Military and space applications continue to play a major role in driving the development of computer technologies, as Donald Brick, James Draper, and H. J. Caulfield remind us in their article, "Computers in the Military and Space Sciences." Reviewing the history of computers, they point out that the space program stimulated research into system concentration in the 1960's and 70's. Today, military and space demands continue to set directions for computer development, particularly in very high-speed integrated circuits, programming languages that support distributed processing, systolic array processors, and optical computers. The authors describe current military and space R&D, optimistic that these programs will yield marketable products for the civilian economy.

Both military and civilian programs can be expected to be users of artificial intelligence, Frederick Hayes-Roth explains in "Knowledge-Based Expert Systems." Knowledge systems combine the power of the computer to perform symbolic computation with the human ability to simplify complex problems and reason effectively, even when faced with faulty data, incomplete information, and subjective judgments. Because most human tasks require knowledge-based reasoning, the advent of computer systems to assist or replace humans marks a significant technological milestone. In the coming years, knowledge systems will increase in number, competence, diversity, and generality. Rather than view knowledge systems as "fifth-generation" computers, however, Hayes-Roth conjectures that these systems will open the doors to the second generic use of computers—applications that can assist, augment, equal, or surpass humans in reasoning and judgment.

Pattern-recognition machines and computer-vision systems have been designed for a range of applications that include character recognition, target detection, medical diagnosis, analysis of biomedical signals and images, remote sensing, identification of human faces and fingerprints, speech recognition, and automatic inspection, K. S. Fu and Azriel Rosenfeld report in "Pattern Recognition and Computer Vision." Many mathematical methods have been offered for solving pattern-recognition problems, but they are either statistical or structural, the authors acknowledge. Researchers are still looking for efficient feature extraction and selection techniques, but most pattern-recognition algorithms are considered computationally slow, and so are not suitable for real-time, on-line applications. Research outlined by Fu and Rosenfeld aims at streamlining these algorithms, and VLSI appears to promise the computing power to support these efforts.

The term "robot" covers a wide range of devices, from simple spot welders to intelligent devices endowed with physical capabilities equivalent and sometimes superior to those of humans. In his article, "Robotics," John Jarvis distinguishes robots from conventional manufacturing machines on the basis of these capabilities. They can sense their surroundings, modify their actions to carry out specified tasks, and alter tasks on command. Jarvis suggests that, once robots are endowed with a greater knowledge base or more refined pattern-recognition capabilities, their place in the design and manufacturing processes will expand greatly, even reaching the "fascinating" level of building themselves.

Kendall Preston, Jr., Lawrence Fagan, H. K. Huang, and Thomas Pryor identify major medical breakthroughs in their article, "Computing in Medicine." Monitoring systems have been developed to permit real-time observations of the vital signs of an intensive-care patient. Direct question-and-answer sessions between the physician and the computer are used to prepare personal medical histories and to aid diagnosis. Likewise, radiology has been revolutionized by commercial minicomputers and array processors that permit computerized tomography and positron and magnetic resonance imaging. In addition, computer vision systems for hematology now analyze blood cells by full-color, image-processing techniques. These devices and new diode-array X-ray scanners are pressing the computing industry to archive in 100,000 G-bit storage systems. Besides taking full advantage of existing computing technology, the authors conclude, health services are making an impact of their own by promoting hardware and software development in medical schools and research foundations.

Progress in speech processing, however, has failed to maintain the pace of the rest of the computer industry, as Harold Andrews observes in "Speech Processing." Recent research, in fact, has scarcely advanced speech processing beyond the stage of a curiosity. Delays in progress can be explained by the absence of a real market, so work in automatic speech recognition, voice encoding, and text-to-speech synthesis remains technology-oriented rather than application-oriented. Progress in related fields should bring speech processor costs to a marketable level: New custom and general-purpose chips are reducing the data-processing burden, so engineers are now placing greater emphasis on marketable applications, making conversational interaction with machines their goal. Speech processing can be expected to join other consumer-oriented applications that generally bring the power of computers to consumers who are often uninformed about computer technology.