



SPEChpc™ 2021 Medium Result

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NVIDIA Corporation

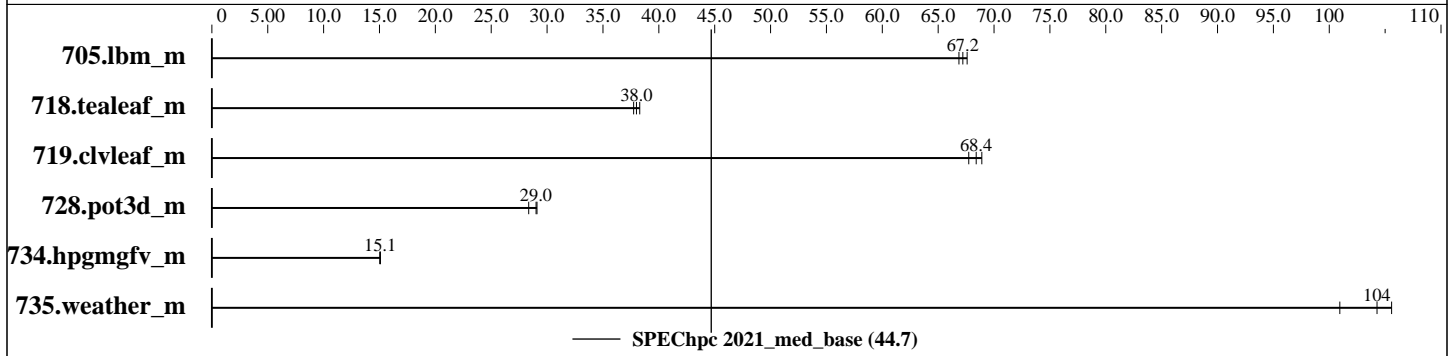
Selene: NVIDIA DGX SuperPOD
(AMD EPYC 7742 2.25 GHz, Tesla A100-SXM-80 GB)

SPEChpc 2021_med_base = 44.7

SPEChpc 2021_med_peak = Not Run

hpc2021 License: 019
Test Sponsor: NVIDIA Corporation
Tested by: NVIDIA Corporation

Test Date: Sep-2022
Hardware Availability: Jul-2020
Software Availability: Mar-2022



Results Table

Benchmark	Base										Peak							
	Model	Ranks	Thrds/Rnk	Seconds	Ratio	Seconds	Ratio	Seconds	Ratio	Model	Ranks	Thrds/Rnk	Seconds	Ratio	Seconds	Ratio	Seconds	Ratio
705.lbm_m	ACC	1024	16	18.3	66.9	18.2	67.2	18.1	67.6									
718.tealeaf_m	ACC	1024	16	35.3	38.3	35.8	37.7	35.5	38.0									
719.clvleaf_m	ACC	1024	16	26.8	68.9	27.3	67.7	27.0	68.4									
728.pot3d_m	ACC	1024	16	63.8	29.0	63.6	29.1	65.2	28.4									
734.hpgmgfv_m	ACC	1024	16	66.3	15.1	66.6	15.0	66.3	15.1									
735.weather_m	ACC	1024	16	23.0	104	23.8	101	22.7	106									

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Results appear in the order in which they were run. Bold underlined text indicates a median measurement.



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Hardware Summary

Type of System: SMP
Compute Node: DGX A100
Interconnects: Multi-rail InfiniBand HDR fabric
DDN EXAScalar file system
Compute Nodes Used: 64
Total Chips: 128
Total Cores: 8192
Total Threads: 16384
Total Memory: 128 TB
Max. Peak Threads: --

Software Summary

Compiler: C/C++/Fortran: Version 22.3 of
NVIDIA HPC SDK for Linux
MPI Library: OpenMPI Version 4.1.2rc4
Other MPI Info: HPC-X Software Toolkit Version 2.10
Other Software: None
Base Parallel Model: ACC
Base Ranks Run: 1024
Base Threads Run: 16
Peak Parallel Models: Not Run
Minimum Peak Ranks: --
Maximum Peak Ranks: --
Max. Peak Threads: --
Min. Peak Threads: --

Node Description: DGX A100

Hardware

Number of nodes: 64
Uses of the node: compute
Vendor: NVIDIA Corporation
Model: NVIDIA DGX A100 System
CPU Name: AMD EPYC 7742
CPU(s) orderable: 2 chips
Chips enabled: 2
Cores enabled: 128
Cores per chip: 64
Threads per core: 2
CPU Characteristics: Turbo Boost up to 3400 MHz
CPU MHz: 2250
Primary Cache: 32 KB I + 32 KB D on chip per core
Secondary Cache: 512 KB I+D on chip per core
L3 Cache: 256 MB I+D on chip per chip
(16 MB shared / 4 cores)
Other Cache: None
Memory: 2 TB (32 x 64 GB 2Rx8 PC4-3200AA-R)
Disk Subsystem: OS: 2TB U.2 NVMe SSD drive
Internal Storage: 30TB (8x 3.84TB U.2 NVMe SSD drives)
Other Hardware: None
Accel Count: 8
Accel Model: Tesla A100-SXM-80 GB
Accel Vendor: NVIDIA Corporation
Accel Type: GPU
Accel Connection: NVLINK 3.0, NVSWITCH 2.0 600 GB/s
Accel ECC enabled: Yes
Accel Description: See Notes
Adapter: NVIDIA ConnectX-6 MT28908
Number of Adapters: 8
Slot Type: PCIe Gen4

Software

Accelerator Driver: NVIDIA UNIX x86_64 Kernel Module 470.103.01
Adapter: NVIDIA ConnectX-6 MT28908
Adapter Driver: InfiniBand: 5.4-3.4.0.0
Adapter Firmware: InfiniBand: 20.32.1010
Adapter: NVIDIA ConnectX-6 MT28908
Adapter Driver: Ethernet: 5.4-3.4.0.0
Adapter Firmware: Ethernet: 20.32.1010
Operating System: Ubuntu 20.04
5.4.0-121-generic
Local File System: ext4
Shared File System: Lustre
System State: Multi-user, run level 3
Other Software: None

(Continued on next page)



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Node Description: DGX A100

Hardware (Continued)

Data Rate: 200 Gb/s
Ports Used: 1
Interconnect Type: InfiniBand / Communication
Adapter: NVIDIA ConnectX-6 MT28908
Number of Adapters: 2
Slot Type: PCIe Gen4
Data Rate: 200 Gb/s
Ports Used: 2
Interconnect Type: InfiniBand / FileSystem

Interconnect Description: Multi-rail InfiniBand HDR fabric

Hardware

Vendor: NVIDIA
Model: N/A
Switch Model: NVIDIA Quantum QM8700
Number of Switches: 164
Number of Ports: 40
Data Rate: 200 GB/s per port
Firmware: MLNX-OS v3.10.2202
Topology: Full three-level fat-tree
Primary Use: Inter-process communication

Software

: --

Interconnect Description: DDN EXAScalar file system

Hardware

Vendor: NVIDIA
Model: N/A
Switch Model: NVIDIA Quantum QM8700
Number of Switches: 26
Number of Ports: 40
Data Rate: 200 GB/s per port
Firmware: MLNX-OS v3.10.2202
Topology: Full three-level fat-tree
Primary Use: Global storage

Software

: --

Compiler Invocation Notes

Binaries built and run within a NVHPC SDK 22.3 CUDA 11.0 Ubuntu 20.04
Container available from NVIDIA GPU Cloud (NGC):
<https://ngc.nvidia.com/catalog/containers/nvidia:nvhpc>
<https://catalog.ngc.nvidia.com/orgs/nvidia/containers/nvhpc/tags>



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Submit Notes

The config file option 'submit' was used.

MPI startup command:

srtn command was used to start MPI jobs.

Individual Ranks were bound to the NUMA nodes, GPUs and NICs using this "wrapper.GPU" bash-script for the case of 1 rank per GPU

```
ln -s -f libnuma.so.1 /usr/lib/x86_64-linux-gnu/libnuma.so
export LD_LIBRARY_PATH+=:/usr/lib/x86_64-linux-gnu
export LD_RUN_PATH+=:/usr/lib/x86_64-linux-gnu
declare -a NUMA_LIST
declare -a GPU_LIST
declare -a NIC_LIST
NUMA_LIST=( $NUMAS )
GPU_LIST=( $GPUS )
NIC_LIST=( $NICs )
export UCX_NET_DEVICES=${NIC_LIST[$SLURM_LOCALID]}:1
export OMPI_MCA_btl_openib_if_include=${NIC_LIST[$SLURM_LOCALID]}
export CUDA_VISIBLE_DEVICES=${GPU_LIST[$SLURM_LOCALID]}
numactl -l -N ${NUMA_LIST[$SLURM_LOCALID]} $*
```

and this "wrapper.MPS" bash-script for the oversubscribed case.

```
ln -s -f libnuma.so.1 /usr/lib/x86_64-linux-gnu/libnuma.so
export LD_LIBRARY_PATH+=:/usr/lib/x86_64-linux-gnu
export LD_RUN_PATH+=:/usr/lib/x86_64-linux-gnu
declare -a NUMA_LIST
declare -a GPU_LIST
declare -a NIC_LIST
NUMA_LIST=( $NUMAS )
GPU_LIST=( $GPUS )
NIC_LIST=( $NICs )
NUM_GPUS=${#GPU_LIST[@]}
RANKS_PER_GPU=$(( SLURM_NTASKS_PER_NODE / NUM_GPUS ))
GPU_LOCAL_RANK=$(( SLURM_LOCALID / RANKS_PER_GPU ))
export UCX_NET_DEVICES=${NIC_LIST[$GPU_LOCAL_RANK]}:1
export OMPI_MCA_btl_openib_if_include=${NIC_LIST[$GPU_LOCAL_RANK]}
set +e
nvidia-cuda-mps-control -d 1>&2
set -e
export CUDA_VISIBLE_DEVICES=${GPU_LIST[$GPU_LOCAL_RANK]}
numactl -l -N ${NUMA_LIST[$GPU_LOCAL_RANK]} $*
if [ $SLURM_LOCALID -eq 0 ]
then
echo 'quit' | nvidia-cuda-mps-control 1>&2
fi
```



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General Notes

Full system details documented here:

<https://images.nvidia.com/aem-dam/Solutions/Data-Center/gated-resources/nvidia-dgx-superpod-a100.pdf>

Environment variables set by runhpc before the start of the run:

SPEC_NO_RUNDIR_DEL = "on"

Platform Notes

```

Detailed A100 Information from nvaccelinfo
CUDA Driver Version:          11040
NVRM version:                 NVIDIA UNIX x86_64 Kernel Module 470.7.01
Device Number:                0
Device Name:                  NVIDIA A100-SXM-80 GB
Device Revision Number:       8.0
Global Memory Size:           85198045184
Number of Multiprocessors:    108
Concurrent Copy and Execution: Yes
Total Constant Memory:        65536
Total Shared Memory per Block: 49152
Registers per Block:          65536
Warp Size:                    32
Maximum Threads per Block:    1024
Maximum Block Dimensions:     1024, 1024, 64
Maximum Grid Dimensions:      2147483647 x 65535 x 65535
Maximum Memory Pitch:         2147483647B
Texture Alignment:            512B
Clock Rate:                   1410 MHz
Execution Timeout:            No
Integrated Device:            No
Can Map Host Memory:          Yes
Compute Mode:                 default
Concurrent Kernels:           Yes
ECC Enabled:                  Yes
Memory Clock Rate:            1593 MHz
Memory Bus Width:             5120 bits
L2 Cache Size:                41943040 bytes
Max Threads Per SMP:          2048
Async Engines:                3
Unified Addressing:           Yes
Managed Memory:              Yes
Concurrent Managed Memory:    Yes
Preemption Supported:         Yes
Cooperative Launch:           Yes
  Multi-Device:               Yes
Default Target:               cc80

```



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Compiler Version Notes

=====
CC 705.lbm_m(base) 718.tealeaf_m(base) 734.hpgmgfv_m(base)
=====

nvc 22.3-0 64-bit target on x86-64 Linux -tp zen2-64
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=====

=====
FC 719.clvleaf_m(base) 728.pot3d_m(base) 735.weather_m(base)
=====

nvfortran 22.3-0 64-bit target on x86-64 Linux -tp zen2-64
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Base Compiler Invocation

C benchmarks:
mpicc

Fortran benchmarks:
mpif90

Base Portability Flags

705.lbm_m: -DSPEC_OPENACC_NO_SELF

Base Optimization Flags

C benchmarks:
-fast -DSPEC_ACCEL_AWARE_MPI -acc=gpu -gpu=cuda11.0 -gpu=cc80
-Mstack_arrays -Mfprelaxed -Mnouniform -tp=zen2

Fortran benchmarks:
-DSPEC_ACCEL_AWARE_MPI -fast -acc=gpu -gpu=cuda11.0 -gpu=cc80
-Mstack_arrays -Mfprelaxed -Mnouniform -tp=zen2



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Base Other Flags

C benchmarks (except as noted below):

-Ispecmpitime -w

734.hpgmgfv_m: -Ispecmpitime -w

Fortran benchmarks (except as noted below):

-w

719.clvleaf_m: -Ispecmpitime -w

The flags file that was used to format this result can be browsed at

http://www.spec.org/hpc2021/flags/nv2021_flags_v1.0.3.2022-11-03.html

You can also download the XML flags source by saving the following link:

http://www.spec.org/hpc2021/flags/nv2021_flags_v1.0.3.2022-11-03.xml

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For questions about this result, please contact the tester. For other inquiries, please contact info@spec.org.

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