proposals will not be available for consideration by the University prior to submission of this proposal.
- (6) We expect that the full lease costs associated with the SUMEX PDP-10 System will be covered by the proposed grant. A full pay-out, 5-year lease is proposed.
- (7) In general, collaborators will provide their own laboratory hardware and applications programming. SUMEX will provide host computer services, system software support, and some assistance in interfacing to the host.
- (8) A beginning date of August 1, 1973, is proposed. This coincides with the end of the current ACME grant.

b. Notes on Budget Elements -- Year 1

The explanation of each budget element requested for Year 1 is presented below.

Salaries: The salaries included in the budget are based upon the following manpower assumptions:

- (1) SUMEX will have a Facility Director, a senior technical project leader, and a one-half time administrative manager on its management team. It is assumed that one project leader might be given the small machine support task while the other would handle the extended realtime support tasks. A total of 10 systems programming personnel are included in the budget. This will make a tight fit in Year 1 when an estimated 5.5 man-years will be devoted to the transition of a PL-type language

to the PDP-10. The number of programmers covered by the budget reflects our concern with becoming "too large" to be manageable as a research team, as well as recognition of the large effort required to achieve our goals.

Five man-years of engineering and technician effort are budgeted. Their primary efforts will involve design, fabrication, installation, and maintenance of special interfaces and communications lines. Much of the collaborators' work described in the proposal will be dependent upon interfacing new hardware to computing systems. For example, two scanning devices are to be acquired by collaborative projects and will be interfaced to machines in the Resource. Detailed planning for this group will be dependent upon future decisions in the participating projects.

The Operations staff will operate, by assumption, both the SUMEX and SUMCCF systems. Since the SUMEX operation will involve only a few research groups, the operations tasks should be relatively light during most hours of operation. If the SUMCCF budgets four full time equivalents and the SUMEX budgets three, then it is feasible to cover all 21 shifts per week. The operations staff figure includes an Operations Manager who would be shared by the two facilities. All of these estimates are based upon the assumptions that SUMEX and SUMCCF will be situated in a common area and that shared operating staffs are desired by computing coordinators in the Center.

The balance of the staff will be comprised of an applied mathematician, one administrative aide, one secretary, plus occasional part time help, including graduate student research assistants. The applied mathematician is requested in order to assist collaborators and core research efforts. Such assistance should prove especially valuable in developing new algorithms, appraising new techniques for image processing, etc.

- (2) Staff Benefits: The standard rate for the University's FY1974 is 17%.
- (3) Training, Consulting, Travel, and Publications: The training budget of \$2,000 will be used to make the staff better acquainted with PDP-10's, various satellite processors, and new software techniques. The consulting item of \$2,500 is an estimate of the first year's needs. It is double the current year budget for ACME outside consulting due to the complexity of tasks to be undertaken. The travel time should provide eight trips to the east coast, 3 to the midwest, and 6 on the west coast (\$3,200 + 900 + 400 = \$4,400). The travel funds will be used to exchange information with other research centers, attend training sessions, disseminate information, and investigate possible network participation.

- (4) Materials and Supplies: These estimates are based entirely upon the experience gained in the ACME Grant. The items are as follows:

<u>Item</u>	<u>Est. Cost</u>
Office Supplies	\$ 4,000
Computer Operations Supplies	6,000
Publications	2,500
Postage and Freight	2,500
Books and Periodicals	200
Office Telephone	7,000
Technical Services	2,000
Engineering Supplies	15,000
Total	<u>\$ 39,200</u>

- (5) Communications Costs: Collaborators in this proposal are situated from 100 feet to 2.5 miles from the existing machine room. This budget element will be used to provide high data rate communications lines as required by each research project. Dr. Kopell's group is located in the Palo Alto Veterans Hospital which is about 2.5 miles distant. The mass spectrometer used by the DENDRAL group is situated in the Chemistry Building which is more than 1,000 feet from the machine room. Communications will be handled by a combination of Telephone Company lines and local hardwire connections. Specific transmission requirements must precede detailed estimates. A 40kb telephone line connecting VA Hospital and the machine room has been priced at \$596 per month plus an installation fee of \$950. This budget element will also include some modem rentals. We anticipate the announcement of a number of commercially available modems which will accommodate bandwidths and data rates of interest.
- (6) Equipment Lease: The hardware described in Section E of the proposal is a KI-10 System with a list purchase price of \$1,744,750. A full payout lease has been offered by DEC at 2.2% of the purchase price per month. A 10% educational discount has been assumed; no negotiation has been held with DEC on this point. To this net price, the 5% California Use Tax must be added. The lease rate is calculated as \$1,744,750 less 10% plus 5% tax at 2.2% per month giving a monthly rate of \$36,274. At the end of five years, the equipment will be owned. The lease rate does not include maintenance. Additional equipment was presented in Section E as "options". The options included additional core, terminal communications add-ons, and a synchronous communications system. In view of the competing demands for funding, these items have been excluded from the budget. If future arrangements with DEC permit the acquisition of more equipment within the budgeted dollars, then optional items will be added to the configuration. The optional items were initially part of the required configuration but were set aside in order to obtain a balance between hardware and personnel within an overall budget which was deemed feasible.

- (7) Maintenance of Equipment: The primary hardware maintenance contract will be with DEC. Using DEC's standard 5-day 12-hour maintenance contract for all items in the budgeted configuration results in monthly charges of \$7,053. This figure includes estimates for six hardware items on which standard maintenance charges have not been announced. This level of maintenance may be adequate for the research activity of SUMEX. If more hours are needed in order to provide better backup support for the SUMCCF, the 5-day 12-hour assumption will be re-evaluated. In addition to the \$84,600 for PDP-10 system maintenance, the budget includes \$9,400 for maintenance contracts covering graphics stations, additional small machine peripherals, communications hardware, etc.
- (8) Other Equipment: In addition to the items identified in the PDP-10 system, SUMEX will require equipment for its engineering group, communications hardware, and graphics support. In a research and development program of the type proposed, equipment needs will arise which cannot be specified today. A few examples of the types of hardware which are likely to be required include: complete graphics station for \$8,000; special hardware interfaces for small machines for \$10,000; expansions to the small machine equipment pool for \$16,000; and communications hardware for \$6,000.
- (9) Alterations and Renovations: \$45,000 are included in the budget in order to provide adequate facilities in which to house the SUMEX hardware. Extension of the existing space occupied by the ACME Machine Room will be needed. The University is being asked to provide structural modifications. This proposal includes the funds to provide necessary air conditioning, false floors, cable tray access, and some special electrical provision for the computing facilities. The cost estimate is rough at this time. Efforts will be made in the near term to obtain requisite approvals from the University plus the funding for the building modifications. Also, more detailed estimates of special facilities associated with the hardware will be prepared.

I. FUTURE PLANS

Our plans beyond the requested five-year period of support call for hardware dedicated to the types of user projects listed in our proposal. We expect that the central hardware will continue to be available as a research resource for a limited number of users. New projects presumably will emerge calling for development of new computing techniques. The current talents of the staff will be deepened and new skills will be developed which we assume will prove highly useful in solution of some of tomorrow's problems.

A lesson from the ACME experience is that technological change, as evidenced by the minicomputer revolution, must be carefully monitored. We hope to anticipate major changes more accurately so that new developments will integrate well with local research efforts. We would expect, based upon current trends, to involve ourselves with computer architectures other than the initial selection for this research resource.

J. APPENDICES

1. ACME User Publications

2. Biographical Sketches

This list contains papers voluntarily reported to ACME.

- Balkian, H., A. Brodie, S. Willoughby, A. Dowdy, G. Nokes, M. Weinberger, and J. Luetscher, "Response of Plasma Aldosterone Concentration in Hypertensive Patients to Changes in Posture and Sodium Intake," CLIN. RES., vol. 17, p. 141, Jan. 1969, (abstract).
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- Bodmer, W., M. Feldman, and M. Nabholz, "The Evolution of the Rh Polymorphism: A Model for the Interaction of Incompatibility, Reproductive Compensation, and Heterozygote Advantage," AMER. J. HUMAN GENETICS, vol. 21, no. 2, pp. 171-193, Mar. 1969.
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BIOGRAPHICAL SKETCH

(Give the following information for all professional personnel listed on page 3, beginning with the Principal Investigator. Use continuation pages and follow the same general format for each person.)

NAME	TITLE	BIRTHDATE (Mo., Day, Yr.)
LEDERBERG, JOSHUA	Professor and Executive Head, Department of Genetics	5-23-25
PLACE OF BIRTH (City, State, Country)	PRESENT NATIONALITY (If non-U.S. citizen, indicate kind of visa and expiration date)	SEX
Montclair, New Jersey	U.S.A.	<input checked="" type="checkbox"/> Male <input type="checkbox"/> Female

EDUCATION (Begin with baccalaureate training and include postdoctoral)

INSTITUTION AND LOCATION	DEGREE	YEAR CONFERRED	SCIENTIFIC FIELD
Columbia College, New York	B.A.	1944	
College of Physicians & Surgeons, Columbia University, New York (1944-46)			
Yale University	Ph.D.	1947	Microbiology

HONORS

- 1957 - National Academy of Sciences
- 1958 - Nobel Prize in Medicine

MAJOR RESEARCH INTEREST	ROLE IN PROPOSED PROJECT
Molecular Genetics; Artificial Intelligence	PRINCIPAL INVESTIGATOR

RESEARCH SUPPORT (See instructions)

SEE ATTACHMENTS:

RESEARCH AND/OR PROFESSIONAL EXPERIENCE (Starting with present position, list training and experience relevant to area of project. List all or most representative publications. Do not exceed 3 pages for each individual.)

- 1961- Stanford University
Director, Kennedy Laboratories for Molecular Medicine
- 1959- Professor, Genetics and Biology, and Executive Head, Department of Genetics, Stanford University
- 1957-1959 University of Wisconsin
Chairman, Department of Medical Genetics
- 1957 Melbourne University, Australia
Fullbright Visiting Professor of Bacteriology
- 1950 University of California, Berkeley
Visiting Professor of Bacteriology
- 1947-1959 University of Wisconsin
Professor of Genetics
- 1946-1947 Yale University. Research Fellow of the Jane Coffin Childs Fund for Medical Research
- 1945-1946 Columbia University. Research Assistant in Zoology

Professional Activities:

- 1967- NIMH: National Mental Health Advisory Council
- 1961-1962 President (Kennedy)'s Panel on Mental Retardation
- 1960- NASA Committees: Lunar and Planetary Missions Board
- 1958- National Academy of Sciences: Committees on Space Biology
- 1950- President's Science Advisory Committee panels. National Institutes of Health, National Science Foundation study sections (genetics)

LIST OF PUBLICATIONS

81. Lederberg, J., 1959
A View of Genetics.
Les Prix Nobel en 1958: 170-89.
182. Buchs, A., A.B. Delfino, A.M. Duffield, C. Djerassi, B.G. Buchanan,
E.A. Feigenbaum, and J. Lederberg, 1970.
Applications of Artificial Intelligence for Chemical Inference. VI.
Approach to a general method of interpreting low resolution mass spectra
with a computer.
Helvitia Chimica Acta 53 (6): 1394-1417.
186. Feigenbaum, E. A., B. G. Buchanan, J. Lederberg, 1971
On generality and problem solving: a case study using the DENDRAL program
in Machine Intelligence 6, (B. Meltzer and D. Michie, eds.),
Edinburgh University Press, P. 165-190.
192. Reynolds, W.E., V.A. Bacon, J.C. Bridges, T.C. Coburn, B. Halpern,
J. Lederberg, E.C. Levinthal, E. Steed, R.B. Tucker, 1970
A computer operated mass spectrometer system.
Analytical Chem. 42:1122-1129, September 1970.
194. Lederberg, J.
"Use of Computer to Identify Unknown Compounds: The Automation of Scientific
Inference" in Biochemical Applications of Mass Spectrometry (G.R. Waller,
ed.). John Wiley & Sons, New York (in press)

RESEARCH SUPPORT:

<u>Grant</u>	<u>Project Title</u>	<u>Dates</u>	<u>Amt.</u>	<u>Budgeted Amt. of Salary</u>
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Research Projects:

JPL Contract 952489	Extended Mission of Mariner Mars	9/1/69 - 6/30/72	\$185,000	16%
NASA NAS-19692	Viking Biology Team	-6/30/72	\$ 9,608	
NIH RR0311	Advanced Computer for Med. Research	1966 - 7/31/73	\$	25%
NIH A1 05160-14	Genetics of Bacteria	9/1/71 - 8/31/72	\$ 58,000	

Managerial:

NIH GM 295-13	Training Program in Genetics	7/1/71 - 6/30/72	\$130,609	
NSF GB 29094	Exchange Program in Genetics and Molecular Biology between Universities of Stanford and Pavia (Italy)	5/1/72 - 4/30/73	\$ 60,000	(Applied for)
NASA NGR 05-020-004	Cytochemical Studies of Planetary Micro- organisms	9/1/71 - 8/30/72	\$240,000	05%

BIOGRAPHICAL SKETCH

(Give the following information for all professional personnel listed on page 3, beginning with the Principal Investigator. Use continuation pages and follow the same general format for each person.)

NAME Edward A. Feigenbaum	TITLE Professor of Computer Science	BIRTHDATE (Mo., Day, Yr.) 1-20-36	
PLACE OF BIRTH (City, State, Country) Weehawken, New Jersey	PRESENT NATIONALITY (If non-U.S. citizen, indicate kind of visa and expiration date) U. S. A.	SEX <input checked="" type="checkbox"/> Male <input type="checkbox"/> Female	
EDUCATION (Begin with baccalaureate training and include postdoctoral)			
INSTITUTION AND LOCATION	DEGREE	YEAR CONFERRED	SCIENTIFIC FIELD
Carnegie Institute of Technology	B. S.	1956	Electrical Engineering
Carnegie Institute of Technology	Ph.D.	1959	Industrial Administration

HONORS

Fulbright Research Scholar, Great Britain, National Physics Laboratory, Teddington, England, 1959-60.

MAJOR RESEARCH INTEREST

Artificial Intelligence Research
Heuristic Programming

ROLE IN PROPOSED PROJECT

Associate Investigator

RESEARCH SUPPORT (See instructions)

Contract/Grant No.	Title	Current Total, Proj.		% Effort	Source of Support
		Year	Period		
ARPA SD-183	The Heuristic Programming Project of the Stanford Artificial Intelligence Project	\$200,000	\$700,548	42%	ARPA
5 R24 RR00612-02 SSS	Resource-Related Research; Computers and Chemistry	214,093	722,062	27%	NIH

RESEARCH AND/OR PROFESSIONAL EXPERIENCE (Starting with present position, list training and experience relevant to area of project. List all or most representative publications. Do not exceed 3 pages for each individual.)

1965- Stanford University, Computer Science Department Faculty
 1965-68 Stanford University, Director, Computation Center
 1968-72 National Institutes of Health, Member, Computer and Biomathematical Sciences Study Section
 1965- Editor, Computer Science Series, McGraw-Hill Book Company, New York
 1960-64 University of California, Berkeley
 Research-Center for Research in Management Science, 1960-64
 Research-Center for Human Learning, 1961-64
 Assistant and Associate Professor, School of Business Administration, 1960-64
 1963 National Science Foundation. Summer Research Training Institute in Computer Simulation of Cognitive Processes. Faculty member.
 1962 Carnegie Corporation. Summer Research Training Institute in Heuristic Programming. Faculty member.
 1956 IBM Scientific Computing Center, New York

Recent Publications

- Smith, D. H., Buchanan, B. G., Engelmores, R. S., Duffield, A. M., Yeo, A., Feigenbaum, E. A., Lederberg, J., and Djerassi, Carl, "Applications of Artificial Intelligence for Chemical Inference VIII. An Approach to the Computer Interpretation of the High Resolution Mass Spectra of Complex Molecules. Structure Elucidation of Estrogenic Steroids," December, 1971.
- Buchanan, B. G., Feigenbaum, E. A., and Lederberg, J., "A Heuristic Programming Study of Theory Formation in Science." In proceedings of the Second International Joint Conference on Artificial Intelligence, Imperial College, London (September 1971). (Also Stanford Artificial Intelligence Project Memo No. 145.)
- Buchs, Armand, Delfino, Allan B., Djerassi, Carl, Duffield, A. M., Buchanan, B. G., Feigenbaum, E. A., Lederberg, J., Schroll, Gustav, and Sutherland, G. L., "The Application of Artificial Intelligence in the Interpretation of Low-Resolution Mass Spectra", Advances in Mass Spectrometry Volume 5, 314-318.
- Feigenbaum, E. A., Buchanan, B. G., and Lederberg, J., "On Generality and Problem Solving: A Case Study Using the DENDRAL Program", Machine Intelligence 6, B. Meltzer and D. Michie, eds., Edinburgh University Press, 1971.
- Lederberg, J., Sutherland, G. L., Buchanan, B. G., Feigenbaum, E. A., Robertson, A. V., Duffield, A. M. and Djerassi, C., "Applications of Artificial Intelligence for Chemical Inference I. The Number of Possible Organic Compounds. Acyclic Structures Containing C, H, O and N", Journal of the American Chemical Society, 91, 2973, 1969.
- Duffield, A. M., Robertson, A. V., Djerassi, C., Buchanan, B. G., Sutherland, G. L., Feigenbaum, E. A. and Lederberg, J., "Applications of Artificial Intelligence for Chemical Inference II. Interpretation of Low Resolution Mass Spectra of Ketones", Journal of the American Chemical Society, 91, 2977, 1969.
- Schroll, G., Duffield, A. M., Djerassi, C., Buchanan, B. G., Sutherland, G. L., Feigenbaum, E. A. and Lederberg, J., "Applications of Artificial Intelligence for Chemical Inference III. Aliphatic Ethers Diagnosed by Their Low Resolution Mass Spectra and Nuclear Magnetic Resonance", Journal of the American Chemical Society, 91, 7440, 1969.
- Lederberg, J., Sutherland, G. L., Buchanan, B. G. and Feigenbaum, E. A., "A Heuristic Program for Solving a Scientific Inference Problem: Summary of Motivation and Implementation", Stanford Artificial Intelligence Project Memo No. 104, November 1969.
- Buchanan, B. G., Sutherland, G. L. and Feigenbaum, E. A., "Toward an Understanding of Information Processes of Scientific Inference in the Context of Organic Chemistry", in Machine Intelligence 5, B. Meltzer and D. Michie, eds., Edinburgh University Press, 1970. (Also Stanford Artificial Intelligence Project Memo No. 99, September 1969)

Publications

Page 2

- Buchanan, B. G., Sutherland, G. L., and Feigenbaum, E. A., "Heuristic DENDRAL: A Program for Generating Explanatory Hypotheses in Organic Chemistry", in Machine Intelligence 4, B. Meltzer and D. Michie, eds., Edinburgh University Press, 1969. (Also Stanford Artificial Intelligence Project Memo No. 62, July 1968.)
- Feigenbaum, E. A., "Artificial Intelligence: Themes in the Second Decade", in Final Supplement to Proceedings of the IFIP68 International Congress, Edinburgh, August 1968. (Also Stanford Artificial Intelligence Project Memo No. 67, August 1967)
- Lederberg, J. and Feigenbaum, E. A., "Mechanization of Inductive Inference in Organic Chemistry", in Formal Representations for Human Judgment, B. Kleinmuntz, ed., Wiley, 1968. (Also Stanford Artificial Intelligence Project Memo No. 54, August 1967.)