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National AIM Project: CADUCEUS
(INTERNIST-I)

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The major goal of the INTERNIST-I Project is to produce a reliable and adequately complete diagnostic consultative program in the field of internal medicine. Although this program is intended primarily to aid skilled internists in complicated medical problems, the program may have spin-off as a diagnostic and triage aid to physicians' assistants, rural health clinics, military medicine and space travel. In the design of INTERNIST-I, we have attempted to model the creative, problem-formulation aspect of the clinical reasoning process. The program employs a novel heuristic procedure that composes differential diagnoses, dynamically, on the basis of clinical evidence. During the course of a INTERNIST-1 consultation, it is not uncommon for a number of such conjectured problem foci to be proposed and investigated, with occasional major shifts taking place in the program's conceptualization of the task at hand.

SOFTWARE AVAILABLE ON SUMEX

Versions of INTERNIST-I are available for experimental use, but the project continues to be oriented primarily towards research and development; hence, a stable production version of the system is not yet available for general use.

National AIM Project: CLIPR -- HIERARCHICAL MODELS OF HUMAN COGNITION

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The CLIPR Project is concerned with the modeling of complex psychological processes. It is comprised of two research groups. The prose comprehension group has completed a project that carries out the text analysis described by van Dijk & Kintsch (1983), yielding predictions of the recall and readability of that text by human subjects. The human-computer interaction group is developing a quantitative theory of that predicts learning, transfer, and performance for a wide range of computer-tasks, e.g. text editing, Kieras & Polson (1985).

SOFTWARE AVAILABLE ON SUMEX

A set of programs has been developed to perform the microstructure text analysis described in van Dijk & Kintsch (1983) and Kintsch & Greeno (1985). The program accepts a propositionalized text as input, and produces indices that can be used to estimate the text's recall and readability.

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National AIM Project: MENTOR -- MEDICAL EVALUATION OF THERAPEUTIC ORDERS

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The goal of the MENTOR project is to implement and begin evaluation of a computer-based methodology for reducing therapeutic misadventures. The project will use principles of artificial intelligence to create an on-line expert system to continuously monitor the drug therapy of individual patients and generate specific warnings of potential and/or actual unintended effects of therapy. The appropriate patient information will be automatically acquired through interfaces to a hospital information system. This data will be monitored by a system that is capable of employing complex chains of reasoning to evaluate therapeutic decisions and arrive at valid conclusions in the context of all information available on the patient. The results reached by the system will be fed back to the responsible physicians to assist future decision making.

Specific objectives of this proposal include:

1. Implement a prototype computer-based expert system to continuously monitor in-patient drug therapy. It will use a modular medical knowledge base and a separate inference engine to apply the knowledge to specific situations.

2. Select a small number of important and frequently occurring drug therapy problems that can lead to therapeutic misadventures and construct a comprehensive knowledge base necessary to detect these situations.

3. Design and begin implementation of an evaluation of the prototype MENTOR system with respect to its impact on the on the physicians' therapeutic decision making as well as its effects on the patient in terms of specific mortality and morbidity measures.

The work in the proposed project will build on the extensive previous work in drug monitoring done by these investigators in the Division of Clinical Pharmacology at Stanford and the University of Maryland School of Pharmacy.

Rutgers AIM Project: RUTGERS RESEARCH RESOURCE-
COMPUTERS IN BIOMEDICINE

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The Rutgers Research Resource provides research support with artificial intelligence systems, and computing support with its DEC2060 facility to a large number of biomedical scientists and researchers. Research activities are concentrated in two major areas: expert medical systems, models for planning and knowledge acquisition, and general AI systems development.

One of the most significant achievements in bringing the work of the Resource to bear on clinical research and practice lies in the transfer of technology from large machines to microprocessor compatible representations. The initial breakthrough came with the automatic translation of a serum protein electrophoresis interpretation model so that a version could be incorporated in an instrument - a scanning densitometer. It is now being used at several hundred clinical locations.

During the current period, we have been working on a new project with long term implications for the impact of AIM technology: the development of a hand-held microcomputer version of an expert consultation system for front-line health workers. In collaboration with Dr. Chandler Dawson (UCSF), Director of the World Health Organization's Collaborative Centre for the Prevention of Blindness and Trachoma, we have developed a prototype model for consultation on primary eye care. This has been oriented at problems of injury, infection, malnutrition and cataract in situations where an ophthalmologist is unavailable. In most developing nations, the incidence of blindness is 10% to 40% higher than in the USA because of these kinds of problems. With the help of a grant from the USAID, we are developing the systems needed for management of eye disease by front-line health workers in developing nations, and outlying parts of the USA.

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National AIM Project: SOLVER -- PROBLEM SOLVING EXPERTISE

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The Minnesota SOLVER project focuses upon the development of strategies for discovering and representing the knowledge and skill of expert problem solvers. Although in the last 15 years considerable progress has been made in synthesizing the expertise required for solving complex problems, most expert systems embody only a limited amount of expertise. What is still lacking is a theoretical framework capable of reducing dependence upon the expert's intuition or on the near exhaustive testing of possible organizations. Our methodology consists of: (1) extensive use of verbal thinking aloud protocols as a source of information from which to make inferences about underlying knowledge structures and processes; (2) development of computer models as a means of testing the adequacy of inferences derived from protocol studies; (3) testing and refinement of the cognitive models based upon the study of human and model performance in experimental settings. Currently, we are investigating problem-solving expertise in domains of medicine, financial auditing, management, and law.

SOFTWARE AVAILABLE ON SUMEX

A redesigned version of the Diagnoser simulation model, named Galen, has been implemented on SUMEX.

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Stanford Project: REFEREE Project

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The goals of this project are related both to medical science and artificial intelligence: (a) use AI methods to allow the informed but non-expert reader of the medical literature to evaluate a randomized clinical trial, and (b) use the interpretation of the medical literature as a test problem for studies of knowledge acquisition and fusion of information from disparate sources. REFEREE will be used to evaluate the medical literature of clinical trials to determine the quality of a clinical trial, make judgements on the efficacy of the treatment proposed, and synthesize rules of clinical practice. The research is an initial step toward a more general goal - building computer systems to help the clinician and medical scientist read the medical literature more critically and more rapidly.

National AIM Project: Computer-Aided Diagnosis of Malignant Lymph Node Diseases (PATHFINDER)

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We are building a computer program, called PATHFINDER, to assist in the diagnosis of lymph node pathology. The project is based at the University of Southern California in collaboration with the Stanford University Medical Computer Science Group. A pilot version of the program provides diagnostic advice on eighty common benign and malignant diseases of the lymph nodes based on 150 histologic features. Our research plans are to develop a full-scale version of the computer program by substantially increasing the quantity and quality of knowledge and to develop techniques for knowledge representation and manipulation appropriate to this application area. The design of the program has been strongly influenced by the INTERNIST/CADUCEUS program developed on the SUMEX resource.

SOFTWARE AVAILABLE ON SUMEX

PATHFINDER-- A version of the PATHFINDER program is available for experimentation on the DEC 2060 computer. This version is a pilot version of the program, and therefore has not been completely tested.

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