**Background**

- Image bitmaps are widely used in memory for fast accesses
  - Application: image processing and machine learning
  - High space and energy consumption in DRAM
- Non-volatile main memory (NVMM) is ideal for bitmaps
  - **Pros**: high density, near-zero stand-by power
  - **Cons**: high latency and energy for writes
- Bit-write reduction in NVMM is cost-inefficient
  - Bitmaps are hard to match the general-purpose data patterns
  - Different patterns due to various bitmap formats

Partial patterns in FPC [NANOARCH'14]

<table>
<thead>
<tr>
<th>Prefix</th>
<th>Pattern</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>000</td>
<td>Zero run</td>
<td>0x000000000 =&gt; 0x00</td>
</tr>
<tr>
<td>001</td>
<td>4-bit sign extended</td>
<td>0x000000002 =&gt; 0x12</td>
</tr>
<tr>
<td>010</td>
<td>1-byte sign extended</td>
<td>0xFFFFF000 =&gt; 0x2CC</td>
</tr>
<tr>
<td>011</td>
<td>Halfword Sign Extended</td>
<td>0x00001C23 =&gt; 0x31C23</td>
</tr>
</tbody>
</table>

RGB bitmap (three channels)

Gray bitmap (one channel)

**Problem**: inefficient bit-write reduction for bitmaps in NVMM (e.g., 94.2% compression ratio for FPC)

**The SimCom Design**

- Idea: leverage the **pixel-level similarity** and **error-tolerance** for approximate compression

- **Similarity-aware data compression**
  - Uncompressed Data
  - Partitioned Data
  - Compressed Data with base word, run
  - Compressed Data with LSB reuse

- **Adaptive compression scheme**
  - Uncompressed Data
  - Mode Selector
  - Quality Table
  - Normalized difference & compressed data

**Comparisons**: FNW [MICRO'09], FPC [NANOARCH'14], BDI [PACT'12], BiScaling [ISLPED'17]

**Evaluation**

- Write latency
- Energy