A MAJOR NEW SEMINAR ON
ARTIFICIAL INTELLIGENCE...

A.I.
SYSTEMS & TECHNOLOGIES

PRESENTED BY THE GUEST EXPERT

Dr. LARRY MASINTER

RAMAT GAN
9–10 OCTOBER, 1985

SPONSORED BY:

TECHNOLOGY TRAINING CORPORATION

HSA Conference Management by:
HYMAN SILVER & ASSOC. LTD.

PROGRAM

FIRST DAY

8:30	REGISTRATION
9:00	START OF SEMINAR — MORNING SESSION
10:15-10:30	COFFEE BREAK
10:30	MORNING SESSION (CONTINUED)
12:30-1:45	LUNCH BREAK
1:45	AFTERNOON SESSION
2:45-3:00	REFRESHMENT BREAK
3:00	AFTERNOON SESSION (CONTINUED)
4:00	ADJOURN — END OF FIRST DAY

SECOND DAY

9:00	START OF SECOND DAY — MORNING SESSION
10:15-10:30	COFFEE BREAK
10:30	MORNING SESSION (CONTINUED)
12:30-1:45	LUNCH BREAK
1:45	AFTERNOON SESSION
2:45-3:00	REFRESHMENT BREAK
3:00	AFTERNOON SESSION (CONTINUED)
4:00	ADJOURN — END OF SEMINAR

Technology Training Corporation

AI Systems & Technologies

presented by

Larry M. Masinter

Ramat Gan
9-10 October, 1985

"Artificial Intelligence": Definition

* "Artificial Intelligence" is a goal, not a fact.

* Tools and techniques are a by-product of research.

* Commercial applications of tools are very recent.

* The press has confused goals with current applications.

* Many vendors of AI technology do too.

* This isn't a new problem
  The first compilers were hailed as doing "automatic programming"

* There is still serious research going on under the title "artificial intelligence."

There is no magic

* AI Technology is no panacea for doing the impossible

  -- or even the very difficult

"Make money on the stock market."

"Transform a functional circuit specification
to an optimized VSLI layout."

AI Technology Areas

* Robotics: techniques for device control.
  - changing industrial assembly

* Vision: making computers see.
  - key to the next generation of robots

* Pattern recognition.
  - A limited kind of "vision"

* Speech: making computers hear and speak.
  - available soon; recognition is harder but coming

* Natural language understanding.
  - Commercial applications in database interface

* Enhanced intelligence in information processing.
  - The vast remainder of applications

Each area has its own tools, techniques.

This seminar is mainly about AI technology in information processing.

AI in Information Processing

* New data structures for representing facts about the world

* New algorithms for reasoning about facts

* Programming Environments for implementation of AI

* Management of programming projects

* New machine architectures

* Styles of human/computer interactions

* Specific applications of AI technology

There is serious research and development in the AI community to improve each of these technology areas.

You don't have to develop tools to use them.

CURRENT AI APPLICATION AREAS

* Lots of "exploration" going on

* Some real commercially viable applications

Some application areas in evidence:

Robotics (navigation, control of vehicles, industrial manufacturing automation)

Design Automation (manufacturing planning, spacial reasoning, IC design)

Database interface (natural language, representation)

Financial decision making (financial planning, expert systems)

Information analysis (sensory data & image processing/understanding)

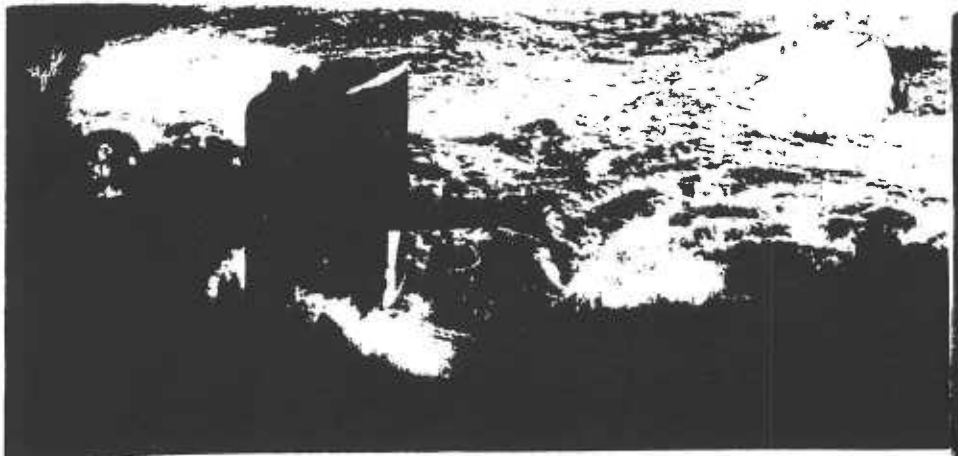
Computer Aided Diagnosis (operator assistant, electronic troubleshooting)

Surveillance (natural language)

Management (resource and project planning, administration)

Education (technical training, literature research)

(A tour through a recent AI Magazine's recruiting ads)



Ph. D. Engineers and Scientists, Recent Grads, Experienced Pros, NUSC Wants Both.

The research opportunities for Ph.D.'s at Naval Underwater Systems Center are unique and waiting for you if you have the following disciplines and special training.

Physicist who knows–Electromagnetic Theory, Scattering Theory, Acoustics–Theoretical Emphasis/Numerical, Materials Research (polymers), Electromagnetics Applied, Systems Theory & Practice, Artificial Intelligence and Classical Hydrodynamics.

Electrical Engineer knowledgeable in–Signal Processing, Underwater Communications, Radio Frequency Theory & Practice, Materials (Piezoelectricity R.I.), System Science, and Large Scale Electronic Systems.

Mechanical Engineer who knows–Hydrodynamics (Classical and Turbulence)

Engineering Mechanic with a background in–Material Science and Structural Analysis.

Applied Mathematician skilled in –Mechanics, Structures and Fluids, Numerical Hydrodynamics, and Systems Science.

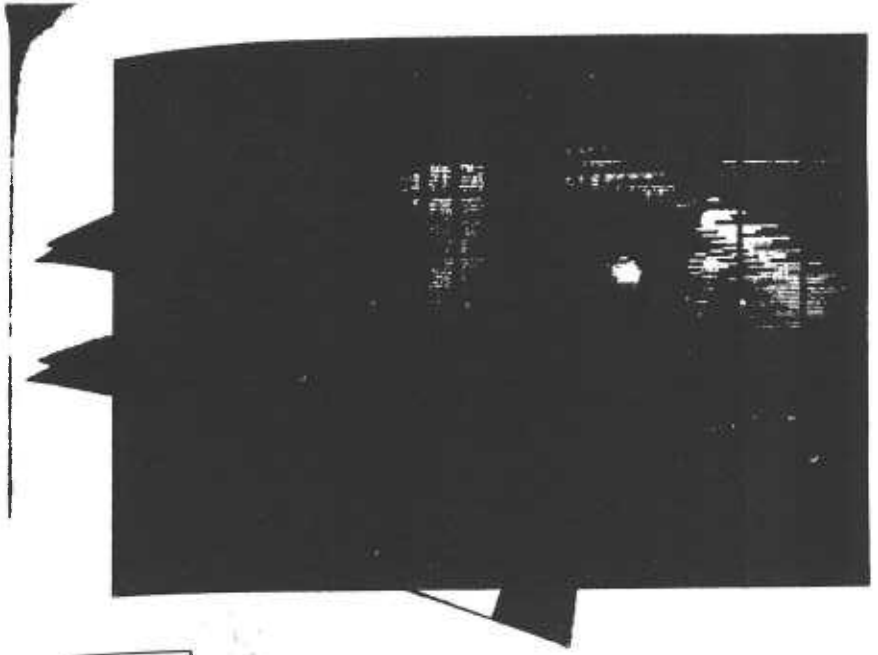
Chemist familiar with–Solid fuels, Battery Chemistry, Piezoelectricity and Ceramics.

At NUSC you'll be teamed up with the Navy's principal research, development, test and evaluation center for submarine weapons systems. NUSC is the technological edge that gives the Navy the tactical and strategic edge in combat systems that are so vital to our national defense.

If you're ready for challenge, immediate responsibility and freedom to be innovative and creative, we'd like you to join the Center's laboratories at Newport, Rhode Island or New London, Connecticut.

Contact us now at Naval Underwater Systems Center, Personnel Staffing Division, AI, Newport, Rhode Island 02841-5047 or call (401) 841-3585.

An Equal Opportunity Employer
U.S. Citizenship Required



PERCEPTION

"A rationally derived awareness discerned through the senses and prompted by direct or intuitive recognition" – the first step in the long, careful process that leads to scientific discovery. We consider our five Laboratories to represent the senses of GTE. As its central research facility, our intellectual curiosities reach out for new ideas and concepts, from which unique innovations and viable technologies may emerge and in turn be rechanneled throughout the Company's global operations.

Artificial Intelligence and Knowledge Based Systems Research

GTE has a strong commitment to both artificial intelligence research and knowledge based systems applications, directed ultimately toward future telecommunications networks and advanced information systems. Our programs focus on expert system technology, natural language processing, knowledge representation, self-improving systems and distributed intelligence, covering the spectrum from the highly conceptual to advanced prototype system development. Our established groups utilize state-of-the-art program development environments and maintain close ties to academia.

GTE Laboratories' continued growth has created several new opportunities for highly qualified AI professionals. Opportunities for professional growth and interactions abound, and the location (outside of Boston) also offers proximity to a variety of leisure, cultural and educational activities.

Send resume to Cynthia Farrar, GTE Laboratories, Box A3, 40 Sylvan Road, Waltham, MA 02254. An equal opportunity employer, M/F.

GTE Laboratories

HUGHES

MEMBER OF THE TECHNICAL STAFF

Southern California

This is the opportune moment to join Hughes Research Laboratories, in Southern California, and be one of the people behind the development of the most sophisticated electronics technology. At our Malibu facility, we're building high performance-VLSI concurrent computing systems for two-dimensional radar, sonar, and computer vision applications. We have immediate openings for Members of the Technical Staff in our Information Sciences and Computer Architecture Section. Here, you'll find professional growth potential due to the wide variety of activities at our facility, such as participating in programs to build sophisticated linear algebraic processor arrays and image understanding systems. New challenge and excitement can be yours at Hughes.

A background in one or more of the following areas is required:

- Concurrent Symbolic and Numeric Computing Architectures
- Computer Vision
- Knowledge Based Systems
- Inference Machines
- Digital Signal Processing

A Ph.D. in Electrical Engineering or Computer Science is preferred.

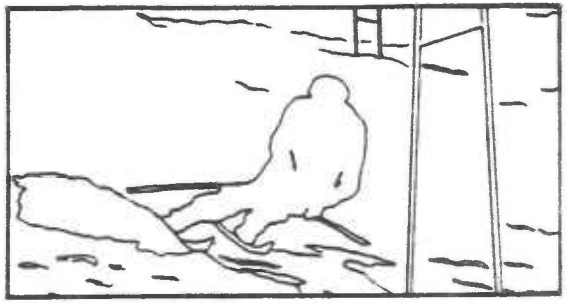
We offer an ideal location, stimulating environment, and excellent employee benefits.

Please send your resume and salary history to: Arryne Luna, Hughes Research Laboratories, Dept. IA-7, 3011 Malibu Canyon Road, Malibu, CA 90265. Proof of U.S. Citizenship Required. Equal Opportunity Employer.

HUGHES

RESEARCH LABORATORIES

AI Career Opportunities in COLORADO



GO AHEAD . . . put yourself in this picture. Whether you're on the slalom slope or the bunny hill, skiing is just one of the phenomenal recreational opportunities available in Colorado, the location of our Advanced Information Technologies Group.

We are Martin Marietta Data Systems, one of the largest full-service data processing companies in the nation investigating and developing new techniques in Artificial Intelligence and related technologies. Our emphasis is on natural language, expert systems and knowledge representation. We're seeking talented individuals skilled in these areas. Positions include:

- **AI CONSULTANT**
  Responsibilities include providing expertise on a broad spectrum of AI issues, both on a day-to-day and a long-term-basis. Will lead and coordinate future AI activities.
  PHD preferred.
- **TECHNICAL MANAGER, EXPERT SYSTEMS**
  Will direct expert and knowledge base systems activity. Must provide both technical and project manager support to existing and future projects. Advanced degree preferred.
- **TECHNICAL STAFF**
  Will actively participate in the design and development of existing and future AI and related projects. Must have at least 2 years of academic or work experience in AI.

All applicants must be able to excel in a team environment. Knowledge of LISP, C, Expert System Tools, SUN workstations and LISP machines will be considered a plus.

Come enjoy the benefits of a large corporation while working in a small independent group. We offer a comprehensive benefits package, which includes, health, dental, vision, and retirement benefits.

COME JOIN OUR ADVANCED INFORMATION TECHNOLOGIES GROUP.

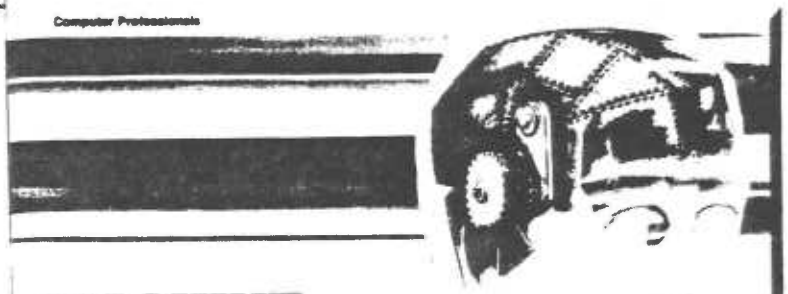
For more information, contact:

Bill Dalton
MARTIN MARIETTA DATA SYSTEMS
98 Inverness Drive East, Suite 135 (P193)
Englewood, CO 80112
(303) 790-3404

MARTIN MARIETTA DATA SYSTEMS

Equal Opportunity Employer M/F/H

Computer Professionals



MACHINE INTELLIGENCE

Significant new opportunities have been created for scientists dedicated to infusing machines with the power of thought.

Grumman-CTEC, Inc., a Grumman Data Systems subsidiary, is a leader in surveillance and communications processing software design. The Laboratory for Machine Intelligence and Correlation reflects Grumman's commitment to bolstering Grumman-CTEC's work in the evolving computing sciences.

THE LABORATORY FOR MACHINE INTELLIGENCE AND CORRELATION SEEKS SCIENTISTS IN THESE SPECIALITIES:

1. Natural Language Understanding, Computational Linguistics, Cognitive Psychology or comparable background. Ideal candidates will have substantive knowledge of natural language computer models; text parsing and understanding; and text generation.
2. Knowledge-Based Systems, Knowledge Engineering or related Computer Sciences. Ideal candidates will have substantive experience in knowledge representation; major responsibility for developing at least one significant system; be well-versed in symbolic programming; and be familiar with a broad range of "styles" of machine intelligence.

Additional considerations include your ability to contribute research results to the technical and professional literature, to establish and maintain peer recognition in the scientific and technical research communities, and to provide technical support to marketing. Required qualifications include a PhD or equivalent in Linguistics, Psychology, Applied Mathematics or Computer Science.

Other qualifications of significance: programming experience of noteworthy quality and scope; broad interdisciplinary skills to complement candidate's depth and competence in specialty areas.

For immediate consideration, please call Tom Skinner at (703) 448- 0228. Or, send your resumé in confidence to: Grumman-CTEC, Inc., 1355 Beverly Road, Suite 200, Dept. 13, McLean, VA 22101.

U.S. citizenship required. An Equal Opportunity Employer.

CUSTOM SOLUTIONS for Managing Information

GRUMMAN

Starting a Knowledge Engineering Project: A Step-by-Step Approach

Mike Freiling, Jim Alexander, Steve Messick, Steve Rehfuss, and Sherri Shulman

Artificial Intelligence Department, Computer Research Laboratory, Tektronix, Inc., Post Office Box 500, Beaverton, Oregon 97077

Getting started on a new knowledge engineering project is a difficult and challenging task, even for those who have done it before. For those who haven't, the task can often prove impossible. One reason is that the requirements-oriented methods and intuitions learned in the development of other types of software do not carry over well to the knowledge engineering task. Another reason is that methodologies for developing expert systems by extracting, representing, and manipulating an expert's knowledge have been slow in coming.

At Tektronix, we have been using a step-by-step approach to prototyping expert systems for over two years now. The primary features of this approach are that it gives software engineers who do not know knowledge engineering an easy place to start, and that it proceeds in a step-by-step fashion from initiation to implementation without inducing conceptual bottlenecks into the development process. This methodology has helped us collect the knowledge necessary to implement several prototype knowledge-based systems, including a troubleshooting assistant for the Tektronix FG-502 function generator and an operator's assistant for a wave solder machine.

One fundamental assumption we make is that knowledge is more valuable than inference strategies. Often a company may have only one chance to acquire the knowledge, but can work on it later at leisure. A second assumption is that a knowledge engineering project must provide adequate documentation of its progress. At any stage in the process, knowledge engineers must be able to show some fruits of their labor.

The Need for Knowledge Engineering Methodologies

In any large organization it is quite common to find "pockets of knowledge" or "knowledge bottlenecks." Pockets of knowledge occur when knowledge crucial to the success of an organization is possessed by only one or a few individuals. Knowledge bottlenecks are pockets of knowledge that impede an organization's progress because the knowledge needs to be more widely distributed.

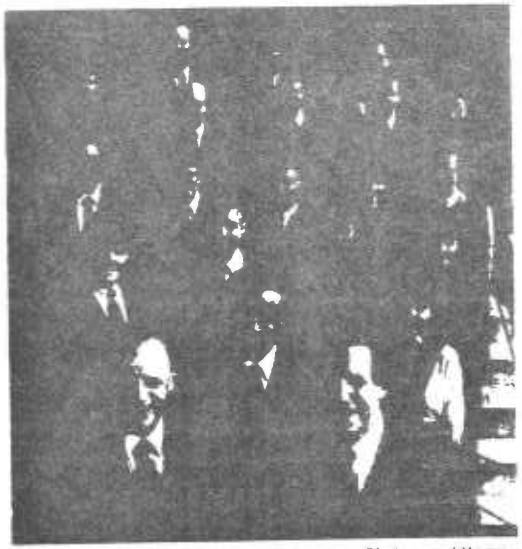
For example, if knowledge about how to keep an important manufacturing process running smoothly resides in the head of only one or two process engineers, we have a pocket of knowledge. If the company now wants to build several similar plants in different international locations, we have a knowledge bottleneck, because the knowledge cannot be distributed as easily as can the material used to build a factory. The lore of manufacturing processes includes stories of engineers who were shuttled by plane between factories in an effort to keep them all running.

It is clear that knowledge pockets and bottlenecks are undesirable and should be eliminated if possible. Pockets of knowledge can quickly become serious bottlenecks if the individuals retire or decide to leave the organization.

Expert system technology has been offered as a means for removing knowledge pockets and bottlenecks. But despite some notable successes, the path to expert system implementation is fraught with difficulties. Among these difficulties are

- **The "AI Mystique."** Terms like "artificial intelligence" or "knowledge engineering" give the impression that there is something magical and/or mystical involved in building expert systems. Despite our claims about making it clear how everyone else does their job, we have had some difficulty making it clear how we do our own. As a result, knowledge engineering is often considered a technology that is far too difficult to attempt.
- **The management problem.** How is it possible to manage the progress of an expert system

AFTER ONLY 6 MONTHS, ALL OF OUR EXPERT SYSTEMS ARE IN PLACE.



The Palladian staff now includes 4 renowned domain experts, 7 high-powered AI types, 3 skilled and daring entrepreneurs, 4 savvy investors and 4 crackerjack administrators.*

To become a successful expert systems company, you have to first assemble the right system of experts.

In just 6 months, after "They" said starting an AI company was impossible, we've attracted financing from the Rockefeller family and a staff with pioneering AI experience.

Soon, more savvy investors were beating a path to our door. Renowned domain experts and high-powered AI types had to take a number before we could see them. Not to mention the throngs of advertising and public relations agencies which were followed by scores of head-hunters.

Today, we have four times more people than we did just a few months ago. We're burning the midnight oil. And firing our guns on some of the most challenging problems in financial and manufacturing decision-making.

In fact, by giving each of our AI talents their own LISP machine, mirabile dictu, we now have a prototype.

Next month, we'll be ready to move into new offices that are 6 times larger than our present space. And by the time you read this ad, we will have doubled the size of our staff again.

To find out more, or to inquire about some of the unique positions still available, contact Philip A. Cooper, Chairman, or John Karcanes, President, at Palladian Software, 41 Munroe Street, Cambridge, MA 02142. (617) 661-7171.

Palladian. The expert systems company with all the right experts.

PALLADIAN

*(For those mathematicians out there, we have added more people since the above picture was taken.)

GM Research Laboratories is one of five technical staffs in the GM Technical Center, an 800 acre complex located in Warren, Michigan. The attractive buildings on the site surround a 22 acre lake in a campus-like setting designed by world-renowned architect Eero Saarinen. The Laboratories concentrate on fundamental investigations in a quest for new knowledge and technology which will allow GM to produce higher quality products more effectively in the future.

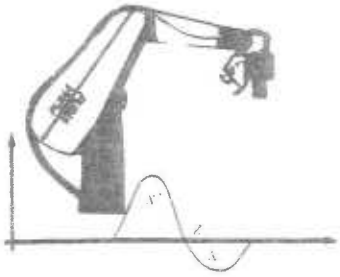
Our Computer Science Department conducts research programs in artificial intelligence, autonomous mobile robots, computer vision, intelligent robotic assembly, geometric modeling, computer graphics, VLSI design automation, manufacturing automation, and other areas, to provide a scientific foundation for the use of high technology throughout GM. Individual initiative of research professionals is valued.

ARTIFICIAL INTELLIGENCE

GM Research Laboratories has a strong a growing program in Artificial Intelliger Research projects include natural langu understanding, expert systems, planning a reasoning and intelligent computer-aided inst tion. Several years of natural language resea has yielded a system called DATALOG. vances have been made in isolating dom dependent knowledge and providing coopera English responses and pronoun references dialog of queries and replies. Researchers h challenging opportunities in applying artificial telligence techniques to solve previously int table problems for one of the largest manu turing operations in the world. In addition modern computing networks, a variet specialized AI software tools and pers workstations such as DEC MicroVAXs, X and Symbolics Lisp machines support AI re chers. GM needs creative scientists who develop new approaches for understanding creating intelligent systems in all of the ab ar

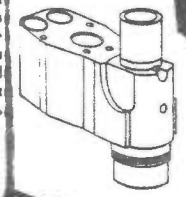
VISION & INTELLIGENT ROBOTICS

Our accomplishments in computer vision and sensor-based robots go back over 15 years and are known world-wide. Past research has defined the state-of-the-art in practical vision systems. But fundamental scientific advances are necessary before the potential benefits of automation can be fully realized. Current research in computational and biological vision, image understanding, manipulator dynamics and control, and robot planning are focussed on two of AI's most fundamental and paradigmatic problems: intelligent sensor-based robotic assembly, and autonomous mobile robots. Openings exist for qualified professionals in navigation, control, and planning systems for intelligent mobile robots, and in model-based vision, task-level planning, and flexible control systems for robotic assembly.



The Machine Perception Lab includes a variety of DEC VAX and PDP-11 computers, LISP machines and micro-VAX workstations, custom and commercial image acquisition and display facilities, a variety of solid state cameras, two PUMA-560 robots, a dextrous 3-fingered hand designed by Ken Salisbury, a mobile platform, and a wide array of optical, mechanical, and electronic instrumentation.

DESIGN AUTOMATION



The Geometric Modeling and Planning Group is known for GMSolid, a comprehensive 3-D solid modeling system, and RoboTeach, an off-line robot programming system based on GMSolid. Current research projects focus on surface representation and combining geometric modeling with modern AI methods to solve important problems in manufacturing planning and spatial reasoning.

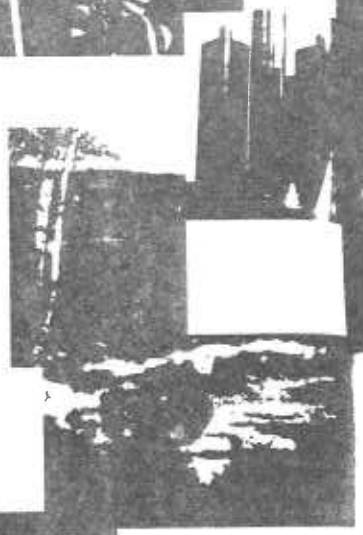
Image synthesis techniques are now being used to create very realistic representations of both mechanical assemblies and surface models. Current research focuses on combining realistic image synthesis with techniques for surface manipulation to develop an environment for aesthetic expression.

Because GM is the 3rd largest captive IC manufacturer in the world, IC design automation is receiving increased attention. A wide variety of software and hardware aids are now used to carry out both fully custom and semi-custom designs. Research topics include functional design tools and silicon compilation. New machine architectures are being explored for application-specific integrated circuits.

OPPORTUNITIES

Since the early days of computers, the Computer Science Department at GM Research Laboratories has conducted leading research in computation and computer systems. Researchers in the Computer Science Department developed the first operating system for a computer and built the first graphics system used for computer-aided design. Early research work in database systems influenced the Codasyl Database Task Group report and the first relational database system used in industry was developed in the Computer Science Department at GM Research Laboratories. Research in Artificial Intelligence began in the late 1960's with pioneering work in machine vision.

The facilities and organization of GM Research Laboratories and the productive environment of the Computer Science Department provide excellent opportunities for research in all areas of science and engineering that relate to computers, automation, and manufacturing productivity. General Motors will be the premier arena for industrial automation and the Research Laboratories will continue to be a source for insights and solutions to fundamental scientific problems. GM Research Laboratories offers unparalleled opportunities for research.



Interested candidates should contact:

Dr. George G. Dodd, Head
Computer Science Department
General Motors Research Laboratories
Warren, Michigan 48090-9057
(313) 575-3101

Candidates must have citizenship or visa status which permits them legally to accept permanent employment under U.S. Immigration laws.

AN EQUAL OPPORTUNITY EMPLOYER

GM General Motors Research Laboratories

SUCCESSFUL AI APPLICATIONS

Embedded AI systems -- a promise for the future

Current successful systems: *help* a *professional* to do a job.

Important characteristics:

Complex information space.

Rich assortment of objects and object types.

Interface between computer and its user is a key element to the success.

User is a professional but not a computer professional.

Computer assists, but does not take over.

Computer Aided Design

Systems that help designers build complex objects.

Computer Aided Design is not just for integrated circuits or electronics equipment.

Successful Computer Aided Design systems have been implemented for designing:

- Configurations of new computer equipment
- Interfaces to Office Equipment
- Grammars for Learning/teaching language
- Planning schedules
- Genetic engineering experiments

Computer Aided Diagnosis & Analysis

Many of the problems are similar to Computer Aided Design.

The systems deal with "real world" data.

There are expert humans

The diagnosis system can also help train new (human) diagnosticians.

Application areas include

* Medical diagnosis & treatment

* equipment failure and diagnosis

* oil well data

* military electronic & acoustic signals

AI Toolkits

Systems developed to deal with:

* Non-numerical calculation

* Separation of domain-specific knowledge from general-purpose inference engine

* Ability to create new "abstractions" in programming language

* Methodology which allows experts to participate in program creation

* Systems enhance human-computer interaction

Structure of AI Applications:

application

inference engine

representation system

implementation environment

operating system & hardware

Rest of tutorial covers these elements

SESSION 2: Inference in AI Systems

* Deduction

* Contexts

* Certainty factors

* Production systems

* Resolution

* Prolog

Inference is the Algorithm of AI

Fundamental property of AI systems:

Separating What from How
Knowledge from Inference

* Easier addition of new information

* Multiple ways of applying same knowledge

DEDUCTION

Framework from formal logic:

for-all (x) [Human (x) = > Mortal (x)]

for-all (x) [Greek (x) = > Human (x)]

Greek (Socrates) therfore Mortal (Socrates).

Key decisions in inference system design:

* How to organization information

* How to retrieve knowledge

* How to search for solutions

Hard problems cannot be solved by resorting to first principles

PLANNER: An early answer

* "logic-based" programming

* Designed in early 1970's

* Planner exposed many fundamental problems

* many systems derive from it