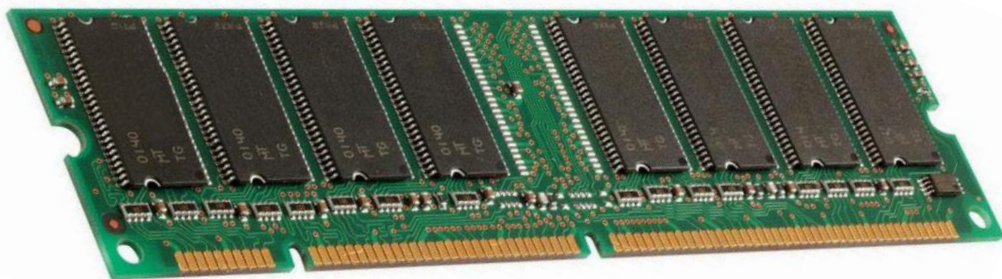


Today, DRAM is just a storage device



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- **MICRO 2013** ----->

RowClone: Bulk Data Copy and Initialization Using DRAM

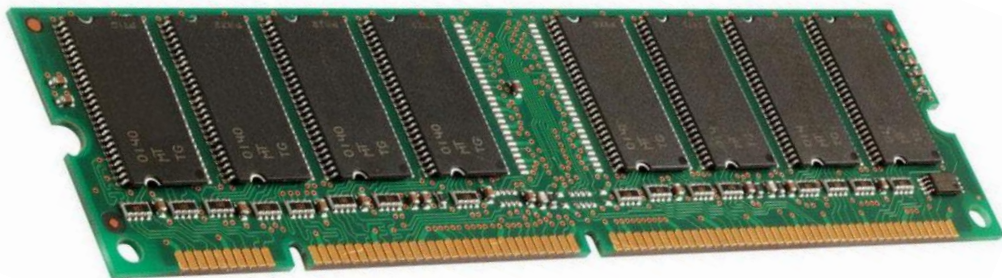


Today, DRAM is just a storage device

- **MICRO 2013** ----->
- ↓
- **MICRO 2015** ----->

RowClone: Bulk Data Copy and Initialization Using DRAM

Gather-Scatter DRAM: Accelerating Strided Accesses Using DRAM



Today, DRAM is just a storage device

● **MICRO 2013** ----->

RowClone: Bulk Data Copy and Initialization Using DRAM

▼ ● **MICRO 2015** ----->

Gather-Scatter DRAM: Accelerating Strided Accesses Using DRAM

▼ ● **MICRO 2017** ----->

Ambit: Accelerating Bulk Bitwise Operations Using DRAM





Throughput of bulk bitwise operations limited by available memory bandwidth

Ambit

Perform bitwise operations **completely inside DRAM chips**

Bitwise AND/OR: Simultaneous activation of three rows

Bitwise NOT: Inverters already present in sense amplifiers

Ambit

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32X improvement in
raw throughput

35X reduction in
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1% area cost over existing DRAM chips

Ambit

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Bitwise AND/OR: Simultaneous activation of three rows

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32X improvement in
raw throughput

35X reduction in
energy consumed

1% area cost over existing DRAM chips

3X-7X performance improvement
in real-world applications

Ambit

In-Memory Accelerator for Bulk Bitwise Operations Using Commodity DRAM Technology

Vivek Seshadri, Donghyuk Lee, Thomas Mullins, Hasan Hassan, Amirali Boroumand,
Jeremie Kim, Michael A. Kozuch, Onur Mutlu, Phillip B. Gibbons, Todd C. Mowry

Session 3A – Tuesday, 11 AM

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