Using New Hardware in Spark

Matei Zaharia
The Problem

Hardware has changed a lot since big data processing systems first came out

- **Storage**: 50+MB/s (HDD) in 2010
- **Network**: 1Gbps
- **CPU**: ~3GHz
The Problem

Hardware has changed a lot since big data processing systems first came out.

<table>
<thead>
<tr>
<th></th>
<th>2010</th>
<th>2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storage</td>
<td>50+MB/s (HDD)</td>
<td>500+MB/s (SSD)</td>
</tr>
<tr>
<td>Network</td>
<td>1Gbps</td>
<td>10Gbps</td>
</tr>
<tr>
<td>CPU</td>
<td>~3GHz</td>
<td>~3GHz</td>
</tr>
</tbody>
</table>
The Problem

Hardware has changed a lot since big data processing systems first came out.

<table>
<thead>
<tr>
<th></th>
<th>2010</th>
<th>2015</th>
<th>10x</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storage</td>
<td>50+MB/s (HDD)</td>
<td>500+MB/s (SSD)</td>
<td></td>
</tr>
<tr>
<td>Network</td>
<td>1Gbps</td>
<td>10Gbps</td>
<td></td>
</tr>
<tr>
<td>CPU</td>
<td>~3GHz</td>
<td>~3GHz</td>
<td>😞</td>
</tr>
</tbody>
</table>

New bottleneck in Spark, Hadoop, etc.
To Make Matters Worse

In response to the slowdown of Moore’s Law, hardware is becoming more diverse.

Have to optimize *separately* for each platform!
Main Questions

1. How to use new storage media for big data?
   » SSDs, NVRAM, 3D XPoint, etc
   » Main storage? Caches? Intermediate results?

2. How to increase CPU efficiency of big data frameworks, or use other processing devices
Ongoing Work

Open source Spark: “Project Tungsten”
» Use off-heap memory in a standard binary format
» Allows Spark to use SSDs, NVRAM, etc for storage

MIT research: Parallel IL
» A parallel intermediate language that can target CPUs, GPUs, manycores, etc
» Captures current big data apps, but easy to
How It Works

- SQL
- machine learning
- graph algorithms

intermediate language

- CPUs
- GPUs
- ...

 transformations
Example: TPC-H Query 6

<table>
<thead>
<tr>
<th>Language</th>
<th>Runtime (sec)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Python</td>
<td>0.53</td>
</tr>
<tr>
<td>Java</td>
<td>0.14</td>
</tr>
<tr>
<td>C</td>
<td>0.08</td>
</tr>
<tr>
<td>HyPer Database</td>
<td>0.11</td>
</tr>
<tr>
<td>Parallel IL</td>
<td>0.03</td>
</tr>
</tbody>
</table>
How MOC Can Help

1. Direct access to diverse new hardware
   » Not virtualized so we have full control

2. Real datasets and workloads to test with

3. Way to expose this work to new users