Creating
World Changing
Technologies

Accelerating the Possibilities with HPC

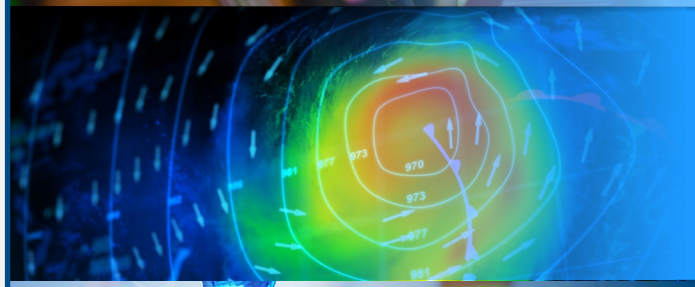
Trish Damkroger
Vice President and General Manager, High Performance Computing

intel.

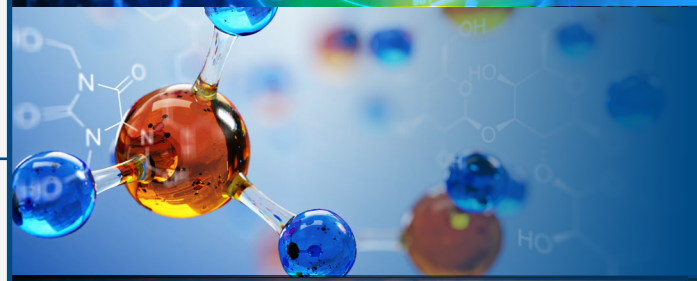
HPC is Evolving, Expanding and Everywhere

More use cases
+ More data
+ More users
= New requirements

Manufacturing

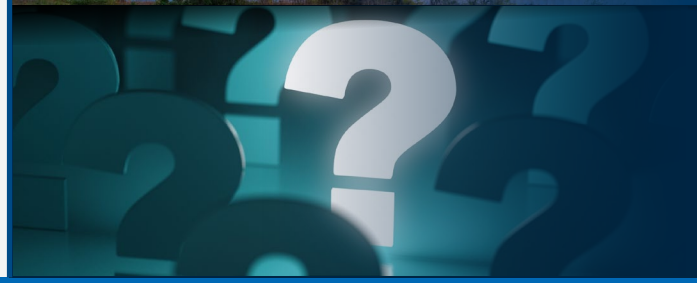


Weather Prediction



Chemical Sciences

Reservoir Simulation



Your Use Case Here

Intel® HPC Portfolio

intel. SELECT SOLUTIONS

oneAPI

XPU Architectures
Compute + Acceleration

Software Tools
oneAPI ▪ HPC & AI Analytics Toolkit

Memory
Optane™ Persistent Memory

Storage
▪ Optane ™ SSDs ▪ DAOS

Interconnect
▪ Ethernet ▪ Fabric support

Security
▪ Crypto Acceleration ▪ Intel® SGX

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Memory
Optane™ Persistent Memory

NEW

DAOS Commercial Support

Storage
▪ Optane ™ SSDs ▪ DAOS

NEW

High Performance Networking

Interconnect
▪ Ethernet ▪ Fabric support

Security
▪ Crypto Acceleration ▪ Intel® SGX

3rd Gen Intel® Xeon® Scalable processors

Up to **6TB**
System Memory Capacity
(Per Socket) DRAM + PMEM

Up to **8CH**
DDR4-3200
2 DPC (Per Socket)

Up to **40 Cores**
per processor

20%
IPC improvement
ISO Freq, ISO compiler

Advanced security solutions

- Intel Software Guard Extensions
- Intel Crypto Acceleration
- Intel Total Memory Encryption
- Intel Platform Firmware Resilience

53%
Increase for HPC workloads*

Scalable, flexible, customizable

- Intel Deep Learning Boost
- Intel Speed Select Technology
- Intel AVX-512
- oneAPI POWERED Optimized Software

*See [108] at www.intel.com/3gen-xeon-config. Results may vary. See backup for configuration details.

intel.

Competitive Leadership

3rd Gen Intel® Xeon® Scalable processor vs. AMD EPYC Milan
Superior performance at equal cores (32)

3rd gen Xeon vs EPYC Milan

Up to **23%**
Better performance across 12 leading HPC applications and benchmarks

Monte Carlo

Up to **105%**
better performance

RELION

Up to **68%**
better performance

LAMMPS

Up to **57%**
better performance

NAMD

Up to **62%**
better performance

Binomial Options

Up to **37%**
better performance

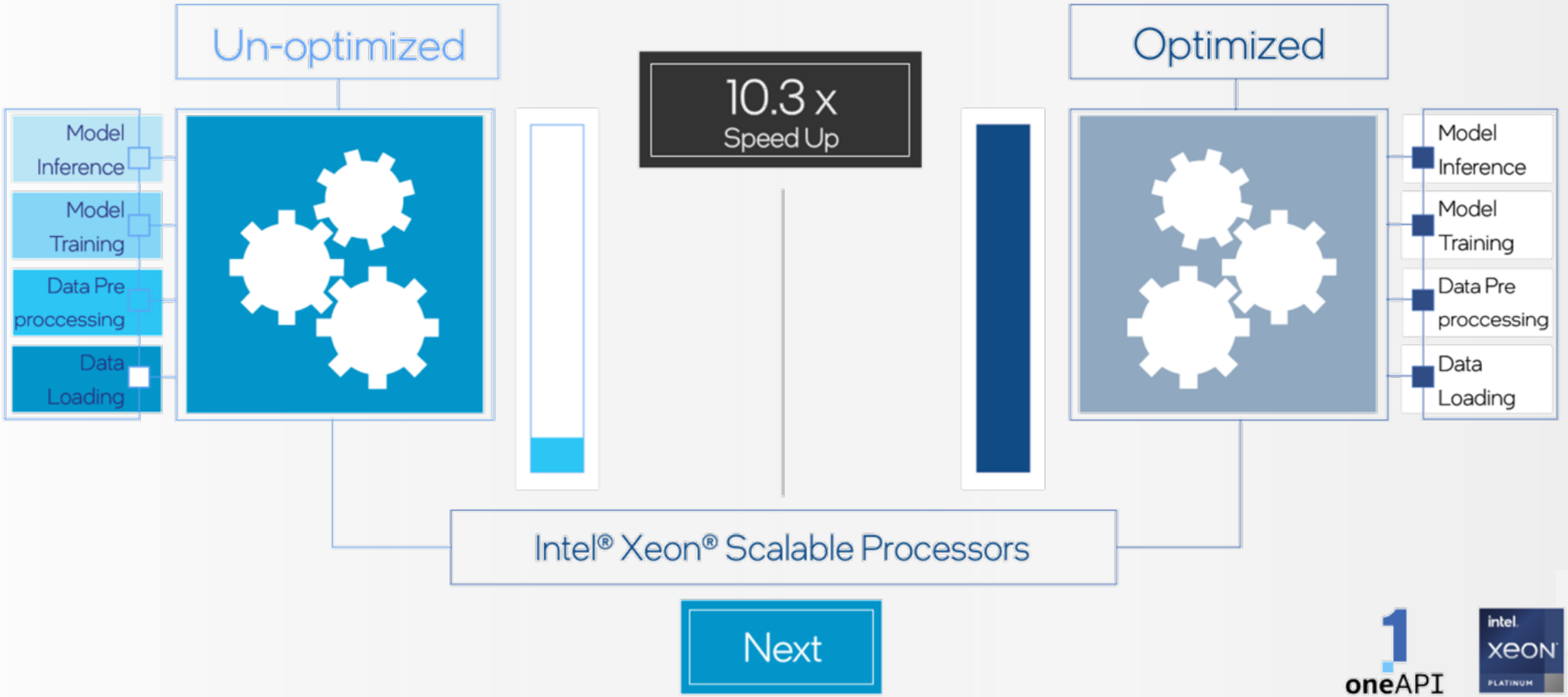
Mainstream SKUs: Intel Xeon 8358 vs EPYC Milan 7543

See backup for configuration details. Results may vary

intel.

Software Optimized Performance

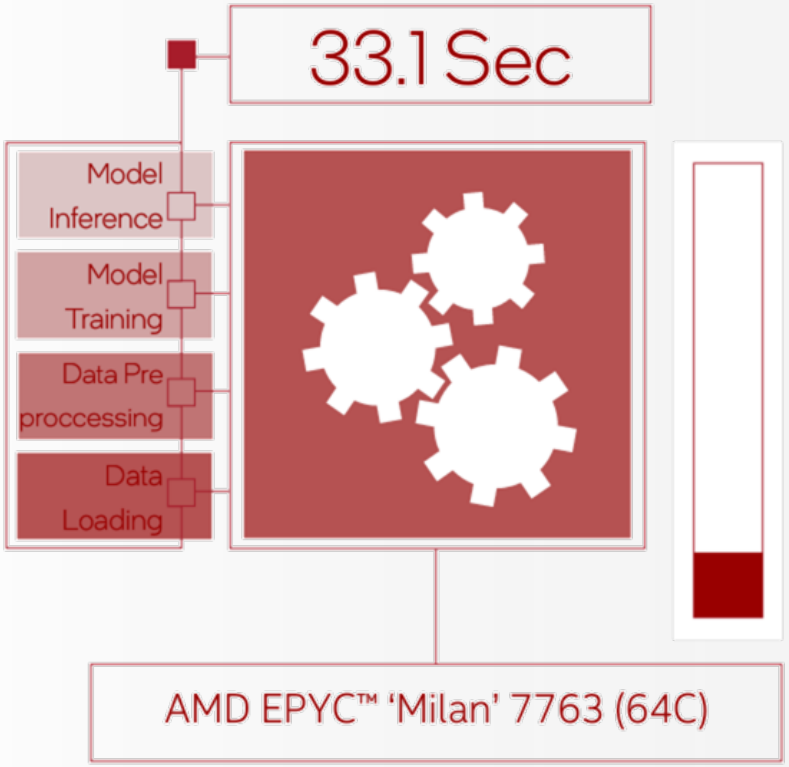
End-to-End Workload Optimization via oneAPI



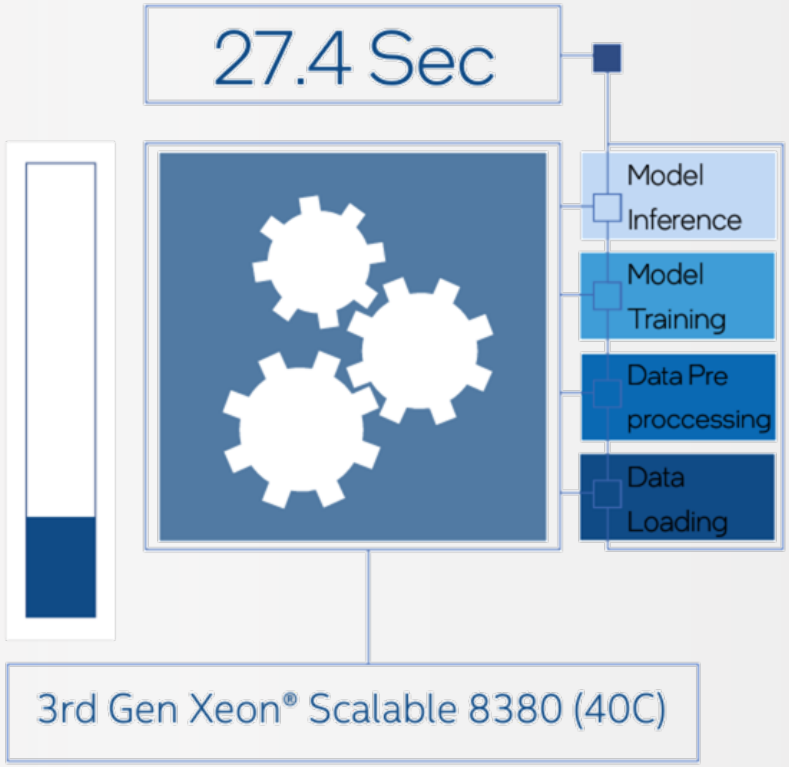
*Performance varies by use, configuration and other factors. See [52] at www.intel.com/3gen-xeon-config.

Leadership AI Performance

End-to-End Workload Optimization via oneAPI



20.7%
Speed Up



*Performance varies by use, configuration and other factors. See [56] at www.intel.com/3gen-xeon-config.

Welcoming Ice Lake customers and partners

3rd Gen Intel ® Xeon® Scalable processor momentum

ABCI
AI Bridging Cloud Infrastructure

ASML

CINECA

DELL Technologies

FLATIRON INSTITUTE
Division of Simons Foundation

KIT
Karlsruhe Institute of Technology

KMA

lrz Leibniz-Rechenzentrum
der Bayerischen Akademie der Wissenschaften

MPCDF
MAX PLANCK
COMPUTING & DATA FACILITY

Cybermedia Center
Osaka University

HIGH PERFORMANCE RESEARCH COMPUTING
TEXAS A&M UNIVERSITY

UNIVERSITY OF CAMBRIDGE

東京大学情報基盤センター
INFORMATION TECHNOLOGY CENTER, THE UNIVERSITY OF TOKYO

ALTAIR

Ansys

DELL Technologies

Hewlett Packard Enterprise

Google Cloud

ORACLE
Cloud Infrastructure

Lenovo

SUPERMICRO

Xe Architecture: Brought to Life

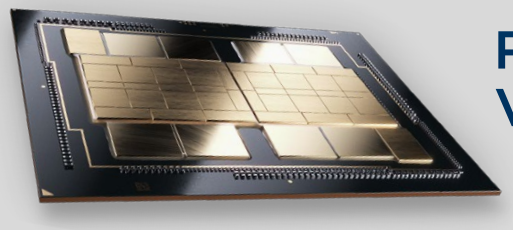
tera flops – peta ops

Xe HPC — Powered On & In Validation

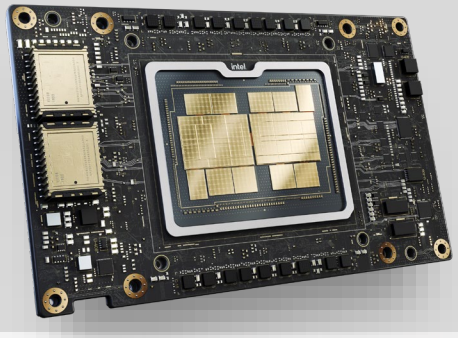
Xe HP — In Intel® DevCloud

Xe HPG — DG2 Sampling

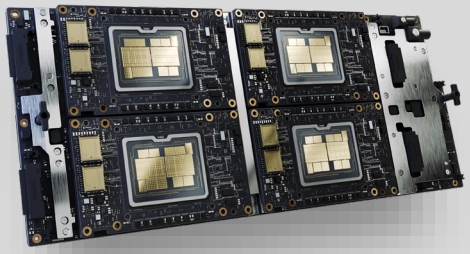
Xe LP
- Shipping — 11th Gen Core Processor
- Shipping — Iris Xe MAX
- Shipping — intel. SERVER GPU



Ponte Vecchio



OAM



x4 Sub-System

Freedom for Accelerated Compute

Break Free from the Constraints of Proprietary Programming Models

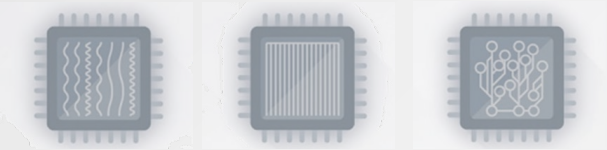
Freedom of Choice in Hardware

Multi-Vendor Adoption Momentum

- Codeplay brings SYCL support for NVIDIA GPUs
- Fujitsu Fugaku uses oneAPI oneDNN on Arm
- Huawei AI Chipset supported by Data Parallel C++
- NERSC, ALCF, Codeplay partner on SYCL for next gen Supercomputer

Realize All the Hardware Value on XPUs

Optimized Libraries, Compilers, AnalysisTools & Intel® DevCloud



CPU GPU FPGA

Confidently Develop Performant Code

Compatible with Existing Languages & Standards

Intel® oneAPI Toolkits for HPC, AI, Rendering…

oneAPI™

UNIVERSITY OF CAMBRIDGE
Research Computing Services

"We see Intel as a vital long-term partner at Cambridge, investing in our community through systems development, training, and access to new and emerging technologies.

[At] the Cambridge Open Exascale Lab... users can access our 10 petaflop system to develop code for Intel GPUs using oneAPI and get help optimizing applications for both CPUs and accelerators. They can also investigate into extreme scale storage systems like Intel DAOS and work with cutting-edge high-performance Ethernet fabrics."

Dr. Paul Calleja
Director of Research Computing Services
University of Cambridge

Leibniz-Rechenzentrum
der Bayerischen Akademie der Wissenschaften

"Intel is providing the blended environment we need, with next-generation Intel Xeon Scalable processors (Sapphire Rapids), with built-in acceleration for new HPC and AI workloads—plus Ponte Vecchio, Intel's upcoming GPU.

Since our users need to access data as quickly as possible, we'll be using Intel DAOS for fast, high bandwidth, low latency, and high IOPS storage, on a system with 3rd Gen Xeon processors and Optane persistent memory."

Prof. Dieter Kranzlmüller
Chairman of the Board of Directors of the Leibniz Supercomputing Centre (LRZ)

Intel® Xeon® Scalable Processor

The ONLY x86 Datacenter CPU with Built-in AI Acceleration

Intel® Advanced Vector Extensions 512
Intel® Deep Learning Boost
Intel® Optane™ persistent memory

Cascade Lake

14nm
New AI acceleration built-in
(Intel® DL Boost with VNNI)
New memory storage hierarchy

Ice Lake

10nm
New microarchitecture
Increased memory bandwidth

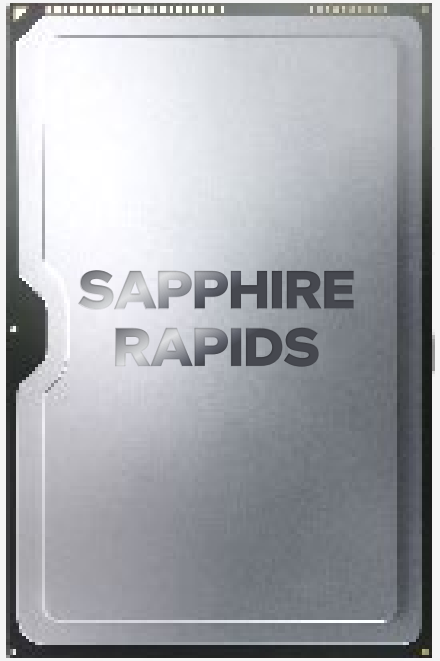
Sapphire Rapids

10nm Enhanced SuperFin
Next gen Intel® DL Boost
(Intel® Advanced Matrix Extensions)

Accelerating Innovation
from Edge to Cloud to Supercomputing

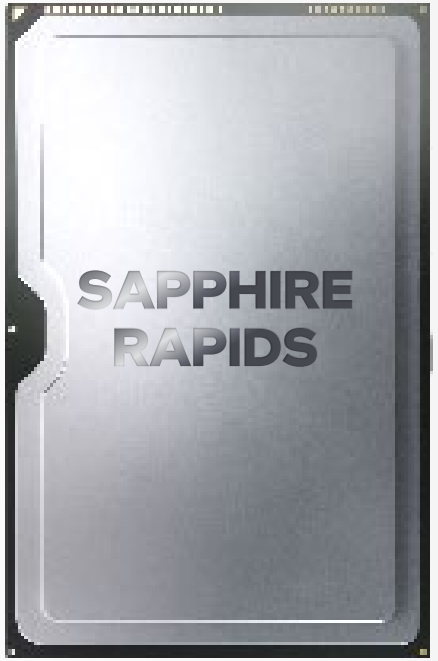
Next-Generation Intel Xeon Scalable Processors

Unique Capabilities Optimized for HPC and AI Acceleration



Next-Generation Intel Xeon Scalable Processors

Unique Capabilities Optimized for HPC and AI Acceleration

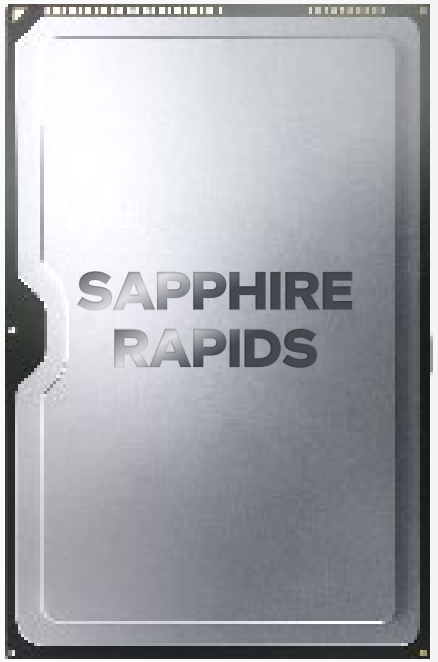


Breakthrough Technology

DDR5	PCIE 5	CXL 1.1
Increased Memory BW	High Throughput	Next-gen IO

Next-Generation Intel Xeon Scalable Processors

Unique Capabilities Optimized for HPC and AI Acceleration



Breakthrough Technology

DDR5
Increased Memory BW

PCIE 5
High Throughput

CXL 1.1
Next-gen IO

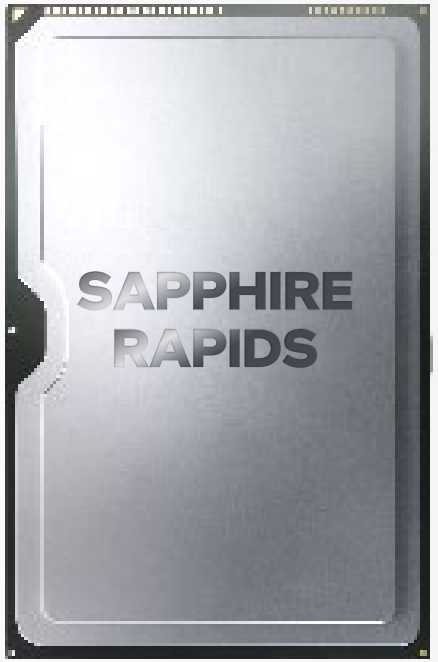
Built-In AI Acceleration

Intel® Advanced Matrix Extensions (AMX)

Increased Deep Learning Inference and Training Performance

Next-Generation Intel Xeon Scalable Processors

Unique Capabilities Optimized for HPC and AI Acceleration



Breakthrough Technology

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Increased Memory BW

PCIE 5
High Throughput

CXL 1.1
Next-gen IO

Built-In AI Acceleration

Intel® Advanced Matrix Extensions (AMX)

Increased Deep Learning Inference and Training Performance

Agility and Scalability

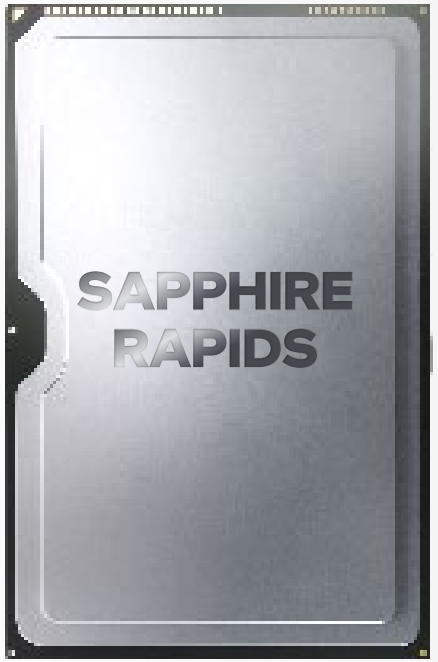
Hardware Enhanced Security

Intel® Speed Select Technology

Broad Software Optimization

Next-Generation Intel Xeon Scalable Processors

Unique Capabilities Optimized for HPC and AI Acceleration



Breakthrough Technology

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Increased Memory BW

PCIE 5
High Throughput

CXL 1.1
Next-gen IO

Built-In AI Acceleration

Intel® Advanced Matrix Extensions (AMX)

Increased Deep Learning Inference and Training Performance

Agility and Scalability

Hardware Enhanced Security

Intel® Speed Select Technology

Broad Software Optimization

NEW

High Bandwidth Memory

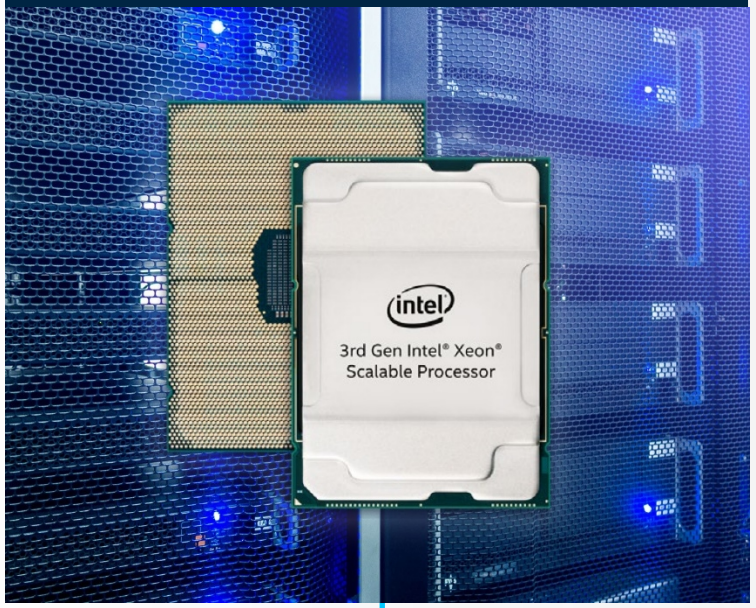
Significant performance increase for bandwidth-bound workloads

Accelerating HPC for the Future

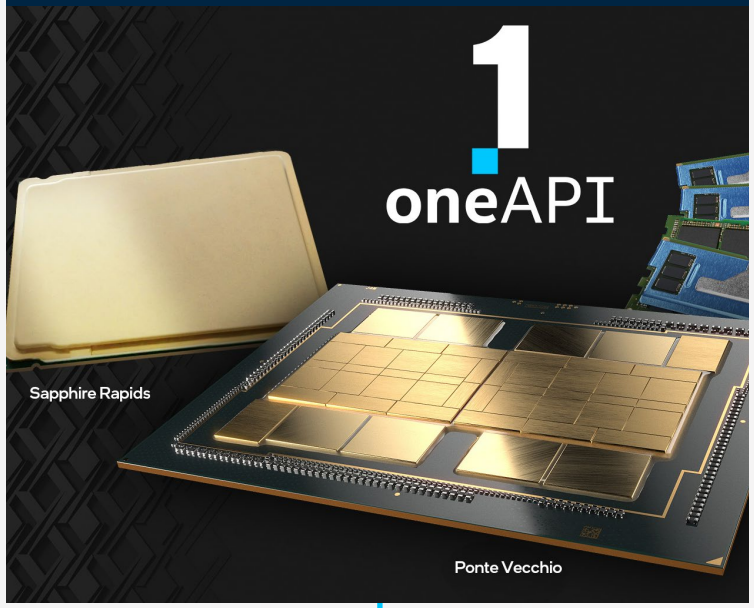
Intel Xeon processors remain the foundation of HPC & AI

Accelerating HPC for the Future

Intel Xeon processors remain the foundation of HPC & AI



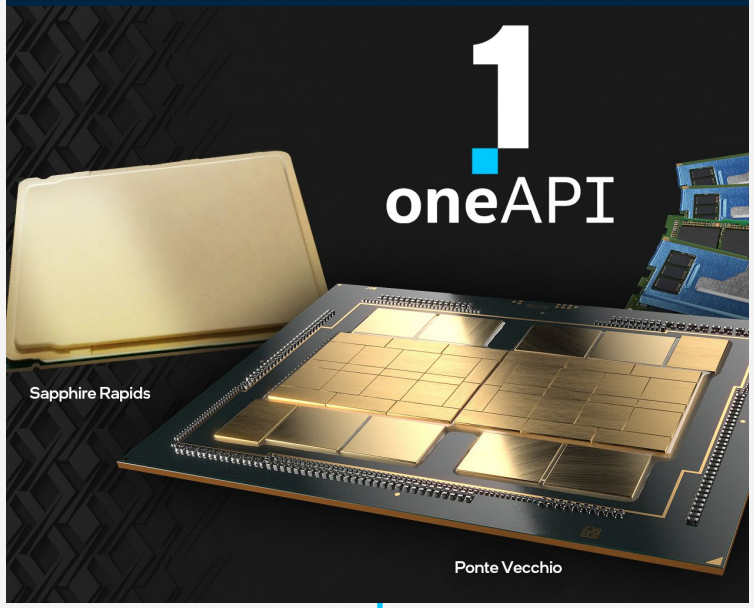
Intel delivers heterogeneous architectures for today's & tomorrow's challenges



Accelerating HPC for the Future

Intel Xeon processors remain the foundation of HPC & AI

Intel delivers heterogeneous architectures for today's & tomorrow's challenges



Intel's HPC portfolio has the flexibility to grow with changing customer demands

Intel @ ISC'21

Visit the Intel HPC+AI Pavilion @ www.hpcevents.intel.com

Fireside Chats

Purpose-Built AI Accelerators Deployment for High Performance Computing

HPC in the Cloud: Extending the Reach and Impact of HPC for Everyone

Standards Driven Heterogenous Programming with oneAPI

Cornelis Networks Omni-Path Express™ (OPX) Technology: Purpose Built, High Performance Fabrics in a Converged HPC/AI World

Intel and Google on Bringing DAOS to the Cloud

CXL Fireside Chat

Fireside Chat Intel System Server D50TNP for HPC

A Look Inside the Powerful HPC Partnership Between HPE and Intel and How the Joint Solutions Overcome Computing Challenges of Today's Digital World

Considerations for HPC and AI in the Cloud

Leadership in Uncertain Times: Observations & Learnings from Industry Leaders

Technical Talks

HPC Productivity Increase with Hybrid HPCaaS

XPU Support for the NAMD Molecular Dynamics Application with oneAPI

Migrating and Tuning a CUDA-Based Stencil Computation to DPC++

Utilizing the oneAPI Rendering Toolkit to Enhance Scientific Discovery

Ice Lake, Together with Mellanox Interconnect Solutions, Deliver Best in Class Performance for HPC Applications

Optimizing a Memory-Intensive Simulation Code for Heterogenous Optane Memory Systems

Intel Quantum Computing: An Example of Workload-Driven System Design

Best Practices in Selection of the Latest Intel Technologies for HPC-Enabled Simulations

Accelerating Derivative Valuations Using AI and AVX-512

Atos to Address Exascale Challenges by Leveraging oneAPI Industry Standard to Get Ready for Intel's Future GPUs and Next Gen Xeon Scalable Processors

A Partnership for Future HPC Technologies Exploration

Accelerate High Performance Computing on the Cloud

Configuration Details: Intel Xeon 8358 vs AMD EPYC 7543 (slide 1 of 2)

HPCG: Platinum 8358: 1-node, 2x Intel® Xeon® Platinum 8358 (32C/2.6GHz, 250W TDP) processor on Intel Software Development Platform with 256 GB (16 slots/ 16GB/ 3200) total DDR4 memory, ucode 0x261, HT on, Turbo on, CentOS Linux 8.3.2011, 4.18.0-240.1.1.el8_3.crt1.x86_64, 1x Intel_SSDSC2KG96, App Version: 2019u5 MKL; Build notes: Tools: Intel MKL 2020u4, Intel C Compiler 2020u4, Intel MPI 2019u8; threads/core: 1; Turbo: used; Build knobs: -O3 -ip -xCORE-AVX512. EPYC 7543: 1-node, 2-socket AMD EPYC 7543 (32C/2.8GHz, 240W cTDP) on Dell PowerEdge R7525 server with 1024 GB (16 slots/ 64GB/3200) total DDR4 memory, ucode 0xa001119, SMT on, Boost on, Power deterministic mode, NPS=4, Red Hat Enterprise Linux 8.3, 4.18, 2x Micron 5300 Pro, App Version: 2019u5 MKL; Build notes: Tools: Intel MKL 2020u4, Intel C Compiler 2020u4, Intel MPI 2019u8; threads/core: 1; Turbo: used; Build knobs: -O3 -ip -march=core-avx2, tested by Intel and results as of April 2021

HPL: Platinum 8358: 1-node, 2x Intel® Xeon® Platinum 8358 (32C/2.6GHz, 250W TDP) processor on Intel Software Development Platform with 256 GB (16 slots/ 16GB/ 3200) total DDR4 memory, ucode 0x261, HT on, Turbo on, CentOS Linux 8.3.2011, 4.18.0-240.1.1.el8_3.crt1.x86_64, 1x Intel_SSDSC2KG96, App Version: The Intel Distribution for LINPACK Benchmark; Build notes: Tools: Intel MPI 2019u7; threads/core: 1; Turbo: used; Build: build script from Intel Distribution for LINPACK package; 1 rank per NUMA node: 1 rank per socket, EPYC 7543: 1-node, 2-socket AMD EPYC 7543 (32C/2.8GHz, 240W cTDP) on Dell PowerEdge R7525 server with 1024 GB (16 slots/ 64GB/3200) total DDR4 memory, ucode 0xa001119, SMT on, Boost on, Power deterministic mode, NPS=4, Red Hat Enterprise Linux 8.3, 4.18, 2x Micron 5300 Pro, App Version: AMD official HPL 2.3 MT version with BLIS 2.1; Build notes: Tools: hpc-x 2.7.0; threads/core: 1; Turbo: used; Build: pre-built binary (gcc built) from https://developer.amd.com/amd-aocl/blas-library/; 1 rank per L3 cache, 4 threads per rank, tested by Intel and results as of April 2021

Stream Triad: Platinum 8358: 1-node, 2x Intel® Xeon® Platinum 8358 (32C/2.6GHz, 250W TDP) processor on Intel Software Development Platform with 256 GB (16 slots/ 16GB/ 3200) total DDR4 memory, ucode 0x261, HT on, Turbo on, CentOS Linux 8.3.2011, 4.18.0-240.1.1.el8_3.crt1.x86_64, 1x Intel_SSDSC2KG96, App Version: McCalpin_STREAM_OMP-version; Build notes: Tools: Intel C Compiler 2019u5; threads/core: 1; Turbo: used; BIOS settings: HT=on Turbo=On SNC=On. EPYC 7543: 1-node, 2-socket AMD EPYC 7543 (32C/2.8GHz, 240W cTDP) on Dell PowerEdge R7525 server with 1024 GB (16 slots/ 64GB/3200) total DDR4 memory, ucode 0xa001119, SMT on, Boost on, Power deterministic mode, NPS=4, Red Hat Enterprise Linux 8.3, 4.18, 2x Micron 5300 Pro, App Version: McCalpin_STREAM_OMP-version; Build notes: Tools: Intel C Compiler 2019u5; threads/core: 1; Turbo: used; BIOS settings: HT=on Turbo=On SNC=On, tested by Intel and results as of April 2021

WRF Geomean of Conus-12km, Conus-2.5km, NWSC-3 NA-3km: Platinum 8358: 1-node 2x Intel® Xeon® Platinum 8358 (32C/2.6GHz, 250W TDP) processor on Intel Software Development Platform with 256 GB (16 slots/ 16GB/ 3200) total DDR4 memory, ucode 0x261, HT on, Turbo on, CentOS Linux 8.3.2011, 4.18.0-240.1.1.el8_3.crt1.x86_64, 1x Intel_SSDSC2KG96, App Version: 4.2.2; Build notes: Intel Fortran Compiler 2020u4, Intel MPI 2020u4; threads/core: 1; Turbo: used; Build knobs:-ip -w -O3 -xCORE-AVX2 -vec-threshold0 -ftz -align array64byte -qno-opt-dynamic-align -fno-alias $(FORMAT_FREE) $(BYTESWAPIO) -fp-model fast=2 -fimf-use-svml=true -inline-max-size=12000 -inline-max-total-size=30000. EPYC 7763: 1-node, 2-socket AMD EPYC 7543: 1-node, 2-socket AMD EPYC 7543 (32C/2.8GHz, 240W cTDP) on Dell PowerEdge R7525 server with 1024 GB (16 slots/ 64GB/3200) total DDR4 memory, ucode 0xa001119, SMT on, Boost on, Power deterministic mode, NPS=4, Red Hat Enterprise Linux 8.3, 4.18, 2x Micron 5300 Pro, App Version: 4.2.2; Build notes: Intel Fortran Compiler 2020u4, Intel MPI 2020u4; threads/core: 1; Turbo: used; Build knobs: -ip -w -O3 -march=core-avx2 -ftz -align all -fno-alias $(FORMAT_FREE) $(BYTESWAPIO) -fp-model fast=2 -inline-max-size=12000 -inline-max-total-size=30000, tested by Intel and results as of April 2021

Binomial Options: Platinum 8358: 1-node, 2x Intel® Xeon® Platinum 8358 (32C/2.6GHz, 250W TDP) processor on Intel Software Development Platform with 256 GB (16 slots/ 16GB/ 3200) total DDR4 memory, ucode 0x261, HT on, Turbo on, CentOS Linux 8.3.2011, 4.18.0-240.1.1.el8_3.crt1.x86_64, 1x Intel_SSDSC2KG96, App Version: v1.0; Build notes: Tools: Intel C Compiler 2020u4, Intel Threading Building Blocks ; threads/core: 2; Turbo: used; Build knobs: -O3 -xCORE-AVX512 -qopt-zmm-usage=high -fimf-domain-exclusion=31 -fimf-accuracy-bits=11 -no-prec-div -no-prec-sqrt EPYC 7543: 1-node, 2-socket AMD EPYC 7543 (32C/2.8GHz, 240W cTDP) on Dell PowerEdge R7525 server with 1024 GB (16 slots/ 64GB/3200) total DDR4 memory, ucode 0xa001119, SMT on, Boost on, Power deterministic mode, NPS=4, Red Hat Enterprise Linux 8.3, 4.18, 2x Micron 5300 Pro, App Version: v1.0; Build notes: Tools: Intel C Compiler 2020u4, Intel Threading Building Blocks ; threads/core: 2; Turbo: used; Build knobs: -O3 -march=core-avx2 -fimf-domain-exclusion=31 -fimf-accuracy-bits=11 -no-prec-div -no-prec-sqrt, tested by Intel and results as of April 2021

Monte Carlo: Platinum 8358: 1-node, 2x Intel® Xeon® Platinum 8358 (32C/2.6GHz, 250W TDP) processor on Intel Software Development Platform with 256 GB (16 slots/ 16GB/ 3200) total DDR4 memory, ucode 0x261, HT on, Turbo on, CentOS Linux 8.3.2011, 4.18.0-240.1.1.el8_3.crt1.x86_64, 1x Intel_SSDSC2KG96, App Version: v1.1; Build notes: Tools: Intel MKL 2020u4, Intel C Compiler 2020u4, Intel Threading Building Blocks 2020u4; threads/core: 1; Turbo: used; Build knobs: -O3 -xCORE-AVX512 -qopt-zmm-usage=high -fimf-precision=low -fimf-domain-exclusion=31 -no-prec-div -no-prec-sqrt. EPYC 7543: 1-node, 2-socket AMD EPYC 7543 (32C/2.8GHz, 240W cTDP) on Dell PowerEdge R7525 server with 1024 GB (16 slots/ 64GB/3200) total DDR4 memory, ucode 0xa001119, SMT on, Boost on, Power deterministic mode, NPS=4, Red Hat Enterprise Linux 8.3, 4.18, 2x Micron 5300 Pro, App Version: v1.1; Build notes: Tools: Intel MKL 2020u4, Intel C Compiler 2020u4, Intel Threading Building Blocks 2020u4; threads/core: 2; Turbo: used; Build knobs: -O3 -march=core-avx2 -fimf-precision=low -fimf-domain-exclusion=31 -no-prec-div -no-prec-sqrt, tested by Intel and results as of April 2021

Configuration Details: Intel Xeon 8358 vs AMD EPYC 7543 (slide 2 of 2)

Ansys Fluent Geomean of aircraft_wing_14m, aircraft_wing_2m, combustor_12m, combustor_16m, combustor_71m, exhaust_system_33m, fluidized_bed_2m, ice_2m, landing_gear_15m, oil_rig_7m, pump_2m, rotor_3m, sedan_4m: Platinum 8358: 1-node, 2x Intel® Xeon® Platinum 8358 (32C/2.6GHz, 250W TDP) processor on Intel Software Development Platform with 256 GB (16 slots/ 16GB/ 3200) total DDR4 memory, ucode 0x261, HT on, Turbo on, CentOS Linux 8.3.2011, 4.18.0-240.1.1.el8_3.crt1.x86_64, 1x Intel_SSDSC2KG96, App Version: 2021 R1; Build notes: One thread per core; Multi-threading Enabled; Turbo Boost Enabled; Intel FORTRAN Compiler 19.5.0; Intel C/C++ Compiler 19.5.0; Intel Math Kernel Library 2020.0.0; Intel MPI Library 2019 Update 8, EPYC 7543: 1-node, 2-socket AMD EPYC 7543 (32C/2.8GHz, 240W cTDP) on Dell PowerEdge R7525 server with 1024 GB (16 slots/ 64GB/3200) total DDR4 memory, ucode 0xa001119, SMT on, Boost on, Power deterministic mode, NPS=4, Red Hat Enterprise Linux 8.3, 4.18, 2x Micron 5300 Pro, App Version: 2021 R1; Build notes: One thread per core; Multi-threading Enabled; Turbo Boost Enabled; Intel FORTRAN Compiler 19.5.0; Intel C/C++ Compiler 19.5.0; Intel Math Kernel Library 2020.0.0; Intel MPI Library 2019 Update 8, tested by Intel and results as of April 2021

Ansys LS-DYNA Geomean of car2car-120ms, ODB_10M-30ms: Platinum 8358: 1-node, 2x Intel® Xeon® Platinum 8358 (32C/2.6GHz, 250W TDP) processor on Intel Software Development Platform with 256 GB (16 slots/ 16GB/ 3200) total DDR4 memory, ucode 0x261, HT on, Turbo on, CentOS Linux 8.3.2011, 4.18.0-240.1.1.el8_3.crt1.x86_64, 1x Intel_SSDSC2KG96, App Version: R11; Build notes: Tools: Intel Compiler 2019u5 (AVX512), Intel MPI 2019u9; threads/core: 1; Turbo: used, EPYC 7543: 1-node, 2-socket AMD EPYC 7543 (32C/2.8GHz, 240W cTDP) on Dell PowerEdge R7525 server with 1024 GB (16 slots/ 64GB/3200) total DDR4 memory, ucode 0xa001119, SMT on, Boost on, Power deterministic mode, NPS=4, Red Hat Enterprise Linux 8.3, 4.18, 2x Micron 5300 Pro, App Version: R11; Build notes: Tools: Intel Compiler 2019u5 (AMDAVX2), Intel MPI 2019u9; threads/core: 1; Turbo: used, tested by Intel and results as of April 2021

OpenFOAM 42M_cell_motorbike: Platinum 8358: 1-node, 2x Intel® Xeon® Platinum 8358 (32C/2.6GHz, 250W TDP) processor on Intel Software Development Platform with 256 GB (16 slots/ 16GB/ 3200) total DDR4 memory, ucode 0x261, HT on, Turbo on, CentOS Linux 8.3.2011, 4.18.0-240.1.1.el8_3.crt1.x86_64, 1x Intel_SSDSC2KG96, App Version: v8; Build notes: Tools: Intel FORTRAN Compiler 2020u4, Intel C Compiler 2020u4, Intel MPI 2019u8; threads/core: 1; Turbo: used; Build knobs: -O3 -ip -xCORE-AVX512. EPYC 7543: 1-node, 2-socket AMD EPYC 7543 (32C/2.8GHz, 240W cTDP) on Dell PowerEdge R7525 server with 1024 GB (16 slots/ 64GB/3200) total DDR4 memory, ucode 0xa001119, SMT on, Boost on, Power deterministic mode, NPS=4, Red Hat Enterprise Linux 8.3, 4.18, 2x Micron 5300 Pro, App Version: v8; Build notes: Tools: Intel FORTRAN Compiler 2020u4, Intel C Compiler 2020u4, Intel MPI 2019u8; threads/core: 1; Turbo: used; Build knobs: -O3 -ip -march=core-avx2, tested by Intel and results as of April 2021

LAMMPS Geomean of Polyethylene, Stillinger-Weber, Tersoff, Water: Platinum 8358: 1-node, 2x Intel® Xeon® Platinum 8358 (32C/2.6GHz, 250W TDP) processor on Intel Software Development Platform with 256 GB (16 slots/ 16GB/ 3200) total DDR4 memory, ucode 0x261, HT on, Turbo on, CentOS Linux 8.3.2011, 4.18.0-240.1.1.el8_3.crt1.x86_64, 1x Intel_SSDSC2KG96, App Version: v2020-10-29; Build notes: Tools: Intel MKL 2020u4, Intel C Compiler 2020u4, Intel Threading Building Blocks 2020u4, Intel MPI 2019u8; threads/core: 2; Turbo: used; Build knobs: -O3 -ip -xCORE-AVX512 -qopt-zmm-usage=high. EPYC 7543: 1-node, 2-socket AMD EPYC 7543 (32C/2.8GHz, 240W cTDP) on Dell PowerEdge R7525 server with 1024 GB (16 slots/ 64GB/3200) total DDR4 memory, ucode 0xa001119, SMT on, Boost on, Power deterministic mode, NPS=4, Red Hat Enterprise Linux 8.3, 4.18, 2x Micron 5300 Pro, App Version: v2020-10-29; Build notes: Tools: Intel MKL 2020u4, Intel C Compiler 2020u4, Intel Threading Building Blocks 2020u4, Intel MPI 2019u8; threads/core: 2; Turbo: used; Build knobs: -O3 -ip -march=core-avx2, tested by Intel and results as of April 2021

NAMD Geomean of Apoa1, STMV: Platinum 8358: 1-node, 2x Intel® Xeon® Platinum 8358 (32C/2.6GHz, 250W TDP) processor on Intel Software Development Platform with 256 GB (16 slots/ 16GB/ 3200) total DDR4 memory, ucode 0x261, HT on, Turbo on, CentOS Linux 8.3.2011, 4.18.0-240.1.1.el8_3.crt1.x86_64, 1x Intel_SSDSC2KG96, App Version: 2.15-Alpha1 (includes AVX tiles algorithm); Build notes: Tools: Intel MKL , Intel C Compiler 2020u4, Intel MPI 2019u8, Intel Threading Building Blocks 2020u4; threads/core: 2; Turbo: used; Build knobs: -ip -fp-model fast=2 -no-prec-div -qoverride-limits -qopenmp-simd -O3 -xCORE-AVX512 -qopt-zmm-usage=high EPYC 7543: 1-node, 2-socket AMD EPYC 7543 (32C/2.8GHz, 240W cTDP) on Dell PowerEdge R7525 server with 1024 GB (16 slots/ 64GB/3200) total DDR4 memory, ucode 0xa001119, SMT on, Boost on, Power deterministic mode, NPS=4, Red Hat Enterprise Linux 8.3, 4.18, 2x Micron 5300 Pro, App Version: 2.15-Alpha1 (includes AVX tiles algorithm); Build notes: Tools: Intel MKL , AOCC 2.2.0, gcc 9.3.0, Intel MPI 2019u8; threads/core: 2; Turbo: used; Build knobs: -O3 -fomit-frame-pointer -march=znver1 -ffast-math, tested by Intel and results as of April 2021

RELION Plasmodium Ribosome: Platinum 8358: 1-node, 2x Intel® Xeon® Platinum 8358 (32C/2.6GHz, 250W TDP) processor on Intel Software Development Platform with 256 GB (16 slots/ 16GB/ 3200) total DDR4 memory, ucode 0x261, HT on, Turbo on, CentOS Linux 8.3.2011, 4.18.0-240.1.1.el8_3.crt1.x86_64, 1x Intel_SSDSC2KG96, App Version: 3_1_1; Build notes: Tools: Intel C Compiler 2020u4, Intel MPI 2019u9; threads/core: 2; Turbo: used; Build knobs: -O3 -ip -g -debug inline-debug-info -xCOMMON-AVX512 -qopt-report=5 –restrict EPYC 7543: 1-node, 2-socket AMD EPYC 7543 (32C/2.8GHz, 240W cTDP) on Dell PowerEdge R7525 server with 1024 GB (16 slots/ 64GB/3200) total DDR4 memory, ucode 0xa001119, SMT on, Boost on, Power deterministic mode, NPS=4, Red Hat Enterprise Linux 8.3, 4.18, 2x Micron 5300 Pro, App Version: 3_1_1; Build notes: Tools: Intel C Compiler 2020u4, Intel MPI 2019u9; threads/core: 2; Turbo: used; Build knobs: -O3 -ip -g -debug inline-debug-info -march=core-avx2 -qopt-report=5 -restrict, tested by Intel and results as of April 2021

Configuration Details (Demo)

End-to-End Census Workload performance (Stock):
Tested by Intel as of 2/19/2021. 2 x Intel® Xeon Platinum 8280L @ 28 cores, OS: Ubuntu 20.04.1 LTS Mitigated, 384GB RAM (384GB RAM: 12x 32GB 2933MHz), kernel: 5.4.0-65-generic, microcode: 0x4003003, CPU governor: performance. SW: Scikit-learn 0.24.1, Pandas 1.2.2, Python 3.9.7, Census Data, (21721922, 45) Dataset is from IPUMS USA, University of Minnesota, www.ipums.org [*Steven Ruggles, Sarah Flood, Ronald Goeken, Josiah Grover, Erin Meyer, Jose Pacas and Matthew Sobek. IPUMS USA: Version 10.0 [dataset]. Minneapolis, MN: IPUMS, 2020. https://doi.org/10.18128/D010.V10.0]*

End-to-End Census Workload performance (Optimized):
Tested by Intel as of 2/19/2021. 2 x Intel® Xeon Platinum 8280L @ 28 cores, OS: Ubuntu 20.04.1 LTS Mitigated, 384GB RAM (384GB RAM: 12x 32GB 2933MHz), kernel: 5.4.0-65-generic, microcode: 0x4003003, CPU governor: performance. SW: Scikit-learn 0.24.1 accelerated by daal4py 2021.2, modin 0.8.3, omniscidbe v5.4.1, Python 3.9.7, Census Data, (21721922, 45) Dataset is from IPUMS USA, University of Minnesota, www.ipums.org [*Steven Ruggles, Sarah Flood, Ronald Goeken, Josiah Grover, Erin Meyer, Jose Pacas and Matthew Sobek. IPUMS USA: Version 10.0 [dataset]. Minneapolis, MN: IPUMS, 2020. https://doi.org/10.18128/D010.V10.0]*

End-to-End Census Workload performance (Intel 8380 vs AMD 7763):
Tested by Intel as of 3/15/2021. Hardware configuration for Intel® Xeon® Platinum 8380: 1-node, 2x Intel Xeon Platinum 8380 (40C/2.3GHz, 270W TDP) processor on Intel Software Development Platform with 512 GB (16 slots/ 32GB/ 3200) total DDR4 memory, ucode X55260, HT on, Turbo on, RedHat Enterprize Linux 8.2, 4.18.0-193.28.1.el8_2.x86_64, 2x Intel_SSDSC2KG019T8.
Tested by Intel as of 5/11/2021. Hardware configuration for AMD: AMD EPYC Milan 7763: 1-node, 2x 7763 processor (64 cores/socket, 2 threads/core), HT ON, Turbo ON, NPS=2, 4.18.0-240.el8.x86_64 with 1024 GB DDR4 memory (16 slots/32GB/3200 MHz), ucode 0xa001119, Red Hat Enterprise Linux 8.3 (Ootpa), 4.18.0-240.el8.x86_64, 2x INTEL SSDSC2KG019T8. Software : Python 3.7.9, Pre-processing Modin 0.8.3, Omniscidbe v5.4.1, Intel Optimized Scikit-Learn 0.24.1, OneDAL Daal4py 2021.2, XGBoost 1.3.3 , Dataset source : IPUMS USA: https://usa.ipums.org/usa/, Dataset (size, shape) : (21721922, 45), Datatypes int64 and float64, Dataset size on disk 362.07 MB, Dataset format .csv.gz, Accuracy metric MSE: mean squared error; COD: coefficient of determination, tested by Intel, and results as of March 2021. Results may vary.

Configuration Details (20% IPC Increase)

20% IPC improvement: 3rd Gen Xeon Scalable processor: 1-node, 2x 28-core 3rd Gen Intel Xeon Scalable processor, Wilson City platform, 512GB (16 slots / 32GB / 3200) total DDR4 memory, HT on, ucode=x270, RHEL 8.0, Kernel Version4.18.0-80.el8.x86_64, test by Intel on 3/30/2021. 2nd Gen Intel Xeon Scalable processor: 1-node, 2x 28-core 2nd Gen Intel Xeon Scalable processor, Neon City platform, 384GB (12 slots / 32GB / 2933) total DDR4 memory, HT on, ucode=x2f00, RHEL 8.0, Kernel Version4.18.0-80.el8.x86_64, test by Intel on 3/30/2021. SPECrate2017_int_base (est). Tests at equal core frequency, equal uncore frequency, equal compiler.

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