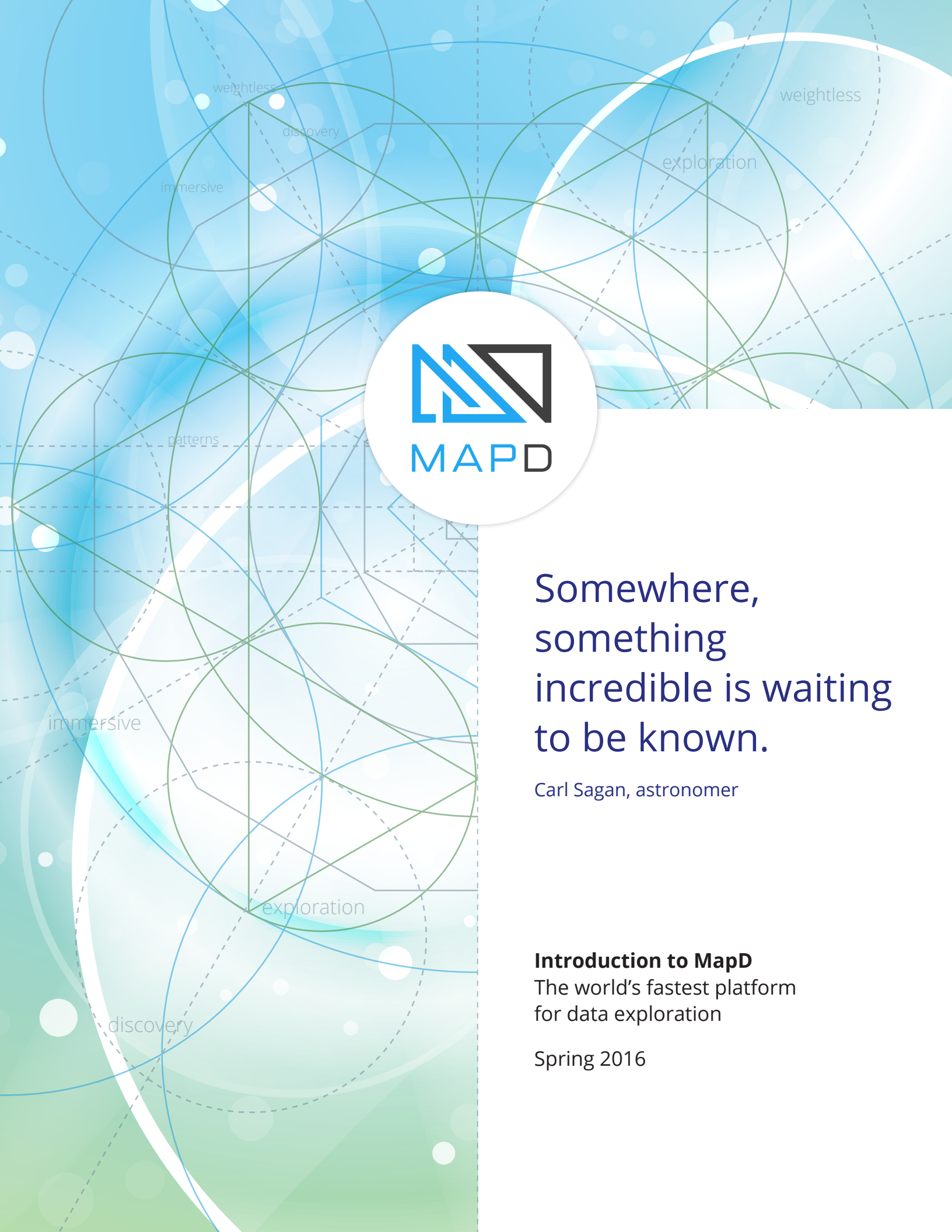

Somewhere, something incredible is waiting to be known.

Carl Sagan, astronomer

Introduction to MapD
The world's fastest platform for data exploration

Spring 2016

What could you do if your data was 100x faster?

As technology advancement creates an explosion of human data—millions of tweets, hours of video, conversions, and patterns every day—a new universe is emerging. Software limitations have left data scientists stuck on the shore of this new "data ocean"—only able to provide a coarse view even with clusters of hundreds of servers.

MapD's breakthrough system is changing this, enabling data queries up to 1,000x faster than anything previously developed. By leveraging the parallel power of modern Graphics Processing Units (GPUs) MapD offers an immersive, lag-free experience for analysts to explore large datasets interactively and in real-time.

With MapD, it is possible to query and visualize billions of records in tens of milliseconds. This enables the creation of hyper-interactive dashboards in which dozens of attributes can be correlated and cross-filtered without lag. Using MapD, analysts can query data at rates approaching three terabytes per second on a single server.

MapD delivers the world's fastest data exploration on a single server by harnessing the massive parallelism of GPUs. Originally designed to render video games, GPUs have evolved into general purpose computational engines that excel at performing tasks in parallel. Buttressed by high-speed memory, GPUs can perform thousands of calculations simultaneously, making them an excellent fit for data queries. The GPUs' prodigious compute capabilities also allow them to excel at many machine learning algorithms, while the graphics pipeline of the cards means they can be used for rendering large datasets in milliseconds.

This white paper begins with an overview of MapD and the key reasons for MapD's extraordinary performance. It then highlights the paradigm shift MapD's solution is enabling in today's data analytics and visualization space. The paper proceeds to overview how early commercial pilots, with diverse big data needs, are utilizing MapD's platform and outlines next steps for interested data explorers.

Founded in 2013
Based in San Francisco, CA

Index

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or follow us on

"The power of imagination makes us infinite."

John Muir, naturalist

Mission: Immersive data exploration

MapD was founded by scientists, engineers, and data analysts on a mission to make data exploration an immersive experience. CEO Todd Mostak first developed a prototype of MapD while waiting hours and sometimes days for a single query to process patterns in hundreds of millions of tweets for his Harvard thesis on the Arab Spring. Frustrated that he couldn't access a cluster of servers to perform his computations, he created his own solution by pairing off-the-shelf video game GPU cards with a new design for parallel databases. Todd pursued this technology as a researcher at MIT's Computer Science and Arti icial Intelligence Laboratory (CSAIL) before launching MapD in 2013.

MapD is backed by Vanedge Capital, NVIDIA, Google Ventures and Verizon Ventures. The company was awarded the $100,000 grand prize as winner of the 2014 GPU Technology Conference's Early Stage Challenge and counts a select group of Fortune 100 companies and academic research organizations as early customers.

MapD's focus is to not just make queries faster, but allow immersive and instantaneous data exploration that removes any disconnect between analyst and data. Immediate, comprehensive data visualizations spur the analyst's process of deduction, allowing for hypotheses to be generated, tested and refined in real-time.

Read more about MapD's story in VentureBeat

"Anyone can build a fast CPU The trick is to build a fast system."

Seymour Cray, inventor

Putting supercomputing into context

Organizations are finding themselves awash with bigger and bigger datasets with greater need to extract actionable insight from them in real time. While hardware has become significantly faster over the last several years, data analytics tools have not kept up. The status quo solution has been to compensate for lack of software performance with more hardware, running clusters of hundreds of servers to query datasets not even a terabyte in size.

Away from the mainstream, the 50-year history of supercomputers is full of massive, warehouse-sized machines only accessible to the most elite scientists and researchers. Only a few hundred supercomputers are in operation in the U.S. today, being used for work on nuclear weaponry, weather modeling, and astrophysics at high-security facilities such as Lawrence Livermore National Laboratory and Argonne National Laboratory.

More recently, there has been migration away from supercomputers toward large clusters of commodity servers, particularly for data analytics. While these clusters are typically less expensive and exotic than traditional supercomputers, they still require significant amounts of rack space, electricity, and trained technicians and continue to exhibit latencies that prevent true interactivity.

Whether by using traditional supercomputers or massive Hadoop clusters, big compute resources have enabled organizations to extract valuable and actionable insight from their data. However, many companies cannot afford the hardware, rack space, and personnel required to host such systems, and for those that can, the costs are tremendous. While the advent of cloud computing lessens the barrier to entry to obtaining heavy compute resources, oftentimes datasets must remain behind the company's firewall due to privacy issues or to protect a competitive advantage embodied in the data.

In short, it is still difficult for organizations to marshall the necessary computing resources to extract the insight hidden in their data. What if the work of racks of computers could be done by a single box, deployable by large and small organizations alike?

MapD's name is an acronym for "Massively Parallel Database."

Lightning fast data visualization and a pioneering SQL database

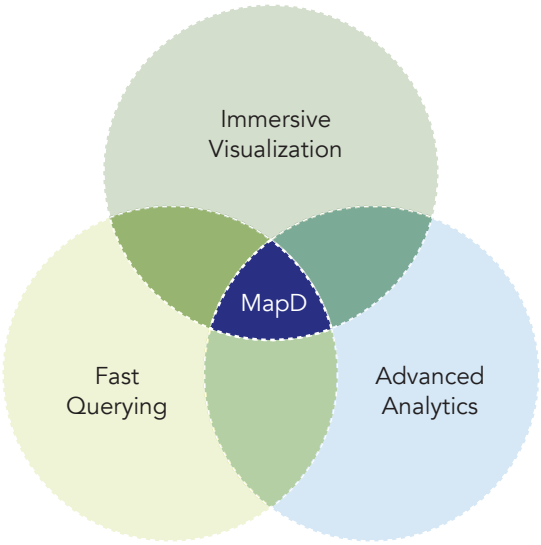
MapD packages two primary capabilities: the MapD analytical database and the MapD Immerse visualization platform.

The MapD database is designed to run in headless server environments and supports multiple GPUs (up to 16 per server), allowing for analysis of multi-billion-row datasets by multiple simultaneous users. The database supports SQL and can be queried in the console, via bindings to major programming languages, or via ODBC.

The database currently runs on a single node, with multi-node capability planned for the near future. A server with 8 Nvidia K80 cards, with a total of 192GB of GPU RAM, can typically handle a dataset of 1 - 3TB in raw size within GPU RAM. Larger datasets of 10 - 15TB can be handled in CPU RAM at still-impressive speeds.

MapD's Immerse visualization client uniquely leverages the power of the MapD database to provide both complex data visualizations (such as detailed GIS representations, scatterplots, data animations, and more) and standard reporting charts (such as line, bar, and pie charts, among others) in-browser. Complex, data-rich visualizations and simpler charts can be placed alongside one another within a single dashboard, providing multi-dimensional insights into large datasets. Simpler charts are rendered in the web browser, while complex renderings of large datasets are fetched from the MapD backend, where they can be generated in milliseconds.

The MapD Immerse frontend is built around the cross-filter model, where applying a filter to one data attribute in the dashboard applies it all other attributes as well, allowing for easy drill-down and correlation analysis. The frontend also allows for easy export of subsets of the data in CSV form for import into other software packages like R or Excel. Combined with the unparalleled speed of the MapD database, MapD Immerse's crossfilter paradigm revolutionizes the process of interactive data exploration and decision-making on big datasets.



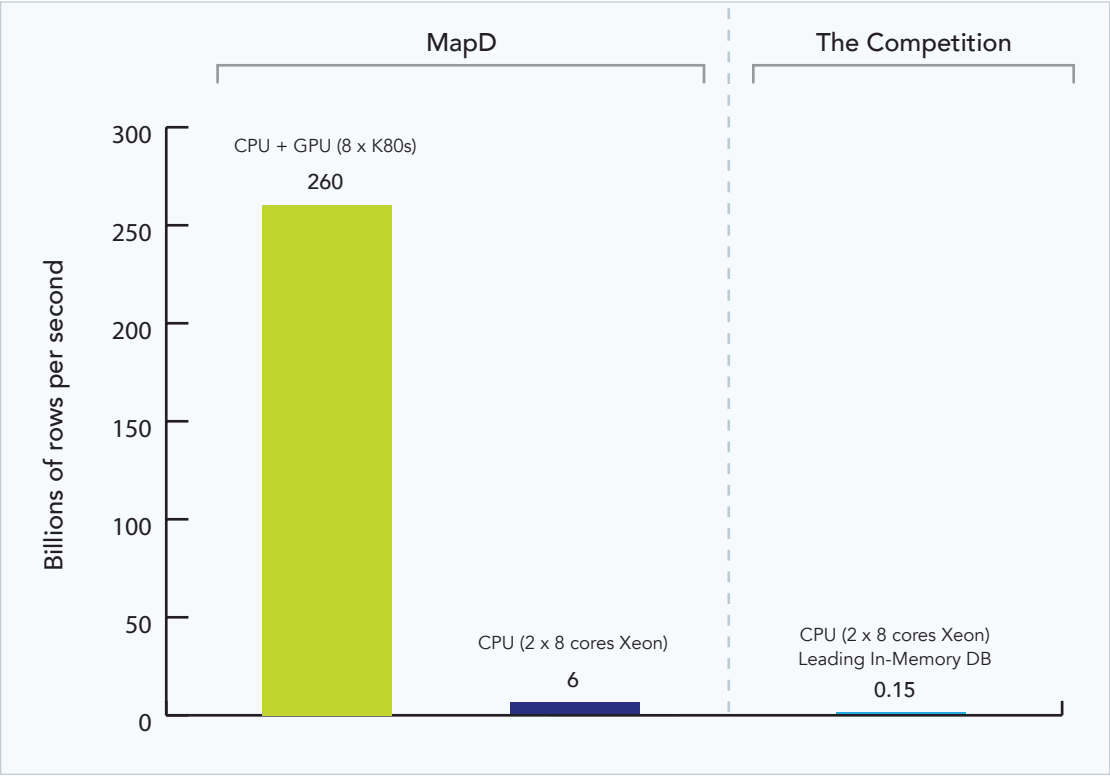
MapD's technology framework

MapD is a data analytics and visualization platform that leverages the massive parallelism and memory bandwidth of GPUs to execute queries up to 1,000x faster than competing solutions. The unprecedented speed of the system allows for lag-free interactive exploration of multi-billion-row datasets by many simultaneous users, allowing analysts to generate and test hypotheses unencumbered by the latency associated with CPU-only platforms. MapD takes advantage of the three distinguishing traits of GPUs: their computational parallelism, their high-speed memory, and their graphics pipeline to form an end-to-end system that allows for high-speed querying, analytics, and visualization on big datasets.

While GPU performance and memory capacity are still rapidly increasing, in the current generation, up to eight GPU cards with 192GB total GPU memory can be installed in a single server, allowing data to be queried at rates approaching three terabytes per second by almost 40,000 cores. Furthermore, using the sophisticated graphics pipeline on each GPU, the data can be visualized *in situ* and sent to the client without the need for costly transfers to other platforms.

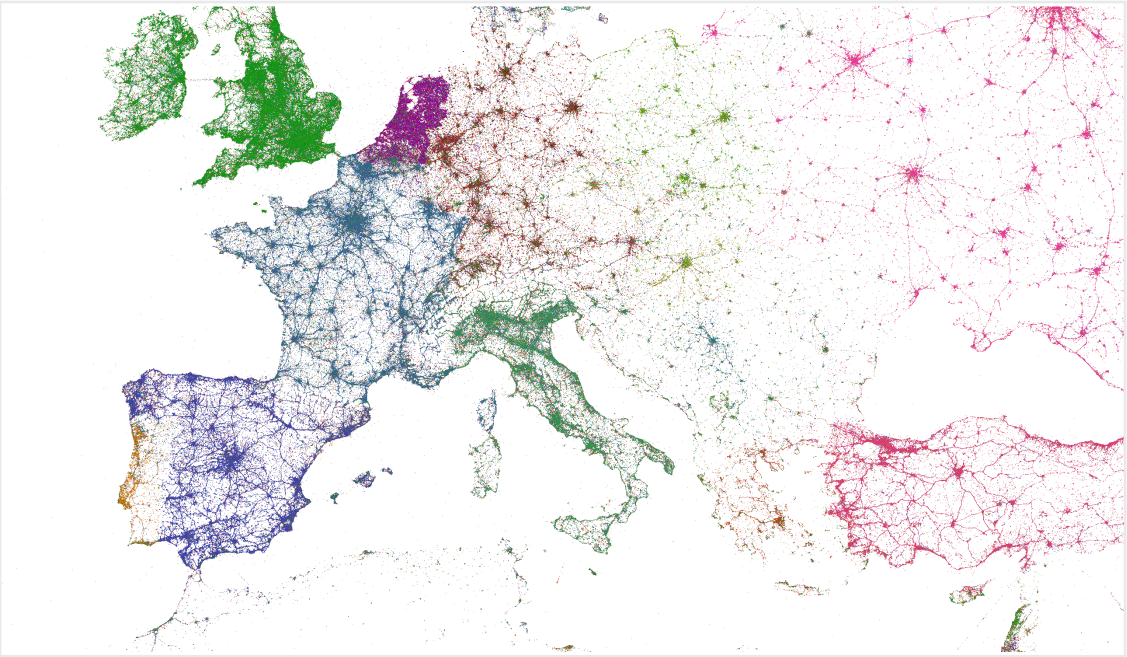
Although MapD was designed to deliver lag-free data exploration straight to the browser, it is equally capable of processing programmatic SQL queries with blistering speed (at a rate over a trillion rows per second per server for certain workloads).

MapD performance compared to leading in-memory database on 2-socket, 8-GPU system



The MapD supercomputing platform uniquely:

- Caches the hot data in GPU memory such that no time is lost moving the data across the PCIe bus onto the GPU when a query is executed.
- Compiles queries on the fly for maximum execution speed using the LLVM framework.
- Vectorizes execution of queries whenever possible. Vectorized code allows the compute resources of a processor to process multiple data items simultaneously. This is a must to achieve good performance on GPUs, which can comprise thousands of execution units. Additionally, optimizing vectorized execution also translates well to CPUs, which increasingly have "wide" execution units capable of processing multiple data items at once.
- Employs highly-optimized kernels for common database operations. Although GPUs are extremely fast, GPU code often requires more optimization work than comparable CPU code to achieve the best performance. MapD is the product of thousands of hours of benchmarking and testing to extract the maximum vectorized performance from both GPU and CPU.
- Executes queries simultaneously on both CPU and GPU, or entirely on CPU if the working dataset cannot fit in GPU memory.
- Visualizes and performs complicated analytics on data *in situ*. Since the relevant data is already cached on the GPUs, MapD does not need to copy the query result set before rendering it (using the GPUs) or using it as input to a follow-on machine learning algorithm.
- Leverages the GPU's native graphics pipeline to render the results of SQL queries. This means even visualizations of millions of data points can be generated in milliseconds and only an image rather than the much larger underlying data needs to be sent to the browser.
- Offers connectivity via JDBC/ODBC as well as Thrift for maximum compatibility with existing infrastructure.



A MapD-rendered visualization of 500 million tweets in Europe colored by language used

"Exploration is the engine that drives innovation. Innovation drives economic growth."

Edith Widder, oceanographer

Case studies

Speed of understanding is one of the most significant business advantages available in today's market. The ability to see patterns and optimize for them has become a requirement for any large-scale operation. Early pilots of MapD's data supercomputing system have explored commercial applications for the technology with some of the largest companies in the world. Business names not disclosed under pilot agreement terms:

Finding patterns in social advertising
A social network with $12 billion in annual advertising revenue launched a pilot with MapD to explore real-time effectiveness of ads across different demographics and geographic regions. MapD's built-in text mining features enable the network's analysts to quickly determine key brand associations for their top accounts. Marketers at the organization are exploring terabytes of data across many simultaneous dimensions without lag. This knowledge allows the company to grow revenue by demonstrating complex conversion lift performance across mobile and web to advertising clients.

Troubleshooting telecom issues in real time
MapD is being tested for real-time analysis on streaming call records and server logs with one of the largest telecommunications companies in the U.S. The company's analysts use MapD to visually correlate call records with server performance data to determine in real time how network traffic is affecting load on the company's servers. They are able to instantly drill down to an individual cell tower, quickly determining if there are any malfunctions or if a device update for a particular handset is causing abnormal load on the network. Faster identification of issues helps the company reduce customer outages and more efficiently deploy technicians.

Finding hyper-regional fashion trends
A team of hundreds of analysts at a Fortune 500 apparel company are using MapD to interactively analyze historical sales transaction records to assess product demand and to help determine future inventory needs. With MapD's platform, they can query several billions of data rows in milliseconds, a significant improvement over the several minutes required by their previous OLAP tools. The company has used MapD's lightning-fast query processing and visualization capabilities to discover store-level fashion preferences and optimize their shipments with new efficiency.

Conclusion

MapD combines hyper-optimized software with the fastest available hardware to create the world's fastest solution for data exploration and analytics, up to 1,000x faster than existing solutions. Such improvements yield unprecedented performance within a smaller cost, space, and energy footprint, and represent a paradigm shift in analysts' ability to rapidly derive insights from their data.

Experience the new paradigm in data exploration for yourself.

Find patterns in a half-billion tweets over a three-year period with MapD's live demo.

Contact us to learn more about MapD as a solution for your business, at sales@mapd.com.

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or follow us on