Interacting with National Water Model (NWM) Predictions

Devika Kakkar & Aaron Williams
April 26, 2018
Speed and Interactivity: How We Visualized the National Water Model (NWM) Predictions

April 25, 2018
Core Density Makes a Huge Difference

CPU Processing

Latency: Time to do a task. | Throughput: Number of tasks per unit time.  

<table>
<thead>
<tr>
<th>Latency</th>
<th>Throughput</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPU</td>
<td>1 ns per task</td>
</tr>
<tr>
<td></td>
<td>(1 task/ns) x (20 cores) = 20 tasks/ns</td>
</tr>
<tr>
<td>GPU</td>
<td>10 ns per task</td>
</tr>
<tr>
<td></td>
<td>(0.1 task per ns) x (40,000 cores) = 4,000 task per ns</td>
</tr>
</tbody>
</table>

*Fictitious example*
MapD is the analytics platform created for GPUs
DEMO TIME!
## Advanced memory management

Three-tier caching to GPU RAM for speed and to SSDs for persistent storage

<table>
<thead>
<tr>
<th>Layer</th>
<th>Storage Type</th>
<th>Size Range</th>
<th>Throughput Range</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CPU RAM (L2)</strong></td>
<td></td>
<td>32GB to 3TB</td>
<td>70-120 GB/sec</td>
</tr>
<tr>
<td><strong>GPU RAM (L1)</strong></td>
<td></td>
<td>24GB to 256GB</td>
<td>1000-6000 GB/sec</td>
</tr>
<tr>
<td><strong>SSD or NVRAM STORAGE (L3)</strong></td>
<td></td>
<td>250GB to 20TB</td>
<td>1-2 GB/sec</td>
</tr>
</tbody>
</table>

**Hot Data**
- Speedup = 1500x to 5000x Over Cold Data

**Warm Data**
- Speedup = 35x to 120x Over Cold Data

**Cold Data**
Query Compilation with LLVM

Traditional DBs can be highly inefficient
• each operator in SQL treated as a separate function
• incurs tremendous overhead and prevents vectorization

MapD compiles queries w/LLVM to create one custom function
• Queries run at speeds approaching hand-written functions
• LLVM enables generic targeting of different architectures (GPUs, X86, ARM, etc).
• Code can be generated to run query on CPU and GPU simultaneously
The GPU Open Analytics Initiative
Creating common data frameworks to accelerate data science on GPUs

- Model Training / Inference
  - H2O.ai
  - TensorFlow
  - torch

- Data Manipulation/Management
  - CONTINUUM
  - Numba

- Data Interchange (Zero Copy)
  - Apache Arrow
  - GPU DATA FRAME

- Data Processing (Filtering, Joining and Aggregation)
  - MAPD CORE

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Coming Soon

Geospatial Data Types and Functions
• Early access available now

LIDAR Data
• Working with Michael Flaxman (Geodesign Technologies)
• An open dataset from the state of Florida with several billion points

Open Source MapD Core Working Group Forming at FOSS4G
• New features coming soon to the open source SQL engine
• If you’re interested in participating, talk with the MapD team
Next Steps

- mapd.com/demos
  Play with our demos

- mapd.cloud
  Get a MapD instance in less than 60 seconds

- mapd.com/platform/download-community/
  Download the Community Edition

- community.mapd.com
  Ask questions and share your experiences
Thank you!
Any questions?