APPLIED INTELLIGENCE

Modeling Technology: Trends for the Early 1990s

JAMES MARTIN

James Martin describes the most significant aspects of computer hardware and software in the early 1990s using a model of future technology.

Major changes in computer hardware technology are looming just beyond the horizon.

Imagine the improvement in productivity possible with desktop computers armed with processing power of 15 million instructions per second (mips), specialized parallel-processing chips, inference processor chips, neurocomputer chips, massively parallel machines and widespread cooperative processing.

Insightful managers will have the chance to use these major technological changes to restructure the business, dramatically increase productivity and use information for strategic advantage.

A major feature of the early 1990s will be an international race for dominance in the ability to manufacture chips with submicron features. Using ultraviolet etching techniques, the diameter of a feature on a chip will drop to between 0.6 and 0.8 of a micron by the early 1990s, thereby permitting a single mass-produced memory chip to contain 100 million components and a microprocessor chip to contain 1 million components.

Improved microprocessor technology will permit widely used medium-priced computer systems to operate at 15 mips, high-end personal workstations at 100 mips, top-of-the-line mainframes at 500 mips, top-of-the-line supercomputers at 40 billion floating-point instructions per second (flops) and large artificial-intelligence inference engines at 500K logical inferences per second (lips).

Specialized Microprocessors: Much of this increase in speed will be obtained through machine designs based on specialized microprocessors such as high-speed Reduced Instruction Set Computer (RISC) chips. Specialized LISP chips will drop in price, and high-speed LISP coprocessors will find wider use in some PCs.

Very large-scale integration (VLSI) neurocomputer chips, with half a million neurons and connections, will be combined on neurocomputer boards for personal computers that will contain 2 million to 10 million neurons and connections. Neurocomputers will find major applications in industry and defense for data analysis, pattern recognition and adaptive control systems.

Parallel Computers: Some powerful processor chips will be designed, such as the transputer, to be linked into efficient parallel-processing configurations. These processor chips will contain a RISC computer, memory and four input/output channels with an interchip communication protocol on one chip. Chips will contain multiple processors for parallel processing on one chip.

Parallel computers will grow in power and popularity as more and more managers realize that the future of computing lies in parallel machine architectures. However, there will be a great diversity of parallel architectures and no consensus on which will become the dominant architecture of the future.

Cooperative processing: The biggest change in computing in the 1980s was the spread of the personal computer. The most significant change in the early 1990s will be the growth of cooperative processing, in which a user's machine on the desk cooperates in intricate ways with more powerful machines.

Transmission rates: Optical fibers will be used increasingly to provide wide-bandwidth links between distributed networks of computers. By the early 1990s, the speed of single-strand optical fibers will be 2.2 billion bits per second (B bps). The capacity of major multifiber optical trunks will be 400B bps. These high-speed channels will often be used to provide a wide-bandwidth link to a desktop machine.

Telephone speech can be stored and transmitted with 16K bps. Using simple compression techniques, real-time television signals can be stored and transmitted at the following rates: videophone, 64K bps; video conferencing, 1.5M bps; NTSC television, 6M bps; and HDTV television, 24M bps.

Intelligent information retrieval: The personal computer user will be confronted with a deluge of data on optical discs and magnetic storage subsystems used as servers attached to local area networks (LANs).

By the early 1990s, artificial-intelligence techniques will be widely employed to help the user find and employ required information. Highly parallel search engines will become important components of LAN-connected database servers.

Computer software: The complexity of software will grow steadily. By the early 1990s, common sizes for large programs, in million lines of code (M loc), will be: large commercial applications, .1M loc; large military projects, 2M loc; and complex vendor software, 20M loc.

Integrated computer-aided software engineering (I-CASE) technology will have matured to the point where it will be used routinely to develop these large systems. System developers will use powerful I-CASE workbenches to support system planning, analysis, design, code generation, database generation, documentation generation and project planning operations.

Integration of I-CASE and AI: An important trend in the early 1990s will be the integration of I-CASE and AI tools. Emphasis will be placed on building application systems from constructs that are mathematically or logically provable and on using rule-processing to validate the system designs.

Methodologies will be developed that enable business professionals to formulate business procedures and requirements in the form of expert-system rules. These rules will be used directly with rule-based processing systems to build applications. End users can validate that the system is doing what they want and can change its behavior by changing the rules.

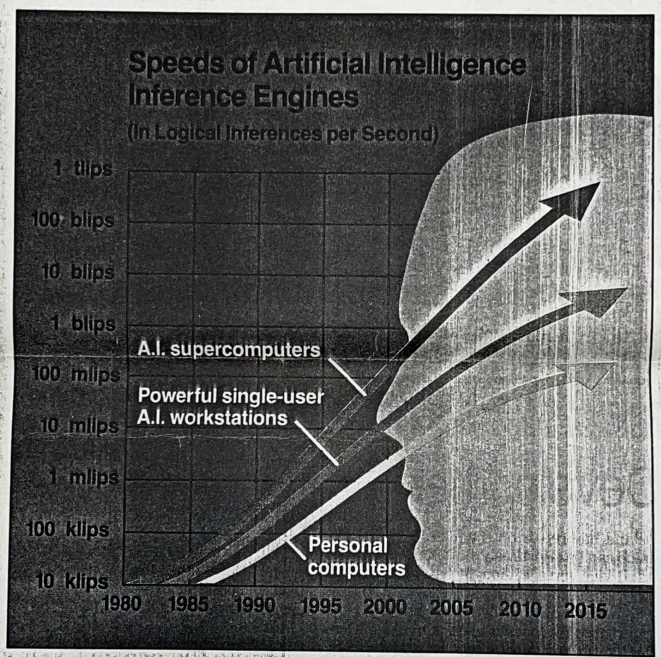
Application standards: The early 1990s will see a major effort to achieve open architectures, open networks, standards for database access, standard forms of user interaction, standards for languages that achieve full portability, standard forms of CASE repository representation and standard forms of knowledge representation.

IBM's SAA (Systems Application Architecture) will have matured and will be widely accepted. It will provide uniform methods for application software to access databases and networks, as well as standard forms of user access to computers. End-user dialogues increasingly will use standard interfaces such as IBM's Common User Access (CUA). Automated tools will assist in the building of common user interfaces.

Languages: Fourth-generation languages (4GLs) will evolve in multiple ways, becoming increasingly integrated and powerful. By the early 1990s, many of these languages will be integrated with CASE front ends and will incorporate rule-based processing and inference engines. Many end-user languages will become application-specific or profession-specific, incorporating the languages of finance, engineering, science, production control and so on. Programming will be accomplished without the need to remember commands, mnemonics or punctuation, using pull-down menus and an intuitive human interface.

Growth of end-user computing: An important continuing trend throughout the 1990s will be the rapid spread of computer literacy among white-collar workers. By the mid-1990s, the number of personal computers per white-collar worker in a typical advanced corporation will rise to 0.7 or higher. In the same period, half of all computer hardware and software expenditures in typical advanced corporations will be devoted to end-user computing.

Next week, we will explore the technology of the late 1990s. Topics include major advances in computer technology, CD and microdisks, neurocomputers, the use of parallelism in software development, artificial intelligence and human factoring. ■



David Harrum

In the 1980s, the biggest change in computing was the PC. For the 1990s, the most significant step will be the growth of cooperative processing.

The James Martin Productivity Series, an information service updated quarterly, is available through High Productivity Software Inc., of Marblehead, Mass. (617) 639-1958. For information on seminars, please contact (in the United States and Canada) Technology Transfer Institute, 741 10th St., Santa Monica, Calif. 90402 (213) 394-8305. In Europe, contact Savant, 2 New St., Carnforth, Lancs., LA5 9BX United Kingdom. (0524) 734 505.