

# Computing Infrastructure

## University of Virginia, Computer Science Department

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### 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, and

serve filesystems via NFS and SAMBA protocols. The fileservers 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](http://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.