



# Introduction to Linux

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Overview

This course is designed for students who have little or no experience with Linux.

By the end of this introductory course, students will:

- Understand the fundamentals of Linux
- Log in to and operate a Linux operating system

- Section 1: What is Linux?
- Section 2: Common Commands
- Section 3: Users & Groups
- Section 4: Processes & Services
- Section 5: Basic Networking
- Section 6: Editing Tools

## Additional tutorials and help with Linux can be found from these sources:

Resource	Link
Linux.org	<a href="http://www.linux.org/categories/linux-tutorials.52/">http://www.linux.org/categories/linux-tutorials.52/</a>
Linux.com	<a href="http://www.linux.com/learn/tutorials">http://www.linux.com/learn/tutorials</a>
Linux Foundation	<a href="http://training.linuxfoundation.org/free-linux-training/linux-training-videos">http://training.linuxfoundation.org/free-linux-training/linux-training-videos</a>
nixCraft	<a href="http://www.cyberciti.biz/faq/">http://www.cyberciti.biz/faq/</a>

# Downloading a Linux Environment



The screenshot shows the Cumulus VX download page. At the top is a green navigation bar with the Cumulus logo and menu items: What We Do, Products, Solutions, Customers, Partners, Support & Services, and Company. A language selector shows 'Russ'. The main content area features the heading 'Download Cumulus VX' and the Cumulus VX logo with the tagline 'Virtual Experience'. Below this is a paragraph: 'Cumulus VX is available for multiple virtual environments. Select & download the image that best suits your use case.' At the bottom, there are four download buttons: 'Cumulus VX VMware', 'Cumulus VX VirtualBox', 'Cumulus VX KVM', and 'Cumulus VX Vagrant Box', each with a 'Download Now' button.

<http://www.cumulusnetworks.com/cumulus-vx/download>



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Section 1: What is Linux?

- Linux was developed in 1991 by a Finnish student named Linus Torvalds
- “Linux” is actually just the kernel itself
- Combined with the GNU project, which lacked a kernel, to produce a complete and free (open source) operating system
- Linux and the GNU project together is commonly referred to as “GNU/Linux”



- Because GNU/Linux is open source, various distributions (“distros”) have been created from that source code over the years
- All of these feature the Linux kernel
- The User Space in each of these distros is often quite different, depending on the needs and wants of the group creating them



CentOS



gentoo linux



debian



cumulus



redhat



ANDROID



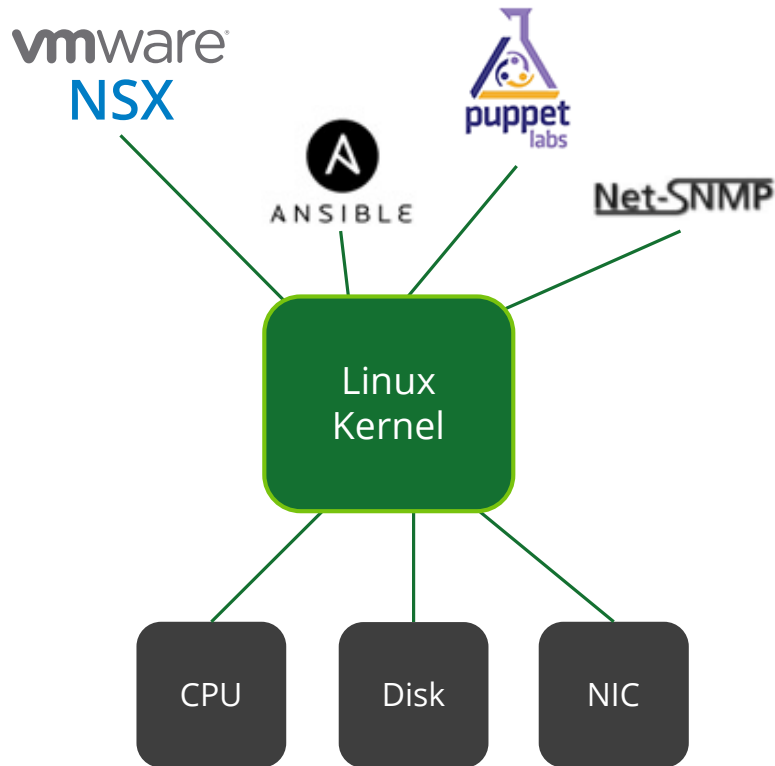
openSUSE



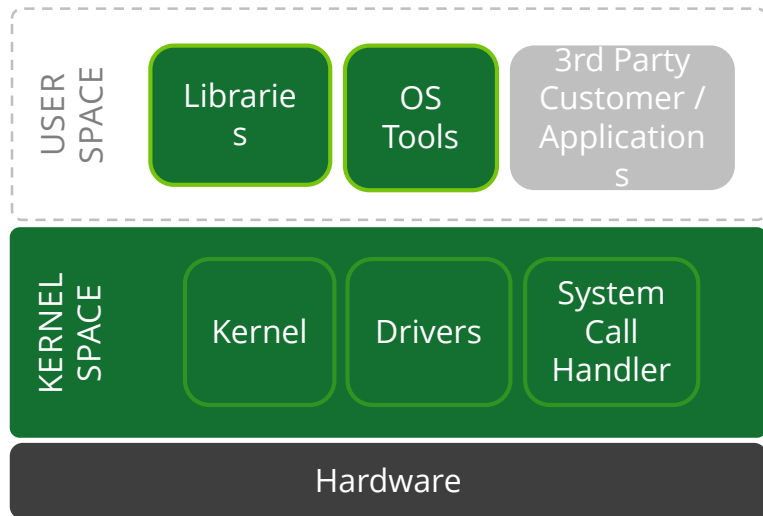
ubuntu

## The kernel is the core of the Linux operating system

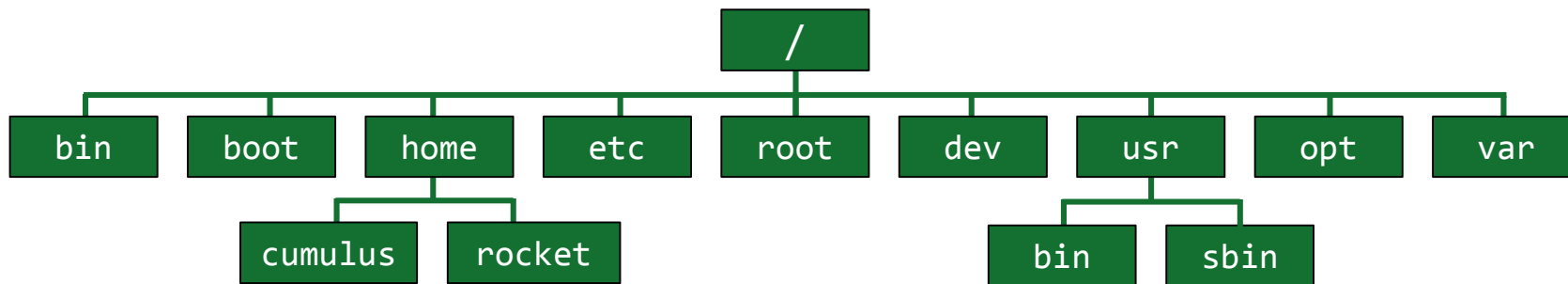
- Translates requests from user commands and applications into hardware calls
- Additional capabilities can be enabled with additional code such as drivers and libraries



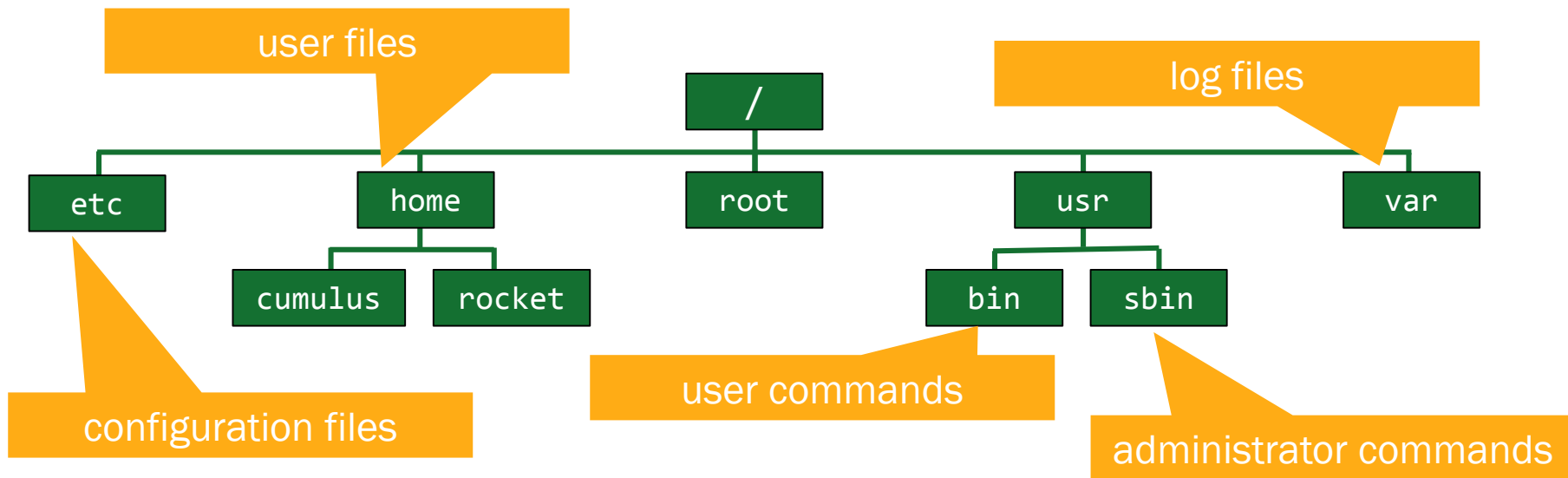
## Applications run in two distinct areas of system memory: kernel space and user space



The file system tree begins with the Root Directory (“/”) and contains many sub-directories



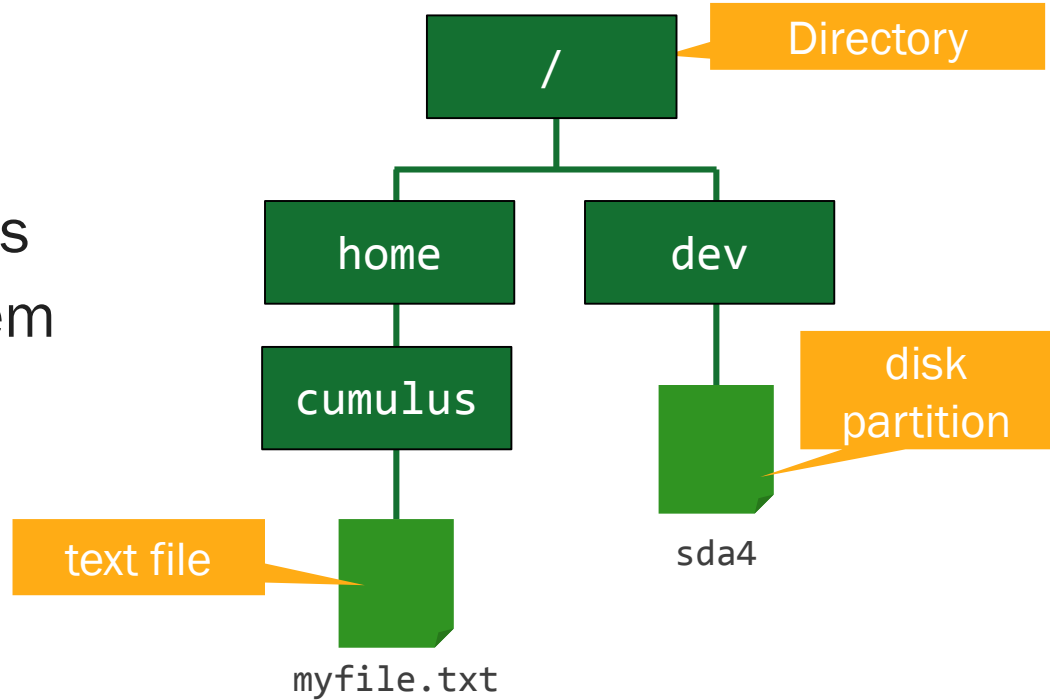
## Different file systems hold specific data

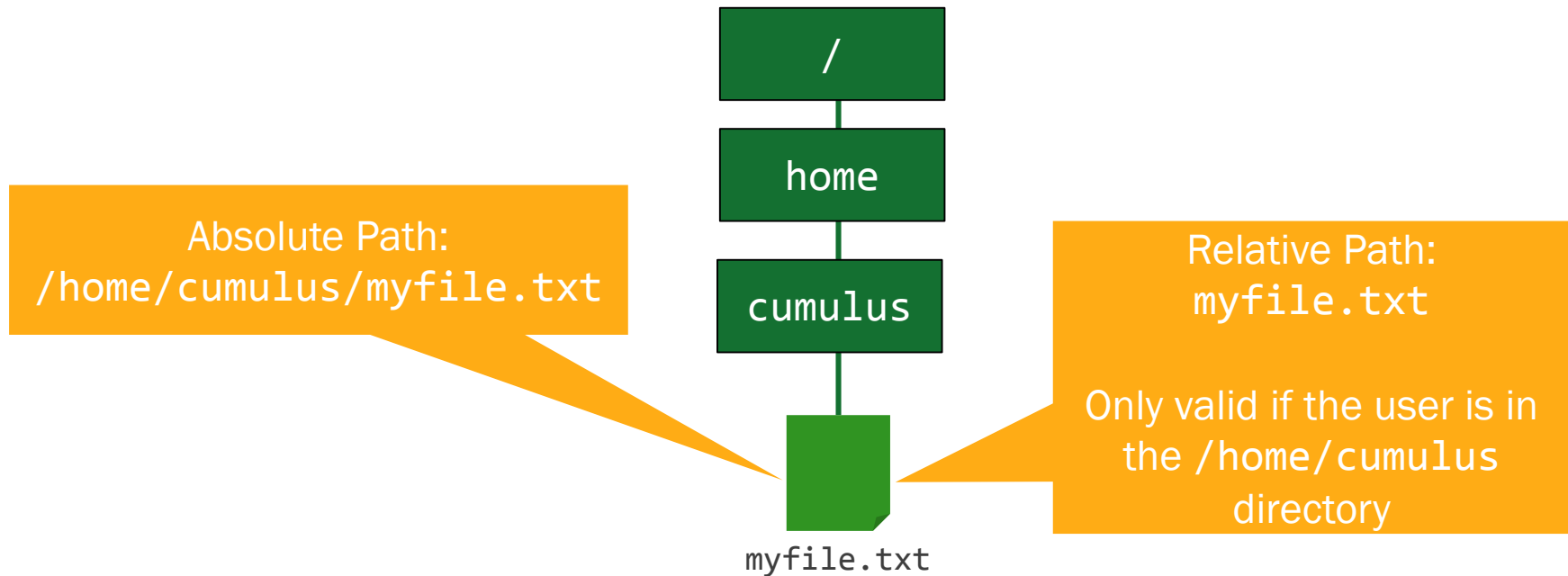


## Everything is a file in a Linux system

Directory: list of other files

Regular file: user or system data





The shell is a command line interpreter that provides a user interface for a GNU/Linux operating system

```
cumulus@leaf1$ echo $SHELL
/bin/bash
cumulus@leaf1$ echo $BASH_VERSION
4.2.37(1)-release
cumulus@leaf1$ cat helloworld.sh
#!/bin/bash
echo Hello World
cumulus@leaf1$ bash helloworld.sh
Hello World
```





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## Section 2: Common Commands

Linux is case sensitive for both commands and file names

Special characters may have functionality in the shell

```
cumulus@leaf1$ ls
helloworld.sh
cumulus@leaf1$ cat helloworld.sh
#!/bin/bash
echo Hello World
cumulus@leaf1$ cat helloworld.SH
cat:helloworld.SH: No such file or directory
```

The `pwd` command is used to output the path of the current working directory

```
cumulus@leaf1$ pwd  
/home/cumulus
```

The `cd` command is used to change the current working directory

```
cumulus@leaf1$ pwd
/home/cumulus
cumulus@leaf1$ cd /etc
cumulus@leaf1$ pwd
/etc
cumulus@leaf1$ cd
cumulus@leaf1$ pwd
/home/cumulus
```

# The `ls` command is used to list the contents of a directory

```
cumulus@leaf1$ ls
testdir          testfile1.txt  testfile2.txt
cumulus@leaf1$ ls -lhR
.:
total 12K
drwxr-xr-x  2 cumulus cumulus 4.0K Sep 14 03:05 testdir/
-rw-r--r--  1 cumulus cumulus   7 Sep 14 03:05 testfile1.txt
-rw-r--r--  1 cumulus cumulus 125 Sep 14 03:05 testfile2.txt

./testdir:
total 4.0K
-rw-r--r--  1 cumulus cumulus 20 Sep 14 03:05 testfile3.txt
```

The `tree` command shows the contents of the current directory in a visual hierarchy

```
cumulus@leaf1$ cd /etc/cumulus/  
cumulus@leaf1$ tree  
|-- acl  
|   |-- acl.conf  
|   |-- policy.conf  
|   `-- policy.d  
|       |-- 00control_plane.rules  
|       `-- 99control_plane_catch_all.rules  
|-- datapath  
|   |-- README  
|   `-- traffic.conf  
|-- etc.replace  
|   |-- lsb-release  
|   `-- os-release  
|-- init  
|   |-- accton_as4600_54t  
|   ...
```

**\***: a wildcard which denotes zero or more characters

```
cumulus@leaf1$ ls testfile*  
testfileA testfileB testfileC
```

**“**, **‘**, and **\**: characters which remove (“escape”) the special meaning of other characters

```
cumulus@leaf1$ ls "testfile*"  
ls: cannot access testfile*: No such file or directory  
cumulus@leaf1$ ls testfile\  
ls: cannot access testfile*: No such file or directory  
cumulus@leaf1$ ls 'testfile*'  
ls: cannot access testfile*: No such file or directory
```



### The `mkdir` command is used to create a new directory

- The `-p` option makes sub-directories automatically

```
cumulus@leaf1$ mkdir levelone
cumulus@leaf1$ mkdir levelone/leveltwo
cumulus@leaf1$ mkdir -p levelone/leveltwo/levelthree/levelfour
cumulus@leaf1$ cd levelone/leveltwo/levelthree/levelfour/
cumulus@leaf1$ pwd
/home/cumulus/levelone/leveltwo/levelthree/levelfour
```

Made automatically using the `-p` option

### The `rmdir` command deletes directories

- Only empty directories can be removed
- The `-p` options removes parent directories

## The `cp` command is used to copy a file

- Use the `-r` option to copy a directory, including its contents

```
cumulus@leaf1$ cp directoryA/testing123.txt directoryB/  
cumulus@leaf1$ ls directoryB  
testing123.txt  
cumulus@leaf1$ cp -r directoryB/ directoryC  
cumulus@leaf1$ ls  
directoryA/ directoryB/ directoryC/  
cumulus@leaf1$ ls directoryC  
testing123.txt
```

# The mv command is used to move or rename a file or directory

```
cumulus@leaf1$ ls directoryA
test.txt
cumulus@leaf1$ ls directoryB
cumulus@leaf1$ mv directoryA/test.txt directoryB/
cumulus@leaf1$ ls directoryB
test.txt
cumulus@leaf1$ cd directoryB
cumulus@leaf1$ mv test.txt testing.txt
cumulus@leaf1$ ls
testing.txt
cumulus@leaf1$ mv testing.txt ../directoryA/testing123.txt
cumulus@leaf1$ cd ../directoryA/
cumulus@leaf1$ ls
testing123.txt
```

## The `rm` command is used to delete a file or directory

- Use the `-r` option to remove directories and their contents recursively

```
cumulus@leaf1$ ls
intro2linux/  levelone/  testdir/  testfile.txt
cumulus@leaf1$ rm testfile.txt
cumulus@leaf1$ ls
intro2linux/  levelone/  testdir/
cumulus@leaf1$ rm -r levelone/
cumulus@leaf1$ ls
intro2linux/  testdir/
```

The `cat` command is used to display the contents of a file

```
cumulus@leaf1$ cat testfile.txt  
This is the text in the testfile.txt file!
```

Output is displayed to *standard output*, which defaults to the screen in Linux

The `less` command is used output the contents of a file one screen at a time

```
cumulus@leaf1$ less /etc/network/interfaces
```

When used with the pipe character (`|`), more can page output from any command

```
cumulus@leaf1$ ls -lR /etc | less
```

### The `head` command is used to display the first few lines of a file

- Displays first 10 lines by default
- Use the `-n` option to specify how many lines to show

```
cumulus@leaf1$ head -n 2 /etc/network/interfaces
# This file describes the network interfaces available on your system
# and how to activate them. For more information, see interfaces(5), ifup(8)
cumulus@leaf1$
```

# The `tail` command is used to display the last few lines of a file

- Use the `-F` option to watch a file being updated in real-time

```
cumulus@leaf1$ tail -F /var/log/messages
Sep 14 14:33:17 leaf1 : /usr/sbin/smond : : Temp2(MPC8541(CPU) Sensor): state
changed from LOW to OK
Sep 14 16:13:30 leaf1 : /usr/sbin/smond : : Temp2(MPC8541(CPU) Sensor): state
changed from OK to LOW
Sep 14 16:13:42 leaf1 : /usr/sbin/smond : : Temp2(MPC8541(CPU) Sensor): state
changed from LOW to OK
```



The `grep` command searches a file for specified arguments

```
cumulus@leaf1$ cat colors.txt
red
blue
purple
cumulus@leaf1$ grep purple colors.txt
purple
```

`grep` can be used with the `|` character to search standard output for patterns

```
cumulus@leaf1$ ls -l /etc | grep ssh
drwxr-xr-x 1 root root 4096 Sep 11 07:22 ssh/
```

## ssh (SSH Client) allows users to log into or run a command on a remote system

- Based on the Secure Shell (SSH) protocol

remote user name

remote host


```
cumulus@leaf1$ ssh cumulus@leaf2
```

```
cumulus@leaf1$ ssh cumulus@leaf2 "ls /home/cumulus/"
```

## Secure copy (SCP) allows you to transfer files between hosts

- Based on the Secure Shell (SSH) protocol

```
cumulus@leaf1$ scp testfile1.txt cumulus@leaf2:/home/cumulus/  
Password:  
testfile1.txt  
100% 258 0.3KB/s 00:00
```



Linux systems have a built in reference manual, known as “man pages”

- The man page to the right is the result of entering `man man`

```
1. cumulus@leaf1: ~ (ssh)
MAN(1)                                Manual pager utils                                MAN(1)
NAME
man - an interface to the on-line reference manuals

SYNOPSIS
man [-C file] [-d] [-D] [--warnings=warnings] [-R encoding] [-L locale] [-M sys-
tem[...]] [-M path] [-S list] [-e extension] [-i|-I] [--regex --wildcard
--names-only] [-a] [-u] [--no-subpages] [-P pager] [-r prompt] [-7] [-E encoding]
[--no-hyphenation] [--no-justification] [-p string] [-t] [-T(device)] [-H browser]
[-X[dot]] [-Z [section] page ...] ...
man -k [options] section ...
man -K [-w|-W] [-S list] [-i|-I] [--regex] [section] term ...
man -f [options] section page ...
man -l [-C file] [-d] [-D] [--warnings=warnings] [-R encoding] [-L locale] [-P
pager] [-r prompt] [-7] [-E encoding] [-p string] [-t] [-T(device)] [-H browser]
[-X[dot]] [-Z file ...] ...
man -w|-W [-C file] [-d] [-D] page ...
man -c [-C file] [-d] [-D] page ...
man [-hV]

DESCRIPTION
man is the system's manual pager. Each page argument given to man is normally the
name of a program, utility or function. The manual page associated with each of
these arguments is then found and displayed. A section, if provided, will direct
man to look only in that section of the manual. The default action is to search in
all of the available sections, following a pre-defined order and to show only the
first page found, even if page exists in several sections.

The table below shows the section numbers of the manual followed by the types of
pages they contain.

1 Executable programs or shell commands
2 System calls (functions provided by the kernel)
3 Library calls (functions within program libraries)
4 Special files (usually found in /dev)
5 File formats and conventions eg /etc/passwd
6 Games
7 Miscellaneous (including macro packages and conventions), e.g. man(7), groff(7)
8 System administration commands (usually only for root)
9 Kernel routines [Non standard]

Manual page man(1) line 1 (press h for help or q to quit)
```



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## Section 3: Users and Groups

# The top-level administrator in a Linux system is the root account

- Also referred to as the *root user* or *superuser*
- Should be rarely used, as it has no security restrictions on it
- The root user can do anything on the system
- May be disabled for security purposes

## There are two types of users on a Linux system:

- System accounts – used for administrative purposes
- User accounts – allow users and administrators access to the system

```
cumulus@leaf1:~$ cat /etc/passwd
root:x:0:0:root:/root:/bin/bash
daemon:x:1:1:daemon:/usr/sbin:/bin/sh
bin:x:2:2:bin:/bin:/bin/sh
sys:x:3:3:sys:/dev:/bin/sh
sync:x:4:65534:sync:/bin:/bin/sync
...
ntp:x:104:107:~/home/ntp:/bin/false
snmp:x:105:108:~/var/lib/snmp:/bin/false
cumulus:x:1000:1000:~/home/cumulus:/bin/bash
```

System  
accounts

User  
account

user name

user ID

group ID

home  
directory

default  
shell



## Groups allow permissions to be assigned to multiple users simultaneously

```
cumulus@leaf1:~$ cat /etc/group
root:x:0:
daemon:x:1:
bin:x:2:
sys:x:3:
adm:x:4:
...
sudo:x:27:cumulus,rocket
...
```

Group name

password

Group ID (GID)

Group members

**sudo** allows a user to execute commands as another user (typically *root*)



`useradd -m rocket`



`sudo useradd -m rocket`



By default, adding a user to the *sudo* group gives privileged command access.

```
cumulus@leaf1:~$ cat /etc/group
root:x:0:
daemon:x:1:
bin:x:2:
sys:x:3:
adm:x:4:
...
sudo:x:27:cumulus,rocket
...
```

## Use the `passwd` command to change your password

- Requires your previous password for security
- Can be used by the root user to change any password without the previous password

```
cumulus@leaf1$ passwd
Changing password for cumulus.
(current) UNIX password:
Enter new UNIX password:
Retype new UNIX password:
passwd: password updated successfully
```

```
cumulus@leaf1$ sudo passwd rocket
Enter new UNIX password:
Retype new UNIX password:
passwd: password updated successfully
cumulus@leaf1$
```

Permissions control what actions a user can take on a file

Permissions can be viewed with the `ls -l` command

```
cumulus@leaf1$ ls -l
total 4.0K
-rw-r--r-- 1 cumulus cumulus 5 Sep 14 02:23 testfile.txt
```

size

Permissions

User  
(owner)

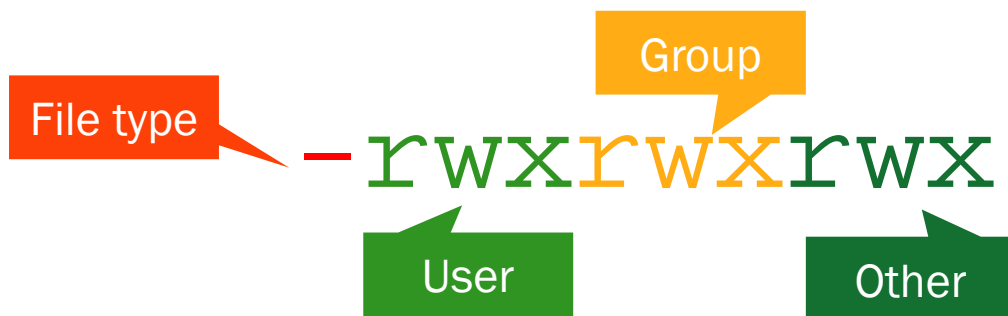
Group

Last  
modified  
date

File name

Permissions are based on three object types:

- User – the owner of the file
- Group – the set of associated users
- Other – anyone else



## Permissions allow three actions:

- **Read** – see the contents of the file
- **Write** – change the contents of the file
- **Execute** – run the file as an executable

– rwxrwxrwx

# Which users could take which actions on files with the following permissions?

- A file marked as `rxwxrwxrwx` belonging to user *cumulus* and group *users*:
- A file marked as `rw-r--r--` belonging to user *cumulus* and group *users*:
- A file marked as `rw-rw----` belonging to user *cumulus* and group *users*:



# File and directory permissions can be changed using the `chmod` command

- Specify the type of permission to change  
**u** (user), **g** (group), **o** (other), **a** (all)
- Specify how to change the permission  
**+** (add), **-** (delete), **=** (set)
- Specify which permission to change  
**r** (read), **w** (write), **x** (execute)

# Example: Changing File Permissions

```
cumulus@leaf1$ ls -l
total 0
-rw-r--r--  1 cumulus cumulus  0 Nov  5 12:48 file1.txt
cumulus@leaf1$ chmod g+x,o= file1.txt
cumulus@leaf1$ ls -l
total 0
-rw-r-x---  1 cumulus cumulus  0 Nov  5 12:48 file1.txt
cumulus@leaf1$ chmod g-x file1.txt
cumulus@leaf1$ ls -l
total 0
-rw-r-----  1 cumulus cumulus  0 Nov  5 12:48 file1.txt
cumulus@leaf1$ chmod a=rw file1.txt
cumulus@leaf1$ ls -l
total 0
-rw-rw-rw-  1 cumulus cumulus  0 Nov  5 12:48 file1.txt
```

The user and group ownership of files and directories can be modified using the **chown** and **chgrp** commands.

- The **-R** option can be used to change ownership recursively
- Requires superuser privileges

```
cumulus@leaf1$ ls -l
total 0
-rwx---rw- 1 cumulus cumulus 0 Sep 21 03:20
testfile.txt
cumulus@leaf1$ sudo chown rocket testfile.txt
cumulus@leaf1$ ls -l
total 0
-rwx---rw- 1 rocket cumulus 0 Sep 21 03:20
testfile.txt
cumulus@leaf1$ sudo chgrp users testfile.txt
cumulus@leaf1$ ls -l
total 0
-rwx---rw- 1 rocket users 0 Sep 21 03:20
testfile.txt
```



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## Section 4: Processes and Services

The `ps` command is used to view a list of processes running on the Linux system

```
cumulus@leaf1$ ps -ef cumulus
UID          PID    PPID  C  STIME TTY          TIME CMD
root           1        0  0  22:12 ?           00:00:00 init [3]
root           2        0  0  22:12 ?           00:00:00 [kthreadd]
root           3        2  0  22:12 ?           00:00:00 [ksoftirqd/0]
root           5        2  0  22:12 ?           00:00:00 [kworker/u:0]
root           6        2  0  22:12 ?           00:00:00 [migration/0]
...
root          1961        1  0  22:14 ?           00:00:00 /sbin/mstpd -v2
ntp           2003        1  0  22:14 ?           00:00:00 /usr/sbin/ntpd -p
/var/run/ntpd.pid -g -U0 -c /var/lib/ntp/ntp.conf.dhcp -u 104:107
root          2089        1  0  22:14 ?           00:00:00 /usr/bin/python
/usr/lib/python2.7/dist-packages/clcmd_server.py
cumulus      3873      2957  0  23:04 pts/0       00:00:00 ps -ef
```

Many options exist for the `ps` command – some examples include:

Option	Behavior
<code>-f</code>	Shows the output in full format
<code>-e</code>	Shows all processes
<code>-u &lt;UID&gt;</code>	Shows processes for a specific user
<code>-p &lt;PID&gt;</code>	Shows processes for a specific process ID (PID)
<code>-C &lt;process_name&gt;</code>	Shows processes of a specific name

Services are maintained by *daemons*, background processes which maintain the service's functions

Services can be controlled using the `service` command:

```
service <service name> [ start | stop |  
restart]
```



# Example: Managing Services

```
cumulus@leaf1$ ps -C lldpd
  PID TTY          TIME CMD
 2277 ?            00:00:00 lldpd
 2299 ?            00:00:01 lldpd
cumulus@leaf1$ sudo service lldpd stop
cumulus@leaf1$ ps -C lldpd
  PID TTY          TIME CMD
cumulus@leaf1$ sudo service lldpd start
cumulus@leaf1$ ps -C lldpd
  PID TTY          TIME CMD
24166 ?            00:00:00 lldpd
24184 ?            00:00:00 lldpd
```

# The Linux system can be shut down or restarted using the `shutdown` command

- Default behavior is to shutdown the system
- Use the `-r` option to reboot
- Use a time delay to run the command later

```
cumulus@leaf1$ sudo shutdown now
Broadcast message from root@leaf1 (pts/0) (Sun Sep 21 18:49:48 2014):

The system is going down for reboot NOW!
cumulus@leaf1$ Connection to leaf1 closed by remote host.
Connection to leaf1 closed.
```



# Thank You!

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## Section 5: Basic Networking

# Changing the hostname in Linux is a three-step process:

- Edit the `/etc/hostname` file
- Assign the new hostname to the `127.0.1.1` address in the `/etc/hosts` file
- Reboot the switch

# Formatting /etc/network/interfaces Entries

Bring up interface during boot up  
or after `sudo ifup -a`

Interface name

inet type: dhcp, loopback or static

```
auto <int_name>  
iface <int_name> inet <type>  
    <option> <value>  
    <option> <value>  
    ...
```

## eth0 – default configuration

```
auto eth0
```

```
iface eth0 inet dhcp
```

dhcp inet type

## eth0 – with IP address

```
auto eth0
iface eth0 inet static
    address 192.168.0.11/24
    address 2001:db8::1/32
    gateway 192.168.0.1
    gateway 2001:db8::2
```

IP address settings for interface,  
only if using static

Install IPv4 and IPv6 default route



## lo – loopback interface

```
auto lo
iface lo inet loopback
address 10.2.1.1/32
address 2001:da8::1/32
```

Loopback inet type

Optional IP address(es)

# Displaying Port State for all Interfaces and Specific Interfaces

```
cumulus@leaf1$ ip link show
```

```
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 1636 qdisc noqueue state UNKNOWN mode DEFAULT  
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00  
2: eth0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state UP mode DEFAULT qlen 1000  
    link/ether 08:9e:01:f8:90:7e brd ff:ff:ff:ff:ff:ff  
3: swp1: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state UP mode DEFAULT qlen 500  
    link/ether 08:9e:01:f8:90:80 brd ff:ff:ff:ff:ff:ff  
4: swp2: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state UP mode DEFAULT qlen 500  
    link/ether 08:9e:01:f8:90:80 brd ff:ff:ff:ff:ff:ff  
...
```

```
cumulus@leaf1$ ip link show dev swp1
```

```
3: swp1: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state UP mode DEFAULT qlen 500  
    link/ether 44:38:39:00:03:c1 brd ff:ff:ff:ff:ff:ff
```

```
cumulus@leaf1$ ip addr show dev swp1
```

```
3: swp1: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state UP qlen 500  
    link/ether 44:38:39:00:03:c1 brd ff:ff:ff:ff:ff:ff  
    inet 192.0.2.1/30 scope global swp1  
    inet6 2001:DB8::1/126 scope global tentative
```

The **-I** option verifies connectivity through a specific interface.

```
cumulus@leaf1:~$ ping -I 10.3.3.1 10.4.4.1
PING 10.4.4.1 (10.4.4.1) from 10.3.3.1 : 56(84) bytes of data.
64 bytes from 10.4.4.1: icmp_req=1 ttl=64 time=0.825 ms
64 bytes from 10.4.4.1: icmp_req=2 ttl=64 time=0.750 ms ...
```

`traceroute` follows a packet to a target to help determine where the routing fails.

```
cumulus@leaf1:~$ traceroute www.google.com
traceroute to www.google.com (74.125.239.49), 30 hops max, 60 byte packets
 1 fw.cumulusnetworks.com (192.168.1.1)  0.614 ms  0.863 ms  0.932 ms
 2 router.hackerdojo.com (157.22.42.1)  15.459 ms  16.447 ms  16.818 ms
 3 gw-cpe-hackerdojo.via.net (157.22.10.97)  18.470 ms  18.473 ms  18.897 ms
 4 ge-1-5-v223.core1.uspao.via.net (157.22.10.81)  20.419 ms  20.422 ms  21.026 ms
 5 core2-1-1-0.pao.net.google.com (198.32.176.31)  22.347 ms  22.584 ms  24.328 ms
 6 216.239.49.250 (216.239.49.250)  24.371 ms  25.757 ms  25.987 ms
 7 72.14.232.35 (72.14.232.35)  27.505 ms  22.925 ms  22.323 ms
 8 nuq04s19-in-f17.1e100.net (74.125.239.49)  23.544 ms  21.851 ms  22.604 ms
...
```

`ip route show` prints the current routing table.

`ip route get` prints the next hop for a route

```
cumulus@leaf1$ ip route show
default via 192.168.0.1 dev eth0
192.168.0.0/24 dev eth0 proto kernel scope link src 192.168.0.11
```

```
cumulus@leaf1$ ip route get 192.168.0.1/24
192.168.0.1 dev eth0 src 192.168.0.11
  cache ipid 0x7b98 rtt 8ms rttvar 12ms cwnd 10
```

```
cumulus@leaf1$ ip route get 3.3.3.3
3.3.3.3 via 192.168.0.1 dev eth0 src 192.168.0.11
  cache
```

# The arp command manages the kernel's IPv4 network neighbor cache.

- To display the ARP cache:

```
cumulus@leaf1:~$ arp -a
? (11.0.2.2) at 00:02:00:00:00:10 [ether] on swp3
? (11.0.3.2) at 00:02:00:00:00:01 [ether] on swp4
? (11.0.0.2) at 44:38:39:00:01:c1 [ether] on swp1
```

- To delete an ARP cache entry:

```
cumulus@leaf1:~$ arp -d 11.0.2.2
cumulus@leaf1:~$ arp -a
? (11.0.2.2) at <incomplete> on swp3
? (11.0.3.2) at 00:02:00:00:00:01 [ether] on swp4
? (11.0.0.2) at 44:38:39:00:01:c1 [ether] on swp1
```



Thank You!

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# Introduction to Linux

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## Section 6: Editing Tools



## Nano is a text editor that behaves like a GUI-based text editor

- Commands are executed by keyboard shortcuts
- Common commands are listed at the bottom of the screen for easy reference



```
GNU nano 2.2.6          New Buffer          Modified
This is a text file.
^G Get Help  ^O WriteOut  ^R Read File  ^Y Prev Page  ^X Cut Text  ^C Cur Pos
^X Exit      ^J Justify   ^W Where Is   ^V Next Page  ^U UnCut Text ^T To Spell
```

## Press `<ctrl>-g` to show all nano commands

```
GNU nano 2.2.6                               New Buffer                               Modified

The notation for shortcuts is as follows: Control-key sequences are notated
with a caret (^) symbol and can be entered either by using the Control (Ctrl)
key or pressing the Escape (Esc) key twice.  Escape-key sequences are notated
with the Meta (M-) symbol and can be entered using either the Esc, Alt, or
Meta key depending on your keyboard setup.  Also, pressing Esc twice and then
typing a three-digit decimal number from 000 to 255 will enter the character
with the corresponding value.  The following keystrokes are available in the
main editor window.  Alternative keys are shown in parentheses:

^G      (F1)      Display this help text
^X      (F2)      Close the current file buffer / Exit from nano
^O      (F3)      Write the current file to disk
^J      (F4)      Justify the current paragraph
```

## Managing Files

Key Sequence	Action
<code>&lt;ctrl&gt;-o</code>	Save the current file
<code>&lt;ctrl&gt;-x</code>	Exit nano (will prompt if save is needed)

## Managing Text

Key Sequence	Action
<code>&lt;meta&gt;-&lt;ctrl&gt;</code>	Copy current line into buffer
<code>&lt;ctrl&gt;-k</code>	Cut current line into buffer
<code>&lt;ctrl&gt;-u</code>	Paste from buffer
<code>&lt;ctrl&gt;-w</code>	Search for a string or regex
<code>&lt;ctrl&gt;-\</code>	Search and replace

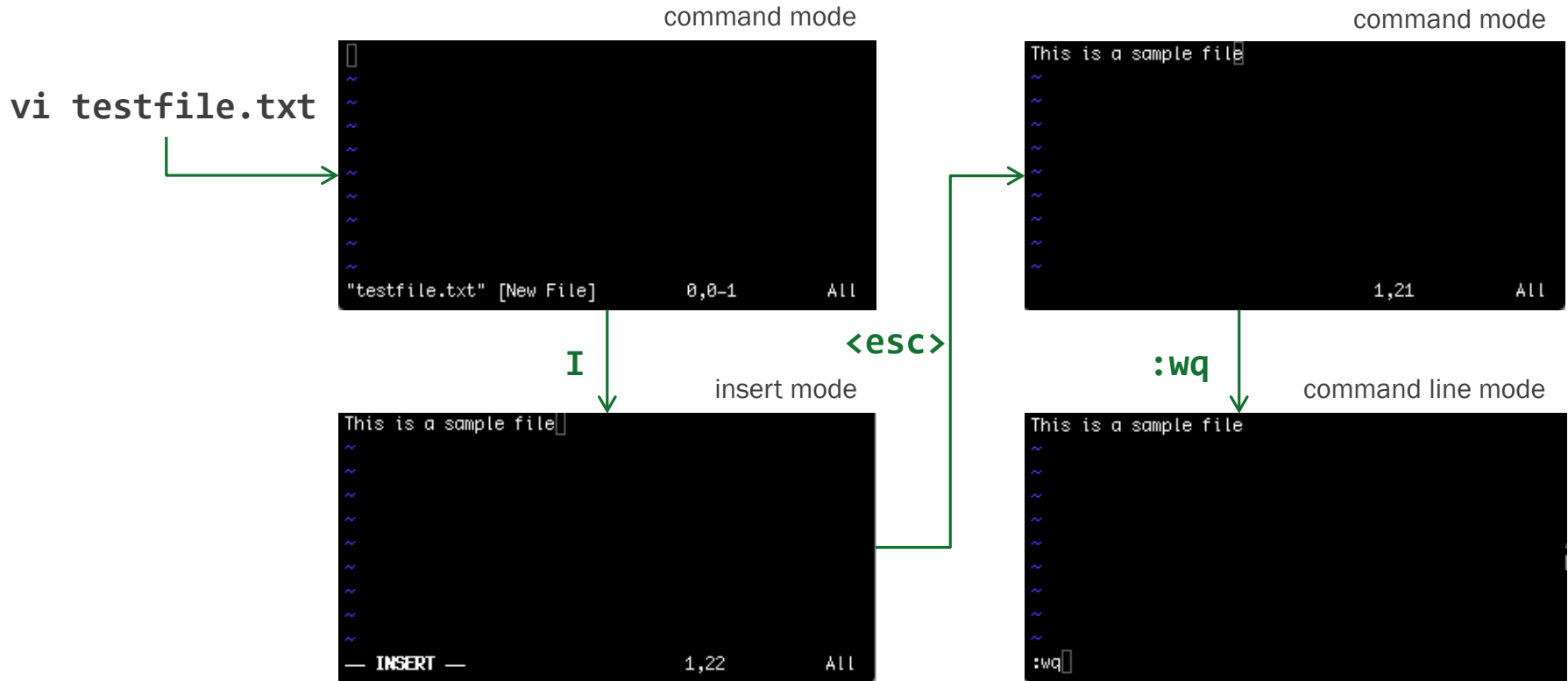
Note: `<meta>` is the `<alt>`, `<meta>`, or `<esc>` key, depending on the user's keyboard mapping.

## vi is a text editor included with all Linux distributions

### When using vi, the editor is in one of three modes:

- Command mode: all keys on the keyboard map to editor commands
- Insert mode: the keys on the keyboard work as expected, allowing users to input text into the file; press the Esc key to return to command mode
- Command line mode: this mode is entered from command mode by using the colon (:), allowing commands to be typed at the bottom of the screen

# vi Modes



## Cursor Movement

Key Sequence	Action
<down arrow> or j	Move cursor down
<up arrow> or k	Move cursor up
<left arrow> or h	Move cursor left
<right arrow> or l	Move cursor right

## Entering Insert Mode

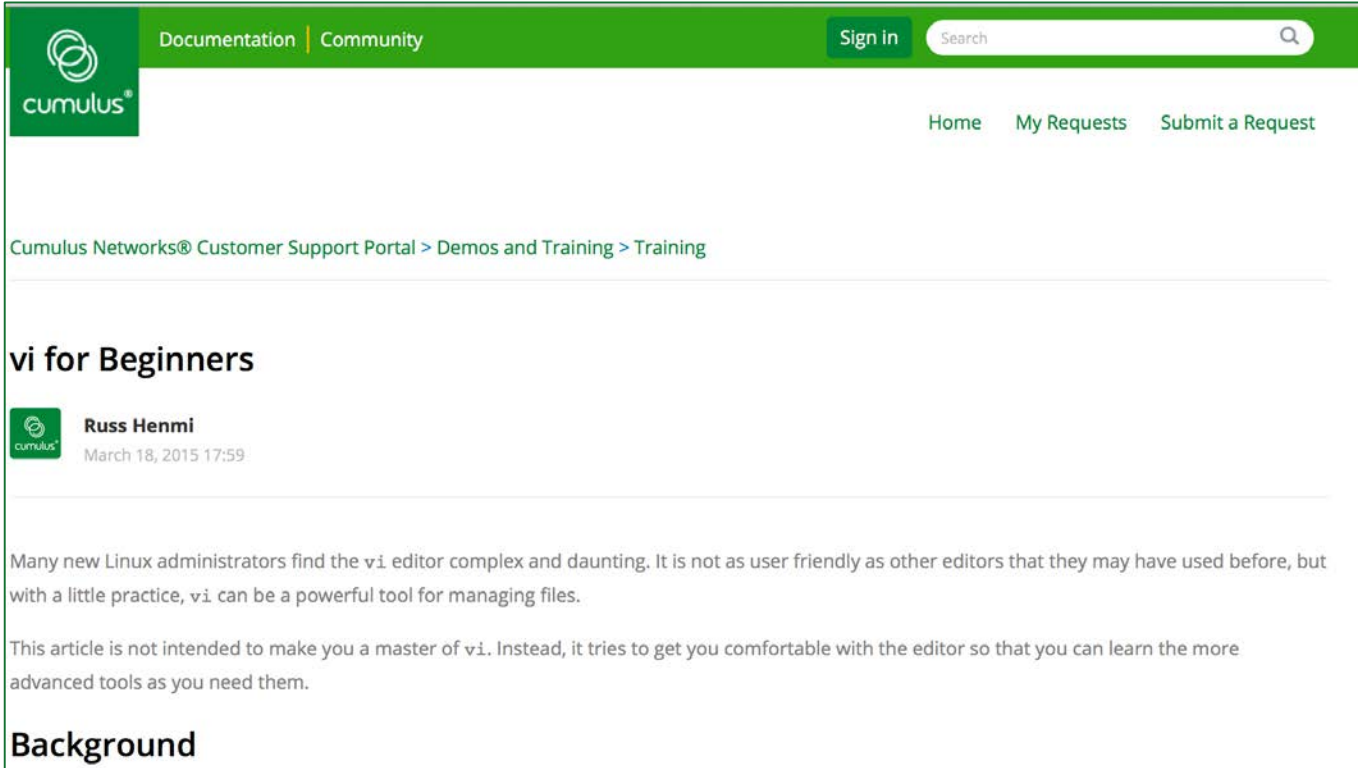
Key Sequence	Action
i	Insert text at cursor location
a	Append text after cursor location
I	Insert text at the beginning of the line
A	Append text to the end of the line
<esc>	Exit insert mode

## Managing Text

Key Sequence	Action
<b>x</b>	Delete character
<b>dd</b>	Delete row
<b>yy</b>	Copy row
<b>4yy</b>	Copy 4 rows into buffer (number can be changed)
<b>p</b>	Paste from buffer
<b>r</b>	Replace character (type in replacement after)
<b>cw</b>	Change word (type in replacement after)

## Using Command Line Mode

Key Sequence	Action
<b>:wq</b>	Write file and exit
<b>:q</b>	Exit without saving




The screenshot shows the Cumulus Networks Customer Support Portal. The top navigation bar is green with the Cumulus logo on the left, 'Documentation | Community' in the center, and a 'Sign in' button and search bar on the right. Below the navigation bar, there are links for 'Home', 'My Requests', and 'Submit a Request'. The main content area shows a breadcrumb trail: 'Cumulus Networks® Customer Support Portal > Demos and Training > Training'. The article title is 'vi for Beginners'. The author is 'Russ Henmi' with a small Cumulus profile picture, and the date is 'March 18, 2015 17:59'. The article text begins with: 'Many new Linux administrators find the vi editor complex and daunting. It is not as user friendly as other editors that they may have used before, but with a little practice, vi can be a powerful tool for managing files.' and continues with: 'This article is not intended to make you a master of vi. Instead, it tries to get you comfortable with the editor so that you can learn the more advanced tools as you need them.' The section 'Background' is partially visible at the bottom.

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Cumulus Networks® Customer Support Portal > Demos and Training > Training

## vi for Beginners

 **Russ Henmi**  
March 18, 2015 17:59

Many new Linux administrators find the `vi` editor complex and daunting. It is not as user friendly as other editors that they may have used before, but with a little practice, `vi` can be a powerful tool for managing files.

This article is not intended to make you a master of `vi`. Instead, it tries to get you comfortable with the editor so that you can learn the more advanced tools as you need them.

### Background





Thank You!

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