Success Story

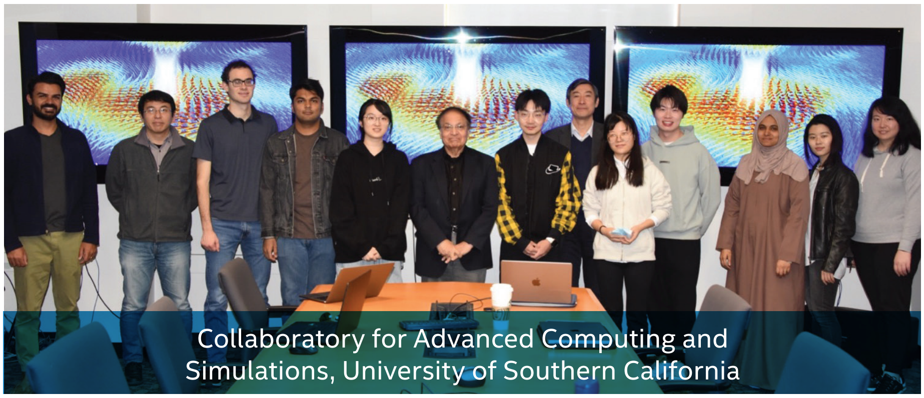
Intel® Academic Program for oneAPI

First-Generation Curriculum for Futuristic Computing

The University of Southern California (USC) is breaking new pedagogical ground for training students to solve emerging problems at the nexus of exascale computing, quantum computing and AI. Drs. Aiichiro Nakano, Ken-ichi Nomura, Rajiv Kalia and Priya Vashishta draw on their collaboration with Argonne National Laboratory and Intel as they develop curriculum for the next generation of cyber science experts.

Computer scientists and other researchers entering the field today have their choice of revolutions from which to choose. Exascale computers have arrived to push back boundaries in human-critical fields such as energy, climate science and genomics. The quantum machines that are moving closer to production will redefine many problem domains. Meanwhile, AI is transforming every aspect of science and engineering.

Not surprisingly, the pedagogical developments needed to prepare technical workforces for emerging paradigms tend to lag behind the technologies themselves. At USC, Professors Nakano, Nomura, Kalia and Vashishta at Collaboratory for Advanced Computing and Simulations (CACS) are working to close that gap in part through their collaborations with the U.S. Department of Energy (DOE) Argonne National Laboratory and the Intel® Academic Program for oneAPI.



Collaboratory for Advanced Computing and Simulations, University of Southern California

CACS is incorporating the Aurora supercomputer at Argonne and oneAPI programming models into new curriculum. The forthcoming Aurora can perform unprecedented two billion billion mathematical operations per second, on which open programming models such as SYCL will be used for unified central processing unit (CPU) and graphics processing unit (GPU) programming. The three-way relationship between USC, DOE and Intel helps strengthen the intellectual and technological connections between academia, industry and public research by co-developing challenging science applications and computing technologies. The shared benefit advances technologies and helps prepare the next-generation cyber workforce.

Large-Scale Problems in Computational Materials Science

CACS focuses on quantum materials science research, which requires massive computation that draws on combinations of exascale supercomputers, quantum computers and AI. A DOE award under the Aurora Early Science Program (ESP) makes CACS one of just a few initial simulation users of the two-exaflop Aurora supercomputer. The ESP brings together research interests from many quarters, including the initial contact between the USC team and the Intel Academic Program for oneAPI. These interactions help build connections that advance shared interests.

One of the world's first exascale supercomputers, Aurora will be capable of more than two exaflops, which is two billion billion operations per second. Programming across Aurora's complex and diverse set of hardware elements presents challenges to models developed for single hardware architectures. Intel Academic Program for oneAPI is helping deliver programmability to the ecosystem for these massive, heterogeneous resources using oneAPI. This approach provides a single interface to code across CPUs and GPUs.

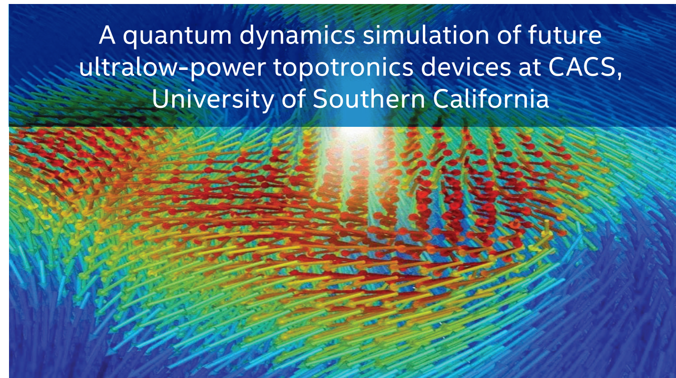
"We were exposed to oneAPI through our Aurora ESP project. Bringing the exciting development at the frontier of computing like Aurora to classrooms is a wonderful way to motivate students and help their future careers."

– Professor Aiichiro Nakano, USC

Dr. Nakano summarizes, "Just as mathematics has been the common language of all science, computing is the common language of the frontier of science that deals with complexity, algorithmic thinking, and computer-human symbiosis." USC advances that vision with a unique dual-degree program, where students in science and engineering PhD programs can concurrently earn MS degrees in computer science. Dr. Nakano teaches classes for a MSCS specialization in HPC and Simulations (HPCS) within that dual program.

Next-Generation Pedagogy for Novel Computing Technologies

CACS is dedicated to bringing student engagement into cutting-edge approaches to exascale, quantum and AI technologies. Under the auspices of a National Science Foundation (NSF) award, "Cyber Training on Materials Genome Innovation for Computational Software (CyberMAGICS)," the team is developing innovative curriculum that applies informatics to design new materials more rapidly.


A quantum dynamics simulation of future ultralow-power topotronics devices at CACS, University of Southern California

oneAPI: Programming for the New Era of Heterogeneous Computing

Hardware accelerators are critical for maximizing throughput and energy efficiency while driving down workload latency and cost on commercial-off-the-shelf (COTS) servers. Developers have used performance engines such as GPUs and FPGAs to supplement the CPU for years, although proprietary programming models such as CUDA have limited the reach of those efforts.

oneAPI changes all that, with a single, open model for code that can execute on CPU cores as well as various hardware accelerators. Intel oneAPI toolkits provide best-in-class compilers, performance libraries, frameworks and analysis and debug tools, so developers can code once and run anywhere, from the largest supercomputers to compute nodes on the distributed edge.

The curriculum approach integrates oneAPI as a programming model for large-scale heterogeneous systems, which is instrumental to realizing the potential of next-generation systems. It is based on training modules that use Jupyter notebooks and tutorials, integrated into a novel, open-source quantum materials simulator named AIQ-XMaS (AI and quantum-computing-enabled exascale materials simulator). The modules are being piloted at classrooms at USC and Howard University, one of the largest historically black colleges and universities, in collaboration with Drs. Pratibha Dev and Tao Wei at Howard.

Teaching kits provided by the Intel Academic Program for oneAPI have been a significant resource for the CyberMAGICS program as well as to students in the HPCS courses. Likewise, Intel® Developer Cloud provides all students a free-to-use cloud environment to develop and showcase projects. CACS also draws Intel expertise into its course materials using books published by Intel engineers, including Data Parallel C++: Mastering DPC++ for Programming of Heterogeneous Systems using C++ and SYCL. The work of the CACS team continues to advance research and education on scalable scientific algorithms, high-end parallel computing, massive data visualization and analysis using AI and computational materials science.

Learn more: Intel Academic Program for oneAPI

Intel does not control or audit third-party data. You should consult other sources to evaluate accuracy.

Your costs and results may vary.

Intel technologies may require enabled hardware, software or service activation.

You may not use or facilitate the use of this document in connection with any infringement or other legal analysis concerning Intel products described herein. You agree to grant Intel a nonexclusive, royalty-free license to any patent claim thereafter drafted which includes subject matter disclosed herein.

The products described may contain design defects or errors known as errata which may cause the product to deviate from published specifications. Current characterized errata are available on request.

© Intel Corporation. Intel, the Intel logo and other Intel marks are trademarks of Intel Corporation or its subsidiaries. Other names and brands may be claimed as the property of others.

0423/OT/MESH/PDF 353911-001US