50 & 25 YEARS AGO

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In the early years, *Computer* was only published bimonthly. Therefore, we will have to skip our interesting and/or informative extractions for October. The next one will appear in the November 2021 issue of *Computer*, and we hope you will eagerly wait for our next publication of this column.

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Essays on Fifty Years of Computing; Stephen S. Yau (p. 24): "This year the IEEE Computer Society celebrates its 50th anniversary in a number of ways, including the publication of this special issue. … The emphasis here is on technology that has made computers easier to use, more powerful, and more economical. We can anticipate that computer technology will continue to be one of the primary driving forces to improve the standard of living." *[Editor's note: The following eight articles analyze the state of the art in eight areas deemed important 25 years ago for the future development of the information technology. In addition to these discussions, the history of computing from the clay tablets of Sumer to the state of the art in 1996 is illustrated by pictures inside the different articles.]*

Microprocessor-Based Computers; Nick Tredennick (p. 27) "The first practical IC was fabricated in 1959 at Fairchild and at Texas Instruments." (p. 31) "Workstation manufacturers, with their high-end requirements and their superscalar microprocessors, saw performance as the route to market share and, therefore, success. Their strategy seemed to be 'if we build performance, unit volumes will follow.' By contrast, as the primary microprocessor supplier to the PC market, Intel seemed to have the strategy 'if we build unit volume, performance will follow'." *[Editor's note: This is a very interesting article that discusses the various steps in integrated circuit development. It correctly predicts the demise of workstations against the PC but, of course, does not foresee further miniaturizations into tablets and smartphones.]*

Evolution of Data Management; Jim Gray (p. 38): "Early data management systems automated traditional information processing. Today they allow fast, reliable, and secure access to globally distributed data. Tomorrow's systems will access and summarize richer forms of data. Multimedia databases will be a cornerstone of cyberspace. … Manual record managers, 4000 BC–1900 … Punched-card record managers, 1900–1955 … Programmed record managers, 1955–1970 … On-line network databases, 1965–1980 … Relational databases and client-server computing, 1980–1995 … multimedia databases, 1995 –." (p. 45) "Today databases are being called upon to store more than just numbers and text strings. They are being used to store the many kinds of objects we see on the World Wide Web and the relationships among them." (p. 46) "Many data management challenges remain, both technical and societal. Large on-line databases raise serious societal issues. The technical challenges are more tractable. … Perhaps the most challenging problem is understanding the data." *[Editor's note: Data management issues and the concepts of data base management systems are explored in detail. It is interesting to note that the author even mentions the societal problems we will have to handle when large online data collections become available. We realize how correct he is when you think, for example, of issues we have with privacy protection.]*

Advances in Software Engineering; C.V. Ramamoorthy et al. (p. 47): "Many processes have been proposed to systematically develop software in small, manageable phases and have served as a mechanism to evaluate, compare, and improve the effectiveness of software development.

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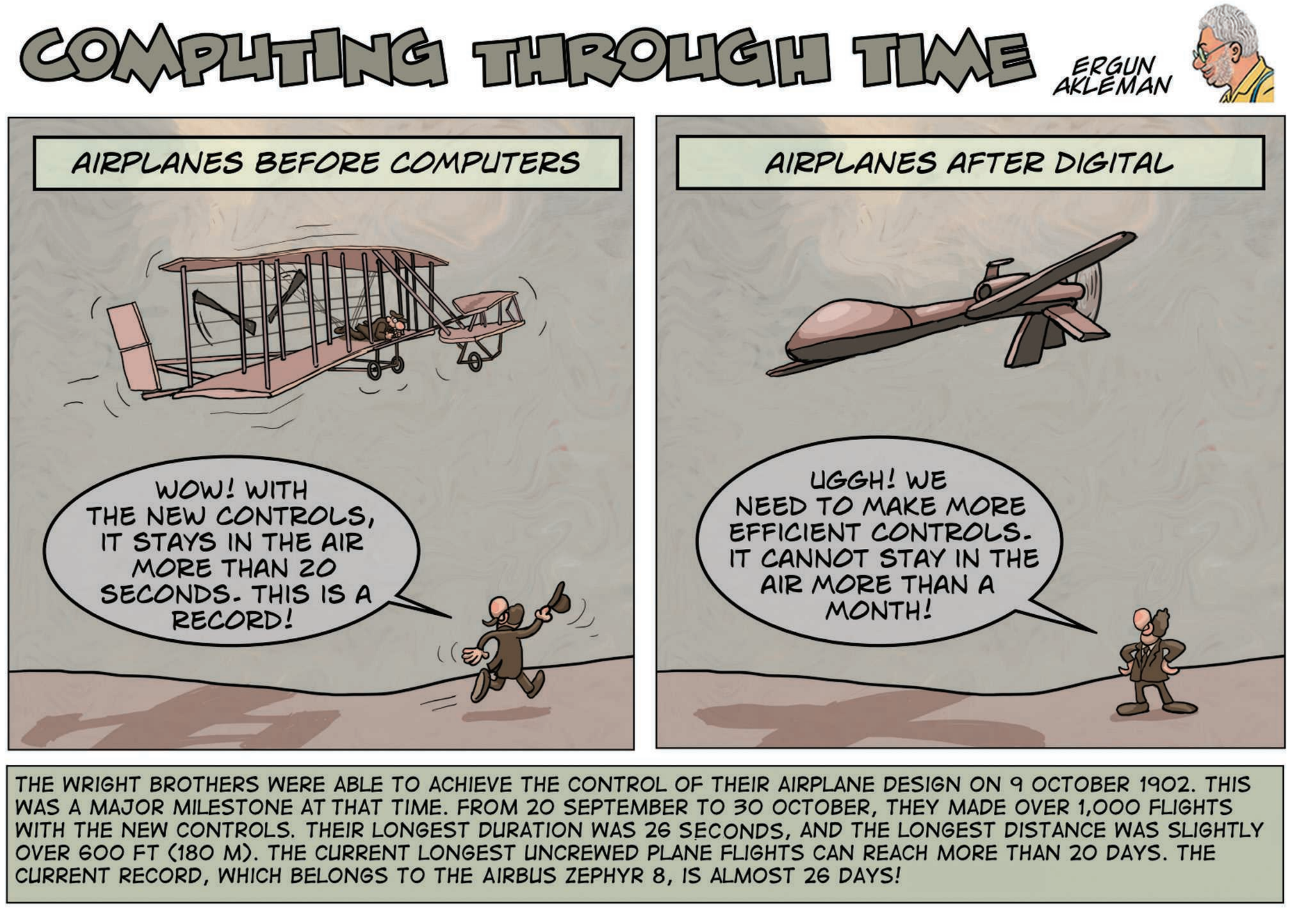
… When the problem or its domain cannot be well understood during specification, a prototyping process—which can be incorporated into the requirements phase—is used to develop a system model to test requirement feasibility, appropriateness, and correctness." (p. 48) "As applications grow and their domains become more complex, the development processes naturally evolve. Object-oriented development processes were developed, for instance, to incorporate modularity, abstraction, and reuse, and to promote programming-in-the-large." (p. 50) "Large project development has almost always been a group activity, with various engineers and domain experts collaborating to successfully complete a project. Tools that support collaborative software engineering and development are called computer-supported cooperative work applications, or groupware." *[Editor's note: The article discusses the various phases of software development in detail including tools to support the different phases: requirements engineering, design, programming, testing, reliability and safety, and maintenance. The article assumes that object-oriented technology will lead to mature processes. It does not foresee the need to adjust the development processes for the innumerable apps in the market today and the need to support those to become reliable, safe, and controllable, for example, for privacy.]*

Toward the Information Network; Hanafy Meleis (p. 59): "The continuing proliferation of media-rich applications, such as video-conferencing, on-line gaming, and virtual reality will drive the further evolution of the next generation of connectivity, the Information Network. This article explains the sequential evolution of three phases of networking—the Arpanet, the Internet, and the Information Network—and explores the barriers to realizing this new information network paradigm." (p. 61) "Estimates of Internet users worldwide vary from 40 to 55 million." (p. 64) "This information network will be much, much more powerful than today's Internet. … For this vision to become reality, new technologies must be developed and tested to ensure that a diverse range of information consumers, network operators, and service providers can exchange information and provide services rapidly, securely, conveniently, and cost-effectively." *[Editor's note: This interesting article analyzes the requirements for solving the three issues raised. It is interesting to note that it does not mention the World Wide Web and its impact, despite the fact that, in 1989, Tim Berners-Lee and Robert Cailliau published the concept, and by 1996 it had been widely accepted after Mosaic was published in 1993.]*

WWW: Past, Present, and Future; Tim Berners-Lee (p. 69): "The World Wide Web is simply defined as the universe of global network-accessible information. It is an abstract space within which people can interact, and it is chiefly populated by interlinked pages of text, images, and animations, with occasional sounds, videos, and three-dimensional worlds. The Web marks the end of an era of frustrating and debilitating incompatibility between computer systems. It has created an explosion of accessibility, with many potential social and economic impacts." (p. 76) "Now, privacy is an issue. Two people talking in the middle of a wheat field have privacy. However, do they have the right to a really private conversation over the Internet? Strong cryptography could provide such privacy. However, governments have limited its use because of national security concerns." (p. 77) "In the long term, there are questions as to what will happen to the world's cultures when geography becomes weakened as a diversifying force. Will this lead to a monolithic world culture that is like the culture of the US, or will it foster even more disparate interest groups than exist today? Will the Web help create a true democracy by informing the voting public of the realities behind government decisions, or will it encourage ghettos of bigotry where emotional intensity rather than truth gains readership? It is for us to decide, and in doing so, we must assess the simple engineering decisions that will affect the outcome." *[Editor's note: There is not much to say about this very interesting article describing the web and the warning it contains about the course of our society. Unfortunately, the bigotry and "fake news" predictions and privacy invasions have come true and are still gaining in strength.]*

History and Impact of Computer Standards; Gary S. Robinson et.al. (p. 79): "Standards are especially important to a young and quickly changing industry like the computer industry. They stabilize technology and encourage investment." (p. 85) "In this article, we have touched on computer standards that have been milestones in the industry. We omitted some important standards, such as the Open Systems Interconnect (OSI) and Posix, because the jury is still out on their historical significance. In general, however, computer standards have had a significant impact on the market. The PC, the modem, and the telephone lines we use for communications are commercially viable largely because someone standardized the underlying infrastructure and allowed innovations to take place. This has been a key to the computer industry's past success and will be important to the industry in the future." *[Editor's note: There is not much to say about this interesting article that describes some of the most important standards that existed in the computing field in 1996.]*

The Challenge of Artificial Intelligence; Raj Reddy (p. 86): "The main challenge of AI is to create models and mechanisms of intelligent action. AI is primarily an



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empirical science, in which researchers use the classical hypothesis-and-test research paradigm to validate these models and mechanisms. The computer is the laboratory where AI experiments are conducted." (p. 88) "Besides finding solutions to exponential problems, Al algorithms must often satisfy one or more of the following characteristics of intelligent systems: … Goal-oriented behavior … Learn from experience … Vast knowledge … Self-awareness … Language and speech … Error and ambiguity … Real time." *[Editor's note: This generally optimistic article describes those properties and introduces a number of illustrative examples, from chess to speech to autonomous driving. As we now know, some of those have been solved satisfactorily in the intervening 25 years, whereas other are still out in the future. For example, autonomous driving and self-awareness (behavior explanation) are still waiting to be solved.]*

Perspectives on Supercomputing: Three Decades of Change; Paul R. Woodward (p. 99): "The supercomputers I have used … span three revolutions in supercomputer design: the introduction of vector supercomputing, parallel supercomputing on multiple CPUs, and supercomputing on hierarchically organized clusters of micro-processors with cache memories." (p. 111) "The DSM or SMP cluster architectures can combine the performance benefits of massively parallel computing with the flexibility of shared-memory multitasking to address irregular problems. Like all supercomputer systems, however, these new machines will strongly favor certain numerical algorithms and force others to execute at much slower speeds." *[Editor's note: This article uses a number of well-known applications to explain the different architectures available over time. It is principally oriented toward science and not toward the now also very important areas of big data analysis and online transaction processing mostly coming from web applications.]*

At a Crossroads: Connectivity Model Determines Distribution Of Power; James A. Schnepf (p. 122): "Historically, access to information and our ability to communicate with large numbers of people over a wide area have been limited, and control of information has been a means to power. However, technological innovations have vastly increased our communication options." (p. 123) "Enter the world of computer communications. The Internet lets millions of people communicate in ways not possible just a few years ago. The political soapbox in the park, which enabled anyone to express his or her views on virtually any topic to anyone within earshot, has become a computer, a modem, and an Internet connection. The audience is anyone on the planet similarly equipped and curious enough to 'listen.' … The two major models of home connectivity are the big pipe/little pipe model and the big pipe/big pipe model. The big pipe/little pipe, or 'couch potato,' model has asymmetrical bandwidth, with high band-width downstream and low bandwidth upstream. … This model appears to have heavy corporate support—and certainly the support of major content producers and distributors. … I believe the right mode of connectivity for Internet access is one of parity. It enables large numbers of people to communicate their ideas, knowledge, and feelings over geographical boundaries. (p. 124) "If we envision a model of connectivity that presumes the vast majority of us are merely consumers of information, it will become a self-fulfilling vision. Instead, let's envision—and adopt—a model that presumes we are all active participants in the 'information revolution'." *[Editor's note: Clearly, we have moved into the big pipe/big pipe model despite the fact that lower cost upstream in general is slower than downstream.]*

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