Citadel Securities and Google Cloud Announce High-Performance Computing Study with Harvard University to Advance Heart Disease Research

Harvard Professor Petros Koumoutsakos Leads Study to Replicate Supercomputer Resources in Public Cloud

MIAMI and SUNNYVALE, Calif. and CAMBRIDGE, Mass., Aug. 16, 2023 /PRNewswire/ -- Citadel Securities and Google Cloud today announced joint sponsorship of a cutting-edge medical research program at Harvard University demonstrating the validity of a novel, minimally invasive approach to unclogging arteries via a large-scale simulation powered by the public cloud. By leveraging high performance computing (HPC) running on cloud infrastructure, Harvard researchers will be able to solve some of the world's most complex calculations and advance heart disease research.

Research lead Prof. Petros Koumoutsakos, of the Harvard John A. Paulson School of Engineering and Applied Sciences (SEAS), pioneered the concept of creating digital twins for therapeutic devices in circulatory diseases. Citadel Securities and Google Cloud are jointly funding and bringing top technical talent and technology together to demonstrate the power of scaled complex simulations for medical research.

Prof. Koumoutsakos' research is focused on the efficacy and usability of magnetically controlled artificial bacterial flagella (ABF) to attack and dissolve blood clots and circulating tumor cells in human vasculatures. Creating digital twins to simulate the effects of this innovative therapeutic approach requires a geometrically accurate representation of complex blood vessels, realistic blood flow/structure interaction, and active control of the ABFs. The complexity of these simulations and the amount of data they involve demands access to enormous amounts of HPC power as well as significant technical expertise—two major benefits that Citadel Securities and Google Cloud are providing to the program.

"Today, the level of computing power required to run simulations of this complexity and at this scale is available from only a small handful of supercomputers around the world," said Prof. Koumoutsakos. "With the support of Citadel Securities and Google Cloud, we aim to demonstrate that public cloud resources can be harnessed to handle large-scale, high-fidelity simulations for medical applications. In doing so, we hope to show that easy access to publicly available cloud computing resources can significantly reduce time to solution, improve testing capabilities, and reduce research costs for some of humanity's most pressing problems."

In initial tests, Prof. Koumoutsakos and his team, which also includes researchers fromETH Zurich, demonstrated the ability to leverage cloud resources to achieve 80 percent of the efficiency available in state-of-the-art, dedicated supercomputer facilities with extensively tuned code. Two types of codes have so far been deployed on both GPU- and CPU-based architectures: a state-of-the-art code that was a finalist for the Gordon Bell prize in 2015, and an open-source general commodity code (LAMMPS) for particle simulations.

"As a global team of technicians, statisticians, and quantitative problem solvers, Citadel Securities is uniquely positioned to support Prof. Koumoutsakos' visionary research," said Costas Bekas, Research Platform head at Citadel Securities. "Democratizing access to large-scale computing resources capable of running simulations of increasing complexity will unlock the vast potential of researchers and innovators across academia and medicine, and we are proud to be part of this important work."

"Google Cloud's high performance computing technologies and solutions are purpose-built to both simplify and scale the largest, most complex workloads, enabling researchers to dramatically accelerate time to discovery and impact," said Bill Magro, Chief Technologist, HPC at Google Cloud. "We are proud to partner with Citadel Securities to bring our configurable and repeatable HPC capabilities to Harvard in the spirit of improving patients' lives and helping create a healthier world."

Harvard's Office of Technology Development and SEAS worked in close coordination with Citadel Securities and Google Cloud to establish the joint sponsored research agreement.

About Citadel Securities

Citadel Securities is a next-generation capital markets firm and a leading global market maker, providing institutional and retail investors with the liquidity they need to trade a broad array of equity and fixed-income products in any market condition. At Citadel Securities, the brightest minds in finance, science, and technology use powerful, advanced analytics to solve the market's most critical challenges, turn big ideas into real-world outcomes, and accelerate their careers. For more information, visit CitadelSecurities.com.

About Google Cloud

Google Cloud accelerates every organization's ability to digitally transform its business and industry. We deliver enterprise-grade solutions that leverage Google's cutting-edge technology, and tools that help developers build more sustainably. Customers in more than 200 countries and territories turn to Google Cloud as their trusted partner to enable growth and solve their most critical business problems.

About SEAS and Petros Koumoutsakos

Harvard John A. Paulson School of Engineering and Applied Sciences (SEAS) serves as the connector and integrator of Harvard's teaching and research efforts in engineering, applied sciences, and technology. Through collaboration with researchers from all parts of Harvard, other universities, and corporate and foundational partners, we bring discovery and innovation directly to bear on improving human life and society. For more information, visit seas.harvard.edu.

Petros Koumoutsakos is Herbert S. Winokur, Jr. Professor of Computing in Science and Engineering and Area Chair of Applied Mathematics at SEAS. He was the Chair of Computational Science at ETH Zurich (1997-2020), which also provided support for this project. He is recipient of the Advanced Investigator Award by the European Research Council, the ACM Gordon Bell prize in Supercomputing and more recently the PRACE HPC Excellence Award. He was elected International Member to the US National Academy of Engineering.

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