



SPECIAL ISSUE

MEMORIES IN THE FUTURE OF INFORMATION PROCESSING

Edited by S. Tiwari

1250 Implications of Scales in Processing of Information

By S. Tiwari

[INVITED PAPER] The physical form of information processing employing electronics is as a collection of small devices—memories included—beholden to the physics of operation of device and its assembly in achieving desired objectives. This paper reviews and explores these scale connections—of transistors, materials, and the variety of device proposals—internally and in their integration.

1274 Phase-Change and Redox-Based Resistive Switching Memories

By D. J. Wouters, R. Waser, and M. Wuttig

[INVITED PAPER] Resistive memories are a collection of physico-chemical approaches where the resistance of the device is programmed and is quite nonvolatile. This paper reviews the current understanding and the future outlook, particularly toward 3-D integration, of such phase-change and electrochemical-change-based structures.

1289 Mott Memory and Neuromorphic Devices

By Y. Zhou and S. Ramanathan

[INVITED PAPER] Correlations of electrons—arising in structural and physical phase transitions—provide a nanoscale-compatible mechanism of possible utility to electronics. This paper discusses the mechanisms and their implications in memory and information processing.

1311 Emerging Trends in Design and Applications of Memory-Based Computing and Content-Addressable Memories

By R. Karam, R. Puri, S. Ghosh, and S. Bhunia

[INVITED PAPER] Logical organization of memory to suit tasks—analytics, mining, pattern recognition—benefits by removing several inefficiencies that arise in the extraction of data. This paper reviews content-addressable and associative memories and discusses challenges and opportunities with reference to the variety of device forms in exploration.

1331 Evolution of Memory Architecture

By R. Nair

[INVITED PAPER] Problems to be tackled efficiently and new applications have a strong say in defining how memory architectures must evolve. With large data as a defining theme, this paper discusses how processor and system architecture is likely to continue to change to move to a form where rapid retrievability will become a critical characteristic.

1346 Heterogeneity and Efficiency in the Brain

By V. Balasubramanian

[INVITED PAPER] The brain is a remarkable information engine. Its efficiency arises via specialized approaches to the task and a hierarchy—a very non-von-Neumann form. The paper suggests that this computational organization is an architecture of memories of procedures and discusses the mathematical and physical basis for how this approach endows the brain with its efficiency for the different tasks.

DEPARTMENTS

1243 POINT OF VIEW

In Defense of Engineering Education  
By G. Temes and L. Solymar

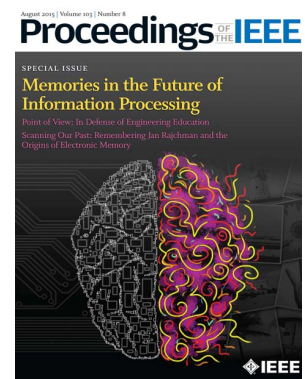
1247 SCANNING THE ISSUE

Memories in the Future of Information Processing  
By S. Tiwari

1426 SCANNING OUR PAST

Remembering Jan Rajchman and the Origins of Electronic Memory  
By A. B. Magoun

1434 FUTURE SPECIAL ISSUES/SPECIAL SECTIONS



On the Cover: On our cover this month we see an artist's interpretation of the special issue theme, which deals with the evolution of electronic memories in coming years.

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**SPECIAL ISSUE: Memories in the Future of Information Processing****1359 The Visual System's Internal Model of the World**By *T. S. Lee*

**|INVITED PAPER|** Perceptual computation can be usefully viewed through Bayesian inferencing. Perception follows as a statistical inference based on an internal model. This paper analyzes different representational schemes and models useful in learning and inference—the information processing task.

**1379 Memory and Information Processing in Neuromorphic Systems**By *G. Indiveri and S.-C. Liu*

**|INVITED PAPER|** In neuromorphic approaches, memories are distributed. This paper reviews the architectures of cortical and deep neural networks inspired by the brain and raises the issues that need to be tackled for these neuromorphic approaches to reach toward full biological richness.

**1398 Bioinspired Programming of Memory Devices for Implementing an Inference Engine**By *D. Querlioz, O. Bichler, A. F. Vincent, and C. Gamrat*

**|INVITED PAPER|** Emerging memory structures have several characteristics that are suitable for neuromorphic implementations. This paper connects the behavior of these “new” memory devices to achieving inference engines and provides a connection between the behavior of different devices and the learning algorithms.

**1417 The Memory Problem of Quantum Information Processing**By *D. P. DiVincenzo*

**|INVITED PAPER|** Quantum computation's critical problem is the delicate nature of the bit. This paper describes emerging approaches to long-term storage of quantum information and the effective use of redundancy in quantum entanglement that make scalable quantum computing conceptually foreseeable.

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