## Backspace



## **Augmented Intelligence**

Vinton G. Cerf

ust a few days before I sat down to write this column, word arrived that one of the true giants and visionaries of computer science had passed away. In the mid-1950s, Douglas Engelbart drew extraordinary sustenance from the famous 1945 article by Vannevar Bush, "As We May Think."1 It opened up for Doug a view of the potential partnership between humans and computers that hasn't been entirely realized even 50 years later. His legacy touches us all. The invention of his oN-Line System (NLS) at Stanford Research Institute (now SRI International) blazed a trail to direct human-computer interactions that included the invention of the mouse, shared documents, hyperlinking, video conferencing, group work, and many other innovations.

The diaspora of the NLS team spread to XEROX PARC and the ALTO Work Station, spawning ideas that drove the Apple Macintosh and Adobe Systems' PDF, among others. Engelbart's system formed the basis of the Network Information Center that documented the work of the ARPANET project and later the Internet's development as well as managing these systems' identifiers (protocols, network addresses, domain names, and so on) and user guides and user directories. He was deeply committed to the proposition that cooperation among groups of people, augmented by computer power, could outthink and outperform groups working without such cohesion.

Engelbart's zeal was matched by the support and encouragement of J.C.R. Licklider, another giant in the field, who was the first director of the Defense Advanced Research Project Agency's Information Processing Techniques Office, which went on to develop the ARPANET and the Internet. Licklider was a psychologist who believed strongly that computers could augment human intellect in ways that we have only begun to explore. Engelbart's 1968 demonstration of NLS has been dubbed "the Mother of All Demos," and produced a standing ovation among those fortunate enough to be present.

Today, we're in a position to make major advances toward an extraordinary partnership between humans and computers. Machines can see, hear, and manipulate the real world that humans inhabit. They can speak multiple languages. They are able to process quantities of information in fractions of a second that vastly exceed human capacity. Although our pattern recognition is often remarkable, these machines can sometimes discover patterns that we could not, simply for our lack of ability to visualize multidimensional data.

Google has begun to experiment with Google Glass, a device worn like glasses but which offers to a computer the ability to see what we see, hear what we hear, and speak and display information to us in a hands-free fashion. At this stage, the device is essentially a platform with a modest number of applications, but the stage is set to unleash human creativity in the development of new applications and functions. Perhaps as important, the device can connect to the Internet and thus access vast information and computing power to apply to tasks that arise. In theory, Glass could see and interpret gestures and respond to them, in combination with spoken dialog. Given sufficient image information, the system could recognize artifacts (buildings, monuments, or objects of all kinds) and provide information about them. Imagine looking at a menu written in a language you don't know and having it translated in the display into a language you do know.

Thinking more generally, the idea that we might be able to discuss our interests and problems with a computer in the same way we do with a human colleague has considerable appeal. I think this view of human and computer partnership informed much of what Douglas Engelbart and cont. on p. 95

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J.C.R. Licklider spoke about and sought to develop. The speed and scope of cloud-based computing, seamlessly coupled with the drive, curiosity, and innovative human intellect, is precisely what Engelbart sought to accomplish in his long career.

Another visionary researcher in Athis space, Ray Kurzweil, is now at Google pursuing these notions, as he has for much of his career. In his book, *How to Create a Mind*,<sup>2</sup> Kurzweil outlines in lucid terms a model for brain function that he believes can be realized using the computing power that can be harnessed in today's cloud environments. The focus on augmented intelligence is a pragmatic and likely achievable goal, even if it's only a milestone along the way to autonomous, silicon sapience. Indeed, we will likely need this kind of help if we are to arrive at nonhuman intelligence in a machine.

## References

- 1. V. Bush, "As We May Think," *The Atlantic*, 1 July 1945.
- 2. R. Kurzweil, *How to Create a Mind*: *The Secret of Human Thought Revealed*, Viking Adult, 2012.

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