Computing Infrastructure

University of Virginia, Computer Science Department
06-Jan-2022

Introduction
The Department of Computer Science (CS) maintains an extensive computing infrastructure consisting of a network, desktop computing, remote desktop computing, department wide storage, backup facility, batch computing facility, and an interactive server computing environment. This infrastructure supports undergraduate and graduate lecture and lab courses, graduate student research, and faculty research.

Equipment Locations
The Department's central computing infrastructure is located in three computer centers, Rice Hall rooms 003, 374, and 574. Room 003 is the main computer center housing critical servers, storage, and large computing systems, and is served by 80 tons of air handlers, 1,600 KVa of utility power, and 80 KVa of UPS power. This room has logged keycard controlled access, only granted to system staff and select faculty. Rooms 374 and 574 contain equipment that also requires logged keycard controlled access, but access is granted to faculty and students with a need to physically access the equipment. Each floor of Rice Hall has a logged keycard controlled access network closet. Equipment inventory and staging is located in Rice Hall room 007. Equipment is received, assembled, and configured in this room. This room also has logged keycard controlled access, only granted to system staff.

Networks
The Department deploys and administers a wired network which connects desktop computers to switches on each floor. These switches are then connected to a building 'core' switch in Rice Hall room 075 via 10Gb downlinks. In the main data center, Rice Hall room 003, racks of servers are connected to Top of Rack (TOR) switches, and each TOR is connected to a Row Aggregation (RAG) switch. Each RAG is then uplinked to a core data center switch at 10Gb. The data center core switch is connected to the building core at 40Gb. The building core switch is linked to the UVA main network via a 10Gb uplink, providing access to the general UVA network and the internet. A high performance firewall blocks commonly attacked services and ports (telnet, ftp, ssh, etc.) from non-UVA addresses, and only allows common services like ssh to be opened to UVA addresses.

Core Services
Core services (DNS, DHCP, NTP, Print, File, etc.) are centrally provided by a set of enterprise quality high performance servers running Linux. These servers are located in Rice Hall room 003, and are configured with high availability features like UPS power, redundant mirrored system disks, error correcting memory, and hot swappable disks and power supplies.

Storage
The Department deploys and administers storage for user home directories, project directories, and research directories. This storage consists of enterprise quality virtual disk arrays which present block level devices to high performance file servers connected via Fibrechannel. All file servers use ZFS,
serve filesystems via NFS and SAMBA protocols. The file servers contain enough memory to allow
opened files to be parked in and served from memory, resulting in excellent performance.

Job Scheduled Computing
The Department deploys more than 200 servers that provide computing via a job scheduler. The servers
are deployed with combinations of large memory, GPU cards, FPGA cards, NVMe memory, and other
features. Servers with GPU accelerators are the most popular, with approximately 75 servers housing
GPUs, and a total of 1.2 million CUDA cores available. Users can request one or more servers for job
execution, either serially or using parallel computing constructs. A current list of computing resources
can be found on our information website www.cs.virginia.edu/computing.

Interactive Servers
The Department deploys and administers a load balanced cluster of interactive session servers that
provide users with general purpose logins. Users can write code, compile code, test code, and perform
many other interactive tasks on these servers. These are heavily utilized by both research and
instructional faculty and students.

Desktop Computing
The Department provides desktop computers to faculty and graduate students. These computers run
either Linux, MacOS, or Windows, and are hardwired to the Department network. Each user has a home
directory served by the Department's ZFS servers. Users can access these home directories directly on a
Linux desktop, or through SAMBA for Mac and PC desktops. The Department administrators provide
users with a recommended, qualified, and tested desktop model and specification that is, by default,
ordered in lieu of special requirements.

Remote Desktop Computing
The Department deploys a NX/NoMachine cluster of several load balanced servers on which users can
create Linux virtual remote desktops for their work. These virtual desktops provide a full Linux desktop
with graphical tools and all the standard software available on any other server. We also deploy a
general purpose Windows server that provides up to 25 Windows remote desktop sessions. This is
useful for students and faculty who need to run Windows software but do not have Windows desktops
or laptops.

Software
The systems support staff installs and supports ~80 software packages for the Department's users.
These software packages are installed centrally, and are accessible on a network share that allows a user
on any of our servers to execute a simple set of commands to load and use the software. This frees our
users from having to install applications themselves, saving considerable time and effort. The Dept.
centrally provides language compilers, interpreters, optimizers, and debuggers for most languages (C,
C++, java, python, go, perl, R, FORTRAN, etc.), web development packages, code development
environments, GPU support libraries (CUDA, TORCH, etc.), parallel computing support libraries
(openmpi, parallel), statistical and mathematical packages (matlab, etc.), databases (MySQL), and
various editors. Users can request new packages to be installed by submitting a help desk ticket.
Specialized packages that are tied to a hardware platform are also locally installed by the system staff.