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Harmon Associates is a management consulting firm that specializes in helping companies evaluate their needs,train their personnel, and implement appropriate small expert systems development programs.

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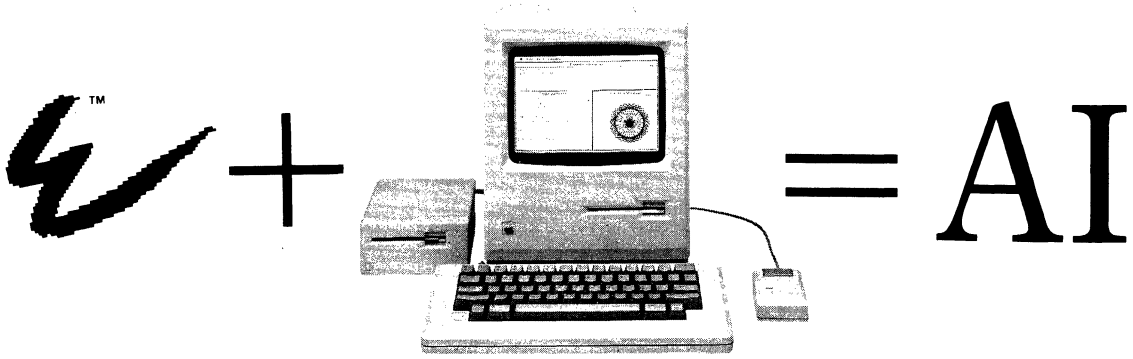

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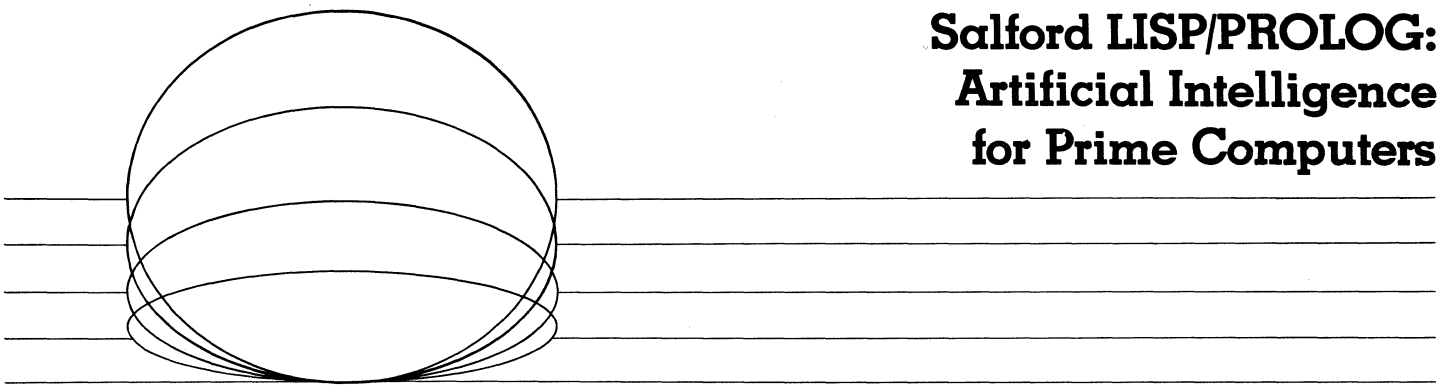

Salford LISP/PROLOG: Artificial Intelligence for Prime Computers

AI Languages Today

LISP and PROLOG are the dominant languages of artificial intelligence today. Developed at MIT in the 1950s, LISP is most popular in the United States. PROLOG is preferred in Europe, where it was developed in the early 1970s, and in Japan where PROLOG is the official language for their Fifth Generation computer project.

Salford LISP/PROLOG

Salford LISP/PROLOG is a joint implementation of LISP and PROLOG designed specifically for computers made by Prime Computer, Inc. Developed at the University of Salford, England, LISP/PROLOG is the first of its kind to combine interpretive and compiled modes for both languages in a single commercial software package.

Language Integration

Salford LISP/PROLOG exploits the power at each level in the computer language hierarchy. Extensive integration is found at the boundaries between low-level, high-level, and very high-level languages.

Low Level (Assembler)

The system is written in FTN77, the popular Fortran 77 compiler from Salford University, using features that promote low-end efficiency:

- in-line assembler via a CODE/EDOC syntax,
- comprehensive functions for address and bit handling.

High Level (Fortran)

Compiled high-level languages like Fortran 77 can also be called by LISP or PROLOG, via a mechanism for loading relocatable binary files (V-mode). This feature:

- provides access to recursive Fortran subroutine CALLs,
- supports calls to Fortran routines with or without arguments,
- links AI programs to conventional bodies of software like numerical simulation, statistical analysis, and data base management
- provides a link back to AI programs from these other codes.

No mechanisms are needed to tell LISP the types of arguments expected by Fortran routines, or to provide implicit type conversions at the interface.

High Level (LISP)

Pure LISP programs can be interpreted or compiled as required, without using PROLOG. The LISP environment:

- supports floating point numbers with 64-bit precision, the only kind of numerical constant (greatly simplifies internal design),
- permits exact integers to 45 bits, real numbers in an exponent range of + − 9000.

The LISP compiler is a recursive procedure (CODE). Given a function CALL to compile, LISP calls itself to compile its arguments if necessary, and then generates its own code. If the LISP compiler encounters a function it cannot compile, it will plant a suitable call to the interpreter.

- Code is compiled straight into memory.
- Many instructions reference directly the system's Fortran variables.
- Local optimizations are performed.
- LISP macros are expanded.

Very High Level (PROLOG)

Pure PROLOG programs can also be compiled or interpreted, using the Edinburgh PROLOG syntax, with extensions:

- Real arithmetic is permitted
- A large number of extra predicates are added to:
  - facilitate file manipulation and I/O
  - perform error trapping
  - activate system utilities like spooling
  - enable many other features.

To permit fast PROLOG compilation without "mode declarations," a scheme of dynamic compilation is used instead by computing "signatures":

- Whenever procedures marked for compilation are found with a signature not previously used, the compiler is invoked to generate code optimized to that specific signature.
- Subsequent calls to procedures with the same signature will use the compiled code already generated.

PROLOG compound terms are implemented as linked lists, eliminating first/best fit algorithms or data compaction after garbage collection.

Mixed Language Programs

LISP and PROLOG can be freely intermixed, and each language can make calls on the other:

- PROLOG expressions may include mathematical functions such as LOG, SIN, COS, & SQRT, as well as user-defined LISP functions.
- A LISP user may execute a PROLOG predicate using the system-supplied "PROLOG" function.

Several functions and predicates have been added to each language to facilitate mixed language programming:

- PROLOG contains pseudo-predicates which set/test the LISP value of an atom, or manipulate LISP property lists.
- LISP contains functions which create PROLOG variables and also assert PROLOG goals.

The mapping between LISP and PROLOG is accomplished by identical representation of atomic constants. All structures are constructed using absolute addresses as pointers, permitting much more efficient compiled code.

By jointly implementing both languages in this way, Salford LISP/PROLOG transcends the current debate between advocates of one or the other language by combining both in a single software package.

Special Features

The system is designed to cater to large programs by extensive use of Prime's segmented virtual architecture and floating-point hardware:

- Execution speed has been kept high, using hardware/firmware arithmetic and in-line assembler.
- Available address space has been made very large, limited only by local system configuration (NUSEG).

To maximize speed, all input-output is performed directly, rather than with Fortran I/O methods.

A SAVE function allows an entire LISP/PROLOG program to be saved exactly, in its entirety, for subsequent restart:

- SAVEd programs can be converted to external commands.

A LISPINDENT facility automatically formats LISP code by indenting nested parentheses and reporting mismatches.

A number of routines exist to provide a graphics interface with Tektronix-compatible terminals, on a screen of size 0-1023 in each direction:

- CLEAR_SCREEN clears terminal screen
- MOVETO moves cursor to new position
- DRAWTO draws a line segment
- CURSOR reads current cursor position

By avoiding memory segments normally used by system utilities, the standard Prime text EDitor (and many other external commands) may be run from within the system.

- This obviates the customary editor built into most AI language processors.

Executes on any Prime Series 50 CPU, providing a very cost-effective alternative to dedicated LISP workstations.

- Prime computers support more than 250 interactive terminals per CPU.
- The implementation is shared by default.

Extensive debugging facilities are provided for both LISP and PROLOG languages:

- Error reporting incorporates textual substitution.
- A DEBUG mode echoes every interpreted function CALL, its depth in the call stack, and its returned value.
- An optional trace of LISP function calls leading to an error is possible:
  - TRACE and UNTRACE functions report the call/return of individual user-defined functions.
  - Any number of functions may be traced simultaneously.
- A general-purpose breakpoint debugger can be invoked via function calls. This debugger is:
  - common to LISP and PROLOG and
  - ideal for mixed-language programming.
  - Manipulation after breaks is analogous to text editing.
- PROLOG debugging is performed with tools essentially similar to those available in LISP.

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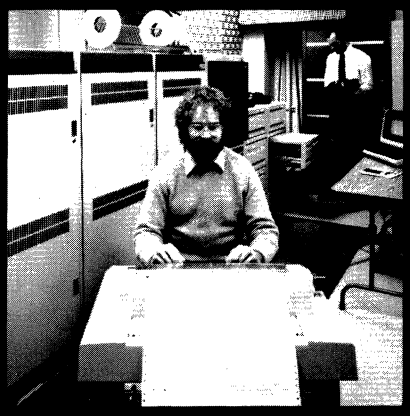

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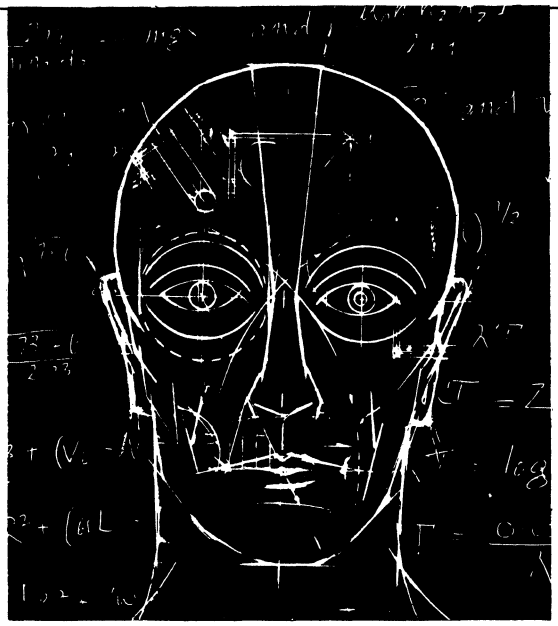

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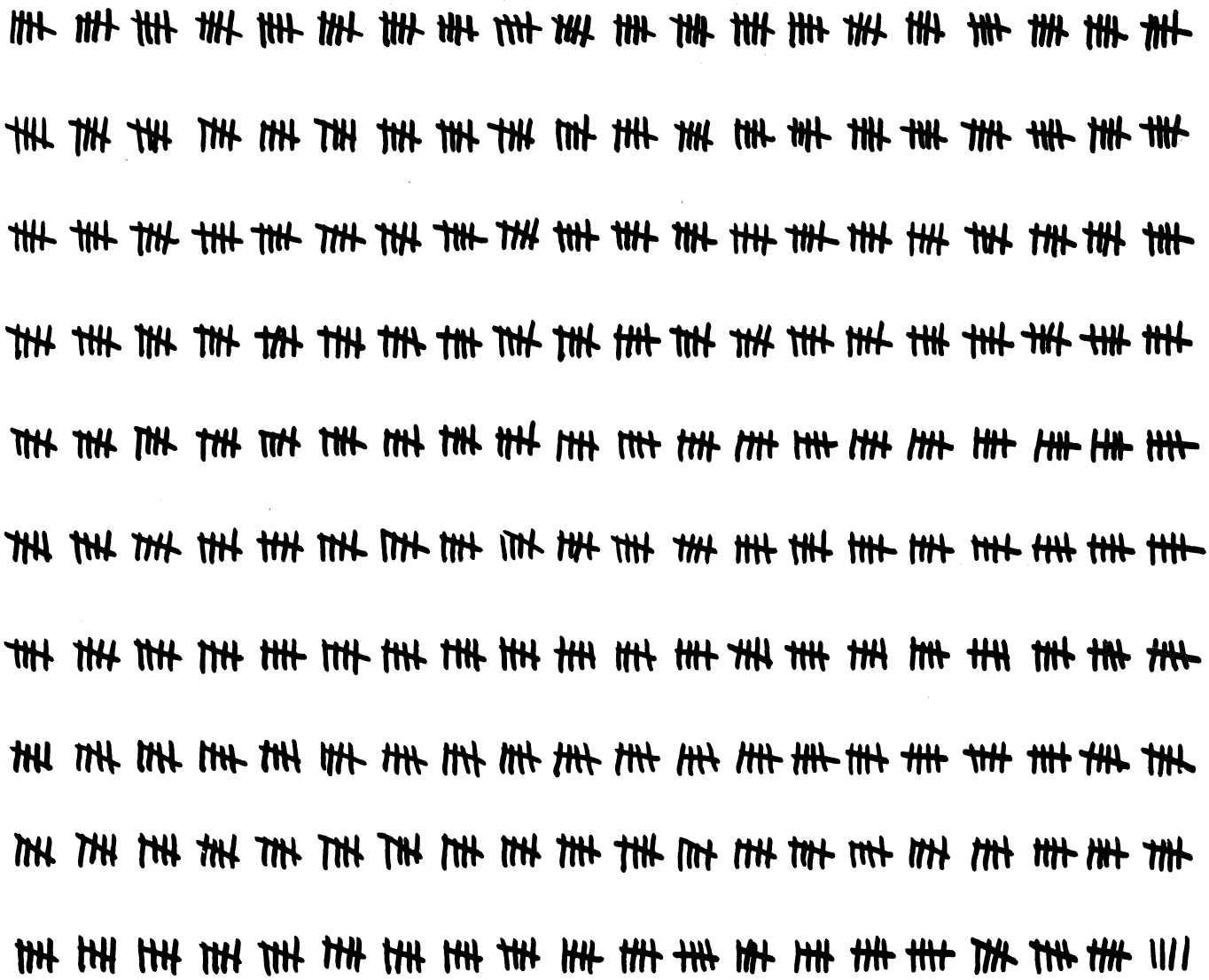

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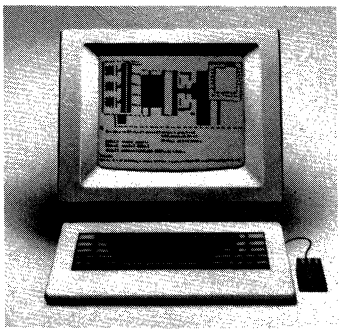

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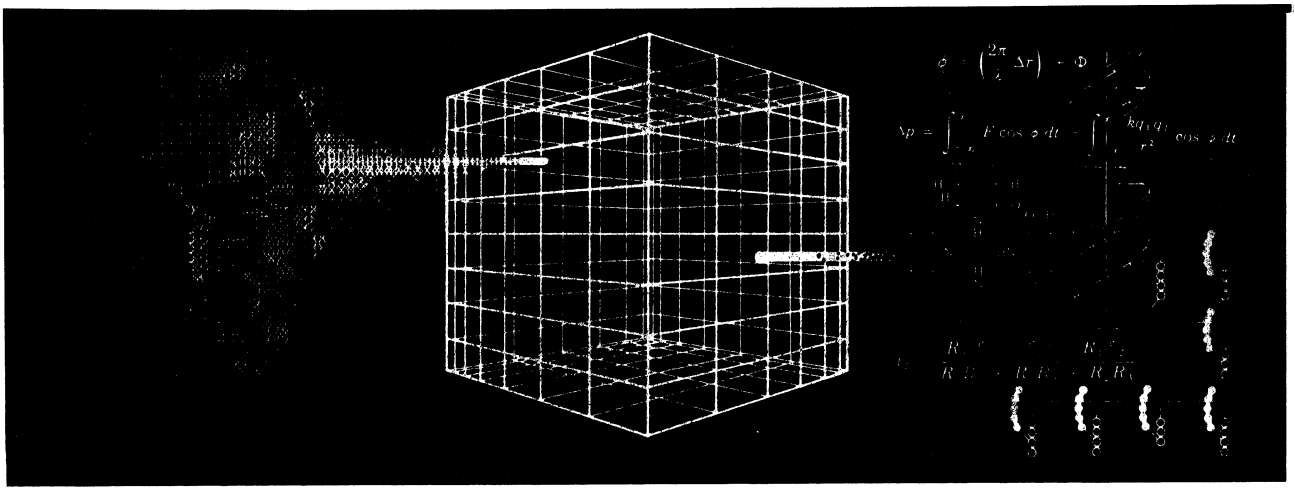


KES—The Logical Choice for Applied AI

The Knowledge Engineering System (KES) Product Group is a family of software tools for developing, implementing and supporting expert systems. Based on recent advances in Artificial Intelligence technology, KES provides all the software necessary to implement an expert system.

A knowledge base author directly records knowledge in an English-like form suitable for the support of reasoning by one of three KES inference mechanisms. The inference mechanisms and user interface components do not have to be reconstructed for each new application . . . reusable "off-the-shelf" reasoning and interface software can be applied to a broad range of government, industrial and business applications.

The result? Significant savings of time and money in the development and implementation of an operational knowledge-based system. An invaluable prototyping tool, KES has proven value in the development of demonstration expert systems in days or weeks.

KES . . . Bridging the gap between state-of-the-art AI and practical applications!

KES Advantages

- **Simple To Build.** Fully operational expert systems can be up and running in a few weeks with KES. Building from initial functional systems, powerful decision aids are readily developed.
- **Simple To Use.** Users access KES-built expert systems through an English-like language dialogue. The system can be applied by users who have never used a computer.
- **Domain Independent.** KES software is reusable and can be applied to virtually any area of knowledge. KES bypasses the heavy start-up costs incurred in the past for individual expert system construction. The inference and user interface software is separated from the knowledge base, making KES applicable to a broad range of problems.
- **Multiple Inference Mechanisms.** A choice of reasoning techniques including production rules, frames, and statistical reasoning enables KES to address problems in the most effective way.
- **Captures Intellectual Capital.** KES provides a convenient way to capture institutional knowledge and expertise as intellectual capital. As knowledge is augmented or changed, the KES knowledge base can be modified to reflect the changes.
- **Complete Support.** KES is fully supported and documented. It runs under various versions of LISP including Franz LISP, A-LISP and Wisconsin-LISP, with conversion planned for Interlisp. Software enhancements are continually made and provided to the licensees.

Building Expert Systems with KES

A knowledge base author builds a KES expert system by developing a knowledge base. This process progresses in four steps:

1. **Outline the Goals**—Determine the scope of knowledge required of the expert system.

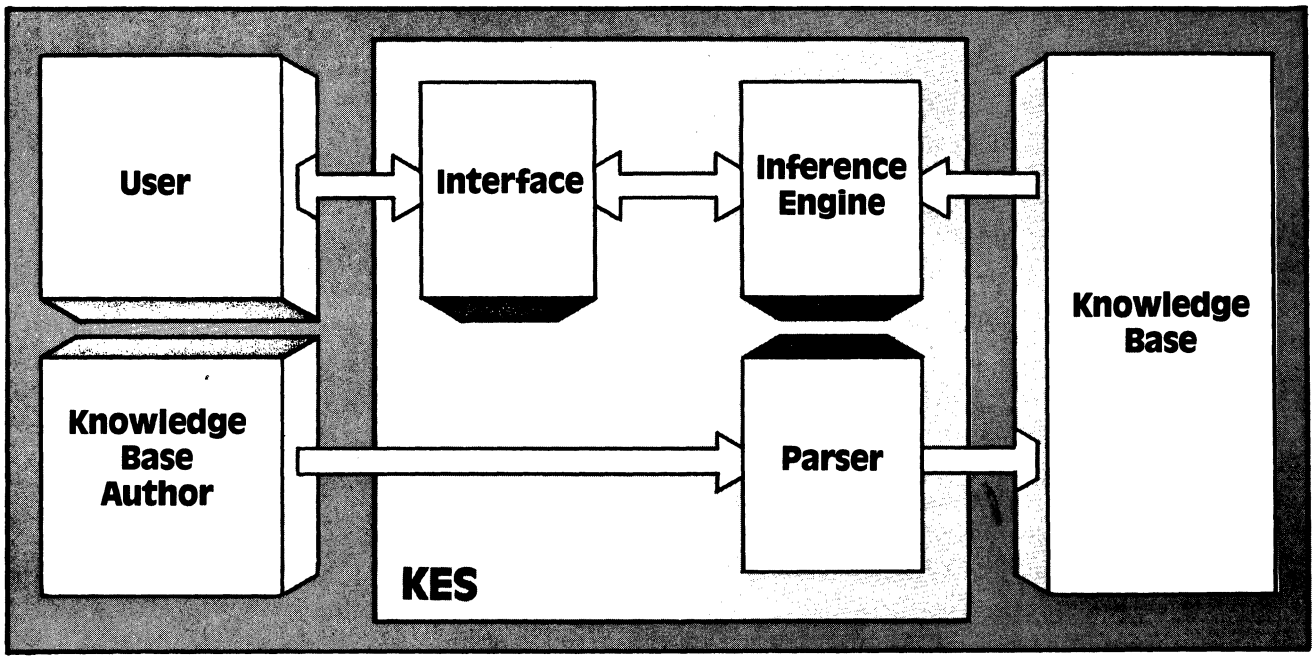
2. **Choose the Inference Technique**—From three available approaches, select the most applicable technique.

3. **Encode the Knowledge**—Using a format consistent with the chosen inference mechanism, cast the knowledge into English-like syntax.

4. **Parse the Knowledge Base**—Parse the knowledge base into a computer useable representation and validate the resulting expert system.

Operating a KES-built Expert System

The KES user interface is easy to use and non-threatening. In minutes, people without computer training can be taught how to use the fundamental aspects of KES-built expert systems. A question and answer format serves as the primary interactive protocol. Other commands, such as demand justification of results, are provided by the system.



System Expertise

Software A & E specializes in the application of advanced software engineering technology to problems in government and industry. In addition to artificial intelligence, Software A & E has extensive expertise in software engineering environments, systems design techniques, and system development. This mix of skills allows Software A & E to integrate expert system technology into existing or new computer-based systems in the most cost-effective manner. In addition to licensing KES, Software A & E offers services to build knowledge bases, to customize KES, or to build systems integrating reasoning technology.

Some current AI projects include:

1. Automatic diagnosis of computer system failure
2. Spatial reasoning applied to tactical military planning
3. Micro computer based workstation for software acquisition management consultation
4. Automatic large data base analysis to uncover trends and patterns

For more information please contact:
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Programs are produced in ANS COBOL 74, and operate in an IMS DB/DC environment. Also generated are all MFS macros, DBD's and PSB's. Each online transaction includes a HELP function.

Generated programs are well-structured, and are of the quality of professionally handwritten code. Moreover, no debugging is required. TRANSFORM/IMS automatically generates the JCL to update source libraries, compile, and link all generated elements.

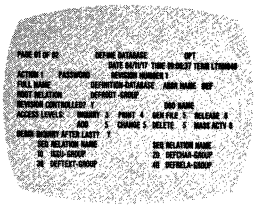
No programming skills or specific knowledge of IMS, COBOL or JCL are required. All that is needed is familiarity with the database concept and knowledge of business practice. Storage and performance tuning may be done by the database administrator using TRANSFORM options after system functional requirements are realized. Generally, only five days of training are required to become fully proficient in using TRANSFORM/IMS.

Standard COBOL output: The generated applications are independent and can be maintained conventionally if desired. You are not "locked in" to a fourth generation interpreter for execution.

Automatic revision control: When migrating from a test to a production version, no retesting is required.

Data dictionary: TRANSFORM/IMS contains its own full-function, active dictionary.

Non-procedural input: Applications are specified by filling out simple online forms. No if-then-else logic is required. This is the source of most errors in programming.



SAMPLE INPUT SCREEN

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Quick prototype creation: Generating a trial system, refining the specifications, and regenerating a new system can be done with very little effort.

Efficiency: Generated systems are compiled and executed, not interpreted, so they perform efficiently and are not limited to small transaction volumes. Performance tests show them to be about equal in efficiency to handwritten code.

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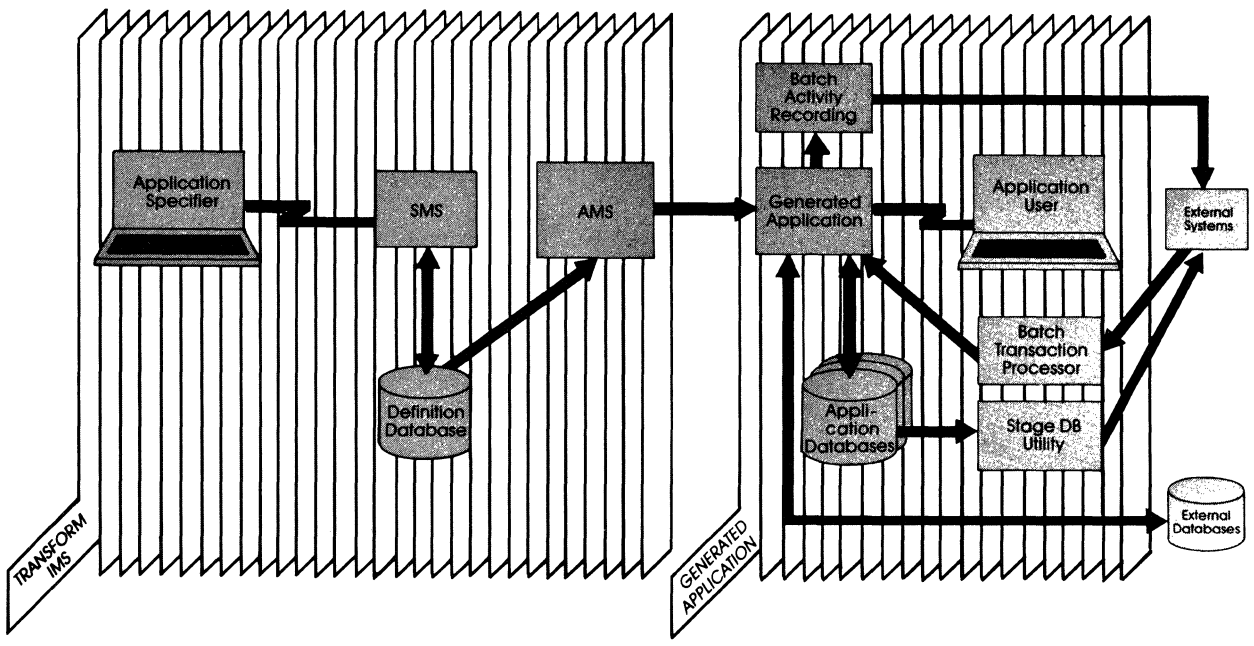

EATURES OF APPLICATION SYSTEMS GENERATED BY TRANSFORM/IMS

Systems generated by TRANSFORM/IMS employ menus and extensive HELP features. CRT screen layouts for online transactions are completely flexible, including multi-screen transactions. Any number of fields, records and databases may be retrieved and/or updated by a single transaction. Design elements are reusable and easily modified.

DEFINITION ELEMENTS INCLUDE:

- Fields
- Relations (Files and Tables)
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- Databases
- User Views
- Screens
- Transactions
- Functions
- Access Modules
- User ID's
- Terminals and Menus

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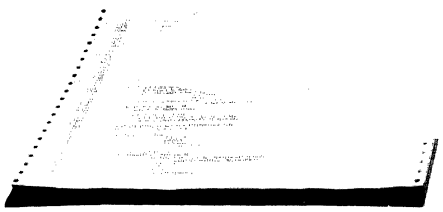
Available transaction features include: audit trails, auto-assignment of data, comprehensive security, deferred update processing, and exit capability to external subroutines.



TYPICAL GENERATED CODE

AUXILIARY FUNCTIONS ARE AVAILABLE TO PROVIDE:

- Automatic reversal of any completed transaction.
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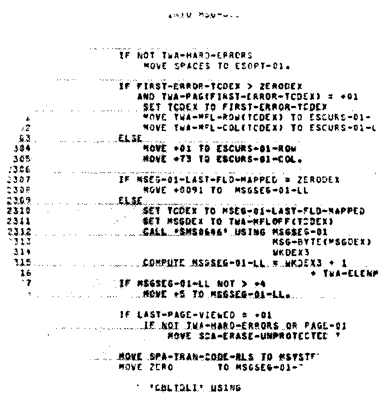
- Batch transaction processing.
- Custom formatting of database content for interface to other computer systems.
- Freezing/unfreezing of database contents.



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(Note: the map below is for indexing purposes only—it is not a depiction of *The AI Map of AI Companies, AI Departments, and AI Labs.*)

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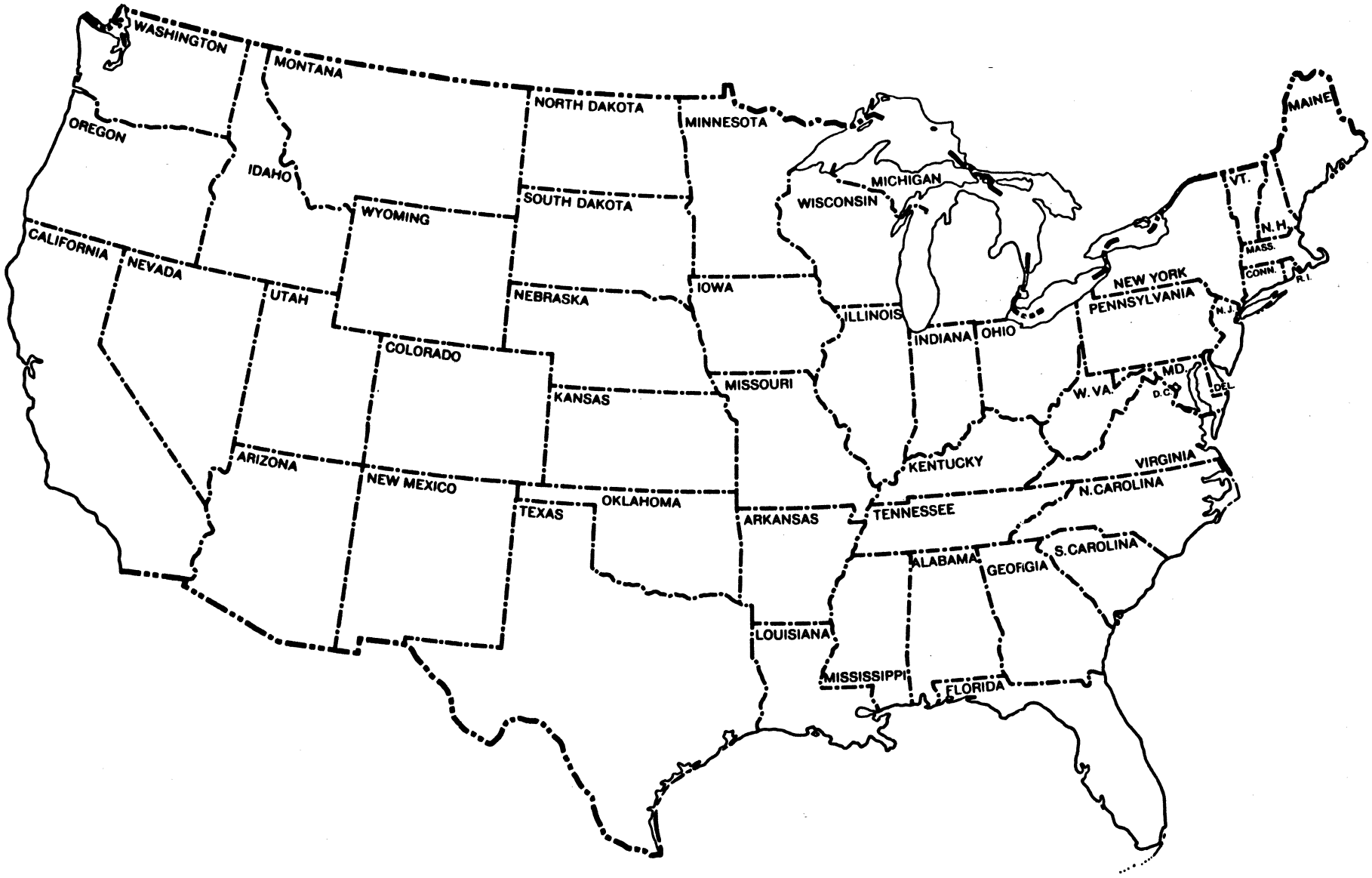

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As the future presents itself, will your company be ready to step into it?

Some companies didn't see the in

Some just never got the message that times were changing. Others flatly refused to believe it.

For them it was still business as usual. Working the same way and using the same methods they had for decades.

But as more and more machinery appeared on the scene, the more those kinds of companies disappeared.

Today, we're poised on the brink of a similar revolution. The advent of a whole new generation of computer technology.

It's called symbolic processing. And its impact on business may turn out to be even more dramatic than that of those first machines over a century ago.

This advanced form of computing doesn't simply crunch numbers faster or more powerfully than traditional computers. It processes data structures which more closely model the way people actually solve problems.

So instead of forcing programs to deal with a real world problem in numerical terms only, it allows them to compute in terms natural to the problem itself. Increasing both the amount and kinds of work that people can perform with a computer.

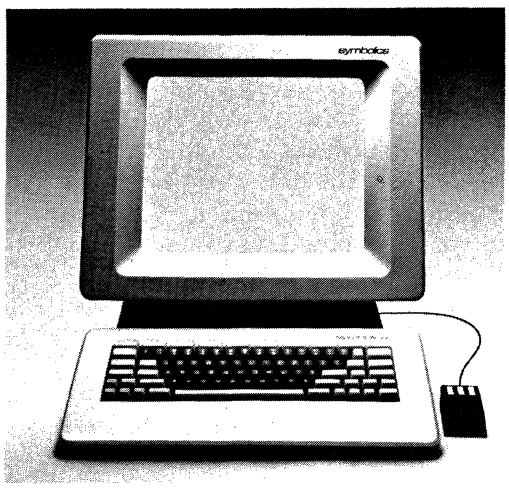
In fact, symbolic processing provides the essential foundations on which most expert systems and other AI applications are based.

dustrial revolution coming either.

For the last five years, Symbolics™ has been leading the way in the development and delivery of advanced symbolic processing systems.

We've taken this technology from the laboratory to the field. And we're ready to put it in your hands today.

But you have to take the next step. To see how symbolic processing will change the way you do business, contact Symbolics, Inc., 11 Cambridge Center, Cambridge, MA 02142.



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Your next step in computing.™

The first forward pass was

Run on first down. Run on second. Run again on third. Then punt.

For years, that's the way the game of football plodded up and down the field.

But on a brisk autumn afternoon around the turn of the century, a young college quarterback and his coach made a careful and calculated game-breaking decision.

To go beyond the tried and true. To take a giant step forward. To throw the ball.

And the game would never be played the same again.

Today, a company called Symbolics™ is offering business the opportunity to take a similar giant step forward.

Not with a computer that's just faster or more powerful, but with a computer that lets you tackle and solve more complex problems than ever before.

The Symbolics 3600™ series provides a more flexible and productive programming environment than numeric computing systems. So it dramatically expands both the amount and kinds of work you can perform with a computer.

That's why symbolic processing is the most widely accepted basis for the development of many AI programs. And is impacting a broad range of traditional

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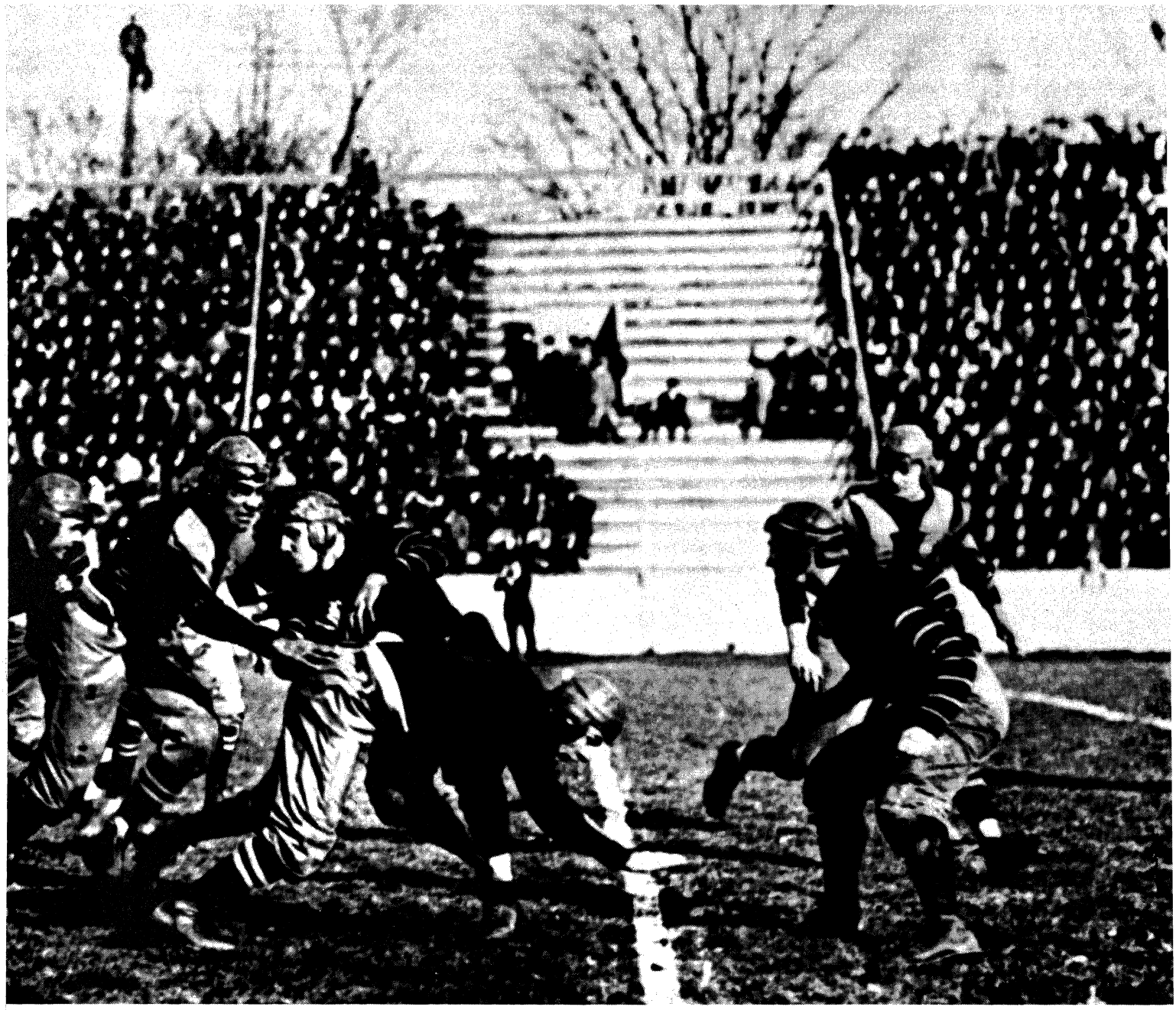
a management decision too.

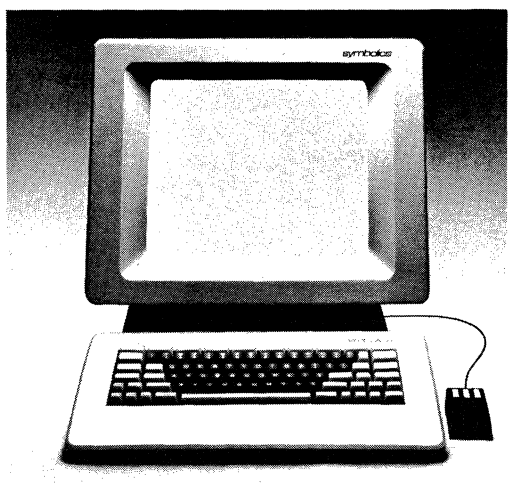


The Ohio State University Photo Archives

computing applications as well.

The people at Symbolics have pioneered this advanced technology every step of the way. From initial development in the laboratory to practical application in the field. And we're ready to put it in your hands today.

But the next step is yours. To see symbolic processing in action, contact Symbolics, Inc., 11 Cambridge Center, Cambridge, MA 02142.



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We exhibit a higher

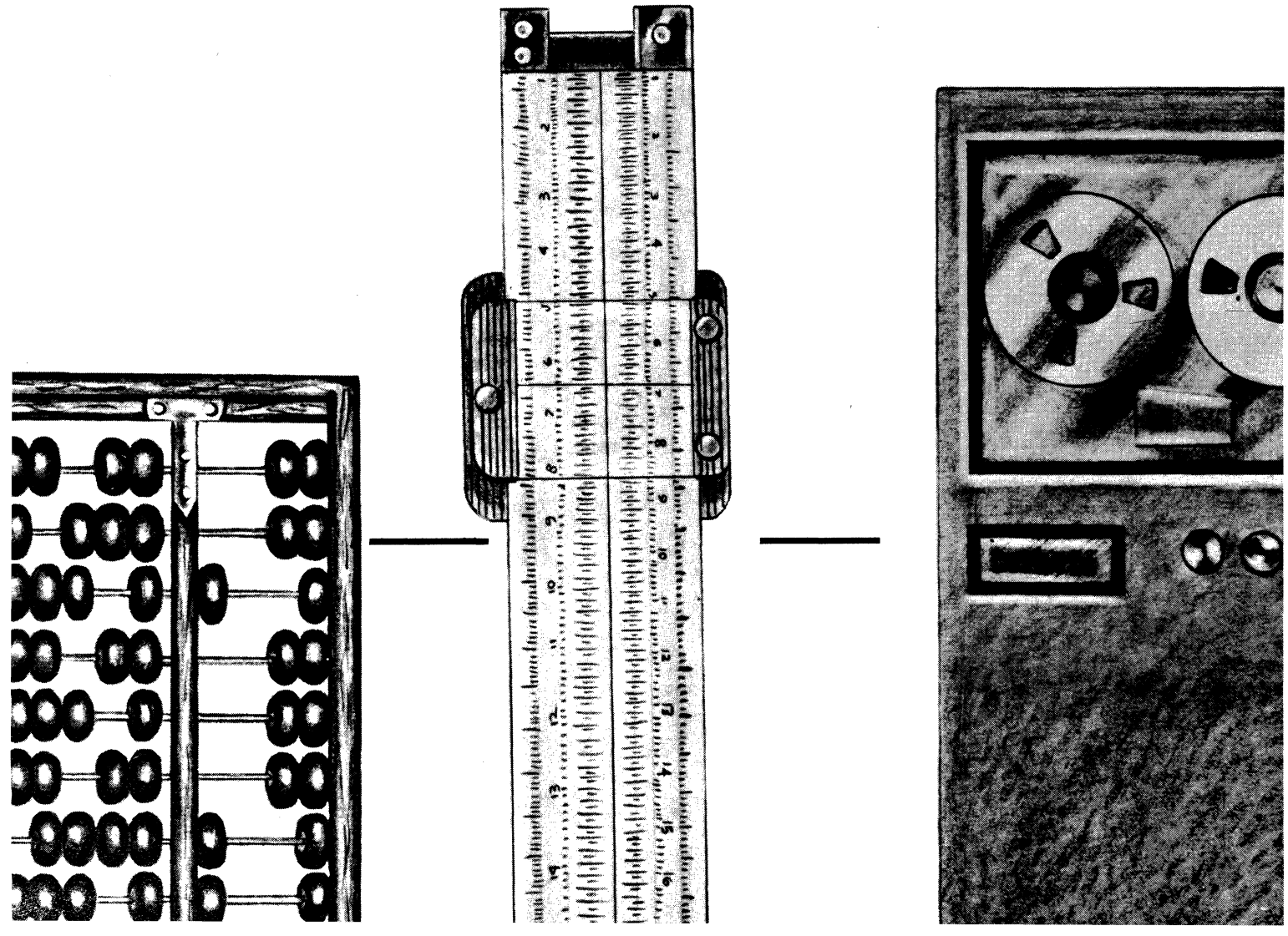
From the days of the very first manual calculating devices to the transistor and digital revolutions, man has thought of computing almost exclusively in numerical terms.

But today, we're evolving computer technology to a higher state with the development of symbolic processing. A means of computing which more closely models the way that people solve problems than is possible with traditional numeric processing.

Expert systems. Complex software development. Custom VLSI engineering. These are just a few areas in which the Symbolics 3600™ series of symbolic processing systems is providing a more powerful, more flexible environment for complex problem-solving.

Computer scientists, programmers and engineers are using this sophisticated tool to expand both the amount and kinds of work that can be performed with computers.

And as these experts further develop and apply its



level of thinking.

potential, the 3600 series continues to put the power of symbolic processing in the hands of a growing universe of users.

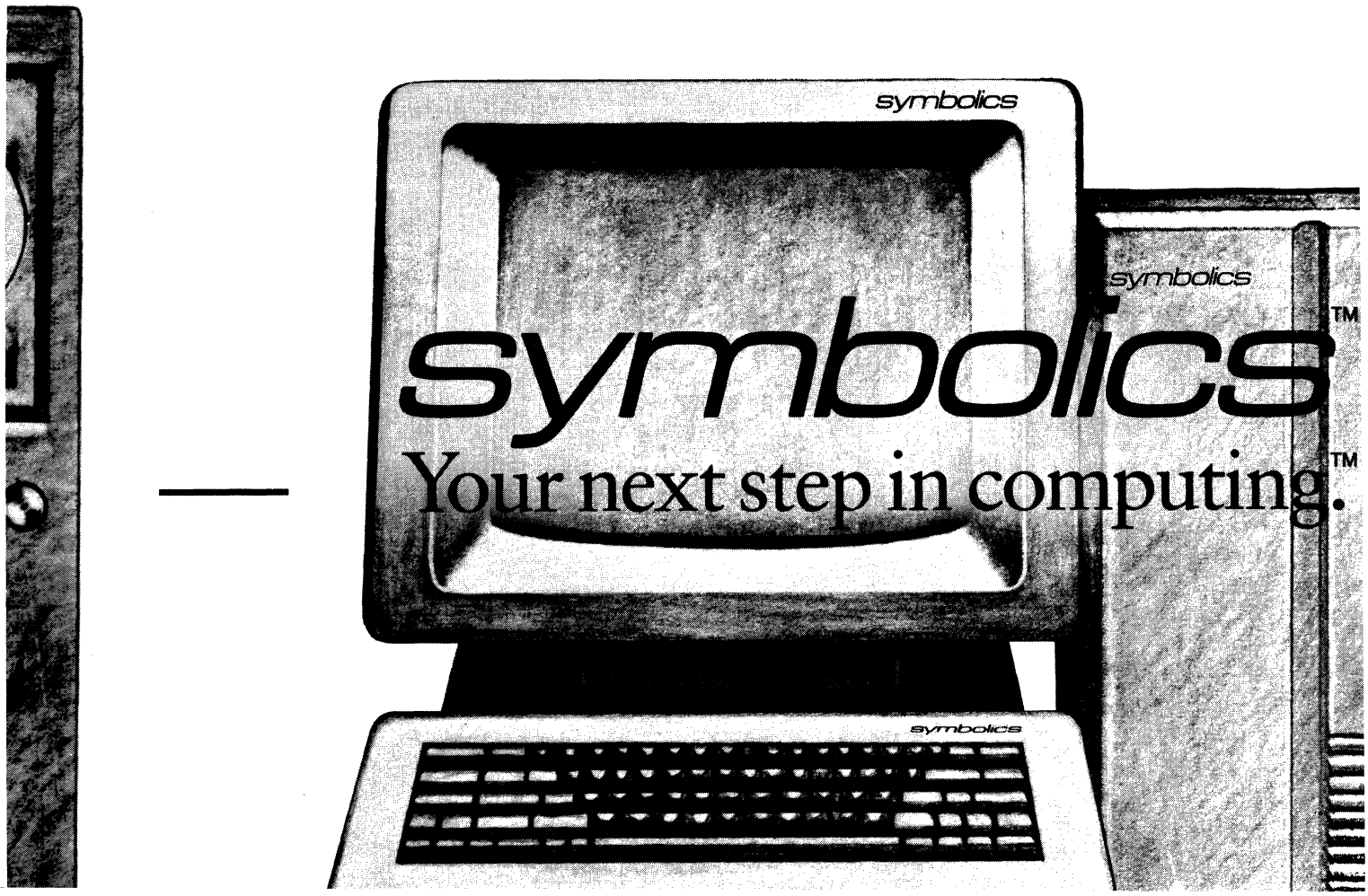
The Symbolics™ family of systems provides hardware to support a tagged architecture, an extended virtual memory and automatic storage reclamation for powerful yet cost-efficient symbolic processing.

The software environment includes windows, the Flavors object-oriented programming system, and incremental compilation of Symbolics' COMMON LISP, PROLOG, FORTRAN-77 and PASCAL.

The systems feature exceptional networking and graphics capabilities as well.

To see the current state of the art in symbolic processing, visit the Symbolics exhibit at this year's AAAI Show.

For more information, contact Symbolics, Inc., 11 Cambridge Center, Cambridge, MA 02142.



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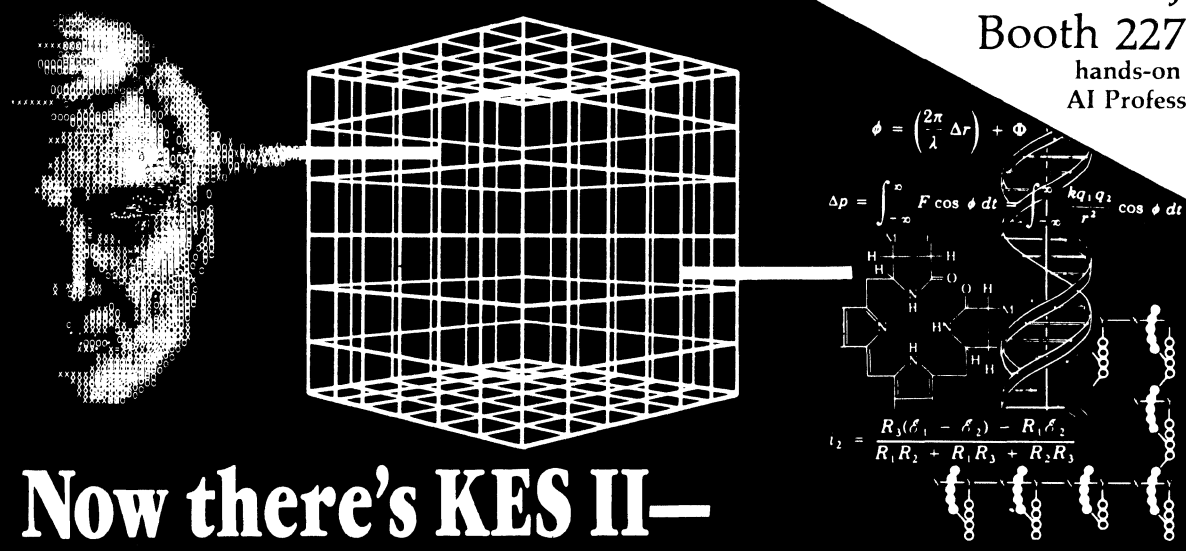
See us at the IJCAI, Booth 227-228, for a hands-on demonstration. AI Professionals: Be sure to ask about employment opportunities.



Now there's KES II— the Knowledge Engineering System that you can easily integrate into your existing applications software

Now you don't have to limit yourself to prototype or stand-alone expert systems software. Software A&E announces KES II, the Knowledge Engineering System written in C for embeddability, for increased performance, for portability. Here are four good reasons why you should give KES II a closer look:

Embeddable in larger applications

Synchronous calls allow you to easily embed new KES II in larger applications. With KES II, it's possible to integrate a knowledge base system with existing hardware and software.

Much faster than LISP

The C language substantially improves KES run-time performance on standard architecture hardware. On systems like the PC, KES may be up to 100 times faster than a LISP system.

Portable to a variety of hardware systems

With KES II, it's easier than ever to design and implement an expert system on a variety of development hardware, or to target different delivery systems. KES II gives you the same functionality on the IBM PC as it does on the VAX, Apollo, Sun, or Tektronix 4404 computers. You can develop your expert system on any of these and deliver it ready to function on any other.

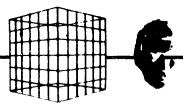
Compatible with existing KES knowledge bases

Knowledge bases created with KES II are compatible with existing KES knowledge bases.

And SA&E offers comprehensive training programs to show you how to make the best use of KES II. We will also tailor an expert system to your requirements.

Find out why the government and so many companies in industry have used KES to create their expert systems. Call Software Architecture and Engineering, Inc. at (703) 276-7910, or our European office at +44 0243 789310. Or write us at either of the addresses below. We'll show you how KES II can help create an expert system fast and efficiently.

A&E A Full Service AI Company



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16 New Park Rd., Chichester, West Sussex, PO19 1XH United Kingdom +44 0243 789310

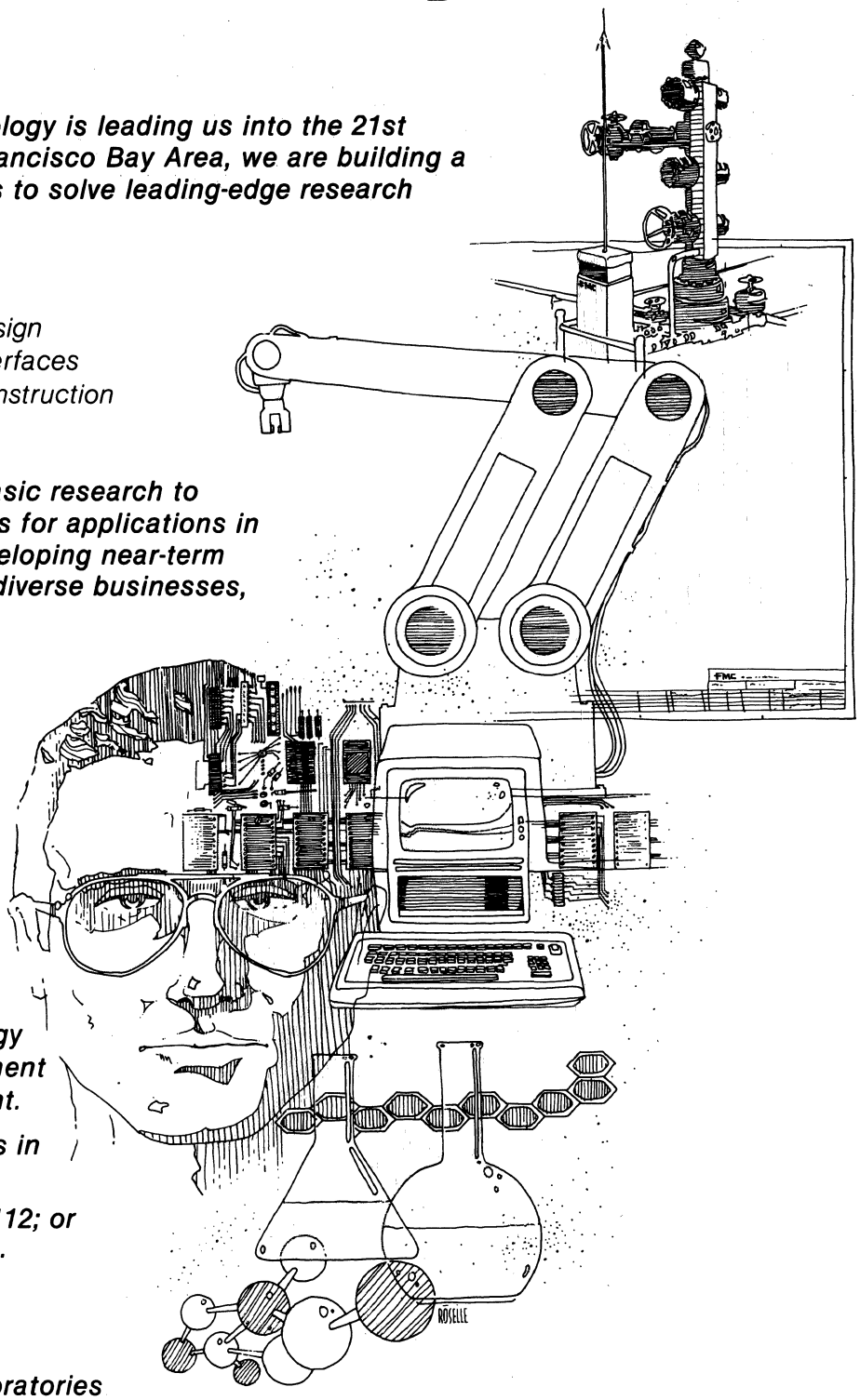
How will AI be used in the year 2000?

At FMC Corporation, AI technology is leading us into the 21st century. Located in the San Francisco Bay Area, we are building a staff of technical professionals to solve leading-edge research problems in the areas of

- ☐ *Real-time heuristic control*
- ☐ *Knowledge-based consultation*
- ☐ *Planning and configuration design*
- ☐ *Intelligent human-machine interfaces*
- ☐ *Intelligent computer-assisted instruction*
- ☐ *Computer vision and robotics*

The AI Center is conducting basic research to develop new tools and methods for applications in the year 2000. We are also developing near-term applications that span FMC's diverse businesses, including:

- ☐ *Defense systems and C^3*
- ☐ *Organic chemicals*
- ☐ *Mineral exploration*
- ☐ *Process control*
- ☐ *Robotic manufacturing*
- ☐ *Petroleum equipment*
- ☐ *Materials handling and food processing*



Our scientists are working to create tomorrow's AI technology in an interdisciplinary environment using state-of-the-art equipment.

To explore career opportunities in Artificial Intelligence, contact:

Perry Thorndyke at (408) 289-3112; or Vivette Payne at (408) 289-3433.

Or send your resume to:

Artificial Intelligence Center
FMC Central Engineering Laboratories
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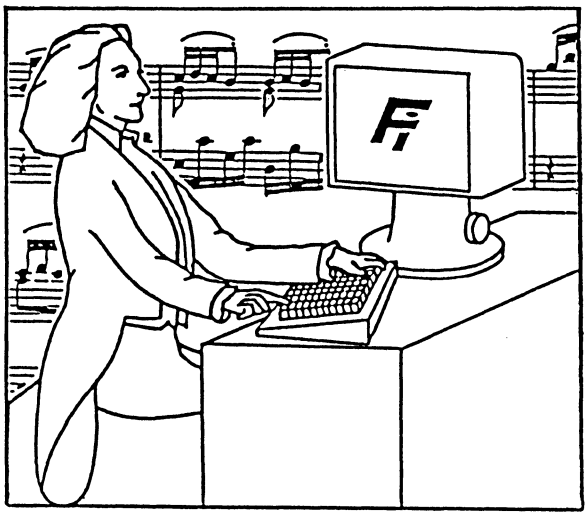
FMC

Franz *the first name in* Lisp

- **Runs a wide range of applications and AI development environments including OPS-5, Flavors, MRS, GLISP.**
- **Compiler, interpreter and library of LISP functions.**
- **The most widely distributed dialect of LISP.**
- **Common LISP compatibility.**
- **Can access C, Fortran and UNIX shell from within a LISP program.**
- **Available on a wide range of machines including Apollo, AT&T (UNIX PC and 3B series), Cadmus, Harris, Masscomp, Silicon Graphics, SUN and VAX (UNIX and VMS). Complete cross machine compatibility.**



New Product

* ExCL COMMON LISP *

- **Implementation of Common LISP as defined in Steele's book.**
- **Lexically scoped interpreter and compiler.**
- **Designed for speed - benchmark us against our competition.**
- **Full LISP environment with graphics, windows, Flavors for object oriented programming.**
- **Widely implemented, fully compatible across machines.**
- **Franz LISP compatibility routines.**

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Who's Who in Artificial Intelligence
Biographical Short Form

Nomination form for inclusion in the next edition of *Who's Who in Artificial Intelligence*™. WWAI™ is a compendium of distinguished people worldwide who have made significant contributions to Artificial Intelligence. We ask you to complete this biographical form, and return it to WWAI as soon as possible. Please also nominate for inclusion in WWAI AI professionals within your company and among your acquaintances you select, by requesting additional forms, or by making a copy of this form and forwarding a copy to each person you nominate.

URGENT: It is urgent that this form be completed and returned to WWAI as soon as possible. Please mail this form or a copy of this form, to: WWAI, Nomination Department 86–87, Box 620098, Woodside, CA 94062.

(1)

Name _____ Title _____

Division or Department _____

Company or Institution _____ Mailstop _____

Address _____ Phone No. (opt.) _____

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(2) Indicate on a scale of 1 to 3, for purposes of WWAI indexing, those AI areas in which you work, with 1 being primary pursuit, and 2 and 3 indicating secondary and tertiary pursuits. Use checkmarks for other AI areas you pursue:

☐ Expert Systems	☐ Natural Language	☐ Voice Recognition	☐ Visual Recognition
☐ AI Software Languages	☐ Workstations	☐ Other Hardware	☐ AI Research
☐ Resources	☐ Tools	☐ Robotics	☐ Other _____

(3) Please write (or attach) a summary of your career in Artificial Intelligence. List degrees, dates and where earned; honors, awards; publications authored or coauthored; products developed or codeveloped. Include major accomplishments, contributions, selected positions helds, courses taught, consulting work, and AI areas of special interest. (Use an additional sheet if necessary.)

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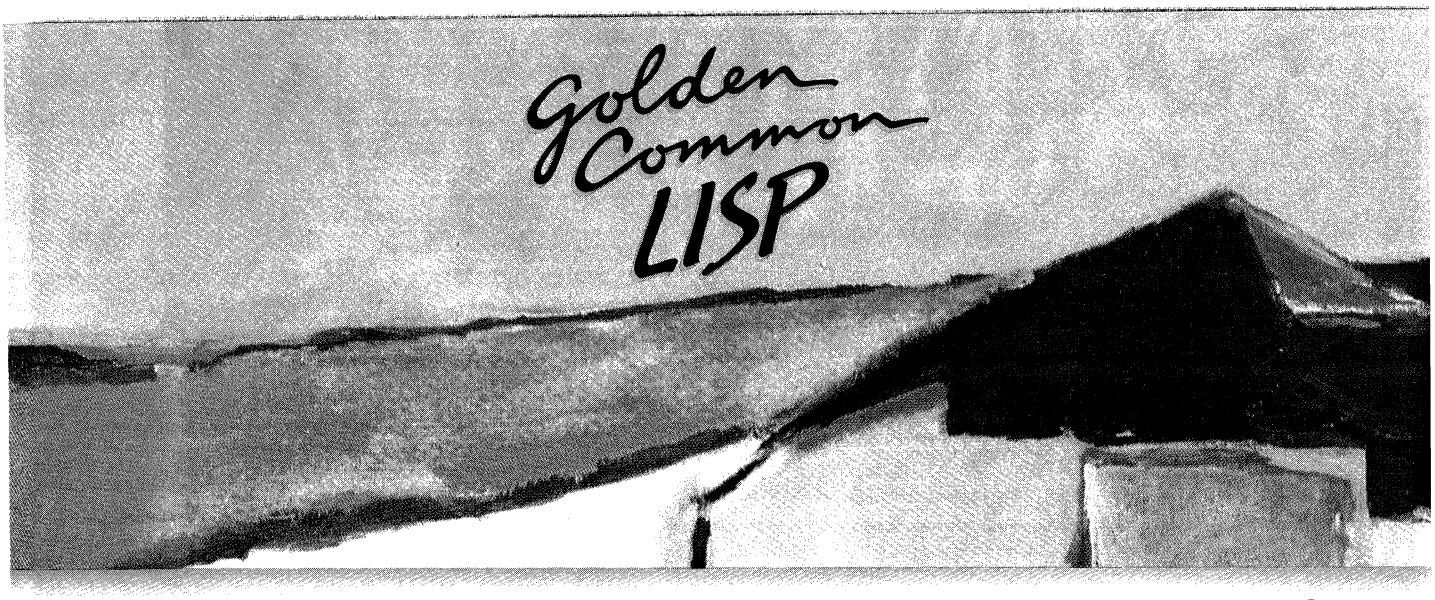

Gold Hill Computers brings the language of Artificial Intelligence to Your Personal Computer.

Why every Computer Professional should know COMMON LISP.

You know how frustrating it is to deal with programs that are stupid and inflexible like those buried inside automated bank teller machines and airline reservation systems. You also know how frustrating it is to engineer solutions to today's information-processing problems with languages designed mainly for number crunching. *It doesn't have to be this way.*

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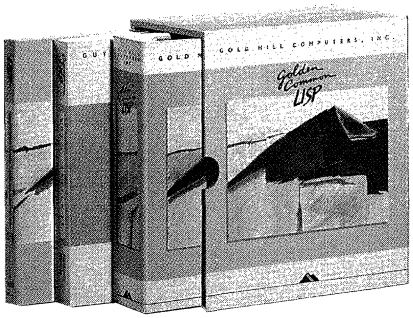
The best way to get started is to buy GOLDEN COMMON LISP,™ the first COMMON LISP for personal computers.

GOLDEN COMMON LISP: The AI Tutor

GOLDEN COMMON LISP makes it easy for you to learn to use COMMON LISP, on your personal computer, by yourself, at your own pace. The San Marco LISP Explorer,™ a 1000-frame interactive software slide show developed by Patrick H. Winston and San Marco Associates, takes you through COMMON LISP and exciting *artificial intelligence applications* like expert systems, intelligent data-access systems, and natural language interfaces.



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The GOLDEN COMMON LISP package includes:

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- the San Marco LISP Explorer
- the On-line Help system
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- the *COMMON LISP Reference Manual* by Steele
- the GOLDEN COMMON LISP User's Manual

GOLDEN COMMON LISP: The Powertool for Personal Computing

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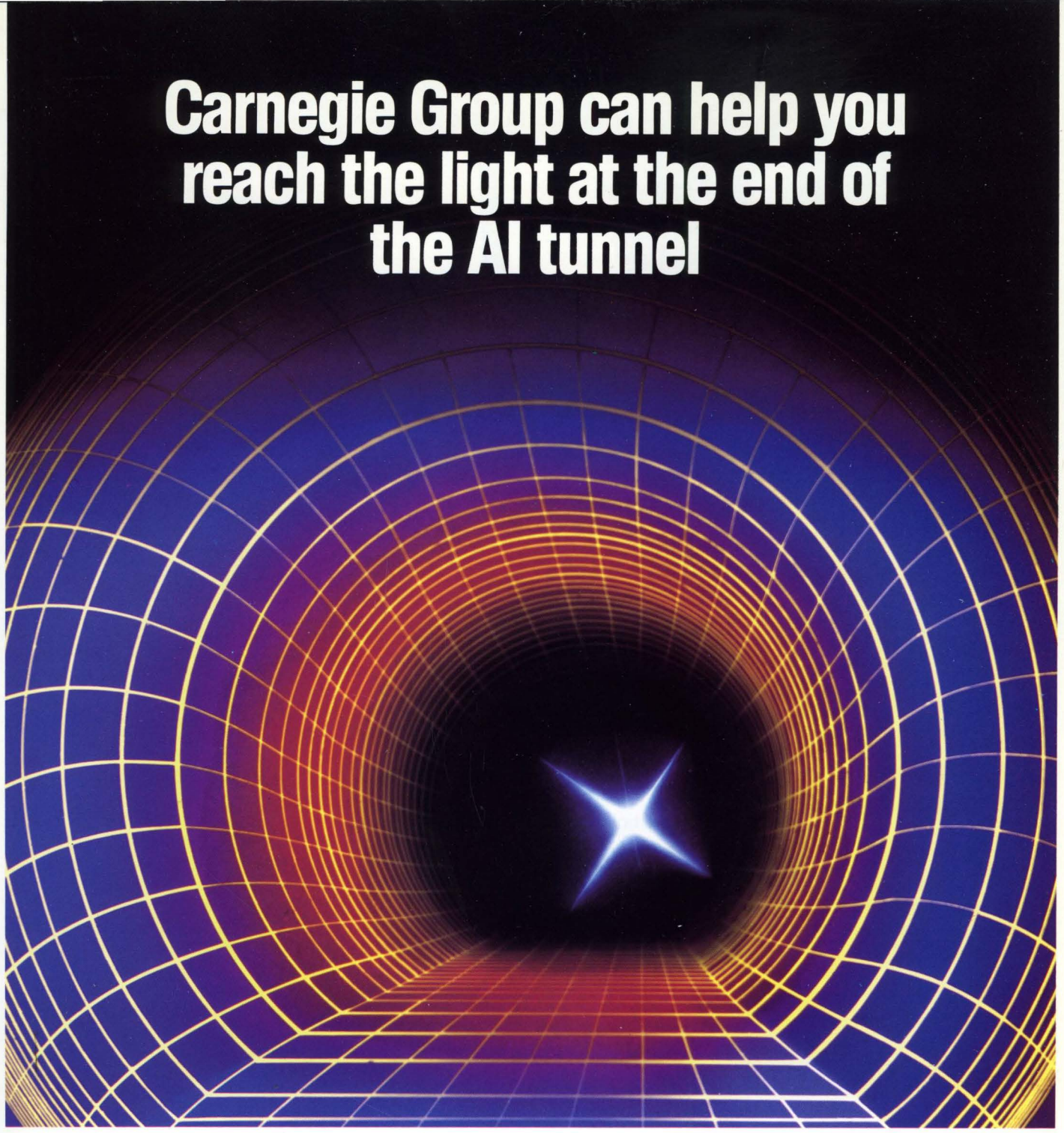
Carnegie Group can help you reach the light at the end of the AI tunnel



Artificial intelligence has the potential to become a powerful tool for solving your complex manufacturing and engineering problems. The most successful knowledge-based systems already rival human performance in such areas as engineering design, factory scheduling, and process diagnosis and control—applications where many problems cannot be solved using conventional computing techniques.

But investing in AI can be a high risk venture. AI cannot solve all of your problems. And there are no packaged solutions for the complex tasks facing most industrial organizations. Without the first-hand experience to discriminate among the multitude of AI alternatives, you may never reach the light at the end of the tunnel.

Carnegie Group is uniquely qualified to help you succeed in the practical application of AI technology. We represent over 200 man-years of achievement in building large knowledge-based systems for industry. Today, over 25 of those systems are in operation or field-test. This track record is unparalleled by any other AI company.

Carnegie Group... uniquely qualified to deliver working AI solutions to industry

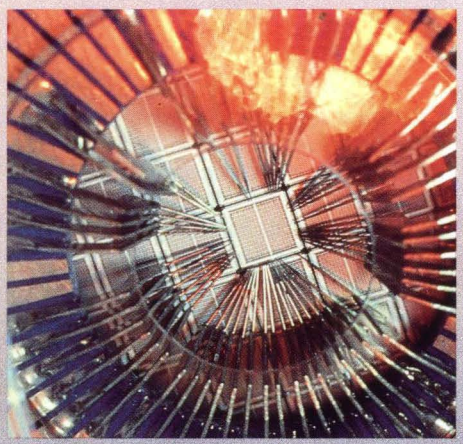
Carnegie Group represents the largest concentration of AI scientists, knowledge engineers and programmers with practical experience in applying artificial intelligence to solve important problems for industry.

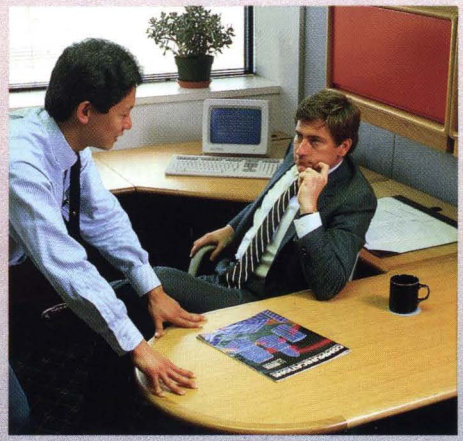
Our AI experience is your best investment

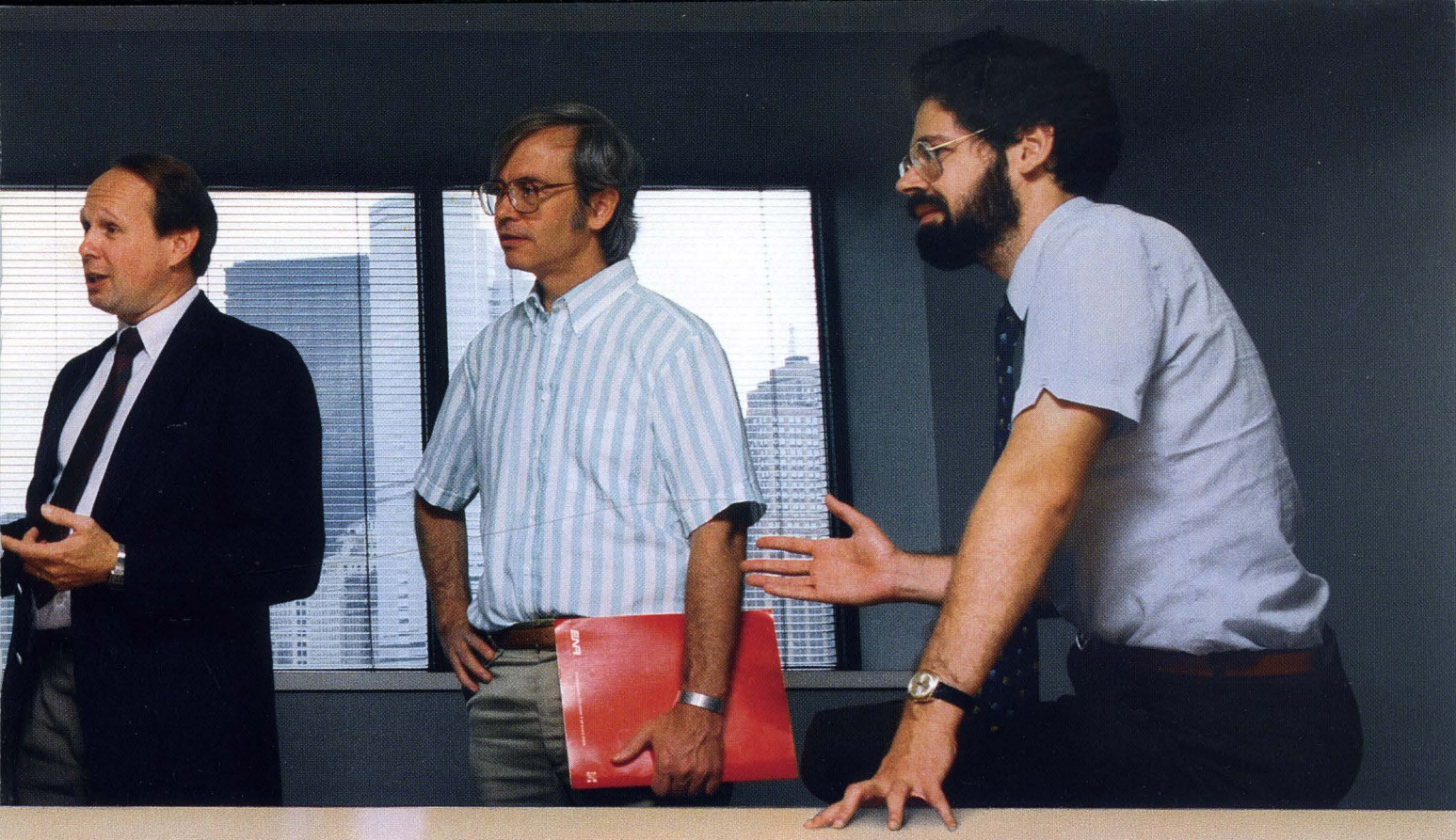
Our founders and senior technical staff have earned world-wide recognition for their pioneering efforts in artificial intelligence, leading to breakthroughs in knowledge engineering and natural language understanding. More recently, they have played leading roles in the development of AI-based commercial applications to solve diverse engineering and manufacturing problems.

Some of the best known AI systems in production use today were conceived, designed and implemented under our direction. These systems have surpassed the limits of conventional technologies in such vital areas as engineering design... production scheduling... realtime machine diagnosis... and manufacturing management.

Our people have already spent a decade or more transferring AI out of the laboratory and into production environments. We've learned the hard way. So you don't have to. We can share with you the accumulated benefits of our experience and guide you toward developing working solutions using proven tools and methods. Your AI investment will repay you sooner and help you gain a strategic advantage in areas with the highest payback.







Proven development tools

We offer the most comprehensive set of development tools available. Tools that have been repeatedly tested in real-world applications. Tools designed to grow with you as technology evolves and your business changes.

Knowledge Craft™ is a software development environment for expert systems featuring a sophisticated knowledge representation, integrated with multiple inference strategies and powerful graphics interfaces.

Language Craft™ is a flexible software development environment for building natural language interfaces to expert systems, databases, operating systems and other software.

Application shells

Carnegie Group application shells, currently under development, solve common, recurring problems encountered at critical steps in the product manufacturing process. Applications include engineering design, production management, process control and machine diagnosis. Because these shells can be installed with far less effort than developing a knowledge-based system from scratch, they dramatically shorten the implementation schedule.

Dedicated to your success

We support our products with extensive hands-on training, either on-site or at Carnegie Group headquarters. And our dedicated staff of experts will be as close as the telephone to answer your questions. In-depth support is available through our comprehensive *Mentor* consulting program and contract software development. Our goal is to help you strengthen your AI organization and to make you more self-sufficient.

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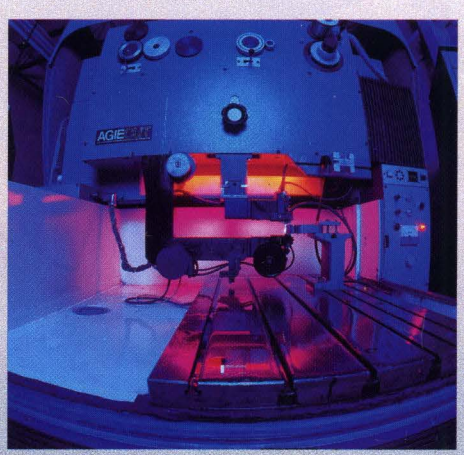

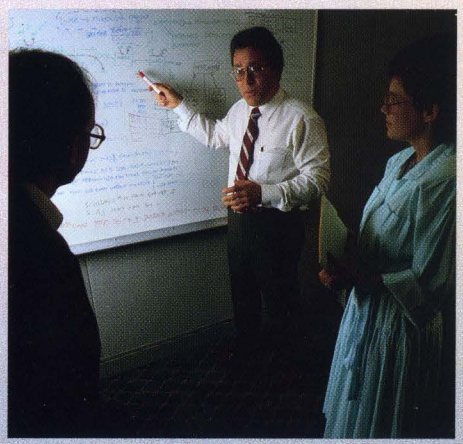

Let Carnegie Group put the power of AI to work for you

Carnegie Group has the experience to help you identify the problems that AI can solve today. We have the proven technology to create working solutions. And we have the expertise to help you implement those solutions successfully.

If you're interested in harnessing the power of AI and putting it to work in your organization, give us a call.

Carnegie Group

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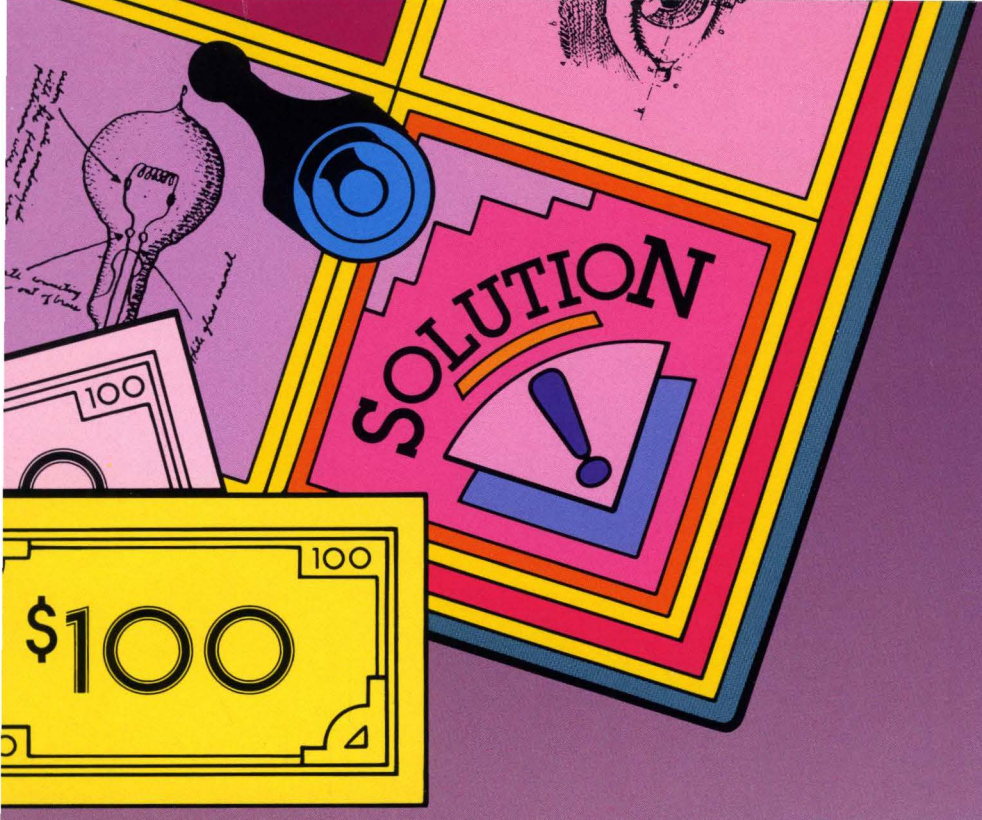
NON-TRIVIAL PURSUIT

Which software company...

1. will change commercial AI by debuting the industry's first host-PC knowledge system delivery product at IJCAI '85?
2. developed the AI industry's first commercial knowledge system development environment?
3. has sold more licenses of its commercial Lisp-based knowledge system development environment than all the others combined?
4. has licensed its knowledge system development environment to more than 20 Fortune 100 companies?
5. has taught hundreds of people how to build knowledge systems?
6. markets a knowledge system development environment that runs on more machines than any other?



1 IntelliCorp.
2 IntelliCorp.
3 IntelliCorp.
4 IntelliCorp.
5 IntelliCorp.
6 IntelliCorp.

When it comes to using artificial intelligence technology to move from problem to solution, there's only one name you need to remember: IntelliCorp. We've been using AI to solve problems since 1980. And since August 1983 other companies have been using our Knowledge Engineering Environment™ (KEE)™ system to do the same thing. Including more than 20 Fortune 100 companies.

And with the debut of the industry's first host-PC delivery system at IJCAI '85, you can now use conventional computing hardware to deliver the knowledge systems you develop on Lisp machines with KEE. Immediately.

At IJCAI '85, IntelliCorp will also be demonstrating the new, advanced features included in the third major release in three years of the KEE system. Features that will get you to your AI solution even faster.

From problem assessment to prototype to deliverable product, IntelliCorp offers a full range of software and services to make you successful in AI. That's why we call ourselves the AI solutions company.™

IntelliCorp™
THE AI SOLUTIONS COMPANY™

Knowledge Systems Division
1975 El Camino Real West
Mountain View, California 94040
Telephone: (415) 965-5500

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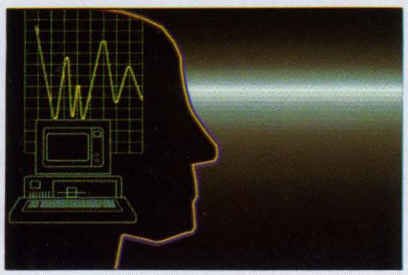
A Second-Generation Knowledge Engineering Facility



RuleMaster™

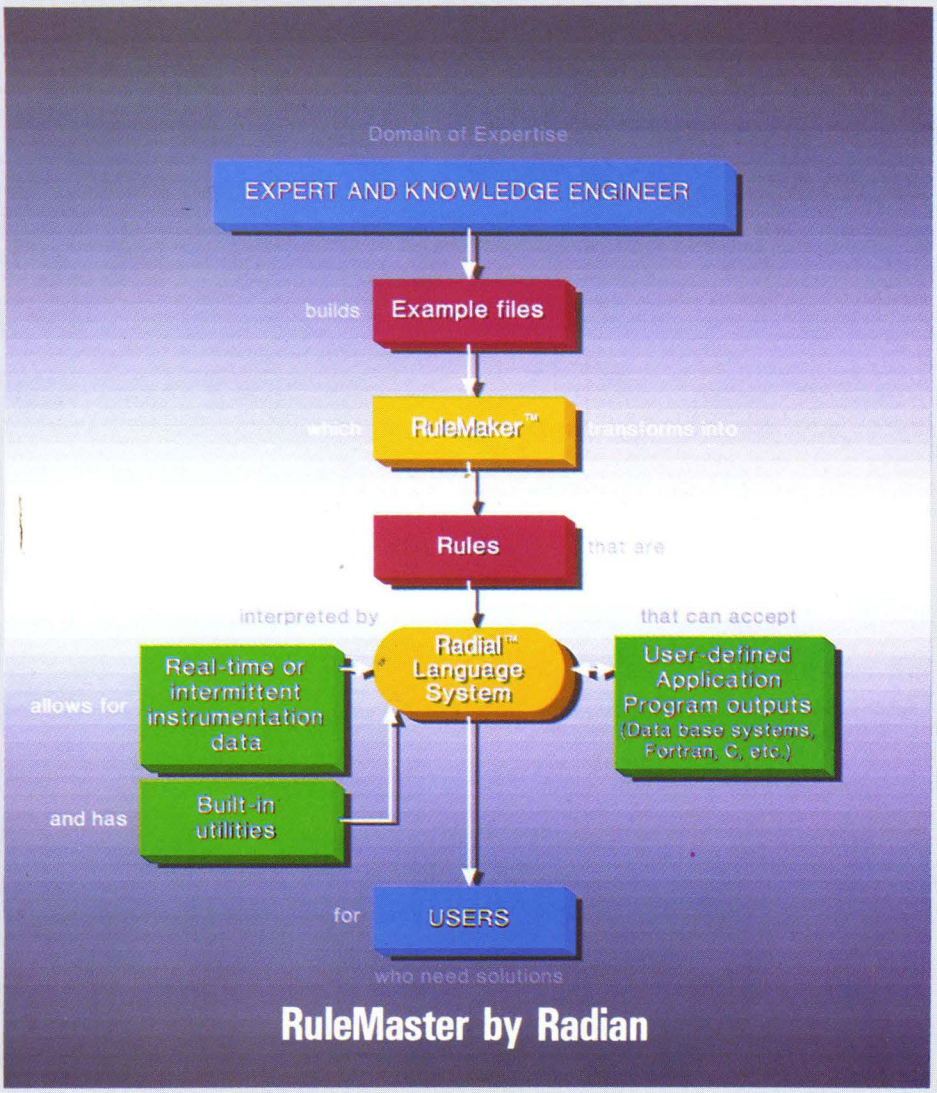
a software tool for building expert systems

Features include:

- Radial – an extensible language for expressing rules
- RuleMaker – the induction of rules from examples
- hierarchical structure of small, understandable rules
- runs on computers with UNIX or the C programming language
- user-definable, application-specific data types and operators
- interface to user's code in various languages
- ability to explain line of reasoning on demand

An expert system can:

- provide expertise when human expertise is not available
- provide expertise more uniformly, and in many cases more rapidly, than available from human experts
- assist an expert in making decisions involving many interacting, complex factors
- provide a common repository for a dynamically growing knowledge base



RuleMaster is a flexible set of tools that can be used in the development of expert systems for use in industry. Radian, with years of experience in providing engineering services to industry, has assembled a group of knowledge engineers who can work with specialists in technical areas to derive a knowledge base and develop a RuleMaster expert system.

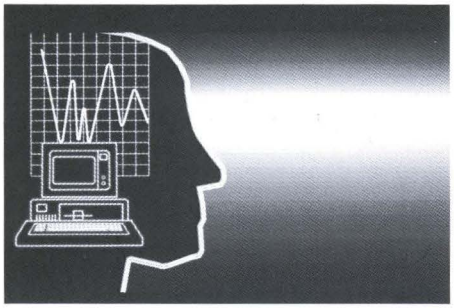
Building a RuleMaster expert system is a two-step process: first, a top-down structuring of the solution and second, a bottom-up definition of rules to fill in the structure. Induction of rules from examples helps domain specialists with the second step because they usually think in terms of declarative examples rather than procedural rules. The expert system is easily refined by adding, changing, or deleting examples. The expert also has the option of entering rules directly.

RADIAN CORPORATION
A company of The Hartford Steam Boiler Inspection and Insurance Company

For more information contact: RuleMaster
8501 Mo-Pac Blvd. / P.O. Box 9948
Austin, Texas 78766 / (512) 454-4797

For your copy of the paper, *A Second-Generation Knowledge Engineering Facility,* authored by Professor Donald Michie et al., and presented to the IEEE/AAAI Joint Conference, please contact Radian Corporation.

RuleMaster™



1. What are the outstanding features of RuleMaster?

The following list summarizes a few of the credentials of this software system.

- A framework within which an expert system can be constructed rapidly
- Facilitates the knowledge engineering task by providing a powerful, easy-to-use tool
- Induction of rules from examples
- Generated rules structured in a hierarchy
- Produces expert systems that run rapidly
- Power to solve industrial-scale problems
- Ability to explain line of reasoning
- Capability to access other information sources
- Interfaces to any user's code in various languages
- User-definable data types and operators allowed
- Automatic generation of Radial code which reduces programming errors
- Computers with C compilers utilized

2. Is there a simple description of RuleMaster?

Not really. Unfortunately or fortunately, depending on your perspective, it consists of many different concepts, capabilities, and attributes. In its simplest terms, RuleMaster is a software framework in and around which simple or sophisticated knowledge-based systems may be constructed and exercised. In other words, it is an expert system builder. Its two major components are RuleMaker, a system that induces rules from examples, and Radial, a language designed for expressing and executing rules. One important feature is that it does not require the usual level of technical AI skills to build a useful, cost-effective advisory, diagnostic, or control system. Many of the features require a more detailed examination in both descriptive and productive aspects.

3. What is rule induction? Why is it important?

Rule induction is the creation of a rule from a set of examples. The information embodied in the examples is generalized to cover many cases which are not specified by that example set. Induction is important because experts are better able to express their knowledge in the form of declarative examples rather than procedural rules. Usually the induced rule is a very compact representation of information which takes more space when expressed as examples. Also this is the best method known for extracting information from experts.

4. Where does the "power" come from in RuleMaster to build large industrial- or technological-based expert systems?

Most of the expert system building tools represent their knowledge bases as production systems, with little or no structure. These systems also typically have limited ways of specifying control strategies. The production systems become unwieldy and hard to understand. This is because the knowledge engineer has to encode the rules and then add whatever structure possible to the knowledge base. The knowledge engineer must typically be a highly trained AI specialist.

RuleMaster knowledge is in the form of a highly structured rule set. Rules are modularized and can be developed and tested separately. Control can be easily specified within each module and between modules to produce the effect of forward or backward chaining. Because of the structuring available in RuleMaster, a problem can be broken down into small components. Each rule is developed separately as an individual module by entering examples to specify particular cases. The rule induced from the example set can then be tested independently. It is much easier to develop rules in a very small domain that can be structured into a larger system approach which has no structure. A RuleMaster system can be developed by a person with the knowledge of problem-structuring techniques and minimal AI training.

5. How does RuleMaster explain its line of reasoning?

For the explanation to be meaningful, the structure of the example files and the definition of the intention of modules are critically important to a successful implementation. RuleMaster's basis in finite state automata provides the tasks required to structure the application such that useful, easy-to-use explanations are provided to reassure the ultimate user of the "why."

The explanations are complete English sentences and are automatically generated by RuleMaster using the intent section of the modules, the question being asked during the consultation, and the advice being given. The really important factor in explaining clearly the logic used by RuleMaster is the initial structuring of the problems.

6. What is this internally generated code "Radial" and how does it help?

Radial is an interpreted language for expressing and executing rules based on finite state machine theory. Radial was designed and developed to support the capabilities that an industrial expert system application might need. The rule structure itself is matched to rules which are induced from examples. The variables, abstract data types, and overloaded operators are included because practical applications often require representing data in those forms. The extensibility feature, that is, the ability for the user to write primitives in other languages, is there because applications often have existing codes in these other languages which they would like to interface to an expert system. This capability allows a problem solution in Radial to be expressed in the language of the domain. Radial is a block-structured language with the same visibility and scoping rules as Pascal and Algol. This allows large applications to be built because of the modularity and hierarchy inherent in the Radial language. In these large applications, individual rules may be placed in the context or in the module where they belong.

7. What is a primitive interface utility?

A primitive interface utility is an external program written in any language that runs under Unix, such as Fortran, Pascal, or C, which provides for communications with an external information source. These sources can be large data bases or a computational algorithm which depends on parameters passed to it by RuleMaster. Real time inputs or varying inputs, such as instruments, can also provide information for RuleMaster to use in providing a diagnosis, a control strategy, or advice.

8. What is an abstract data type and associated operator?

The data types in normal computer languages include integers, strings, floating points, and so forth. The operators associated with integers, for example, are such things as plus, minus, the relational operators, less than, equal to, and greater than. RuleMaster allows the user to define additional data types which are used in the language just like the built-in data types such as integer and floating point. These data types may be simple, or they may be complex, which means that they contain a number of different pieces of information, which may even be organized hierarchically to include other data types. The user may also define operators which are associated with any data type that he defines. Along with each operator, he defines its properties, how many arguments to expect on the left-hand side, and the precedence of how it should be bound when the expression is parsed. Whenever this operator appears correctly in an expression along with that data type, the operator code supplied by the user will be invoked. For example, a matrix data type can be defined along with matrix operators such as addition, multiplication, and matrix inversion. Then in Radial code, two matrices, A and B, can be multiplied using the matrix multiplication operator (×) by saying A×B. This extensibility property of RuleMaster is very powerful.

9. What computers are RuleMaster running on?

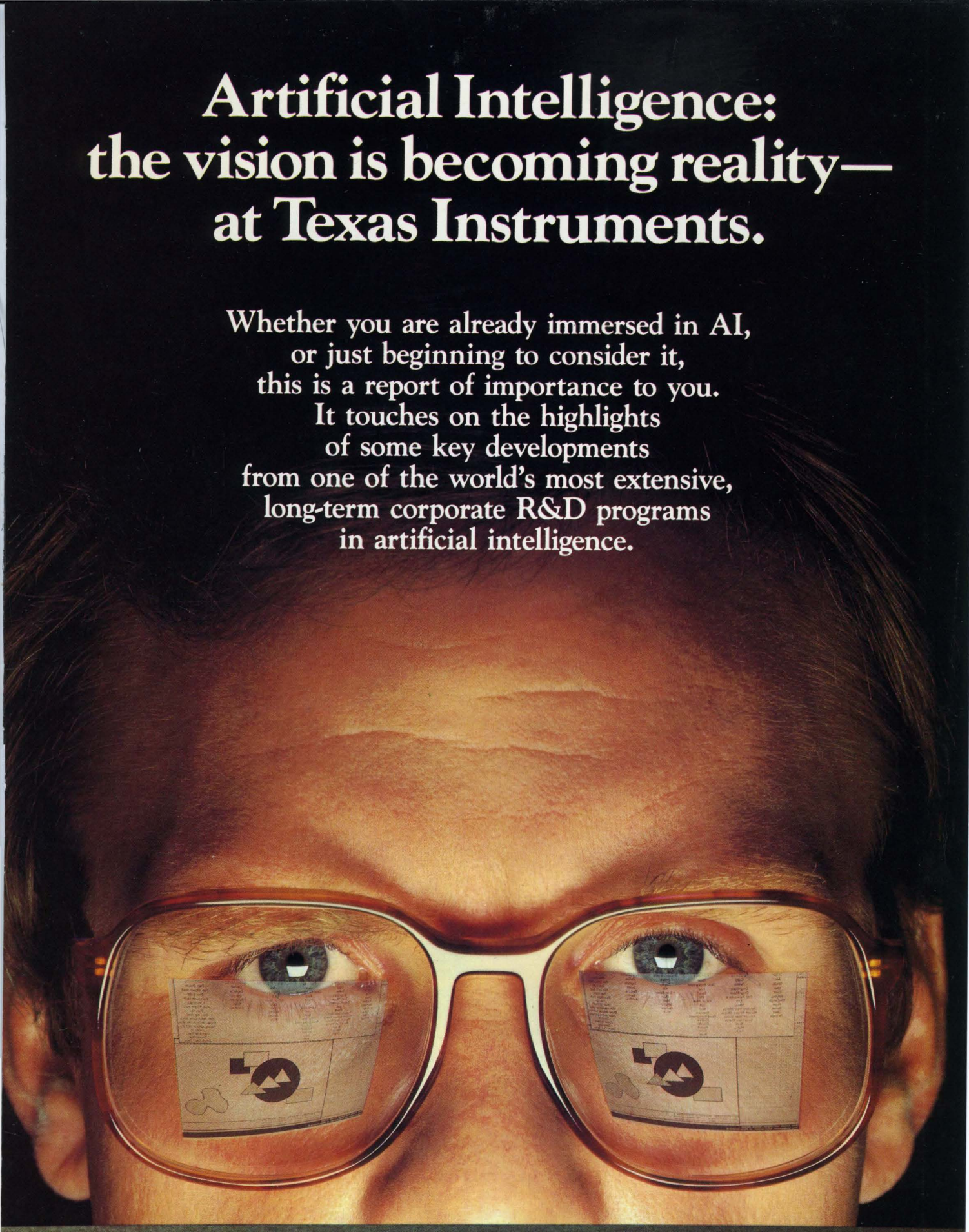
The current versions of RuleMaster are designed to run on Unix operating systems. It utilizes the C compiler for its base code and, therefore, can be transported with some programming effort to computers that have only C compilers, but not necessarily Unix. An abbreviated version runs under PC DOS on the IBM PC/XT. This portability is an important feature of RuleMaster.

RADIAN CORPORATION

RuleMaster was co-developed with Professor Donald Michie and Intelligent Terminals Limited, Industrial Associate of The Turing Institute, U.K.
IBM PC/XT is a trademark of International Business Machines Corporation.

Artificial Intelligence: the vision is becoming reality— at Texas Instruments.

Whether you are already immersed in AI,
or just beginning to consider it,
this is a report of importance to you.
It touches on the highlights
of some key developments
from one of the world's most extensive,
long-term corporate R&D programs
in artificial intelligence.



The next generation of computer technology is coming of age—at Texas Instruments.

Once again, Texas Instruments is pioneering important new technology which promises dramatic increases in human productivity. And, once again, TI brings technology within your reach through practical, problem-solving products at affordable prices.

Artificial intelligence is an emerging set of technologies whose goal is to enable computers to solve problems traditionally thought to require human intelligence or capabilities.

Key to these next generation systems is a significant new approach to computer programming known as symbolic processing. Conventional computer programs require precise sequences of mathematical steps carried out in a prestructured manner. Symbolic processing works with ideas and knowledge rather than numbers, analogous to the way humans reason with knowledge they possess.

Conventional computers experience many shortcomings in areas where symbolic processing systems have proven especially effective: dealing with complex problems, interpreting information, using "rules of thumb" gained by experience, and handling uncertain or incomplete information.

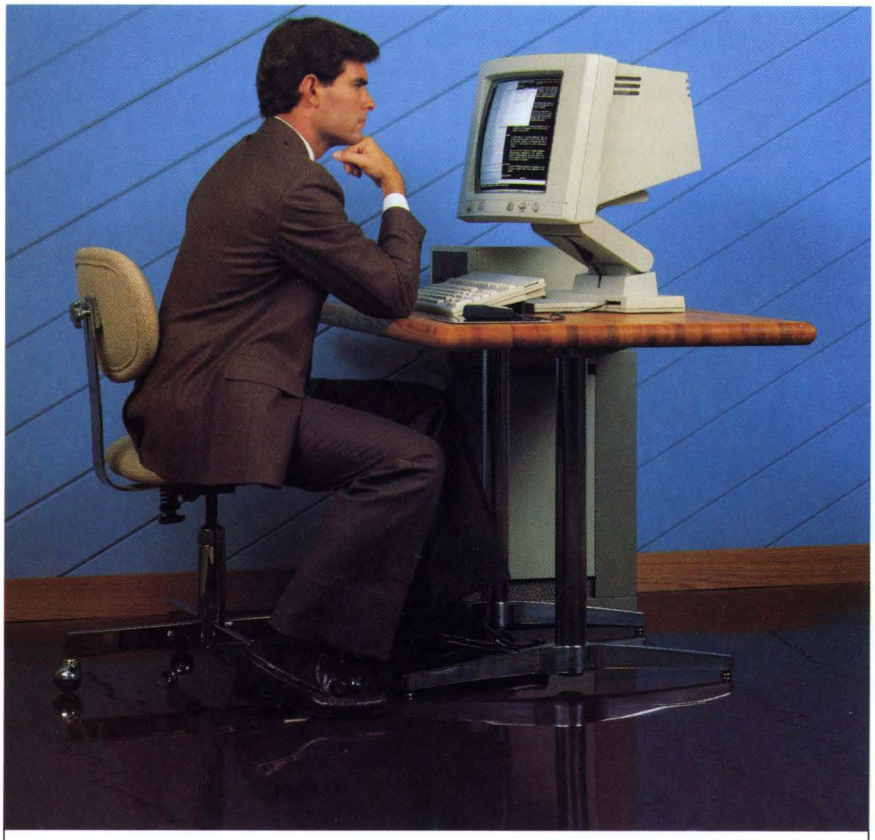
SYMBOLIC vs. ARITHMETIC	
Qualitative	Quantitative
Logical	Numerical
Inferential	Computational

People conceptualize ideas in symbolic terms rather than numbers. Symbolic processing computers manipulate information and knowledge in much the same way.

Symbolic processing, combined with other AI technologies—natural language, speech recognition and synthesis, computer vision—promises to open new dimensions in the way computers serve people. Using AI, computers can now be applied to the broader range of problem solving and decision making that people continually face in the real world.

At TI we're making AI work for you—now.

The transition from basic research to useful products is a commitment at Texas Instruments. We're concentrating not only on fundamental AI research, but on developing and marketing useful products that take full advantage of our experience. Today, TI has a number of products that are a direct result of this commitment.



The Explorer system represents an important advancement in providing exploratory programming and rapid prototyping capabilities for faster development of AI applications.

The TI Explorer™ system. Solving problems beyond the reach of traditional computing.

The Explorer system from Texas Instruments uses a new computer architecture especially designed for AI applications. It executes the language of artificial intelligence, LISP (List Processing). Programmer-friendly ease-of-use features promote rapid productivity for new users.

In contrast to conventional computers, which are designed for numerical data processing, the Explorer system is designed for the efficient processing of symbols and concepts, which represent real-world objects, their properties and relationships, and "chunks" of knowledge.

Until recently, symbolic processing systems were large, expensive computers that required special environments. This limited their use primarily to research laboratories. But, using its advanced semiconductor capability, TI has set a new standard for symbolic processing computers. The Explorer system's compact design, advanced user console, and powerful software packages now make it possible to move artificial intelligence solutions out of the laboratory and into the workplace.

For the company working on AI development, or for the organization just beginning to evaluate it, The Explorer system from Texas Instruments is a "must" consideration.

Bringing AI technology to personal computing.

Making technology affordable and accessible to more people is a prime mission at Texas Instruments. In putting AI research to practical use, TI has developed a number of new capabilities for personal computers that are making artificial intelligence applications available to everyone who needs them.

The Personal Consultant™—expert system development tools for personal computers.

The Personal Consultant software package from TI lets you develop and run expert systems on a TI Professional Computer or other personal computer.

Expert systems are computer programs designed to simulate the reasoning processes of human experts in a particular field—in effect, a computerized consultant. It asks a series of questions, and applies rules used by human experts to analyze the answers and make recommendations.

With Personal Consultant software, you can even ask for *help*, inquire *why* you were asked a particular question by the computer, or *how* the system reached its conclusion.

The economies offered by Personal Consultant make adaptation of this advanced technology practical for business and industry today, allowing the expansion of expert systems development and applications to a much greater degree than was affordable up to this time.

Arborist™—powerful decision-analysis software.

Arborist software illustrates the application of AI techniques to solve conventional problems. A combination of LISP processing language, multiple window displays, graphic representation of data, and plain English commands breaks through old barriers to make decision-tree problem solving techniques available to anyone who needs to make better and faster decisions.

Available as a direct result of TI research in artificial intelligence, this new software makes a versatile professional productivity tool easy-to-use and affordable on economical personal computers.

◀ *The Explorer computer system for high-performance symbolic processing.*

Natural language software—helping PCs use plain English.

A leader in the development of natural language interfaces, Texas Instruments developed NaturalLink™ software to allow people to communicate with computers in everyday English sentences, rather than in more traditional computer commands.

Invented in TI's Artificial Intelligence Research Laboratory, NaturalLink packages are available now to provide simplified access to many of today's most popular commercial PC software packages. These include word processing, spreadsheet, database, and graphics programs—programs that impact the majority of personal and business computing needs.

System developers may also build natural language interfaces for their own applications by using the TI NaturalLink Technology Package.

Computers that speak—and respond to the human voice.

Back in 1978, TI brought a major breakthrough in synthesized speech to the fingertips of children in practical, affordable, *talking* learning aids that spawned a whole new generation of electronic products.

With the emergence of personal computers, Texas Instruments has applied advanced speech technologies to PCs with the TI-Speech™ system. This innovation brings together our latest developments in both voice recognition and voice synthesis. The TI-Speech system permits users to verbally enter commands in the computer and provides sophisticated telephone management functions. It makes using a computer easier. And for some hands-busy applications, or for some handicapped individuals, it makes computerization possible.

The Business-Pro™ computer combines advanced personal computing power with capabilities for artificial intelligence applications.

At TI we're using AI today ...for tomorrow.

TI has made an extensive commitment to the application of AI technology for in-house productivity and to solve customer problems. We began our R&D efforts in 1978 and are leading the way in bringing practical, cost-effective AI products to market.

As an established world leader in the research and development of symbolic processing computers, expert systems, and natural language and speech processing, TI is now utilizing the benefits of these efforts. We've discovered new ways to apply AI solutions to improve our own productivity—to speed and improve the development process for advanced VLSI semiconductors, to increase the productivity of automated production systems, to enhance the effectiveness of vital defense systems, to analyze seismic data more accurately for more effective oil exploration, and to develop software that provides better, more timely management information.

The results of these efforts, and our own experience, is bringing thoroughly tested AI products to the marketplace and making them available to an ever increasing number of disciplines.

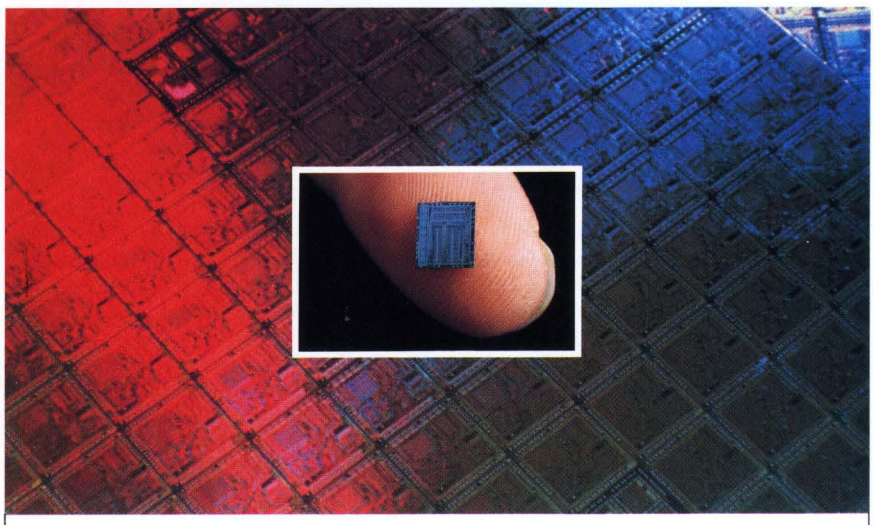
Expert systems, natural language processing, and speech recognition have been applied to fields ranging from genetic engineering to financial management to education. Symbolic processing computers such as Explorer are being used to perform tasks once thought to be solely the province of human experts: planning space missions, diagnosing machinery failures, designing control systems for chemical processing plants.

Texas Instruments dedication to research in artificial intelligence has made significant contributions to this exciting new field. As one of the world's largest technology companies, TI has the resources and commitment necessary to continue its leadership role in the development and production of reliable new products which capitalize on the results of artificial intelligence research.

The next generation of symbolic processing has already begun at TI.

One such program currently underway at Texas Instruments is the development of a LISP processor on a single chip. As part of the Strategic Computing Program of the Defense Advanced Research Projects Agency, this microprocessor is designed to provide up to 10 times the power of symbolic processors previously available.

This new chip will lead the way to many new commercial applications of artificial intelligence. When you link your AI development work to TI, you know you will stay at the leading edge of this fast developing technology—a potentially critical factor in competitive strategies for tomorrow.



A new single-chip LISP processor, being developed by Texas Instruments, will have 10 times the power of previously available symbolic processors.

TI's worldwide support and quality products help you make the most of AI technology.

To make artificial intelligence a practical reality takes more than product innovation. Texas Instruments already has a worldwide support system to provide technical assistance and follow-through. It's a total program of training, documentation, engineering support, and field service designed to provide you with the assistance needed to take maximum advantage of advanced AI technologies.

And for value, TI's exacting design and manufacturing standards enable us to deliver a higher quality product, a more reliable product, with greater functionality and at lower cost than would otherwise be possible.

Explore the promise of AI with TI.

- A proven track record for innovation in new technologies.
- An extensive, long-term R&D effort in artificial intelligence and the resources and commitment to sustain it.
- A leadership role in AI research applied to practical, affordable products—commercially available now—with new products under development.
- Consider TI's one-of-a-kind credentials in artificial intelligence. Whether you are just beginning to think about this new wave of computing technology or already have a program in place, Texas Instruments can help you lead the way.

For more information.

If you would like to know more about the exciting new developments in AI at TI, write to us at Texas Instruments, P.O. Box 809063, Dept. DEE02, Dallas, TX 75380-9063 and we'll send you additional information.

Discover new dimensions in computing with the Explorer symbolic processing system.

From the company that pioneered the transistor radio, integrated circuit, electronic calculator, integrated-circuit computer, computer-on-a-chip, microprocessor, and synthetic speech.

Once again, Texas Instruments is pioneering an important new technology and bringing it within your reach through a practical, problem-solving product at an affordable price. The Explorer computer system will play a vital role both in extending the boundaries of knowledge and in delivering the products emerging from artificial intelligence research.

A closer look at the Explorer system.

The Explorer system is an advanced computer system designed for high-performance symbolic processing. The Explorer is ideally suited for the development and execution of software that employs artificial intelligence techniques to help solve complex application problems.

The LISP environment.

The system features one of the most productive software development environments available today. The software is based on Common LISP to promote portability and consistency of software applications among different LISP machines. The Explorer also provides high-level extensions to LISP, including Flavors—an object-oriented programming facility.

Unique software.

In addition to the standard LISP machine environment, Texas Instruments provides a number of unique software packages as a standard part of the system software. The Command Interface Toolkit provides standard interfaces to the system. The Suggestions Menu System helps novices rapidly learn the Explorer environment. The Glossary Utility offers online definitions of terms. These packages greatly reduce the time it takes a new user to become productive on the Explorer system.

Advanced hardware.

The Explorer hardware supports high-speed symbolic processing through a number of advanced architectural features. These include a tagged architecture for run-time data typing, bit-field hardware for manipulating complex data structures, hardware assisted memory management (garbage collection), and a 128M byte virtual address space. In addition, physical memory can be expanded to 16M bytes and disk storage can expand to 1120M bytes unformatted (896M bytes formatted).

Explorer, Personal Consultant, Arborist, NaturalLink, TI-Speech, and Business-Pro are trademarks of Texas Instruments Incorporated.

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DEAZ040

RESUMÉ Workbook & Career Planner

This Workbook has been prepared for graduate engineers and computer science professionals. The advice herein is especially appropriate for individuals working in high technology fields such as computer technology, telecommunications, integrated circuit development, software engineering, defense electronics, etc.

MCMLXXXV SCIENTIFIC PLACEMENT HOUSTON

Your Resume may determine whether or not you get the job you want. It deserves the best you can give. In technical fields, the resume is the key to getting an interview; therefore, appeal is essential. Your resume must offer something of interest and value to a prospective employer.

Most hiring is a process of weeding out and narrowing down a list of candidates. It is not a positive process of trying to locate the best-qualified candidate. Rather, it is a negative process of finding the things that are wrong with each applicant and then selecting those with the least number and magnitude of things wrong. Your resume can be eliminated because of inappropriate qualifications, incompatible expectations or attitudes, implied problems, and missing information. The further your experience and education are from the theoretical ideal for a given position, the greater the temptation to assume the worst and go on to the next resume.

Employers go through a "cream-skimming" process. They look at resumes to find super "fits" or applicants who are super-applicable to their needs. They are not generally looking for "superstars".

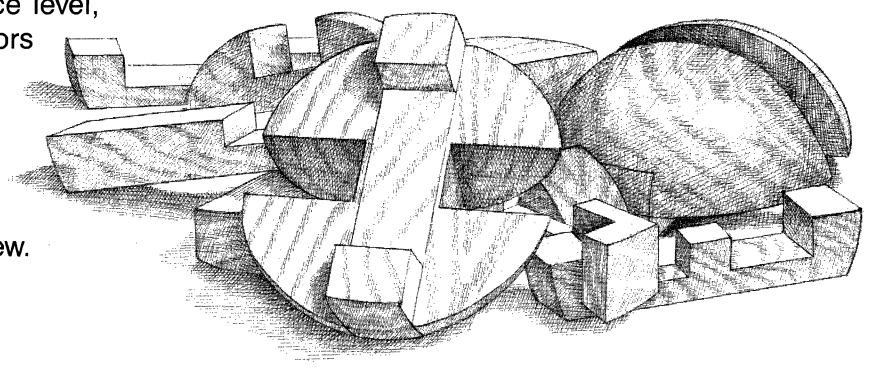
This screening typically occurs on two levels. First, a non-technical (personnel) person screens against job requisitions for salary and experience level, technical key words, and subjective factors such as quality and amount of education. Those resumes selected are than passed along to a technical manager who evaluates the work experience and decides whether to conduct a telephone or personal interview.

The goal of your resume is to convince an employer to spend the time and money required to interview you. The resume should not be a self-serving bit of flattery, a superficial overview, nor a detailed biography. *It should aim at getting you an interview, no more and no less.*

A resume competes for attention with other resumes and communications stimuli. No manager can attend to all the stimuli. He or she will read only so far as his or her interest is maintained. Brevity, organization, physical appearance, and presentation all play a role in holding the reader.

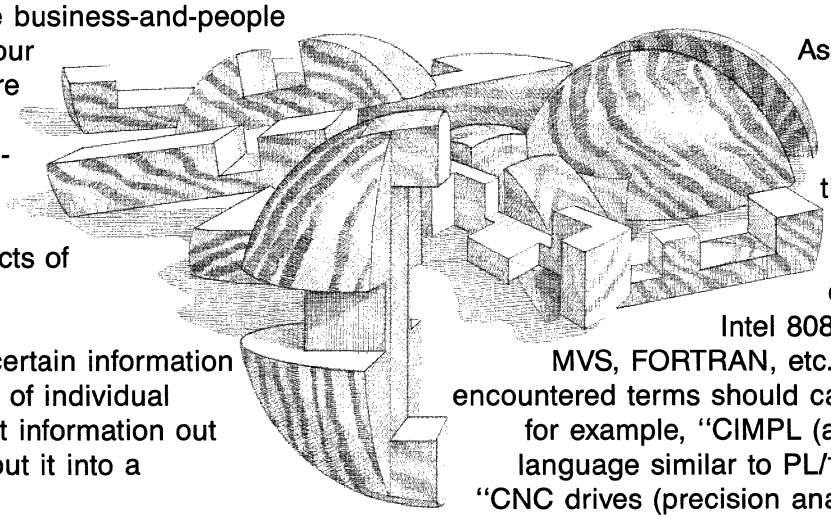
Thus the best resumes are prepared so as to attract and be understood by both technical and non-technical readers. Acronyms and technical terms are spelled out and explained for the non-technical reader, while enough technical details are included that the hiring manager can understand what the writer has actually done.

Scientific Placement, Inc.
P. O. BOX 19949
HOUSTON, TEXAS 77224
(713) 496-6100



Resumes should not be printed in fancy type on expensive paper. Resumes should not look as if they were done by a press agent to make you "look good." Your resume should look as if it were done by you simply to describe your qualifications. Consider doing it on a typerwriter and making photocopies. Fancy resumes make you look as if you have been packaged for mass distribution!

There is no "best" format for resumes. Your objectives, education, and experience will dictate the best order of presentation and emphasis. If you are a new graduate, you will want to highlight education and interests, including thesis, special projects, etc. If you are trying to move from research and development into sales and marketing, you may want to play down patents and grants and emphasize the more business-and-people related aspects of your experience. If you are trying to move from support into development, you should concentrate on the most technical aspects of your experience.



If you want to vary certain information to fit what you know of individual companies, take that information out of the resume and put it into a cover letter.

Length of resume depends on type size and what you have to say. The more education and the more years of work experience, the longer the resume. In most cases, one page is sufficient for an individual with a bachelor's degree and up to five years of work experience. Two pages are sufficient for almost everyone else. Three pages can be appropriate for a Ph.D. with a long list of publications. Four pages is too long for anyone.

Work Experience is the real heart of the resume. This section will influence more decisions than any other part of the resume. Since improvements in the experience section can have a strong impact on an individual's marketability, study this section of the workbook very carefully.

The key point about work experience is that it should be *applicable* to the prospective employer's needs and problems. Try to empathize with the hiring manager who could be your new boss. Indicate how you can help solve his or her problems. Draw most heavily on those elements of experience that would be of value in the new situation.

Frequently we find that a candidate's prior work experience really is related to the position—but no one could tell it from the resume. Unfamiliar buzz words, acronyms, and specialized industry lingo are deadly. Weed out, or at least spell out, terms like: "Lt(JG) aboard SSB(N) 619 assigned to CINC PAC FLT;" "comparative evaluation of COSMIC and conventional frame, programmed DMS-23 in CIMPL;" and so on. Technical people are forever making simple things complicated. Consider the computer jock who "powers down" the computer instead of "turning it off."

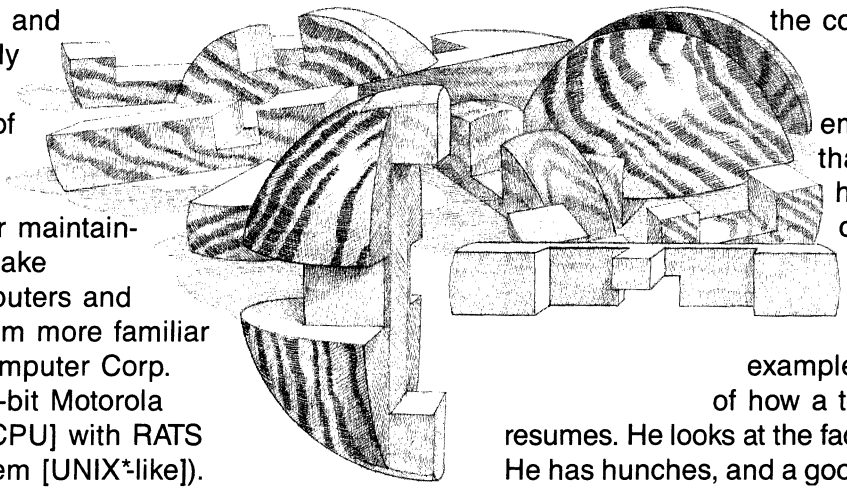
As a general rule, it is acceptable to use without explanation only the most common technical terms (UNIX* operating system, Intel 8086, "C" language, MVS, FORTRAN, etc.). Less-frequently encountered terms should carry explanations; for example, "CIMPL (a block structured language similar to PL/1 and Pascal)" or "CNC drives (precision analog servo control and positioning circuits for computer-controlled machine tools)." Point out the basics of a system ("Radar jamming system design—computer-controlled jamming of selected frequencies that optimizes use of available power").

Use where possible terms that are familiar and applicable to many situations, such as microprocessor-controlled, RF design, software development, realtime, etc.

Break down computer experience into hardware (DEC VAX 11/780, AT&T 3B20), operating systems and other systems software (UNIX*, DECNet, IMS), and languages (Pascal, FORTRAN, "C"). List computer experience after each position held in which computer usage was significant. Do not lump every machine you have touched over the past fifteen years into a single summary. An employer wants to know which experience was most recent and which was really significant. For example, if you have done systems-level work in an operating

*UNIX is a trademark of AT&T/Bell Laboratories

system, say so and describe exactly what it was—rewriting part of the system, extending it, modifying it, or maintaining it. Try to make off-brand computers and languages seem more familiar (i.e., Jones Computer Corp. Model 320 [32-bit Motorola 68020-based CPU] with RATS operating system [UNIX*-like]).



The standard practice of listing jobs in reverse chronological order is usually best. Do not carry the chronological listing to an extreme, though. It would be ridiculous to detail fifteen or twenty individual assignments with one employer. Unless earlier projects are really relevant to your current job search, generalize about earlier work and place the greatest weight on the last five years.

Never give personal opinions or draw conclusions. State facts—problems solved, projects for which you were responsible, noteworthy accomplishments, etc. From these details, the potential employer will draw his or her own conclusions as to your qualifications. Do not dwell on accomplishments or assignments that are irrelevant to the situation you are seeking.

Education should be featured prominently but briefly, as shown in the sample resume. Highly-trained engineers and scientists with publications tend to fill up the whole first page of a resume with education and related material. Leave out minor awards and special schools and move patents, publications, and similar details to the very end. Keep the college, the degree(s), significant honors, and professional registrations at the beginning. If you have no degree, consider explaining straightforwardly in a cover letter why not (however, don't just say "flunked out" or "dropped out to find myself").

Objectives and attitudes can be included in a cover letter or in the resume itself. Remember that applicability is a function of both qualifications and attitudes. Resumes usually do a reasonable job of indicating qualifications, but attitudes require guesses unless they are stated. For example, if an applicant has always lived in a particular part of the country, (grew up there, went to school there, works there now), an employer might assume that he or she would be happy only in that part of the country—unless the resume specifically states otherwise. This geographic example is a good illustration of how a typical employer reads resumes. He looks at the facts. He makes guesses. He has hunches, and a good applicant can be disregarded on such a hunch.

Always indicate why you are considering a change. Employers look for that central "Why." They generally eliminate candidates seeking to get rich quick, junior engineers interested in management openings, and people who appear to be "job-hoppers" or seem to have no reason for wanting to change jobs.

Any indication that you are a "prima donna" will kill your chances. Your objectives should focus on what you want to *do* rather than on what you want to *be*. The individual who talks about contributions and results is always more attractive than someone preoccupied with titles and rewards. Do not elaborate on your title or formal job description. Instead, explain what you actually did. Leave out the title entirely unless it accurately describes what you actually did. A position as "Director of Software Development" in a research division of AT&T Information Systems is obviously quite a different matter from a similar position in a three-person company. Titles can cause the reader to pigeonhole an applicant quickly and to discard the resume without reading further. Similarly, downplay grandiose ambitions, expressing them in the future (if at all)—"Seeking opportunity leading toward top management." At the junior levels, your objectives (if reasonable) can sometimes substitute for experience. Companies like to hire someone who "wants what we can offer." Conversely, they shy away from someone whose expectations are probably unattainable.

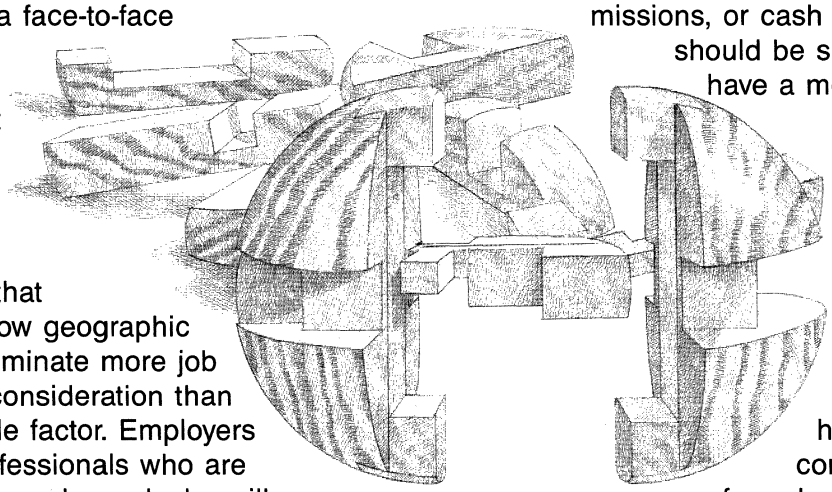
Remember that you seldom jump directly to a management position merely by changing jobs. You will better serve yourself to say that you want a position where your accomplishments will be more directly visible than at present and your prospects for promotion are better.

*UNIX is a trademark of AT&T/Bell Laboratories

Do not be too specific. Overly-specific objectives can exclude a candidate from consideration for other positions.

If you feel that your background qualifies you for several different positions, it is a good idea to spell them out. For example: "My interests include power and distribution, instrumentation and control, and computer process control." But be reasonable. Relate your objective carefully to your background by mentioning only areas for which your training and experience actually make you suitable—not those in which you simply have an interest.

The idealist, with a detailed list of terms and conditions under which he will accept employment, is seldom pursued. Do not write to a company describing your dream job and assuming that you might compromise later. Describe instead a range of jobs, indicating thereby that you are flexible and realistic. Remember—the resume is for getting the interview. The time to maneuver, negotiate, and optimize comes later—after you have gotten acquainted in a face-to-face interview and established a mutual interest with the prospective employer.



Keep in mind that extremely narrow geographic preferences eliminate more job seekers from consideration than any other single factor. Employers like to hire professionals who are flexible on geography and who will consider relocating should the need arise. A prominent note on the resume stating "No Geographic Restrictions" will do a lot for anyone's marketability. You must be reasonable in regard to geography; you are unlikely to find a high-tech development position in rural Montana.

Salary Information is critical in a resume and deserves some separate discussion. First of all, you may read books or articles that advocate leaving current salary off the resume for purposes of negotiating the highest possible offer. Such advice is ill-founded. The fact is that few companies will put you on an airplane for an interview without knowing your present salary. As a rule, when an applicant refuses to divulge his or her salary, all discussions terminate.

Why? Because most employers have formalized wage and salary administration systems. In such a system, each job is rated and a salary range established. A company typically attempts to hire in at about the middle of the range so as to provide room for future merit increases. Suppose a company has a job to fill with a range of $40-50,000/yr and a target hiring salary of $45,000 (the midpoint). Its personnel department brings someone in from out of town for an interview without knowing the present salary. After a day of interviewing, they extend an offer of $45,000. The candidate turns it down because he or she is already at $51,000. Such incidents are embarassing and frustrating to all concerned. The only way to avoid them is to verify that salary is in the ballpark before the interview takes place.

Your resume should state current base salary exclusive of fringe benefits and expense reimbursements. Any extras, such as overtime, commissions, or cash profit-sharing bonuses, should be shown separately. If you have a merit increase promised, it is a good idea to include a note ("expecting 7% raise in August"). Whatever you do, *don't lie about your salary.* Individuals have been known to exaggerate the figures in hopes of getting a higher offer. As a result, companies frequently ask for salary verification after offer acceptance but before the actual start date (check stub, W-2 form, etc.).

Salaries that are unusually low or high require explanation. The lower-than-normal salary raises questions as to the individual's quality. The abnormally high salary may raise questions as to the applicant's honesty. Here is a sample cover letter explanation for a low figure: "I know that my salary is unusually low for my education and experience. My current employer has been losing money, with resultant austerity programs and salary freezes. I don't expect to catch up in one giant leap, but I do want to work for a company with a better compensation program." And for the high-salaried individual: "I know that my salary is on the high

Margarite P. Streeter
1234 Riverside Drive
Blinkhorn, Missouri 64130
(816) 555-1212

Objective: Management position requiring vision and leadership qualities. Strong desire to direct and supervise. (1)

Experience:

1977-Present — Blendex Corporation, Nuclear Weapons Manufacturer
Project Leader responsible for all aspects of the project from engineering through to the production stage for the non-nuclear portion of nuclear weapons. Includes budgeting, directing, and changes for a $10 million dollar project. Interface with R&D, manufacturing and purchasing.

(2) 1970-1976 — Monument Industries, Kansas City, Missouri
Jr. Engineer
Technician/engineer on Monument's most successful product, the QIA324.b monitor. — ??

(3)

Education: 1967 — University of Missouri, Rolla, Missouri
B.S. Engineering Science
Is this similar to M.E., or E.E., or ??

References: Available upon request — extraneous

Salary: Will discuss (6)

Personal: Married, 7 children (5) — 5'1" 210 lbs. — Pass our Physical Exam?
Excellent Health
Homeowner (4)
Husband is successful Kansas City Attorney
Active in local charities and civic clubs

Misc.: Familiar with H5118ME general purpose computer and machine language for octal and hexadecimal machines.
Have written diagnostics.
Fluent in Spanish and Arabic
Mensa Member
What is it and when did she do it?

This resume raises more questions than it answers.

① The objectives are too strongly stated, and the resume fails to make the case that she is qualified for the position sought.

② Lots of time is unaccounted for.

③ The work experience doesn't sound very *applicable* to a new employer who isn't in the nuclear weapons business. There is insufficient detail. Is she a technical and design person or more of a manufacturing coordinator? Is the product basically mechanical or mostly electronic?

④ Seems to have deep roots in Kansas City and doesn't say anything about relocating.

⑤ When does she have time to work?

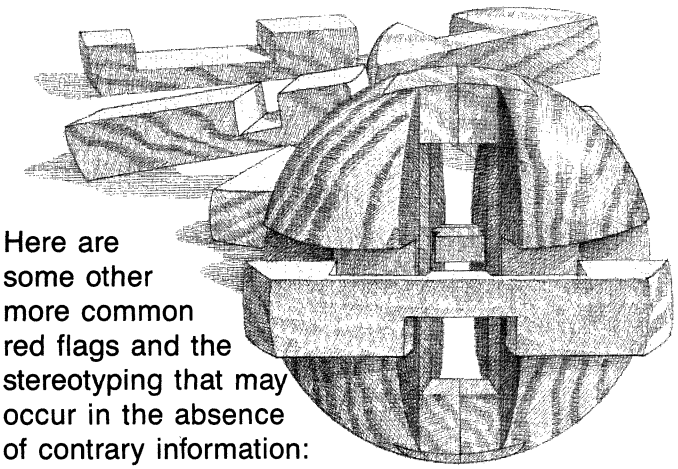
⑥ It's almost always a mistake to leave out current salary.

side. My employer gave me a 20% increase when I was transferred to NYC three years ago. I've also been rated in the top 10% in every performance review I've ever had."

What about minimum expected salary—should you indicate it on the resume? Our advice is to leave it off. It isn't reasonable to expect an individual to know accurately what to ask for before going on interviews and learning about such aspects as benefits programs, job opportunities, cost of living, etc. An exception occurs when you feel that you just must have a big salary increase to change jobs. Increases of more than 10% are not common; 15% is unusual; 20% is extremely rare; and 25% isn't a possibility except under very unusual conditions. If you are going for big numbers, it's a waste of everyone's time (including yours) not to let the employer know up front.

Resume Editing involves going through the resume and trying to eliminate or explain away the "red flags" that everyone seems to have. This is where attention to detail can pay big dividends.

Consider, for example, the case of a young chemical engineer entering the job market during a slump in the textile fibers industry. The "Before" resume read: "80-Present-E.I. Du Pont Co. Synthetic Fibers Div., Wilmington, North Carolina. Process engineer doing process trouble shooting and process development work for the polymer end of a tire cord plant." The "After" resume read: "80-Present-E.I. Du Pont Co. Wilmington, North Carolina. Process engineer doing process trouble shooting and process development work in a polymer manufacturing plant." While in two examples we have said the exact same thing, the latter example is less specific as to the end-use of the polymer being manufactured. The improvement in marketability can be dramatic from just such a minor editing of a resume. "Polymer experience" seems more applicable to more alternative situations than does "tire cord experience."



Here are some other more common red flags and the stereotyping that may occur in the absence of contrary information:

- ☐ Immigrant . . . . . Poor communicator and unsociable
- ☐ Low salary . . . . . Poor performer
- ☐ High salary . . . . . Liar
- ☐ Low grades in school . . . . . Stupid
- ☐ Unusual degree . . . . . Unqualified
- ☐ Unknown college . . . . . Poorly prepared
- ☐ Always lived in New England . . . . . Wouldn't be happy elsewhere
- ☐ Big title . . . . . Would want more than we can offer
- ☐ Not currently employed . . . . . Fired
- ☐ Time unaccounted for . . . . . Bummed around during that time
- ☐ Too many jobs . . . . . Unstable
- ☐ Too young . . . . . Immature
- ☐ Too old . . . . . Out of gas
- ☐ Doesn't reveal present salary . . . . . Wants a 50% increase
- ☐ Self flattering resume . . . . . Pompous, conceited
- ☐ Female with children . . . . . Unable to travel or relocate

Most employers don't mean to discriminate or to use such obvious stereotypes in their selection process. In many cases, to do so is illegal. However, employers must review a lot of resumes and don't have the time, staff, or budget to interview everyone. Therefore, they do play hunches, and red flags like these often form the basis of such hunches.

The best approach is usually to identify the red flags in your own resume and to explain or offset them, either in editing the resume or in the cover letter. For example, "I have been in the United States for four years as a permanent resident. I am active in Little League and my homeowner's

Daniel A. Brietling
1592A Longchamp Avenue
Indian City, Florida 32909
305-221-8760
305-343-9000 (Office) — Good to include if you can talk privately

Downtown L.A.?
Will Relocate-Sunbelt

① Date of Birth: 8/17/52
Marital Status: Married 3 years

Specialty Discipline: Communications systems development, Project Engrg.

Responsibilities: (Large Aerospace Contractor) — Name should be included

1979 to present

② System design of Space shuttle extravehicular communication system
27 Mbps digital communication test set development
Low rate coded digital communication system
Video, Digital, Data compression, encoding, facsimile, systems requirements analysis

1974 to 1979 – Include month and year

② Staff engineer for Apollo uplink and relay group
Study project to reduce transmitted noise
NASA contractor monitoring and supervision

Education:

B.S.E.E., M.I.T., 1972 — Spell out
M.S.E.E., M.I.T., 1974
Thesis: Space Communications Options
Eta Kappa Nu — Honor or Social?

Interests?
Clearance?
U.S. Citizen?
Accomplishments?
Current Salary?

Numerous Publications-List available upon request ③

Hobbies: Chess, Photography, Bicycle Racing

This individual is a data compression expert, and he tried to "data compress" his own resume. It's obvious that the writer didn't take any time at all to write the resume—he just quickly listed the things he'd worked on.

① If you're going to include personal data, then you might as well include everything—height, weight, number of children, homeowner or renting, etc.

② The work experience portion of this resume should be expanded substantially. We should be able to tell a little bit more about the systems worked on and about Brietling's involvement. This resume might look fine to a technical manager but is liable to confuse the personnel representative who does the initial screening. The personnel guy is searching the resume for the buzz words that are in his company's job requisitions (Microwave, Satellite Communications).

③ If the publications are relevant to the position sought, they should be appended to the resume.

association. I have served as primary point of customer contact on several projects, and I frequently participate in client presentations." Or, "I earned 70% of my college expenses by working 30 hours a week all four years. As a result, my grades, particularly in subjects outside my major, weren't as high as I would have liked."

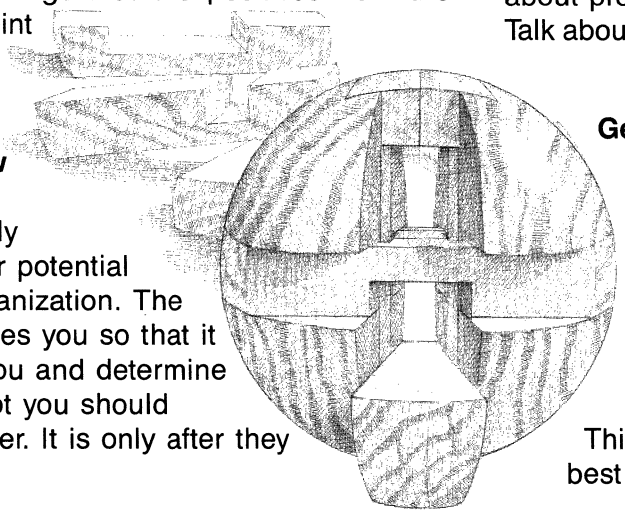
A special case is that of too many jobs. In this situation, it sometimes helps to include a "Reason for Change" immediately after each job listed. Presumably, the reasons will be something more pressing than, "Left because I was offered more money across the street" or "Left to move to Utah because I like to ski."

The Cover Letter is used to emphasize certain aspects of your experience that are *applicable* to a particular employer, to overcome red flags in the resume, and to make the employer aware of important attitudes.

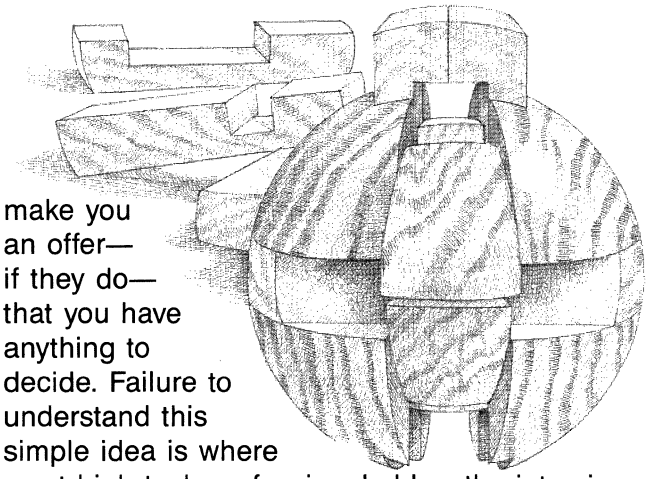
Remember — be careful with the attitudes part. When you state things like: "I want to be a manager," or "I'm seeking relocation to your part of the country," you may not strike a responsive chord. Your desire to be a manager may be seen as a problem in terms of fitting you into the organization initially, and your geographic preference might mean that you won't accept a transfer later on.

It is unreasonable to expect big concessions from a prospective employer who hasn't even met you!

Again, *the resume and cover letter are sales tools.* They are for getting you into the interview. They are not for getting you the job, but are merely the first steps. When composing them, try to concentrate on the things that are positives from the employer's point of view.



The Interview is where the company really assesses your potential role in its organization. The company invites you so that it can assess you and determine whether or not you should receive an offer. It is only after they make you an offer— if they do— that you have anything to decide. Failure to understand this simple idea is where most high tech professionals blow the interview. They spend a whole day looking over the company and asking questions. By 5 P.M. they decide this could be a job they would really like to have. But by this time it is too late to get around to selling themselves.



Try to steer the conversation toward what you can do to help the company solve problems in the job under consideration. Remember that one or two people will probably have the key votes. It is important that you identify these people and make your best impression on them. The person who would be your immediate supervisor always gets a vote.

Never bargain until you have gotten them interested. Someone going in for an interview should not start off by laying down a list of demands. The first order of business is to convince the employer that you are just the employee needed. You want to point out the relevance of your qualifications, and you want to demonstrate interest, enthusiasm, and flexibility.

If by day's end it is obvious that you've made an extremely positive impression, then you can talk about problem areas. Don't negotiate or haggle. Talk about working things out to eliminate remaining problems and concerns.

Getting the Right Job is hard work and takes time. You'll do a lot better if you commit yourself to preparing a good resume, selling yourself in the interview, and then making your decision.

All too often, engineers start into the evaluation step first instead of last. This frequently leads to elimination of the best alternative before it is fully developed.

THOMAS R. JOHNSON
17989 Smithfield Road
Norfolk, Virginia 26668
703-387-5893 (Home), 703-386-7777 (Work)

Will Relocate Anywhere
Renting
Current Salary: $33,500

PERSONAL: Height 5'11" Weight 185 lbs. Married, 1 Child U.S. Citizen Born 1/1/53

EDUCATION:

1978 UNIVERSITY OF ILLINOIS, Urbana, Illinois
Ph.D. Computer Science G.P.A. 3.8 of 4.0

1976 SAN DIEGO STATE COLLEGE, San Diego, California
M.S.E.E. G.P.A. 3.5 of 4.0

1974 SAN DIEGO STATE COLLEGE, San Diego, California
B.S.E.E. G.P.A. 3.2 of 4.0

Good format

SUMMARY: Seeking a position in computer research. Flexible on area of assigned work but most interested in computer architecture, distributed processing, and microprocessor applications. Enjoy hands-on, practical aspects and people involvement--prefer to avoid purely analytical (guru) assignments.

Available upon release from active duty in May 1984. Relocation costs to home of record (San Diego) or equivalent will be borne by the government.

BUSINESS EXPERIENCE:

7/78 to Present United States Air Force, Eagle A.F.B., Portsmouth, Virginia
Independent Test and Verification Officer (Active Duty)
Responsible for the evaluation and formulation of hardware/software alternatives for a highly complex, state of the art, computer system used for detailed analysis of prototype Electronic Warfare, Intelligence, and Communication Systems. Duties include modification of existing operating system software packages, development of new software computational abilities, and the formulation of plans for possible hardware modifications to the existing system.

Previously responsible for the supervision and management of personnel and material for all aspects of a multimillion dollar development test and evaluation of a highly complex, state of the art, prototype Electronic Warfare, Intelligence, and Communication System. Duties included assisting in the formulation of technically sound test plans; planning, coordinating, and budgeting of limited personnel, money and material resources; supervision of government and contractor test teams in execution of test plans; and conducting briefings and conferences on testing results.

PUBLICATIONS:

Johnson, T.R., "A New Approach to Parallel Processors." Ph.D. Dissertation, Department of Computer Science, University of Illinois, Urbana, Illinois, May 1978

Johnson, T.R., "A Dedicated DBMS Processor for Local Area Networks." Proceedings of the 1979 International Conference on Distributed Processing, August 1979

MISC: Top Secret Clearance with E.B.I. (Extended Background Investigation)

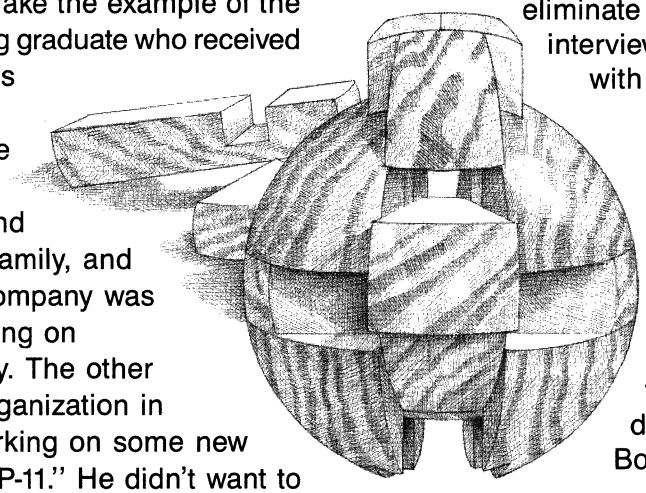
This is a very well done resume. It's not very long, but it succeeds in telling the story. The reader has a clear idea of the capabilities and interests of the applicant. Specialized military lingo has been eliminated, and yet there is plenty of technical information remaining to make the employer want to interview him. The resume contains a lot of information but it is well organized, and there is nothing superfluous. After reading this resume, both the personnel representative and the technical manager know "what the deal is on Tom Johnson."

This resume is designed to be all-purpose: he can submit it to computer manufacturers, military contractors, independent research labs, etc. He wanted to incude just enough on electronic warfare to get credit for his work and not so much as to make him look like a defense electronics specialist. If he were to apply to an electronic warfare contractor, he might include some of the military lingo in the cover letter to that employer. Similarly, he might emphasize his work on distributed processing in a letter to a networks R&D lab.

He elected not to list individual computers, operating systems, and languages because his actual programming experience had been on older and rarely seen computers —he feared that listing them might be a negative.

For example, Boston sounds "good" and New Jersey sounds "bad," so you eliminate the New Jersey job immediately. It turns out that the Boston job is routine and the New Jersey job would have permitted you to grow technically and professionally. The New Jersey job might be located in a beautiful setting and the Boston job in a slum. Always check a job out first. You should be as flexible as possible when you first start your job search, then narrow down and eliminate as you go. To do otherwise is to deal in stereotypes that often don't hold up under scrutiny.

People are forever selecting the wrong jobs. They do so by too-casually specifying preferences at the outset and by placing too much weight on the wrong selection criteria. Take the example of the 1975 Electrical Engineering graduate who received two offers. The first, in his hometown in Southern California, involved a little more money, a nicer facility, better benefits, and proximity to his friends, family, and the beach; further, the company was a famous firm then working on state-of-the-art technology. The other offer was with a small organization in snowy New England, working on some new computer called the "PDP-11." He didn't want to take a chance, so he took the job designing automotive controls in his hometown and passed up Digital Equipment. The moral is obvious: career decisions are long-term decisions, and factors such as industry prospects, company products, and quality of management should be taken into account. The more immediate (short-term) factors should be considered, but should not be given top billing.



Be sure to allow enough time for your job search. Assuming that you'll have to travel, each interview might consume an average of 1.5 work days. If you were to take 5 or 6 interviews, you could easily consume 7 or 8 work days in the interviewing process. You don't want to get a company interested and then have to put them off. When they've made a decision to invite you in for an interview, they expect you to be eager and enthusiastic, not balky and hesitant. It's a good idea to look at your calendar and to plan ahead before you send out the resume.

Employment Service Firms, like Scientific Placement, can be of some help to you in planning your career and in approaching the job market. Almost every major employer uses them. A good employment service firm will not charge you anything at all. Most professional employment services are paid by the company when, and if, an individual is hired.

A growing segment of the employment service industry consists of technical specialists who can cover entire industries. Technical or industry specialists should have good knowledge of a specific employer's reputation, salary practices, products, etc. They should know who would be most likely to hire you and what you might achieve in terms of position, salary, etc. They can help you eliminate wasteful and unnecessary interview trips. They can help you with timing. You can use them as a sounding board to get an idea of your marketability and chances of obtaining a particular type of job. If you are wondering how a certain advanced degree would affect your market value, or if you want some data on the cost of living in Boulder, they should be able to help.

When selecting an agent, pick one really good employment service that knows something about the industry in which you want to work. Their counselors should know something about your background, and they should do a good deal of business with companies seeking people like you. The trend is toward specialization by industry and away from the small agency that attempts to service all the companies in a particular city or region. More and more, a scientific programmer living in Chicago and seeking relocation to Tampa goes to an agent in Houston for help. He finds that the orientation toward a particular industry or technology is more important than office location.

About this Workbook.

In 1968, we began offering the Engineer's Resume Kit to those who were interested. The original kit has been reprinted many times and distributed to several hundred thousand individuals.

BARBARA JONES-SMYTHE
3784 14th Street
Wayland, Massachusetts 01872
(617) 388-7686 (Residence)
(617) 465-6868 (Work-Discreetly)

PREFER MASS., N.H., CT.

CURRENT SALARY: $38,000/yr.
(1) ASKING SALARY: $38,000/min.

PERSONAL: Married, No Children U.S. Citizen D.O.B. 10/12/1957 5'7" 135 lbs. Homeowner

EDUCATION:

6/78 BOSTON UNIVERSITY, Boston, Massachusetts
B.S. Mathematics G.P.A. 2.9 of 4.0

MISC.: Alpha Gamma Gamma Sorority President
28 weeks total schooling on Digital Equipment Corporation Computers (VAX/VMS operating system, Decnet, etc.). Significant college experience programming on Data General Eclipse Series computers, AOS operating system, mainly in Fortran. Worked as student programmer on school administration applications.

OBJECTIVE: (2)

Seeking an applications programming position with project leader responsibility. Prefer D.E.C./VAX Computer installation running either VMS or UNIX operating system. Prefer commercial applications (not accounting) with substantial user/customer involvement for the lead programmer. I have enjoyed my systems programming experience and feel that it has given me excellent technical skills. However, I miss the people involvement and the day to day real world problems that applications programming can provide. Long term, I would like to know as much about business as I do about programming so that I would feel competent to design really good programs that are user oriented.

BUSINESS EXPERIENCE:

10/80 to Present CAMBRIDGE HOUSE, INC., Cambridge, Mass.
Software Engineer developing system software to run on Digital Equipment Corp. Computers (VAX and PDP11).
Currently functioning as lead programmer on a team charged with implementing a new data base management system (DBMS-BESTO) for VAX that would run on the VMS operating system. This software product is a full relational DBMS that includes shared files, transaction processing, logging, etc. The initial release is aimed at vendors of turn key systems (technical OEM's) and is limited to VAX, but the product is ultimately to have much wider application. Serve as the primary interface between the system designer (outside consultant and university professor) and a team of 3 working systems programmers.

During my first year at Cambridge, I worked on a series of utility programs that were designed to help D.E.C. PDP11 users migrate commercial applications programs from the PDP11 to the VAX computer. These utilities were aimed specifically at converting from the RSTS/E interactive multi-user PDP11 operating system to VAX/VMS. User programs were to be converted from Basic Plus 2 (RSTS) to the VAX native mode Basic language. This assignment gave me a good understanding of language compilers and of the problems faced by users having many programs to migrate to a different system.

(3) Skills summary: DEC PDP11 & VAX Computers, RSTS/E & VMS operating systems, Languages: Fortran, "C," Basic Plus 2, VAX Basic, Macro-11, Assembler.

6/78 to 10/80 ATLAS AUTO PARTS COMPANY, Worcester, Mass.
Applications Programmer for large multi-location wholesale auto parts distributor. Wrote new programs, debugged and enhanced existing programs, for order entry, inventory, and warehousing applications. These were on-line interactive programs written to be very user friendly (fill-in-the-blanks screen formats, numerous data entry edits, help messages, etc.). The computer environment was distributed processing with 4 Digital Equipment Corporation (D.E.C.) PDP11/70 computers each running the RSTS/E operating system and interconnected with DECNET network software. My major projects were: 1) An inventory program for small parts and incidentals designed to cut down on paperwork; 2) A formal study evaluating the problems of converting our applications software from the PDP11 to VAX; and, 3) Becoming the DECNET expert.

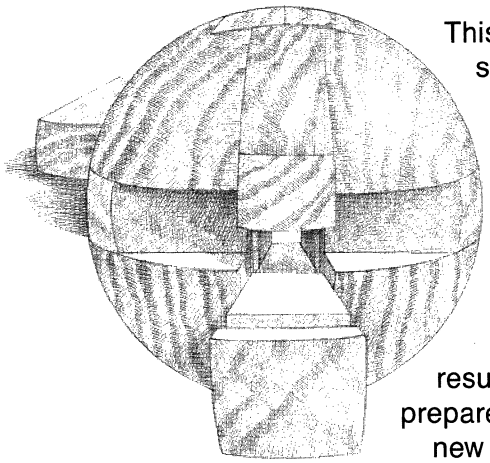
Skills summary: DEC PDP11 computer, RSTS/E operating system, DECNET communications and networking software, Basic Plus 2 language.

A very impressive resume aimed at a limited market but likely to draw quite a bit of interest. It succeeds in giving the reader a clear picture of Barbara's interests and qualifications without getting lost in D.E.C. technical verbage.

① Barbara fears that her salary is on the high side so she included asking salary to indicate flexibility.

② The objectives are up front because she is seeking to change the direction of her career.

③ A skills summary is included after each job because the skills are crucial to her vocation.



This workbook represents a substantial improvement over the original kit. If the points herein are carefully considered, you should be able to prepare a better resume and be better prepared to search for a new job whenever the time comes.

Most of the suggestions contained in this workbook were derived from our experience working with engineers and with hiring companies. We have screened resumes ourselves and we have had a great deal of experience seeing how companies judge resumes.

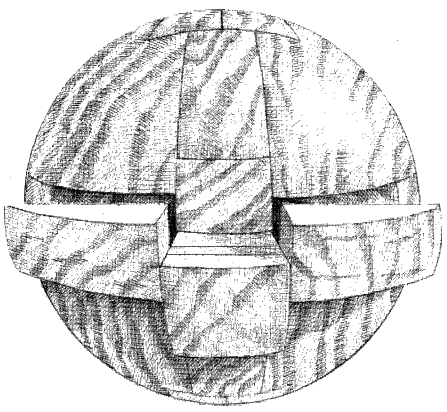
We hope that you'll take the time to update your resume now—while it's on your mind. If you do, please send us a copy. We'd like to have it on file for future opportunities that may occur. You'll find a tear-out registration form in the back of this book that should be sent along with your resume. There is a check-off box on the form to indicate whether you are actively looking or just registering for that outstanding opportunity.

Also, feel free to send us your resume while it is in rough draft form. We'll try to answer your questions and help with the editing process as much as possible. We won't write it for you because we don't want to distort the facts. Be we will try to improve it wherever we can.

If you liked our resume workbook, we hope that you'll let us know that, too. We're thinking about producing similar booklets on interviewing, negotiating for higher salary offers, and other career planning topics. Let us know if you'd like to receive future publications.

David A. Seratt

President



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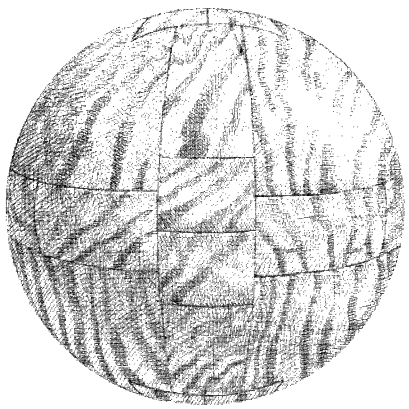

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AI IN THE PERSONAL COMPUTER ENVIRONMENT, TODAY AND TOMORROW

Tom J. Schwartz

T S A
1470 Wildrose Way
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ABSTRACT

It has been almost thirty years since John McCarthy first started to work on LISP at MIT. Since then, AI has emerged from a laboratory curiosity to a blossoming technology with worldwide strategic implications. As this technology proliferates, the PC will become a major delivery vehicle for expert systems. The PC is already being used to develop small expert systems and its power is bound to increase over the coming years. Here we examine the history of the PC in AI, and the current state of development. We attempt to envision future developments in the merging of these technologies.

PERSONAL COMPUTER POWER

1981 was a watershed year for computers according to market research from INPUT Inc. It was the first year that installed end user computing power (PC's and individual workstations) equaled that of mainframe computers. It is estimated that in 1986 PC computing power alone will equal that of all other computers. This pattern will continue as PC's become increasingly more powerful and the boundary between PC's and workstations becomes forever blurred.

VISIONS OF THE PERSONAL COMPUTER

One of the first people to foresee the concept of the personal computer was Dr. Alan Kay. Dr. Kay's work on the Alto and the Dynabook along with others at the Xerox Palo Alto Research Center in the 1970's was the basis of many of the current developments we see today. Some of these developments include: bit-mapped graphics, flat screens, personal workstations and networking. Dr. Kay's Dynabook actually predicted the portable, flat personal computer. The Dynabook currently has many commercial realizations, including machines by Apple, HP, Data General, Osborne, Morrow, Radio Shack, Grid, Convergent Technology and NEC. These machines, while not achieving the full performance envisioned by Dr. Kay, will surely be improved to fulfill his design goals.

AI AND THE PERSONAL COMPUTER, TODAY

Today many run time expert systems are being delivered on PC's and dedicated workstations. One of the most ambitious is the GE Cats-1 expert system for assisting in diesel locomotive repair. This expert system is deployed on a dedicated workstation and contains over 1200 production rules. Cats-1 is an expert tutor. When used in conjunction with a video disk player it can show diagrams and training film sequences in conjunction with the consultation process. PUFF is an expert system, written in EMYCIN, and is used to diagnose obstructive airway diseases. PUFF originally consisted of 55 production rules, and has been rewritten in Basic. PUFF is now commercially provided on a system that incorporates diagnostic hardware and uses an

Apple II as a delivery vehicle. Applied Expert Systems has already deployed an expert system on the IBM PC-XT, for use in the financial services industry. The use of PC delivery vehicles is easily predicted because of its large installed base and declining price. Workstations will continue to be popular because their power reduces expert system development time.

Development of expert systems on dedicated workstations has proceeded from the introduction of the LM 2 by Lisp Machines Inc. and continues unabated on workstations from a wide range of vendors. The evolution of expert systems on PC's is now gaining momentum. There are now at least a dozen implementations of Lisp and PROLOG for the IBM-PC. ExperTelligence has recently introduced a Lisp for the Macintosh with an OPS5 soon to be released. There are already two versions of OPS5 available for the IBM PC as well as a version of Small talk. The wide availability of the classic AI languages on the PC will lead to numerous expert systems being developed and deployed on the PC.

Many expert system shells, production rule languages and induction extraction tools have already been developed for the PC. (See the table on the next page.) These include PC implementations of EMYCIN and other English like production rule systems. Systems which learn by example, typically called inductive extraction systems, are made available by three manufacturers. RuleMaster by Radian is one of these systems, and is unique because it combines inductive extraction and a production rule system in one product. A few of these tools also have hooks to other programs to further increase their power. The commercial success of these systems is demonstrated by SRI's Series PC which has been used to develop and field an expert system for copier diagnosis and repair.

AI AND THE PERSONAL COMPUTER, TOMORROW

Many of these PC-based systems are suitable for the development of small expert systems (under 200 rules). These small systems are now being called "technician systems" and will find wide use in business and technical training. Induction extraction tools will enable users of spread sheets to build such technician systems and deploy them with little or no help from knowledge engineers. These systems will be used as learning curve accelerators and to disseminate routing expertise to less experienced members of an organization.

The deployment of dedicated expert systems on hand-held calculator-like devices using application-specific integrated circuits will make expert systems as pervasive as the microporcessor in the world of tomorrow. Low cost expert systems will aid us in many of our daily activities such as: commuter route selection, business and investment decision-making, human interaction, personal health care and even wagering. Automated knowledge acquisition will allow every expert to become his own knowledge engineer. Even the breaking of the common sense barrier can be foreseen.

ACKNOWLEDGEMENTS

Reprinted from IJCAI Proceedings, 1985. The author would like to thank Amos Oshrin, Dr. Alan Kay, Stan Curtis, and Robert Laddaga.

ABOUT THE AUTHOR

Tom Schwartz is president of TSA. TSA provides consulting for developers and users of expert system technology. TSA can be contacted at 415-965-4561.

EXPERT SYSTEM SOFTWARE FOR PERSONAL COMPUTERS

The following systems run on IBM PC's.

Company	Phone number	Product Name	Price	Written In	Maximum Rules / Comments
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California Intelligence 912 Powell Street San Francisco, CA 94108	415/391-4846	XSYS	$1,000.00	IQ LISP	Can chain systems Opportunistic control
Digitalk, Inc. 5200 W. Century Blvd. Los Angeles, CA 90045	213/645-1082	Methods	$250.00	Assembly & Basic	5000 Can link Good Smalltalk Supports mouse
Dynamic Master Systems P.O. Box 566456 Atlanta, GA 30356	404/425-7715	TOPSI	$175.00 $195.00	Pascal C	5000 Can link Good OPS 5 Plans to get better
Expert Systems Int'l 1150 First Ave. King of Prussia, PA 19406	215/337-2300	ES/P ADVISOR	$1895.00	Prolog	400 Can link Best used with their Prolog
EXSYS, Inc. P.O. Box 75158 Albuquerque, NM 87194	505/836-6676	EXSYS	$395.00	C	5000 Can link Good hooks to other programs
General Research Inc. 7655 Old Springhouse Road McLean, VA 22102	703/893-5900	TIMM	$9,500.00	Fortran 77	500 Induction based Very portable
Human Edge Software Inc. 2445 Farber Place Palo Alto, CA 94303	415/493-1593	Expert Ease Expert Edge	$695.00 $795.00	Pascal C	300 Induction. Rule based 5000 Good hooks & Ed.
Level 5 Research Inc. 4980 S-A1A Melbourne Beach, FL 32951	305/729-9046	INSIGHT 1 INSIGHT 2+	$95.00 $495.00	Pascal Pascal	500 for Learning 5000 Can link Will upgrade
Lightwave Consultant's PO Box 295039 Tampa, Fl 99163	813/988-5033	ESIE	$15.00	Pascal	500 for learning Good place to start. Limited

The following systems run on IBM PC's.

Company	Phone number	Product Name	Price	Written In	Maximum Rules/ Comments
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Radian 8501 MO-Pac Blvd Austin, TX 78766	512/454-4797	Rule Master	$995.00	C	200 can link Induction & Rule based system
Software Architecture and Engineering 1500 Wilson Blvd. Arlington, VA 22209	703/276-7910	KES	$4,000.00	IQ Lisp Going to C	Can link. 4 types of inference Very portable
SRI International 333 Ravenswoood Ave. Menlo Park, CA 94025	415/859-5889	SeriesPC	$15,000.00	IQ Lisp	300 Can link Includes 2 Weeks of consulting
TEKNOWLEDGE 525 University Ave Palo Alto, Ca 94301	415/327-6606	M1 M1A	$5,000.00 $2,500.00	Prolog going to C	1000 Can link Good training available
Texas Instruments P.O. Box 2909 12501 Research Blvd. Austin TX, 78769	800/527-3500	Personal Consultant +	$995.00 $2995.00	IQ Lisp Scheme	300 Can link 1000 Can link. + has more power & is frame based
This system runs on Macintosh by Apple Inc.					
ExperTelligence Inc. 559 San Ysidro Road Santa Barbara, CA 93108	805/969-7874	ExperOPS5	$195.00	ExperLisp	Good OPS 5 Can link Forward & backward.
This system runs on Commodore 64, Apple II and Atari 800 machines.					
Ultimate Media Inc. 275 Magnolia Ave Larkspur, CA 94939	415/924-3644	Advisor	$95.00	Assembly	255 Max. Chip available for deployment

Adapted from paper presented at Ninth International Joint Conference on Artificial Intelligence. There have been significant product introductions since then. For more information contact TSA President Tom Schwartz at 1470 Wildrose Way, Mt. View, CA 94043, 415/965-4561.

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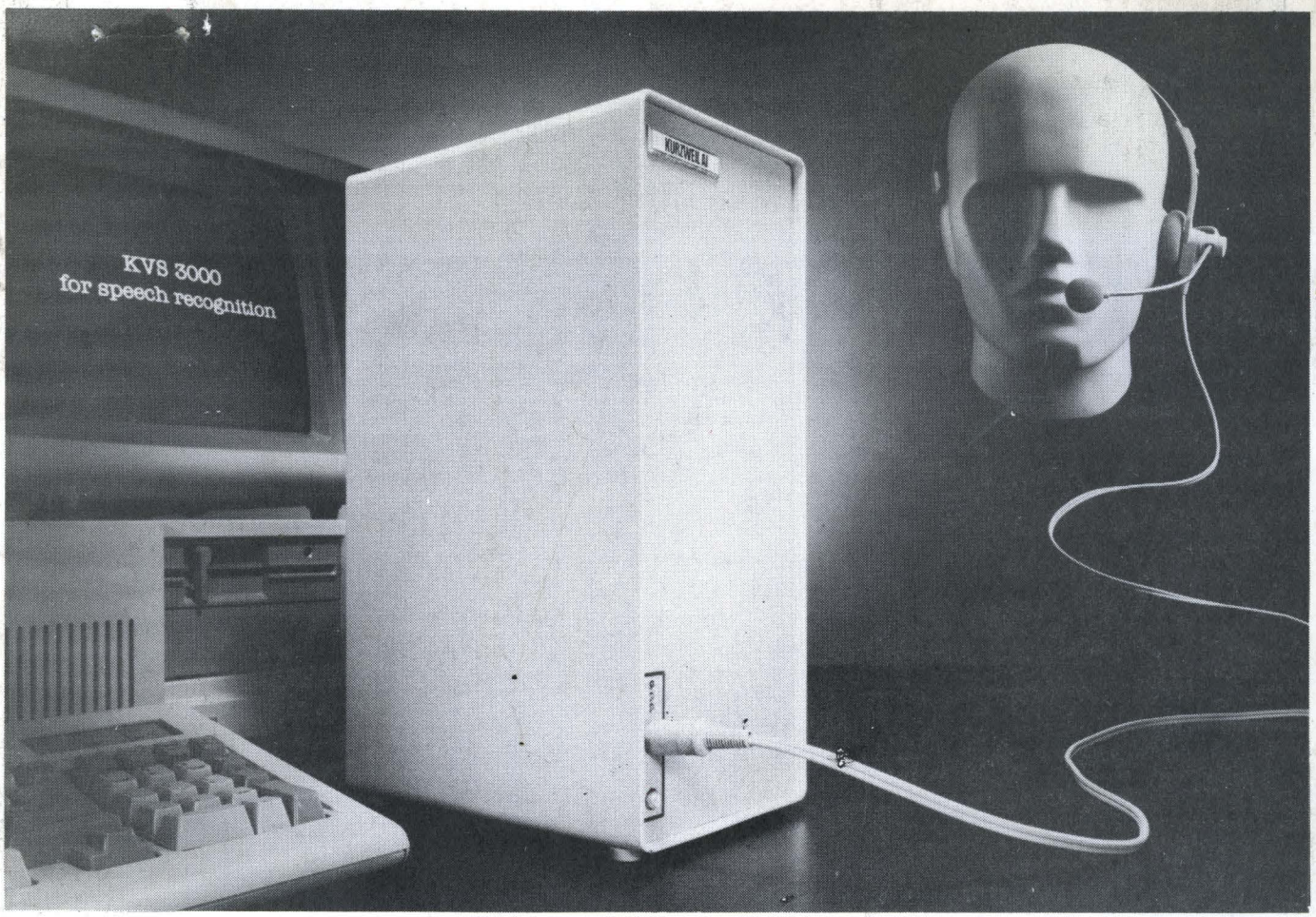

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