SUMEX

STANFORD UNIVERSITY
MEDICAL EXPERIMENTAL COMPUTER RESOURCE
RR-00785

ANNUAL REPORT - YEAR 16

Submitted to

BIOMEDICAL RESEARCH TECHNOLOGY PROGRAM
NATIONAL INSTITUTES OF HEALTH

June 1, 1989

STANFORD UNIVERSITY SCHOOL OF MEDICINE

Edward H. Shortliffe, Principal Investigator

Edward A. Feigenbaum, Co-Principal Investigator

DEPARTMENT OF HEALTH AND HUMAN SERVICES
PUBLIC HEALTH SERVICE
NATIONAL INSTITUTES OF HEALTH

DIVISION OF RESEARCH RESOURCES
BIOMEDICAL RESEARCH TECHNOLOGY PROGRAM

ANNUAL PROGRESS REPORT
PART I., TITLE PAGE

1. PHS GRANT NUMBER: 5 P41 RR00785-16

2. TITLE OF GRANT: SUMEX — Stanford University Medical Experimental Computer Resource

3. NAME OF RECIPIENT INSTITUTION: Stanford University

4. HEALTH PROFESSIONAL SCHOOL: School of Medicine

5. REPORTING PERIOD:
   - 5a. FROM: 08-01-88
   - 5b. TO: 07-31-89

6. PRINCIPAL INVESTIGATOR:
   - 6a. NAME: Edward H. Shortliffe, M.D., Ph.D.
   - 6b. TITLE: Associate Professor of Medicine and Computer Science
   - 6c. SIGNATURE: Edward H Shortliffe

7. DATE SIGNED: June 1, 1989

8. TELEPHONE: 415-723-6979

Table of Contents:

I. Title Page 1

II. Description of Program Activities 3
II.A. Scientific Subprojects 3
II.B. Books, Papers, and Abstracts 3
II.C. Resource Summary Table 3

III. Narrative Description 5
III.A. Summary of Research Progress 5
III.A.1 Resource Overview 5
III.A.1.1 SUMEX-AIM as a Resource 5
III.A.1.2 Significance and Impact in Biomedicine 11
III.A.1.3 Summary of Current Resource Goals 12
III.A.2 Details of Technical Progress 16
III.A.2.1 Key Areas of Progress 16
III.A.2.3. Core ONCOCIN Research 26
(1) Overview of the ONCOCIN Therapy Planning System 26
(2) Implementation of the ONCOCIN Workstation in the Stanford Clinic 27
(3) E-ONCOCIN: Domain Independent Therapy Planning 28
(4) OPAL: Graphical Knowledge Acquisition Interface 29
(5) Generalized Knowledge Acquisition through PROTÉGÉ 31
(6) Speech Input to Expert Systems 31
(6.1) Prototype Speech Hardware/Software System 31
(6.2) Speech Experiments 33
(7) Object Language Support for ONCOCIN Project 34
(8) Personnel 34
III.A.2.2. Core AI Research 36
(1) Rationale 36
(2) Highlights of Progress 37
(2.1) Large Multi-use Knowledge Bases for Science and Engineering 37
(2.2) Adaptive Intelligent Systems 40
(2.3) Advanced Architectures 41
(2.4) Knowledge Acquisition and Machine Learning 45
(2.5) Symbolic Simulation 45
III.A.2.4. Core System Research and Development 47
(1) Introduction and Overview 47

(2) The Phase-Out of the DECSystem-20 49
(3) The New SUN-Based SUMEX-AIM Resource 51
(3.1) File Access and Management 52
(3.2) The SUMEX Perpetual Archive System 53
(3.3) Printing Services 55
(4) Electronic Mail 56
(4.1) Macintosh client - MacMM 58
(4.2) Mail Reader User-Interface 58
(4.3) The Mail Composition User Interface 60
(4.4) Texas Instruments Explorer Client 60
(4.5) DEC-20 IMAP2 Server 60
(4.6) UNIX IMAP2 Server 61
(4.7) Transition Strategy and Plan 62
(5) Lisp Systems 62
(5.1) Standards 62
(5.2) Lisp System Performance 63
(5.3) Lisp Programming Environments 65
(6) Workstation System Environments 66
(6.1) Macintosh II Workstations 66
(6.2) Texas Instruments Explorers 68
(6.3) SUN Workstations 72
(6.4) NeXT Workstations 73
(6.5) Xerox D-Machines 75
(6.6) Symbolics Lisp Machines 79
(6.7) HP 9836 Workstations 80
(7) Remote Workstation Access, Virtual Graphics, and Windows 80
(7.1) Remote Access 80
(7.2) Virtual Graphics and Windows 80
(7.3) Remote Graphics Applications 81
(8) Network Services 84
(8.1) National and Wide-Area Networks 84
(8.2) Local Area Networks - LAN's 86
(9) Distributed Information Resources and Access 88
(10) Distributed system operation and management 90
III.A.2.5. Relevant Core Research Publications 91
III.A.2.6. Resource Equipment 98
(1) Purchases This Past Year 98
(2) Current Subsystem Configurations 100

III.A.2.7. Training Activities 105
III.A.2.8. Resource Operations and Usage 108
(1) Operations and Support 108
(2) Resource Usage Details 108
(2.1) Overall Resource Loading Data 109
(2.2) Individual Project and Community Usage 110
III.B. Research Highlights 117
III.B.1. INTERNIST-I/QMR 118
III.B.2. PathFinder 119
III.B.3. The Distributed SUMEX-AIM Community 120
III.B.4. ONCOCIN 121
III.C. Administrative Changes 123
III.D. Resource Management and Allocation 124
III.D.1. Overall Management Plan 124
III.D.2. Cost Center 124
III.E. Dissemination of Resource Information 127
III.E.1. Software Distribution 127
III.E.2. AIM Community Systems Support 128
III.E.3. Video Tapes and Films 128
III.E.4. Special Seminars 128
III.F. Suggestions and Comments 129
III.F.1. Resource Organization 129
III.F.2. Electronic Communications 129

IV. Description of Scientific Subprojects 130
IV.A. Stanford Projects 131
IV.A.1. Guardian Project 132
IV.A.2. MOLGEN Project 137
IV.A.3. ONCOCIN Project 143
IV.A.4. PENGUIN Project 157
IV.A.5. PROTEAN Project 166
IV.A.6. Reasoning Under Uncertainty 174
IV.A.7. VentPlan Project 183
IV.B. National AIM Projects 190
IV.B.1. INTERNIST-I/QMR Project 191
IV.B.2. MENTOR Project 197

IV.C. Pilot Stanford Projects 202
IV.C.1. REFEREE Project 203
IV.D. Pilot AIM Projects 210
IV.D.1. The Pathfinder Project 211
Appendix A: Knowledge Systems Laboratory Brochure 219
Appendix B: Lisp Performance Studies 229
Appendix C: AIM Management Committee Membership 261

List of Figures:

Figure 1. NSFNet Configuration as of January 1989 85
Figure 2. SUMEX-AIM DEC 2060 Configuration 100
Figure 3. SUMEX-AIM SUN-4 Configuration 101
Figure 4. SUMEX-AIM SUN-3 File Server Configuration 101
Figure 5. SUMEX-AIM Xerox File Server Configuration 102
Figure 6. SUMEX-AIM VAX File Server Configuration 103
Figure 7. SUMEX-AIM Develcon X.25/TCP-IP Gateway Configuration 103
Figure 8. SUMEX-AIM Ethernet Configuration 104
Figure 9. Total CPU Hours Consumed by Month 110
Figure 10. CPU Usage Histogram by Project and Community 111
Figure 11. Table of Resource Use by Project 112