# **Facilities, Equipment & Other Resources**

## **The Vermont Advanced Computing Core (VACC)**

The Vermont Advanced Computing Core (https://www.uvm.edu/vacc) is a University of Vermont core facility created in 2006 that facilitates discovery by providing rapid access to large-scale advanced computing infrastructure while oﬀering responsive technical support to researchers.

As of January 2020, the VACC provides two clusters: Bluemoon and DeepGreen.

### **Bluemoon**

#### **HARDWARE**

A 300 node, 4004 core, high-performance computing cluster, modeled after national supercomputing centers, supporting large-scale computation, low-latency networking for MPI workloads, large memory systems, and high-performance parallel ﬁlesystems.

* 32 dual-processor, 12-core (Intel E5-2650 v4) Dell PowerEdge R430 nodes, with 64 GB each, 10Gbit/s Ethernet-connected
* 8 dual-processor, 12-core (Intel E5-2650 v4) Dell PowerEdge R430 nodes, with 256 GB each, 10Gbit/s Ethernet-connected
* 9 dual-processor, 20 core (Intel 6230), PowerEdge R440, with 10GB , 10Gbit/s Ethernet-connected
* 3 dual-processor, 10-core (Intel E5-2650 v3) Dell PowerEdge R630 nodes, with 256 GB each, Ethernet-connected
* 130 dual-processor, 6-core (Intel X5650) IBM dx360m3 nodes, with 24GB each, Ethernet- connected
* Infiniband: 8 dual-processor, 160-core (Intel E5-2650 v3) Dell PowerEdge R630 nodes, with 64 GB each, Inﬁniband 4XFDR (56Gbit/s)-connected
* Infiniband: 32 dual-processor, 640-core (Intel E5-2650 v3) Dell PowerEdge R630 nodes, with 64 GB each, Inﬁniband 4XFDR (56Gbit/s)-connected
* Infiniband: 22 dual-processor, 252-core (Intel E5-2630) IBM dx360m4 nodes, with 32GB each, Inﬁniband 4XFDR (56Gbit/s)-connected
* 2 dual-processor, 12-core (Intel E5-2650 v4) Dell R730, with 1TB
* 1 dual-processor, 8-core (Intel E7-8837) IBM x3690 x5, with 512GB
* 2 dual-processor, 12-core (Intel E5-2650 v4) Dell R730 GPU nodes, each with 2 NVidia Tesla P100 GPUs. (Each GPU has 3584 CUDA cores and 16GB RAM)
* 2 I/O nodes (Dell R430s, 10G ethernet connected) along with 2 I/O nodes (IBM x3655s, 10G ethernet connected) connected to:
	+ 1 IBM DS4800 providing 260 terabytes of raw storage to GPFS (roughly 197TB usable)
	+ 1 IBM DS4700 providing 104 terabytes of raw storage (roughly 76TB usable)
	+ 1 IBM DCS3850 providing 240 terabytes of raw storage to GPFS (roughly 164TB usable)
	+ 1 Dell MD3460 providing 357.5 terabytes of raw storage to GPFS (roughly 260.5TB usable), and 43 terabytes of solid-state disk to GPFS (for fast random-access data and metadata, roughly 27.5 TB usable)
	+ 1 IBM V3700 providing 10 terabytes of solid-state disk to GPFS (for fast random- access data and metadata)
* 2 Flash-storage GPFS Metadata nodes (IBM x3655s, 10G Ethernet connected)

#### **SOFTWARE**

* Operating System: RedHat Enterprise Linux 7 (64-bit) with the GNU compilers (gcc, f77)
* Resources Manager: Slurm v20
* Package Manager: Spack v0.11

### **DeepGreen**

#### **HARDWARE**

DeepGreen is a new massively parallel cluster deployed in Summer 2019 with 80 GPUs capable of over 8 petaﬂops of mixed-precision calculations based on the NVIDIA Tesla V100 architecture. Its hybrid design can expedite high-throughput artiﬁcial intelligence and machine learning workﬂows, and its extreme parallelism will forge new and transformative research pipelines.

* 10 GPU nodes (Penguin Relion XE4118GTS) each with:
	+ 2 Intel(R) Xeon(R) Gold 6130 CPU @ 2.10GHz (2x 16 cores, 22M cache)
	+ 768GB RAM (256GB for GPFS pagepool)
	+ 8 NVIDIA Tesla V100s with 32GB RAM
	+ 4 2-lane HDR (100Gb/s, so 400Gb/s/node) Inﬁniband links to QM8700 switch
	+ 2 NVMe nodes, each with 64TB NVMe devices (8x8TB), replicated to provide 64TB /gpfs3 ﬁlesystem
* Mellanox QM8700 switch running at HDR speeds

#### **SOFTWARE**

* Operating System: RedHat Enterprise Linux 7 (64-bit) with the GNU compilers (gcc, f77)
* Resources Manager: Slurm v19
* Package Manager: Spack v0.11