

## SOFTWARE ADVANCES

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June 1996

Many new content areas stand out as important for employment opportunities, for advanced professional qualifications, and for involving intellectual stimulation.

- The National Science Foundation has identified Human-Computer Interaction (HCI) as the primary gating function for widespread use of the planned National Information Infrastructure, considering HCI to be a core subject in computer science. More than half of all software project development effort is at the interface, yet very few computer science departments teach HCI, and only half-a-dozen specialize in HCI.
- The Internet has captured the imagination of industry, and skilled web developers have grown into great demand over the course of only two years. Educational programs need to include courses and special training in modern Internet languages and techniques (such as Java, intelligent agents, networking, cryptography, and compression).
- A revolution in reprogrammable hardware (FPGA-like architectures) is redefining the relationship between hardware and software. VLSI simulation and testing, reconfigurable opcodes, just-in-time circuitry, and dynamic optimization provide unique demands for training in formal methods and computational models.
- Multimedia, multisensory games, and interactive exploration currently dominate the cash flow of software applications. Virtual reality techniques, 3D graphics, real-time programming, exotic interface devices, embedded narrative, and the development of a new media for education and entertainment all provide inherently exciting and rewarding content and programming activities.
- Ubiquitous, transparent computing systems in household appliances, automobiles, and entertainment units pose new challenges for product design and interactivity. Wearable computers for enhanced productivity in remote work environments are creating a strong demand for energy-efficient hardware and software, novel interaction techniques, specialized algorithms, and task-specific software applications. Legacy program maintenance remains a dominant force in industry software economies, and provides challenges for automated translation, verification, and partitioning. Mass information access is placing unprecedented demands on database technologies, networking protocols, high-bandwidth encoding techniques, intelligent information retrieval, and data filtering for relevance. These massive changes in the software industry, and in computer science in general, dictate a new approach to computer science education, one that focuses on formal methods, reality-anchored programming, and responsive curriculum change.