



## **NetApp-Pittsburgh Capstone Project Fall 2022**

### **Database Performance Optimizations Using SQLite**

#### **Project Background**

[ONTAP®](#) is NetApp's proprietary operating system powering a wide variety of hardware- and software-based data storage and retrieval systems, including storage disk arrays and cloud-hosted storage offerings. It helps users to create a storage infrastructure that reduces cost, accelerates critical workloads, and secures data. With countless operations going on in such systems every second, a high-functioning scalable database engine can have a massive impact on the system enabling higher scalability and faster data access speeds.

[SQLite](#) is a widely used open-source software library that provides a relational database management system with full SQL support. It is feature-rich and highly configurable at compile and runtime. Using a series of optimization approaches interacting with SQLite, it is possible to realize significant savings using system resources and/or improve transaction performance. Undertaking database performance improvements can help us identify bottlenecks in the current design and enable the system to handle ever-increasing workloads.

For this Capstone project, NetApp is looking to explore the efficiencies and the optimizations of using SQLite to further improve the performance of ONTAP® and provide a better user experience for our customers.

#### **Project Summary**

In this project, students will work on developing and testing various SQLite performance improvements. They will work on analyzing the results of the changes to see which improvements lead to more performant database operations. The creative student team can propose additional features and improvements to implement and test in collaboration with the NetApp engineering lead.

#### **Project Goals**

- Implement and run performance tests to analyze the impact of different changes in the use of SQLite as well as changes to SQLite library source code.
- Present the results to NetApp engineers along with recommendations on which improvements to keep.
- Stretch goal – Test additional improvements based on team's investigation and findings.

## **Project Details**

Over the course of this Capstone project, students will utilize several programming languages and concepts, including:

- Coding in C/C++ to interact with SQLite library.
- Making changes to open-source software projects.
- Learning and enacting modern testing methodologies and practices.
- Working with a large<sup>1</sup> relational database to run the performance testing on.
- Using Agile development.

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<sup>1</sup> The database is less than a Gigabyte large, but the results you find will help us optimize databases of 100+ Terabytes



## About NetApp

NetApp is the Data Authority in the Hybrid Cloud. Throughout the world, leading organizations count on NetApp for software, systems, and services to manage and store their data. We help enterprises and service providers envision, deploy, and evolve their IT (Information Technology) environments. Customers also benefit from our open collaboration with other technology leaders to create the specific solutions they need.

Our team is passionate about customer success. Our company culture and work environment support that dedication. Together with our global network of partners, we are united in one goal: to help our customers achieve the outcomes that matter most to them. To learn more, visit [www.netapp.com](http://www.netapp.com).

The project is driven by the Scale Out Storage team which provides the [file system infrastructure](#) within the kernel to achieve high performing, scalable containers that are a key component of the NetApp Data Fabric architecture.

## NetApp At-A-Glance

- \$6.2B+ in revenue
- Over 10,000 employees in more than 150 offices worldwide
- Great Place to Work Institute's "World's Best Multinational Workplaces" list
- Great Place to Work Institute's "Best Companies to Work for in APAC" list
- Great Place to Work Institute's "Best Companies to Work for in Europe" list
- FORTUNE Magazine's "100 Best Companies" list
- A FORTUNE 500® Company
- Member of S&P 500 and NASDAQ
- Stock symbol: NTAP
- Close partnerships with global industry leaders

"We believe that the strongest and most creative product teams have the best talent, are unified in spirit, and diverse in thought and background representing the customers and communities that we serve." — George Kurian, NetApp CEO