

ARTIFICIAL INTELLIGENCE IN THE PERSONAL COMPUTER ENVIRONMENT,

TODAY AND TOMORROW

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ABSTRACT

It has been almost thirty years since the Dartmouth Conference on artificial intelligence. Since then, AI has emerged from a laboratory curiosity to a blossoming technology with world wide strategic implications. As this technology proliferates, the PC will become a major delivery vehicle for expert systems. The PC is already being used to deploy small expert systems and its power is bound to increase over the coming years. This panel will examine the history of the PC in AI, the current state of development and attempt to envision future developments in the marriage 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 champion 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 developments we see today. 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 and fulfill his design goals.

AI AND THE PERSONAL COMPUTER, TODAY

Today many run time expert systems are being delivered on PC's and dedicated workstation's. 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 an expert system, written in EMYCIN is used to diagnose obstructive airway diseases. PUFF which originally consisted of 55 production rules, has been rewritten in Basic and is now being commercially provided on a system which 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 and a Smalltalk 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 Smalltalk. 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 (table 1). 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 manufactures. 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 routine expertise to less experienced members of an organization. They can also be used to enhance homogeneity in the decision making process thereby making delegation more effective.

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 microprocessor 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 decisions 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.

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ON THE FOLLOWING FOUR PAGES

The following systems run on IBM PC's

Company	Phone number	Product Name	Price	Written In	Maximum Rules	Source Available
Artelligence Inc. 1402 Preston Road Dallas TX 75240	214/437-0361	OPS5+	\$3000.00	C	1500	Negotiable
California Intelligence 912 Powell Street San Francisco, CA 94108	415/391-4846	XSYS	\$1,000.00	IQ LISP	Systems can be linked	Yes
Digital, Inc. 5200 W. Century Blvd. Los Angeles, CA 90045	213/645-1082	Methods	\$250.00	Assembler & Basic	Systems can be linked	Included
Dynamic Master Systems P.O. Box 566456 Atlanta, GA 30356	404/425-7715	TOPSI	\$75.00	Turbo Pascal	5,000 Systems can be linked	Negotiable
Expert Systems Int'l. 1150 First Ave. King of Prussia, PA 19406	215/337-2300	ES/P ADVISOR	\$1895.00	PROLOG	400, systems can be linked	Negotiable
EXSYS, Inc. P.O. Box 75158 Albuquerque, NM 87194	505/836-6676	EXSYS	\$295.00	C	5,000	Yes
General Research Inc. 7655 Old Springhouse Road McLean, VA 22102	703/893-5900	TIMM	\$9,500.00	Fortran 77	500	Negotiable
Human Edge Software Inc. 2445 Farber Place Palo Alto, CA 94303	415/493-1593	Expert Ease	\$695.00	UCSD Pascal	300, systems can be linked.	Negotiable
Level 5 Research Inc. 4980 S-41A Melbourne Beach, FL 32951	305/729-9046	INSIGHT 1	\$95.00	Turbo Pascal	2,000	Negotiable
PPE Inc. P.O. Box 2027 Cathersburg, MD 20879	301/977-1489	Expert System	\$20.00	Basic	5,000	Provided
Radian 8501 MO-Pac Blvd Austin, TX 78766	512/454-4797	Rule Master	\$5000.00	C	200, systems can be linked	Negotiable
Software A & E Inc. 1500 Wilson Blvd. Arlington, VA 22209	703/276-7910	KES	\$4,000	IQ LISP	Systems can be linked	Negotiable

Table 1

The following systems run on IBM PC's

Company	Phone number	Product Name	Price	Written In	Maximum Rules	Source Available
SRI International 333 Ravenswood Ave. Menlo Park, CA 94025	415/859-5889	SeriesPC	\$15,000.00	IQ LISP	300, systems can be linked	Negotiable
TEKKNOWLEDGE 525 University Ave Palo Alto, Ca 94301	415/327-6606	M1 M1A	\$10,000 \$2,500	PROLOG	300, systems can be linked	Negotiable
Texas Instruments P.O. Box 2909 Austin TX, 78769	800/527-3500	Personal Consultant	\$3,000.00	IQ LISP	400, systems can be linked	Negotiable
This system runs on Macintosh by Apple Inc.						
Expertelligence Inc. 559 San Ysidro Road Santa Barbara, CA 93108	805/969-7874	ExpertOPS5	\$195.00	ExperLisp	Systems can be linked	Negotiable
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	Assembler	255	Negotiable

The following systems run on IBM PC's

Company	Run time licences	Classes Available	Internal Editor	Hooks to the outside world	Comments
Artelligence Inc.	Available	Available	Yes	Yes	Implementation of OPS 5, a forward chaining system. Requires a mouse.
California Intelligence	Available	Included	Yes	Yes	Forward and backward chaining on an opportunistic basis. Supports uncertainty, math and direct LISP programming. Rule based. Requires IQ LISP
Digitalk, Inc.	Available	Coming	Yes	Yes	Implementation of Smalltalk. An object orientated programming language. Supports forward and backward chaining, math and confidence levels.
Dynamic Master Systems	Negotiable	Negotiable	Yes	No	Implementation of OPS 5, a forward chaining system.
Expert Systems Int'l.	*Used with PROLOG	Negotiable	No	No	Forward and backward chaining, is best used with their PROLOG. Can be compiled.
EXSYS, Inc.	Included	Negotiable	Yes	No	Rule based language supports math and confidence levels. Backward chaining.
General Research Inc.	Available	Coming	Yes	Negotiable	Induction extraction tool, can generate it's own examples. Generated rules can be deleted. Supports confidence levels.
Human Edge Software Inc.	Available	Coming	Yes	Planned	Induction extraction tool, forward chaining Supports confidence levels.
Level 5 Research Inc.	Available	Available	No	No	Rule based language, supports confidence levels. Backward chaining with limited forward chaining ability.
PPE Inc.	Included	Available	Yes	Yes	Rule based system, uses internal data base system for rule entry it supports confidence levels and math. Backward chaining, This is a freeware program.
Radian Inc.	Available	Included	Yes	Negotiable	Induction extraction tool. Rules can be edited. Supports math and confidence levels.
Software A & E Inc.	Negotiable	Coming	Yes	Yes	Supports multiple objects, inheritance, procedural control and Bayesian probabilities. Includes IQ LISP and supports direct LISP programming.
SRI International	Available	Included	No	No	Rule based language. Requires IQ LISP licence and supports direct LISP programming. Backward chaining.

Table 1 cont.

The following systems run on IBM PC's

Company	Run time licences	Classes Available	Internal Editor	Hooks to the outside world	Comments
TEKNOLEDGE	Available	Available	No	M1 only	Rule based language, supports confidence levels, variables, math, and cycles. Backward chaining.
Texas Instruments	Available	Available	Yes	Yes	Rule based language will also support direct LISP programming. Includes IQ LISP. Backward chaining with multiple context structure, inheritance and confidence levels.
This system runs on the Macintosh by Apple Inc.					
Expertelligence Inc.	Available	Negotiable	Yes	Yes	Implementation of OPS 5, a forward chaining system. Requires ExpertLisp, supports direct Lisp programming.
This system runs on Commodore 64, Apple II and Atari 800 machines.					
Ultimate Media Inc.	Available	Available	Yes	Negotiable	Rule based language. Backward chaining with opportunistic forward chaining.

Table 1 cont.