RowClone: Fast and Energy-Efficient In-DRAM Bulk Data Copy and Initialization

Limited bandwidth

High energy

Carnegie Mellon University

Intel Pittsburgh
RowClone: Fast and Energy-Efficient In-DRAM Bulk Data Copy and Initialization

- Forking
- Zeroing
- Checkpointing
- VM Cloning

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- High energy

Bulk Data Copy  Data Initialization

Unnecessary Data Movement

Forking  Zeroing  Checkpointing  VM Cloning

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RowClone: In-DRAM Bulk Copy & Initialization

Source Row

Destination Row

Row Buffer
RowClone: In-DRAM Bulk Copy & Initialization

Copy from source row to row buffer
RowClone: In-DRAM Bulk Copy & Initialization

Copy from source row to row buffer

Copy from row buffer to destination row
RowClone: In-DRAM Bulk Copy & Initialization

Copy from source row to row buffer

- Latency: 11x

Copy from row buffer to destination row

- Energy: 74x

Very few changes to DRAM
(0.01% increase in die area)
RowClone: In-DRAM Bulk Copy & Initialization

- End-to-end system design to exploit DRAM substrate
- Several applications that benefit from RowClone
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- End-to-end system design to exploit DRAM substrate
- Several applications that benefit from RowClone

8-Core System

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