Can biology provide creative solutions for next-generation memory devices?

Steven Kushner
Erasmus Medical Center, Rotterdam, The Netherlands

Widely considered the most complex and sophisticated machine ever known, the brain is capable of many extraordinary computations. Shaped by an exceptionally long history of adaptive evolutionary forces, the brain was designed to maximize reproductive fitness. Over the past century, neurobiologists have gained increasingly precise knowledge about the mechanisms by which brain accomplishes its responsibilities. Through detailed anatomical studies, we have a deep understanding of the brain's unique architecture. Further, electrical recordings and functional imaging have provided critical data about how information is processed and encoded. Most recently, the emergence of genetic technologies has heralded new challenges and unique opportunities in establishing an increasingly precise, yet complex model for information encoding in neural circuits.

Taken together, experience-dependent plasticity has emerged as the dominant theme in considering how information is stored with the brain. My presentation will review the most current neurobiological theory for information encoding in the brain. Further, I will address practical questions for the potential impact on microelectronics development: What is the fundamental unit of information storage in the brain? What forms of information does the brain process and code most efficiently? For which forms does the brain function poorly? And finally, can the neural mechanisms for information processing highlight creative solutions for microelectronics engineering.