HPP-69-6

J. Lederberg, G.L. Sutherland, B.G. Buchanan, E.A. Feigenbaum, A.V. Robertson, A.M. Duffield, and C. Djerassi, "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 (1969).

HPP-69-7

A.M. Duffield, A.V. Robertson, C. Djerassi, B.G. Buchanan, G.L. Sutherland, E.A. Feigenbaum, and J. Lederberg, "Application of Artificial Intelligence for Chemical Inference II. Interpretation of Low Resolution Mass Spectra of Ketones". Journal of the American Chemical Society, 91:11 (May 21, 1969).

HPP-69-8

C.W. Churchman and B.G. Buchanan,
"On Design of Inductive Systems: Some Philosophical
Problems". British Journal for the Philosophy of
Science, 20 (1969).

HPP-69-9

G. Schroll, A.M. Duffield, C. Djerassi, B.G. Buchanan, G.L. Sutherland, E.A. Feigenbaum, and J. Lederberg, "Application of Artificial Intelligence for Chemical Inference III. Aliphatic Ethers Diagnosed by Their Low Resolution Mass Spectra and NMR Data". Journal of the American Chemical Society, 91. (1969).

HPP-70-1

A. Buchs, A.B. Delfino, C. Djerassi, A.M. Duffield, B.G. Buchanan, E.A. Feigenbaum, J. Lederberg and G. Schroll,

"Application of Artificial Intelligence for Chemical Inference. IV. Saturated Amines Diagnosed by Their Low Resolution Mass Spectra and Nuclear Magnetic Resonance Spectra", Journal of the American Chemical Society, 92, (1970).

HPP-70-2

AIM-123

Bruce G. Buchanan, Thomas E. Headrick, "Some Speculation About Artificial Intelligence and Legal Reasoning", (May 1970). Stanford Law Review Fall 1970.

HPP-70-3

Y.M. Sheikh, A. Buchs, A.B. Delfino, G. Schroll, A.M. Duffield, C. Djerassi, B.G. Buchanan, G.L. Sutherland, E.A. Feigenbaum and J. Lederberg, "Applications of Artificial Intelligence for Chemical Inference V. An Approach to the Computer Generation of Cyclic Structures. Differentiation Between All The Possible Isomeric Ketones of Composition C6H100", Organic Mass Spectrometry, 4, 493, (1970).

HPP-70-4

A. Buchs, A.B. Delfino, A.M. Duffield, C. Djerassi, B.G. Buchanan, E.A. Feigenbaum and J. Lederberg, "Applications of Artificial Intelligence for Chemical Inference VI. Approach to a General Method of Interpreting Low Resolution Mass Spectra with a Computer", Helvetica Chimica Acta, 53, 1394 (1970).

HPP-70-5

AIM-131, CS-176, AD715128

Edward A. Feigenbaum, Bruce G. Buchanan, Joshua Lederberg, "On Generality and Problem Solving: a Case Study Using the DENDRAL Program", (August 1970). Also in Machine Intelligence-6, Edinburgh Univ. Press, 1971.

HPP - 71 - 1

A. Buchs, A.B. Delfino, C. Djerassi, A.M. Duffield, B.G. Buchanan, E.A. Feigenbaum, J. Lederberg, G. Schroll, and G.L. Sutherland, "Applications of Artificial Intelligence for Chemical Inference VII. The Application of Artificial Intelligence in the Interpretation of Low-Resolution Mass Spectra", Advances in Mass Spectrometry, 5, 314 (1971).

HPP-71-2

AIM-141, CS-205, AD730506
Bruce G. Buchanan, Joshua Lederberg,
"The Heuristic DENDRAL Program for Explaining Data",
In proceedings of the IFIP Congress 71, Ljubljana,
Yugoslavia (February 1971).

HPP-71-3
AIM-147, CS-216, AD732457
Robert E. Kling,
"Reasoning by Analogy with Applications to
Heuristic Problem Solving: a Case Study",
Thesis: Ph.D. in Computer Science (August 1971).

HPP-71-4 AIM-141

B.G. Buchanan, E.A. Feigenbaum, and J. Lederberg, "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).

HPP-71-5

B.G. Buchanan, A.M. Duffield, A.V. Robertson,
"An Application of Artificial Intelligence to the Interpretation
of Mass Spectra", Mass Spectrometry Techniques and Appliances,
G.W.A. Milne, Ed., John Wiley & Sons, Inc., p. 121, (1971).

HPP-72-1

D.H. Smith, B.G. Buchanan, R.S. Engelmore, A.M. Duffield, A. Yeo, E.A. Feigenbaum, J. Lederberg, and C. Djerassi, "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", Journal of the American Chemical Society, 94, 5962 (1972).

HPP-72-2

B.G. Buchanan, E.A. Feigenbaum, and N.S. Sridharan, "Heuristic Theory Formation: Data Interpretation and Rule Formation". In Machine Intelligence 7, Edinburgh University Press (1972).

HPP - 72 - 3

AIM-181, CS-325

Bruce G. Buchanan.

"Review of Hubert Dreyfus' 'What Computers Can't Do': a Critique of Artificial Reason", (December 1972).

Computing Reviews (January, 1973).

Also in Computing Reviews, January 1973.

HPP-72-4

J. Lederberg,

"Rapid Calculation of Molecular Formulas from Mass Values". Journal of Chemical Education, 49, 613, (1972).

HPP-72-5

Joshua Lederberg,

"Use of a Computer to Identify Unknown Compounds:

The Automation of Scientific Inference",

Biochemical Applications of Mass Spectrometry, (1972).

HPP-72-6

STAN-CS-318

H. Brown, L. Masinter, and L. Hjelmeland, "Constructive Graph Labeling Using Double Cosets". Discrete Mathematics, 7, 1 (1974).

HPP-73-1

D.H. Smith, B.G. Buchanan, R.S. Engelmore, H. Aldercreutz and C. Djerassi,

"Applications of Artificial Intelligence for Chemical Inference IX. "Analysis of Mixtures Without Prior Separation as Illustrated for Estrogens". Journal of the American Chemical Society, 95, 6078 (1973).

HPP-73-2

D.H. Smith, B.G. Buchanan, W.C. White, E.A. Feigenbaum, C. Djerassi and J. Lederberg.

"Applications of Artificial Intelligence for Chemical Inference X. "INTSUM. A Data Interpretation Program as Applied to the Collected Mass Spectra of Estrogenic Steroids". Tetrahedron, 29, 3117, (1973).

HPP-73-3

AIM-205, CS-370, AD764288

N.S. Sridharan, et.al,

"A Heuristic Program to Discover Syntheses for Complex Organic Molecules", (June 1973).

HPP-73-4

STAN-CS-73-381

N.S. Sridharan,

"Computer Generation of Vertex Graphs", (July 1973).

HPP-73-5

R. Carhart and C. Djerassi,

"Applications of Artificial Intelligence for Chemical Inference XI: The Analysis of Cl3 NMR Data for Structure Elucidation of Acyclic Amines", Journal of the American Chemical Society (Perkin II), 1753, (1973).

HPP-73-6

AIM-215, CS-387, AD769380

B.G. Buchanan and N.S. Sridharan,

"Analysis of Behavior of Chemical Molecules:

Rule Formation on Non-Homogeneous Classes of Objects".

In proceedings of the Third International Joint

Conference on Artificial Intelligence, (August 1973).

Also in Machine Intelligence-7, Edinburgh Univ. Press, 1974.

HPP-73-7

D. Michie and B.G. Buchanan.

"Current Status of the Heuristic DENDRAL Program for Applying Artificial Intelligence to the Interpretation of Mass Spectra", in "Computers for Spectroscopy", [Also: University fo Edinburgh, School of Artificial Intelligence, Experimental Programming Report No. 32 (1973).]

HPP-73-8

AIM-217, CS-391, AD770610

N.S. Sridaran

"Search Strategies for the Task of Organic Chemical Synthesis", (August 1973).

HPP-73-9

E.H. Shortliffe, S.G. Axline, B.G. Buchanan, T.C. Merigan, S.N. Cohen,

"An Artificial Intelligence Program to Advise Physicians Regarding Antimicrobial Therapy", Computers and Biomedical Research, 6:544-560 (1973).

HPP-73-10

AIM-216, CS-389, AD71299

Larry Masinter, N.S. Sridharan, J. Lederberg, D.H. Smith "Applications of Artificial Intelligence for Chemical Inference XII: Exhaustive Generation of Cyclic and Acyclic Isomers", (September 1973). Also in J. Am. Chem. Soc. Vol. 96, No. 25, December 11, pp. 7702-7714, (1974).

HPP-74-1

E.H. Shortliffe, S. G. Axline, B.G. Buchanan, S.N. Cohen, "Design Considerations for a Program to Provide Consultations in Clinical Therapeutics, Proceedings of San Diego Biomedical Symposium 1974 (February 6-8 1974).

HPP-74-2

AIM-251, CS-465, ADA001373

Edward H. Shortliffe,

"MYCIN: A Rule-Based Computer Program for Advising Physicians Regarding Antimicrobial Therapy Selection", Thesis: Ph.D. in Medical Information Sciences,

Thesis: Ph.D. in Medical Information Sciences, (October 1974).

HPP-74-3

B.G. Buchanan,

"Scientific Theory Formation by Computer". In Proceedings of NATO Advanced Study Institute on Computer Oriented Learning Processes, Bonas, France, (1974).

HPP-74-4

E.A. Feigenbaum.

"Computer Applications: Introductory Remarks", in "Proceedings of Federation of American Societies for Experimental Biology", 33, 2331 (1974).

HPP-74-5

L.M. Masinter, N.S. Sridharan, R.E. Carhart and D.H. Smith, "Applications of Artificial Intelligence for Chemical Inference XIII. Labeling Of Objects Having Symmetryl,2", Journal of the American Chemical Society, 96, 7714, (1974)/

HPP-74-6

D. Michie and B. G. Buchanan, "The Scientist's Apprentice." In Computers for Spectroscopy (ed. R.A.G. Carrington) London: Adam Hilger, 1974.

HPP-75-1

E.H. Shortliffe, B.G. Buchanan, "A Model of Inexact Reasoning in Medicine", Mathematical Biosciences, 23:351-379, (1975).

HPP-75-2

E.H. Shortliffe, R. Davis, S.G. Axline, B.G. Buchanan, C.C. Green, S.N. Cohen,

"Computer-Based Consultations in Clinical Therapeutics; Explanation and Rule Acquisition Capabilities of the MYCIN System", Computers and Biomedical Research, 8:303-320, (August 1975).

HPP-75-3

E.H. Shortliffe, F.S. Rhame, S.G. Axline, S.N. Cohen, B.G. Buchanam, R. Davis, A.C. Scott, R. Chavez-Pardo, and W.J. Van Melle, "MYCIN: A Computer Program Providing Antimicrobial Therapy Recommendations". Clinical Medicine, (August 1975).

HPP-75-4

E.H. Shortliffe,

"Judgmental Knowledge as a Basis for Computer-Assisted Clinical Decision Making, Proceedings of the 1975 International Conference on Cybernetics and Society, (September 1975).

HPP-75-5

E.H. Shortliffe, S. Axline, B.G. Buchanan, R. Davis, S. Cohen, "A Computer-Based Approach to the Promotion of Rational Clinical Use of Antimicrobials, International Symposium on Clinical Pharmacy and Clinical Pharmacology, (September 1975), Boston, Mass. Also in Clinical Pharmacy and Clinical Pharmacology, William A. Gouveia, Gianni Tognoni, Eppo van der Kleijn, Editors, Elsevier/North-Holland Publishing Company, pp. 259-274, (1976).

HPP-75-6

AIM-266, CS-517, ADA019641

Randall Davis, Bruce Buchanan, Edward Shortliffe, "Production Rules as a Representation of a Knowledge-Based Consultation Program", (October 1975).

HPP-75-7

AIM-271, CS-524,, ADA019702/OWC

Randall Davis, Jonathan King,

"An Overview of Production Systems", Machine Representations of Knowledge", Dordrecht, D. Reidel Publ. Co., 1976. Proceedings of NATO ASI Conference, (October 1975).

HPP-75-8

R.G. Dromey, B.G. Buchanan, J. Lederberg and C. Djerassi, "Applications of Artificial Intelligence for Chemical Inference. XIV." "A General Method for Predicting Molecular Ions in Mass Spectra", Journal of Organic Chemistry, 40, 770 (1975).

HPP-75-9

D.H. Smith,

"Applications of Artificial Intelligence for Chemical Inference. XV. Constructive Graph Labelling Applied to Chemical Problems. Chlorinated Hydrocarbons". Analytical Chemistry, 47, 1176 (1975).

HPP-75-10

R.E. Carhart, D.H. Smith, H. Brown and N.S. Sridharan, "Applications of Artificial Intelligence for Chemical Inference XVI. Computer Generation of Vertex Graphs and Ring Systems", Journal of Chemical Information and Computer Science, 15, 124 (1975).

HPP-75-11

R.E. Carhart, D.H. Smith, H. Brown and C. Djerassi, "Applications of Artificial Intelligence for Chemical Inference XVII. An Approach to Computer-Assisted Elucidation of Molecular Structure", Journal of the American Chemical Society, 97, 5755 (1975).

HPP-75-12

B.G. Buchanan,

"Applications of Artificial Intelligence to Scientific Reasoning", In Proceedings of Second USA-Japan Computer Conference, American Federation of Information Processing Societies Press, (August 1975).

HPP-75-13

R.E. Carhart, S.M. Johnson, D.H. Smith, B.G. Buchanan, R.G Dromey, J. Lederberg,

"Networking and a Collaborative Research Community: A Case Study Using the DENDRAL Program", in "Computer Networking and Chemistry", P. Lykos, Ed., American Chemistry Society, Washington, D.C., (1975).

HPP-75-14

D.H. Smith,

"The Scope of Structural Isomerism", Artificial Intelligence for Chemical Inference. XVIII. Journal of Chemical Information and Computer Sciences, 15, 203 (1975).

HPP-75-15

E.H. Shortliffe, R. Davis,

"Some Considerations for the Implementation of Knowledge-Based Expert Systems", SIGART Newsletter, 55:9-12, (December 1975).

HPP-76-1

D.H. Smith, J.P. Konopelski and C. Djerassi, "Applications of Artificial Intelligence for Chemical Inference. XIX. Computer Generation of Ion Structures", Organic Mass Spectrometry, 11, 86, (1976).

HPP-76-2

Raymond E. Carhart and Dennis H. Smith, "Applications of Artificial Intelligence for Chemical Inference XX. Intelligent Use of Constraints in Computer-Assisted Structure Elucidation". (1976).

HPP - 76 - 3

C.J. Cheer, D.H. Smith, and C. Djerassi,
"Applications of Artificial Intelligence for Chemical Inference XXI.
Chemical Studies of Marine Interbrates - XVII. The Computer-Assisted
Identification of [+]-Palostrol in the Marine Organism Cespitularia
sp., aff. subviridis". Tetrahedron. Vol. 32, pp. 1807 to 1810, Pergamon
Press, (1976).

HPP-76-4

B.G. Buchanan, D.H. Smith, W.C. White, R.J. Gritter, E.A. Feigenbaum, J. Lederberg, and Carl Djerassi,

"Application of Artificial Intelligence for Chemical Inference XXII. Automatic Rule Formation in Mass Spectrometry by Means of the Meta-DENDRAL Program", Journal of the American Chemical Society, 98, 6168 (1976).

HPP-76-5

T.H. Varkony, R.E. Carhart and D.H. Smith,

"Applications of Artificial Intelligence for Chemical Inference XXIII. Computer-Assisted Structure Elucidation. Modelling Chemical Reaction Sequences Used in Molecular Structure Problems1,2". (1976).

HPP-76-6

D.H. Smith and R.E. Carhart

"Applications of Artificial Intelligence for Chemical Inference XXIV. Structural Isomerism of Mono and Sesquiterpenoid Skeletons 1,2-", Tetrahedron, Vol. 32, pp. 2513 to 2519, Pergamon Press (May 1976).

HPP-76-7

AIM-283, CS-552

Randall Davis,

"Applications of Meta Level Knowledge to the Construction, Maintenance and Use of Large Knowledge Bases",

Thesis: Ph.D. in Computer Science, (July 1976).

HPP-76-8

AIM-286, CS-570

Douglas Lenat,

"AM: An Artificial Intelligence Approach to Discovery in Mathematics as Heuristic Search",

Thesis: Ph.D. in Computer Science, (July 1976).

HPP-76-9

AIM-291, CS-577

Bruce G. Buchanan, Joshua Lederberg, John McCarthy, "Three Reviews of J. Weizenbaum's Computer Power and Human Reason", (November 1976).

HPP-76-10

Bruce G. Buchanan and Dennis Smith,

"Computer Assisted Chemical Reasoning", in Proceedings of the III International Conference on Computers in Chemical Research, Education and Technology", Pleum Publishing, (1976). HPP-77-1

STAN-CS-77-593

A. C. Scott, W. Clancey, R. Davis, E. H. Shortliffe, "Explanation Capabilities of Knowledge-Based Production Systems", American Journal of Computational Linguistics, Microfiche 62, Knowledge-Based Consultation Systems, (1977).

HPP-77-2

STAN-CS-77-589

Robert S. Engelmore and H. Penny Nii
"A Knowledge-Based System for the Interpretation of Protein X-Ray
Crystallographic Data", (January 1977).

HPP-77-3

B.G. Buchanan, R. Davis, V. Yu and S. Cohen, "Rule Based Medical Decision Making by Computer", (Submitted to MEDINFO.77, 1977).

HPP-77-4

T.M. Mitchell and G.M. Schwenzer,
"Applications of Artificial Intelligence for Chemical Inference.
XXV. A Computer Program For Automated Empirical 13C NMR Rule
Formation", (Submitted to JACS, January 1977).

HPP-77-5

STAN-CS-77-596

Mark Stefik and Nancy Martin,

"A Review of Knowledge-Based Systems as a Basis for a Genetics Experiment Designing System", (February 1977).

HPP-77-6

STAN-CS-77-597

Bruce G. Buchanan and Tom Mitchell.

"Model-Directed Learning of Production Rules", Submitted to the Proceedings for the Workshop on Pattern-Directed Inference Systems in Hawaii, (February, 1977).

HPP-77-7

H. Penny Nii and Edward A. Feigenbaum, "Rule-based Understanding of Signals", to be presented at Workshop on Pattern-directed Inference Systems, (May 1977).

Hpp-77-8

R. Davis.

"Knowledge Acquisition on Rule-based Systems: Knowledge about Representations as a Basis for System Construction and Maintenance", submitted to Pattern-Directed Inference Conference, (May 1977).

HPP-77-9

R. Davis,

"interactive Transfer of Expertise I: Acquisition of New Inference Rules", submitted to Fifth IJCAI, (August 1977).

HPP-77-10
R. Davis,
"A Decision Support System for Medical Diagnosis and Therapy Selection in Data Base", SIGBDP Newsletter, 8, pp. 58-72, (Winter 1977).

HPP-77-11

Dennis H. Smith and Raymond E. Carhart,
"Structure Elucidation Based on Computer Analysis
of High and Low Resolution Mass Spectral Data".
Proceedings of the Symposium on Chemical Applications
of High Performance Spectrometry, University of
Nebraska, Lincoln, (1976 in press).

Budget Heuristic Programming Project Proposal for Renewal of Contract DAHC 15-73-C-0435 July 1, 1977 - June 30, 1979

Total Budget 7-1-77/6-30-78 7-1-78/6-30-79 7-1-77/6-30-79

	7-1-77/6-30-78	7-1-78/6-30-79	7-1-77/6-30-7
<u>Salaries</u> Faculty			
Feigenbaum, Edward A. Professor 33%, Summer Quarter, 1977 17%, Academic Year, 1977-78 100%, Summer Quarter, 1978 18%, Academic Year, 1978-79	8,089	15,829	23,918
Buchanan, Bruce G. Adjunct Professor 50%, Calendar Year	15,750	16,695	32,445
Michie, Donald Visiting Professor in Artificial Intelligence 38%, One Quarter	-	3,750	3,750
Research Staff Brown, Dennis Research Associate 100%, Summer Quarter	4,667	4,947	9,614
Creary, Lewis G. Research Associate 100%,Summer Quarter	4,375	-	4,375
Davis, Randall (or replacement) Research Associate 54%, Calendar Year	10,000	-	10,000
Engelmore, Robert Research Associate 50%, Calendar Year	15,120	16,027	31,147
Research Associate (to be named) 100%, Calendar Year	-	19,000	19,000
Nii, H. Penny Scientific Programmer 100%, Calendar Year	24,538	26,010	50,548
White, William C. Programmer 50%, Calendar Year	9,896	10,490	20,386
Five Student Research Assistants (to be named) 50%, Academic Year; 100% Summer Quarter	34,965	37,065	72,030
Secretarial and Clerical Assistance 100%, Calendar Year	9,600	10,368	19,968
Subtotal, Salaries	137,000	160,181	297,181

	7-1-77/6-30-78	7-1-78/6-30-79	7-1-77/6-30-79
Staff Benefits			
19.0% 9-1-78/8-31-77 20.0% 9-1-77/8-31-78 20.8% 9-1-78/8-31-79 <u>Travel</u>	27,126	33,109	60,235
10 West Coast trips 6 East Coast trips 1 Foreign trip	5,000	5,000	10,000
Expendable Supplies and Materials			
Telephone, postage, office supplies, consulting, etc.	7,000	7,100	14,100
Publications and Report Costs	3,000	3,300	6,300
Equipment Rental and Maintenance	6,000	6,500	12,500
Equipment Purchase			
Terminal Equipment	7,500	10,000	17,500
Subtotal Direct Costs	192,626	225,190	417,816
<u>Indirect Costs</u> , 58% (excluding equipment)	107,374	124,810	232,184
TOTAL BUDGET	300,000	350,000	650,000