Introduction to UNIX

Dr. Princess Rodriguez

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Learning Objectives

- Log in to the VACC, a high-performance computing (HPC) cluster.
- Learn basic command-line navigation.
- Copy data into your home directory.
- List files within a directory.

Introduction to Command Line

The command-line interface (CLI) and graphical user interface (GUI) are two different ways of interacting with a computer's operating system.

Figure 1: GUI-vs-CUI

What is a Shell?

Most data processing and remote access will be command-line based. For this we need an **interpreter**. A shell is a command-line interpreter that allows users to type commands to launch programs.
The most popular UNIX shell is BASH (the Bourne Again SHell) — so named because it is derived from a shell written by Stephen Bourne.
Learning to use the shell requires time and effort.
While a GUI presents you with choices to select, CLI does not automatically display these options to you. Instead, you will need to learn specific commands. This will resemble learning a new language!

Benefits of Using the Shell

Using the shell provides access to internal system controls, remote servers, and customizable workflows through scripting. With the shell, you can create, edit, and delete files, as well as perform many other tasks efficiently.

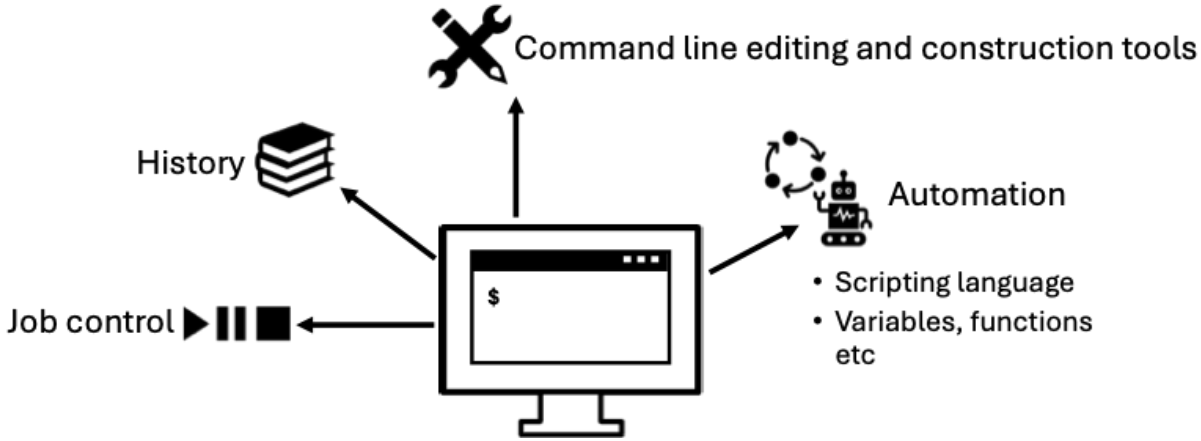


Figure 2: Shell-benefits

How to access the shell

On Mac or Linux machines, you can access the shell locally through a program called **Terminal**. However, for simplicity and convenience, we will use the shell through the open-source web portal **Vermont Advanced Computing Center - Open OnDemand (VACC-OOD)**. Once you open the terminal, you will begin learning the basics of shell programming with the Bourne Again Shell (Bash).

Working with Remote Machines: Vermont Advance Computing Center Cluster (VACC)

Why work on the VACC?

Most data-processing tasks in bioinformatics require more computing power than we have on our workstations. For all bioinformatics projects performed in this course, you will work over a network connection with the VACC.

Cluster Basics

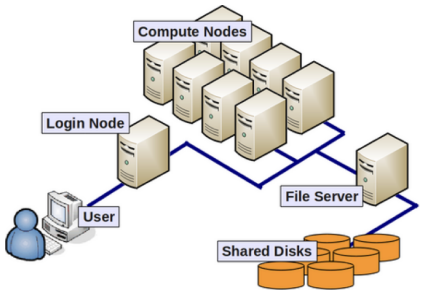


Figure 3: Cluster Architecture

The image above illustrates the multiple computers that make up a cluster. Each individual computer in the cluster, referred to as a “node”, is significantly more powerful than a typical laptop or desktop computer. A “cluster” is a large system composed of hundreds to thousands of nodes, each serving a specific purpose.

Nodes are generally classified by their roles: login nodes and compute nodes. Login nodes are used for accessing the cluster, setting up jobs, and managing workflows, while compute nodes handle the actual computational analysis or work. Most clusters have a few login nodes and many compute nodes to efficiently handle diverse workloads.

Common characteristics of a Cluster:

- Large memory
- Storage shared across nodes
- High speed interconnection network; suitable for high-throughput applications
- Shared by many users

As of March 2022, the VACC provides three Clusters:

- BlackDiamond
- Bluemoon
- DeepGreen

Figure 4: Bluemoon cluster

We will primarily use the **Bluemoon** cluster for any downstream analysis.

Please note that more information can always be found at the Vermont Advanced Computing Center website.

Connecting to the VACC

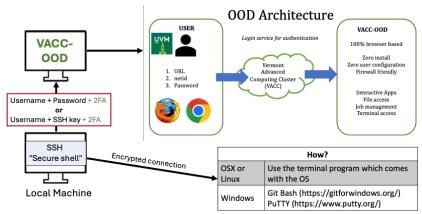


Figure 5: VACC-OOD Architecture

To connect to the VACC cluster you can either use SSH or VACC-OOD.

VACC-OOD Overview

Each student has been provided with their own personal VACC account that they can use to access VACC-Open OnDemand (OOD).

What is Open OnDemand (OOD)?

Open OnDemand (OOD) is an open source web portal for high performance computing (HPC) that provides users with an *easy-to-use* web interface to HPC clusters.

Benefits of using OOD:

1. Web-based, no additional software needs to be installed on your local machine
2. The easiest way to run graphical user interface (GUI) applications remotely on a cluster
3. Typical computing with command-line requires a *high learning curve* whereas OOD is easy to use and simple to learn

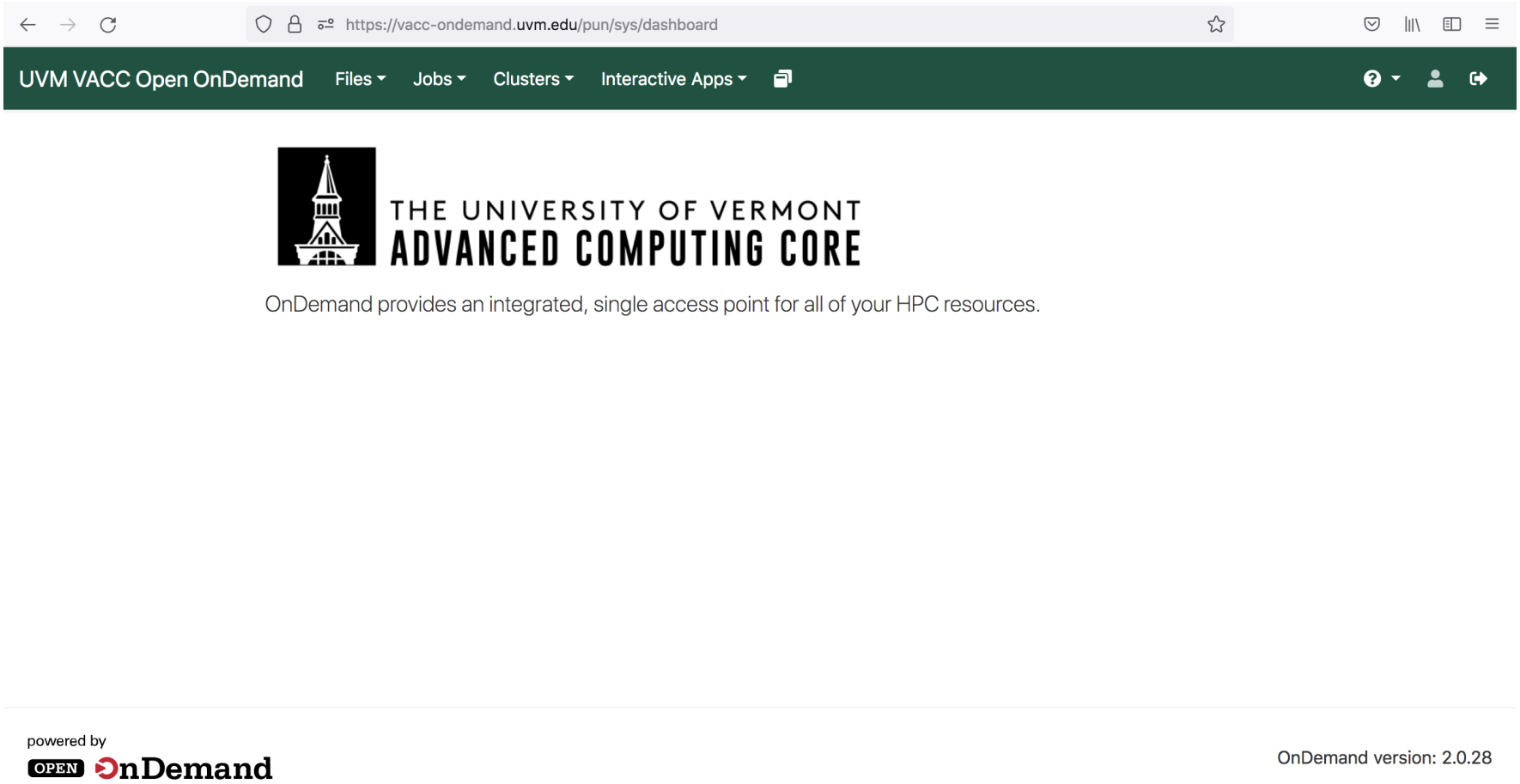
GUI applications offered by VACC-OOD:

- Equipped with **Terminal**: this is used to perform tasks on the command line (shell), both locally and on remote machines.
- RStudio: an integrated development environment for R

Figure 6: RStudio-Logo

How to log-in to VACC-OOD:

1. Use the VACC-OOD link to access the site
2. Add your UVM netid and password
3. You should be viewing the following dashboard



Connecting to VACC with SSH

If you already had a VACC account and/or are currently working towards generating and analyzing your own data, you may want to learn to log-in without VACC-OOD.

- To do so, first open your terminal locally on your computer.
- Once you open your terminal, your screen should look similar to below:

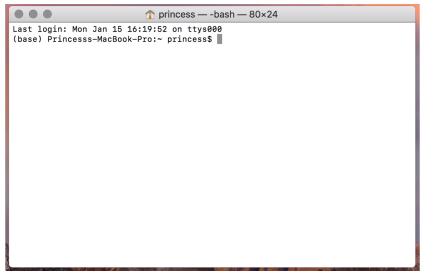


Figure 9: Terminal View

What is SSH?

There are many ways to connect to another machine over a network, but by far the most common is through the secure shell (SSH). We use SSH because its encrypted. This makes it secure to send passwords and edit private data files.

Step-by-step instructions:

Step by step instructions to login using SSH can be found here: https://www.uvm.edu/vacc/docs/start_guide/ssh/

Using VACC-OOD OFF-campus

To use OFF-campus you will need to VPN first. See install-cisco-vpn for more information!

Running Commands On Terminal

Now that we are logged-in to the VACC, lets explore terminal. Your screen should look similar to the following:

Figure 10: Login Explained

To run a program, we will follow these basic steps:

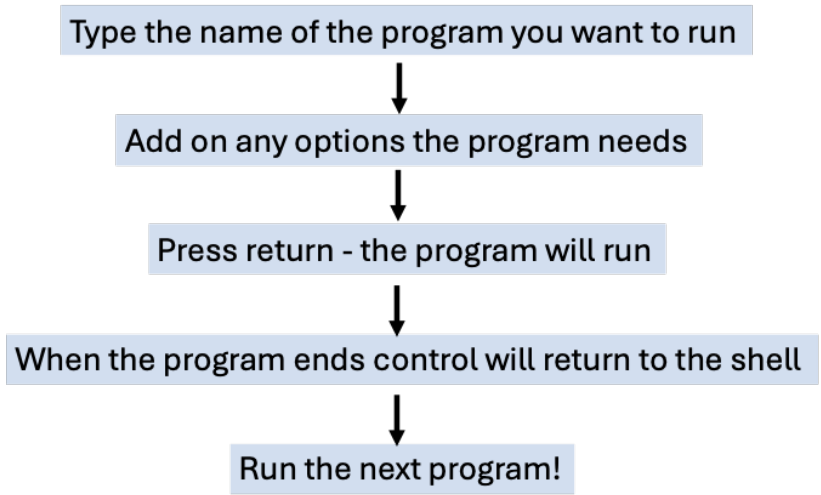


Figure 11: Steps to Running a Program/Command

The “$” is called the **“command prompt”**.

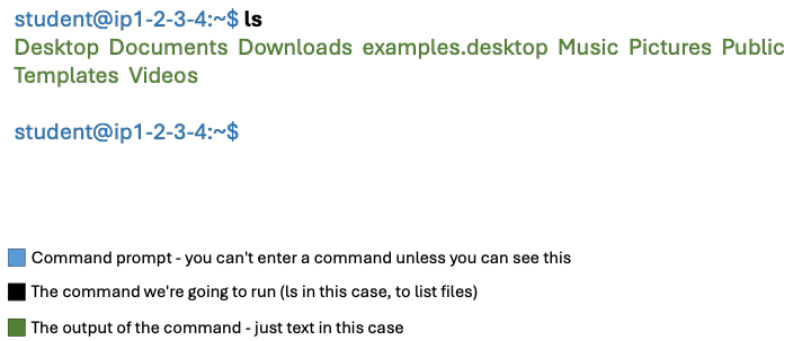


Figure 12: Running A Command

How to get more information on Arguments

Most commands will take additional arguments that control their behavior. How do we know what arguments are available for a particular command? The most commonly used shell commands have a manual available that can be accessed using the `man` command. Let's try this command with `ls`:

```
man ls
```

Core Programs	Non-Core Programs
Included with the install	Additional installs e.g analysis tools
Manual page (always)	Help Page (usually)
`man [program]`	`[program] --help (or -h)`

Figure 13: figure-out

Summary of Commands

```
cd
  + Change Directory
      +   used to move throughout the filesystem of a computer

ls
  + List
      +   list the contents of a directory

rm
  + Remove
      + used to remove a file
```

Citation

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*Other parts of this lesson were derived from: