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The representation language used in one domain is seldom borrowed and adapted to another, because the facilities that were assets for one task become limitations elsewhere. For this reason, most such languages are built from scratch. The goal of the RLL effort is to reduce the amount of time expended in building a representation language, by providing a Representation Language Language, that is, a language that provided the user with the components of many representation languages, and with the ability to integrate them. RLL contains a large library of "representational pieces," for example, the mode of inheritance used by the Examples link of the Units package, or the A-Kind-Of type of slot used in the MIT Frames Representation Language, FRL. A novice user can easily design a language simply by picking an amalgamation of pieces; RLL is responsible for meshing them together into a coherent and working whole. A more advanced user can exploit RLL's mechanisms for designing new parts, for example, a new mode of inheritance, or a new type of format for a slot. He could then use these in the system he is building. The use of high level operators (e.g. "Create-New-Inheritance-Like(Instance-Of)") will greatly lessen the time required to construct the desired language.

The RLL system is an ongoing effort. It has recently been used in two small, internal tasks, an adventure game simulation and an exploration into a more complete self-description of various of its parts, using lower level primitives.

Handbook of Artificial Intelligence

The Handbook of Artificial Intelligence is a comprehensive overview of important ideas, techniques, and systems that have been developed during the last twenty five years of AI research. It contains about 200 short articles that are written at a level appropriate for students interested in AI, and for non-specialist engineers and scientists. In addition, overview articles discuss sub-areas of AI and the ideas and issues that characterize these sub-areas. Some of the overview articles are among the best critical discussions available of activity in the field.

Volumes 1 and 2 (of three) of the Handbook will be published early in 1981.

Expert Systems Research: Why Do It? What Is Its Significance?

Artificial Intelligence is the computer science of symbolic representations of knowledge and symbolic inference. There is a certain inevitability to this branch of computer science and its application, in particular, to medicine and biosciences. The cost of computers will fall drastically during the coming two decades. As it does, many more of the practitioners of the world's professions will be persuaded to turn to economical automatic information processing for assistance in managing the increasing complexity of their daily tasks. They will find, in most of computer science, help only for those of their problems that have a mathematical or statistical core, or are of a routine data-processing nature. But such problems will be rare, except in engineering and physical science. In medicine, biology, management—indeed in most of the world's work—the daily tasks are those requiring symbolic reasoning with detailed professional knowledge. The computers that will act as "intelligent assistants" for these professionals must be endowed with such reasoning capabilities and knowledge. The researchers of the Heuristic Programming Project believe that their basic and applied work in Artificial Intelligence is aimed at this inevitable development.

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The objective of our program of research is to develop capabilities in computers for intelligent behavior in complex situations, and to understand and extend the methods and the principles underlying such performances. We conduct a variety of projects aimed at increasing the ability of computer-based systems to solve problems, communicate with people, and perceive and interact with the physical world.

The following are our major areas of activity:

* Planning and Problem-Solving
* Image Processing and Vision
* Natural Language Processing
* Knowledge-Based Expert Systems
* Industrial Automation and Robotics
* Distributed Data Management
* Automatic Program Synthesis

Our strategy for research is to establish a nucleus of long-term projects in these core areas of artificial intelligence and to fit related activities into these larger contexts. Underlying these projects is a set of basic concepts and techniques that provide the mechanisms for integration: representation and modeling; inference and commonsense reasoning; heuristic search procedures and control structures.

Brief descriptions of the core areas will illustrate the scope of the program; the names of staff members involved are listed after each section.

Planning and Problem Solving—This work focuses on commonsense reasoning about actions and their effects. Systems have been developed that plan and execute action sequences for a mobile robot, that interactively guide the assembly and disassembly of electromechanical equipment by an apprentice technician, and that plan and execute retrieval strategies from large, distributed data bases. Efforts are under way to develop plans that can be executed by multiple effectors in parallel, that can be modified interactively by human decision-makers, and that will make it possible for problem-solving to be carried out by multiple independent processors.

(Barbara Grosz, Robert Moore, Nils Nilsson, William Park, Ann Robinson, Earl Sacerdoti, David Wilkins)

Image Processing and Computer Vision—This work covers a broad range of activities, from research into the fundamental principles of vision (in animals or machines) to applications in remote sensing, cartography, medicine, and advanced automation. Continuing basic research investigates the initial stages of visual systems, so that intrinsic features of points in a scene (namely, incident illumination, reflecting characteristics, and surface shape) may be determined. Systems are also being developed to act as assistants to a cartographer, aiding him in image calibration, mensuration, tracing of features, and interpretation.
(Gerald Agin, Harry Barrow, Robert Bolles, Ted Brain, David Falconer, Martin Fischler, Thomas Garvey, Gerald Gleason, Gregory Jirak, David Kashtan, Lynn Quam, Martin Tenenbaum, Andrew Witkin, Helen Wolf)

Natural-Language Processing—This work has spanned the full range of language phenomena, encompassing acoustics, phonology, prosodics, syntax, semantics, discourse structure, and the context of communication. It entails the integration of knowledge, beliefs, goals, and plans, as well as the use of deductive inference procedures and commonsense reasoning. Systems have been developed both for basic research on understandng natural-language dialogues and for providing practical natural-language interfaces to a variety of computer software systems.
(Barbara Grosz, Norman Haas, Gary Hendrix, Jerry Hobbs, Kurt Konolige, William Lewis, Robert Moore, Ann Robinson, Jane Robinson, Earl Sacerdoti, Don Walker)

Industrial Automation and Robotics—This work explores and develops general-purpose, cost-effective techniques and hardware/software modules for computer-controlled systems of manipulators (especially robots), sensors (especially visual), and other components that are flexible, adaptable, and easily trained to perform material handling, inspection, and assembly tasks in discrete-part manufacturing.
(Stephen Barnard, Robert Bolles, Gerald Gleason, John Hill, Jan Kremers, Dennis McGhie, David Nitzan, William Park, Randall Smith, Antony Sword)

Knowledge-Based Expert Systems—This work combines substantive knowledge about a particular field of research with procedures for acquiring and managing that knowledge to construct systems that can be used by specialists in the course of their professional work. Procedures for intelligent acquisition and management utilize rule-based representations of judgmental knowledge, partitioned semantic networks to store factual knowledge, subjective Bayesian probability theory to propagate measures of belief, and augmented transition network grammars for language processing.
(Richard Duda, John Gasching, Peter Hart, Kurt Konolige, Reve Reboh, Michael Wilber)

Distributed Data Management—This work applies artificial intelligence techniques to the management of information stored in large, distributed data bases. It incorporates techniques from commonsense reasoning, automatic programming, and natural-language understanding to create systems for interpreting data base queries posed in English, translating these queries into programs that can run in the languages of the data base management systems in which the desired information is stored, and monitoring the execution of those programs over a computer network.
(Barbara Grosz, Norman Haas, Gary Hendrix, Kurt Konolige, Robert Moore, Earl Sacerdoti, Daniel Sagalowicz)

Automatic Program Synthesis—This work focuses on basic issues entailed in generating computer algorithms automatically from a specification of the purpose of a given program. It draws upon and supports related work in the Center on theorem-proving, automatic planning, and programming languages for artificial intelligence. Systems have been developed for program generation based on both theorem-proving and program transformation techniques.
(Richard Waldinger)

Resources and Facilities

The Center has a wide range of advanced computer capabilities, including a DEC KL-10 time-shared computer that provides the main facility for program development. On-line access through CRT and printing terminals is available to all personnel, in support as well as staff funcitons. The computer is accessible over both the ARPANET and TYMNET communication networks.

The Center also has extensive laboratory facilities for research in vision and industrial automation. The vision laboratory has DeAnze and Ramtek color displays controlled by a VAX 11-780 with a high-speed link to the KL-10 via a shared disk channel. The industrial automation laboratory includes a Unimate 2000B manipulator with an LSI-11 microcomputer for performing coordinate transformations, an assembly station consisting of an x-y table controlled by a PDP 11-40, an SRI-developed Vision Module, an Autoplace manipulator, and a Unimate Puma. A testbed is being developed that will contain several robots equipped with vision and tactile sensing; it will coordinate subassembly stations feeding into a final-assembly operation. There is also a laboratory for research on visually guided arc welding with a Cincinnati Milacron T3 controlled by a PDP 11-34.

Other equipment includes a multicolor krypton ion laser rangefinder controlled by an LSI-11 microcomputer, a Threshold Technology VIP-100 word recognition system, and a Federal Screw Works VOTRAX ML-I Multi-Lingual Voice system for synthesizing speech.

Through an internal SRI computer network, the Center also has access to the SRI DEC PDP-11/45 UNIX time-sharing system, a B6700, and a CDC 6400.