Linux OS Fundamentals for the Windows Admin

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Level: Intermediate

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TECHMENTOR

Rules

- Ask questions during the session
- I talk fast, ask me to slow down…it's cool

Overview

- Installing Linux
- Linux Architecture
- Interacting With Your Linux System
- I/O Redirection and Pipelines (break)
- File System Basics
- Working With PowerShell on Linux
- Working With Packages (break)
- Managing Services With systemd
- System Resource Management
- Getting Help

What is Linux?

- **What is Linux?**
  - An operating system. Kernel and programs
- **Where did Linux come from?**
  - Linus Torvalds and Richard Stallman
- **Who are the major players?**
  - Red Hat, Debian, Ubuntu and you!
- **Who's using Linux?**
  - Enterprise, Government, Hosting and you!

Getting Linux

- RedHat
  - Subscriptions, Evaluation or Developer
- Clones
  - CentOS, Scientific Linux and more

Basic Linux Installation Options

- Booting - DVD, USB, PXE
- Installation UI - Anaconda or Text
- Installation Sources - DVD, NFS, HTTP, FTP
- Software Selection - Server with GUI
- Network Configuration - hostname, IP and gateway
- Installation Destination - disk, RAID, FC, Xen, VirtIO

Virtual Consoles

	Key sequence
Main	`ctrl + alt + F1`
Root shell	`ctrl + alt + F2`
Installation logs	`ctrl + alt + F3`
Storage logs	`ctrl + alt + F4`
Program logs	`ctrl + alt + F5`
Installation interface	`ctrl + alt + F6`

Installation Logs

- `/tmp/anaconda.log` - overview
- `/tmp/program.log` - programs run during installation
- `/tmp/storage.log` - storage module info
- `/tmp/packaging.log` - yum and rpm info
- `/tmp/syslog` - hardware related messages

Demo

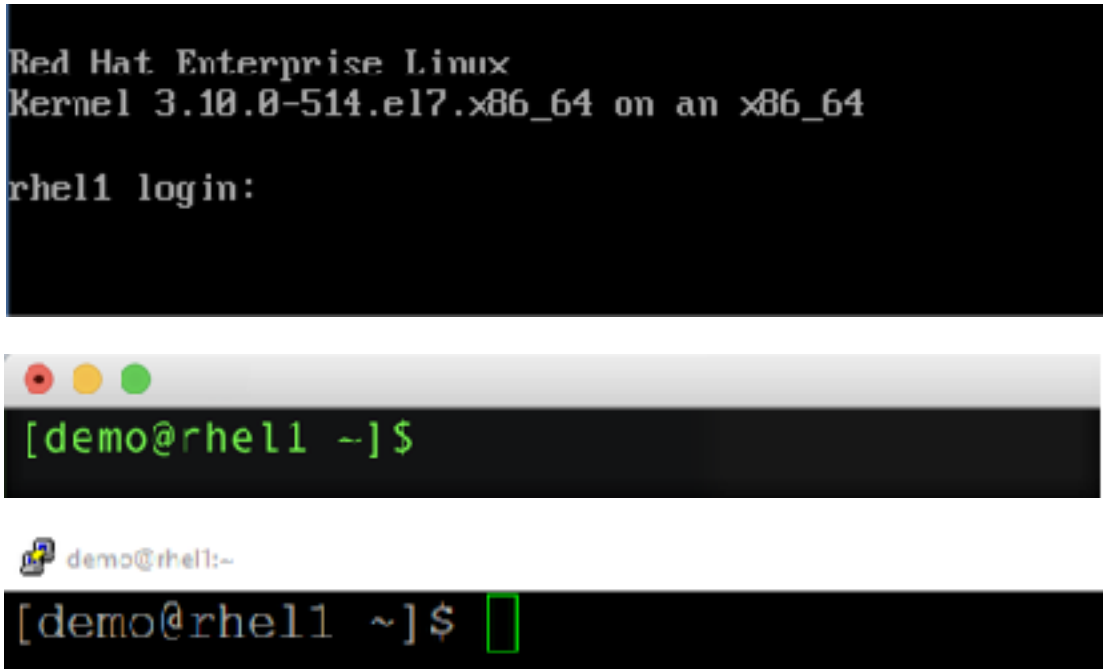
- Installing CentOS from ISO
- Virtual Consoles
- Installation Logs

Linux Architecture

User Space	Users	Interact with the Shell	Cause Problems :)
	Shell	Executes Your Commands…Your Interface to the Kernel	Commands, Editors…any User Program
Kernel Space	Kernel	Resource Management and Access	Process, Memory and File Systems
	Hardware	Physical Resources	CPU, Disk and Memory

Interacting With Your Linux System

- Text
  - Console
  - SSH - Secure Shell
    - Terminal (Linux/Mac)
    - PuTTY (Windows)
- Graphically
  - Desktop Manager
  - VNC



What is a Shell?

- **User interface**
  - Your interface into the kernel
- **Command line interpreter**
  - The command prompt, where you enter commands
- **Common Shells**
  - bourne (sh), bash (bash) , C (csh) and many more

Executing Commands

command	option	argument
ls	-la	/home

bash's Features

- Basic bash features
  - Command execution, aliases, variables, environment variables (PATH), tab completion

- Advanced bash features
  - Job control, input and output redirection, pipes and scripts

bash's Features (con't)

- Keyboard Shortcuts (http://bit.ly/2hvLvpw)
  - `ctrl+a` - move to the start of the line
  - `ctrl+e` - move to the end of a line
  - `ctrl+l` - clear the screen
  - `ctrl+z` - backdrop the currently running task
- History
  - Previously executed commands
  - We can execute a command with `!n`

Switching Users

- Linux security is based on user ids
  - root
    - UID 0
    - # at the command prompt
    - Try to avoid using root
  - Regular Named Users
    - UID >= 1000
    - $ at the command prompt

```
[root@rhel1 ~]#
```

```
[demo@rhel1 ~]$
```

Switching Users

- Switching users
  - `su` - switch user, uses that users password
  - `sudo` - Allows for users to execute and individual command with escalated privileges. Your password.

Demo

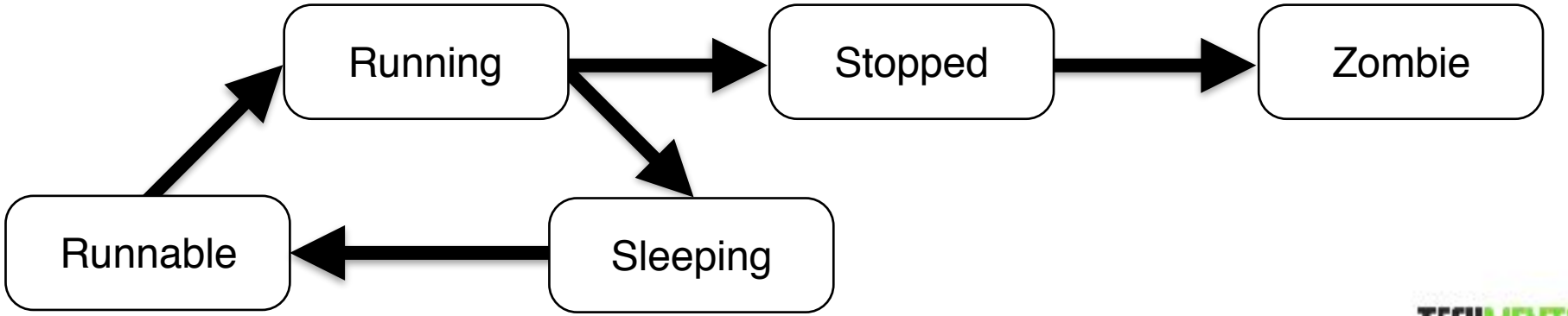
- Interacting with your system
- Keyboard shortcuts and job control
- Command History
- Access and privileged access
- Switching Users

What is a Process

- Process
  - Executing program, program code, memory and resources
- Process Creation
  - fork - parent process yields a child process with a PID
- Process Tree
  - The hierarchy of parent and it’s child processes

What is a Process (con't)

- Viewing and monitoring processes
  - `ps, top, ps --forest, gnome-system-monitor`
- Process States
  - Running, Sleeping, Runnable, Stopped and Zombie



Controlling Processes

- Signals
  - Methods of process control
    - `kill` and `killall`
- Niceness
  - Set the execution priority
    - `nice` and `renice`
    - Default 20, lower is less “nice”

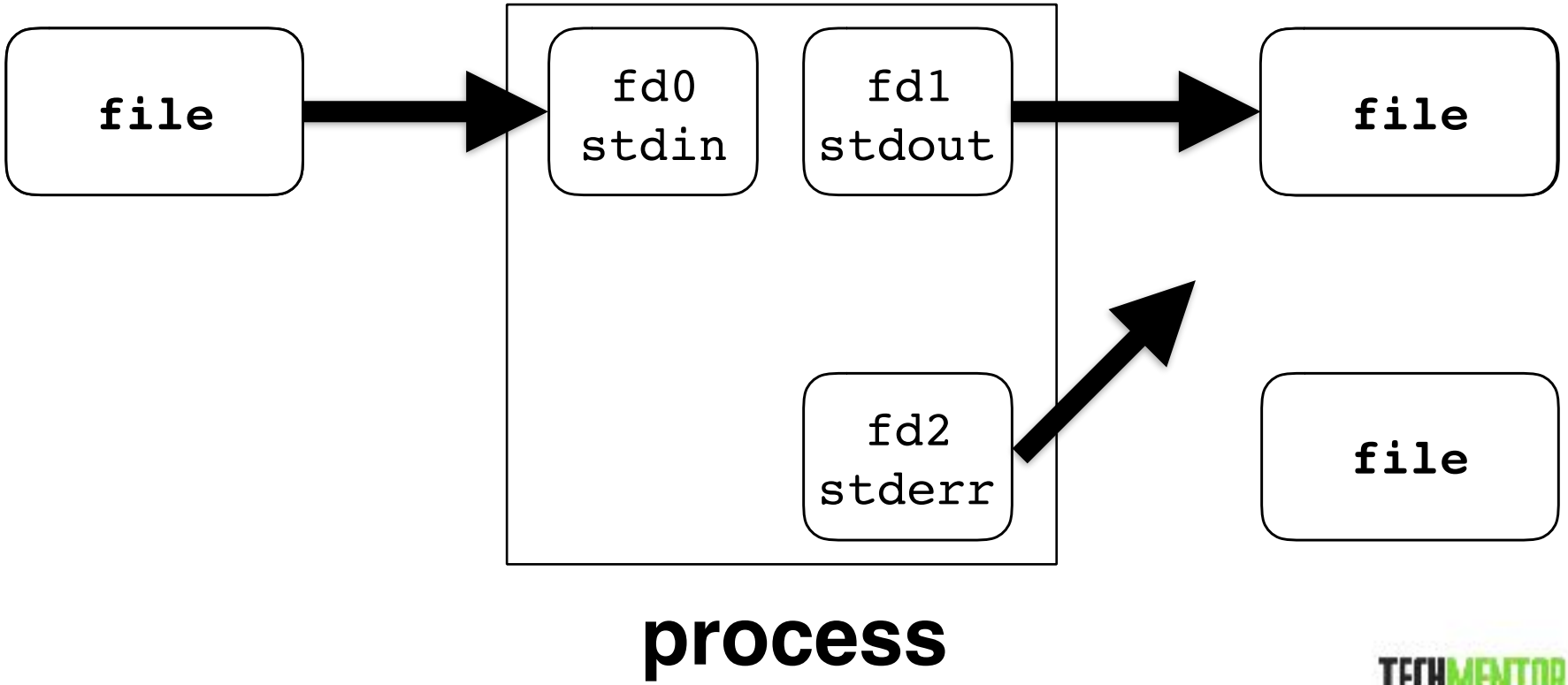
Demo

- Process
- Viewing and monitoring a process
- States
- Signals

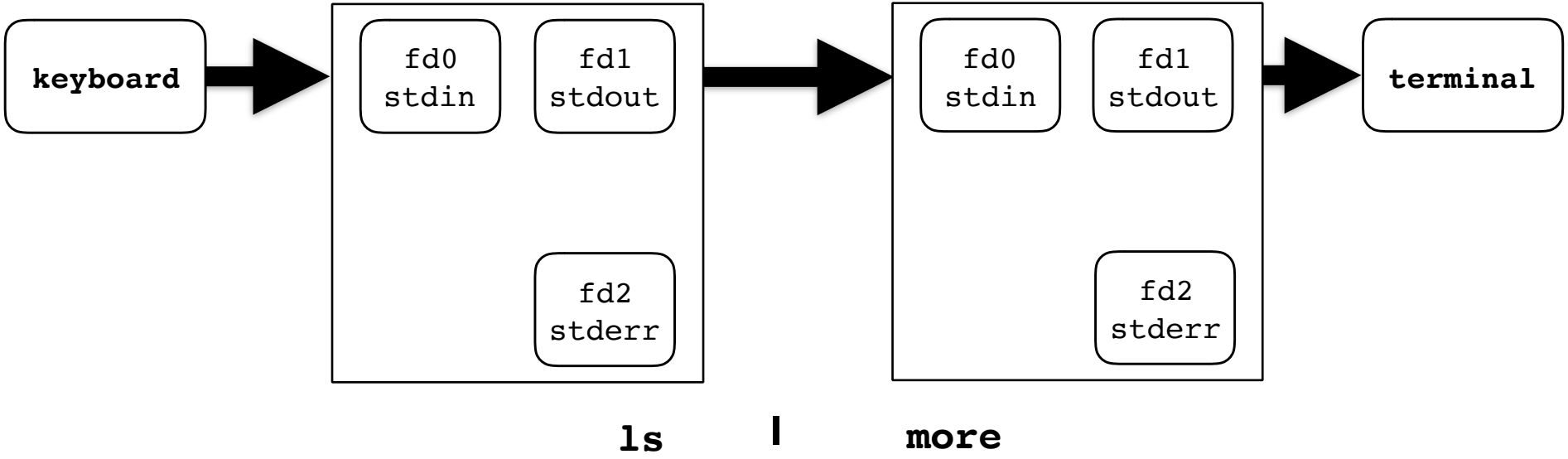
Many UNIX programs do quite trivial things in isolation, but, combined with other programs, become general and useful tools

Kernighan and Pike

I/O Redirection



Text Based Pipelines



I/O Redirection

- Redirect standard output - stdout (> and >>)
  - Normally directed to the terminal
  - Useful for redirecting the output of a command to file or another process
- Redirect standard input - stdin (< and <<)
  - Normally input via keyboard
  - Useful for directing input into a program from a file
- Redirect standard error - stderr (2>)
  - Normally output to terminal
  - Useful for separating error output from standard output and redirect to another location

Using Pipelines

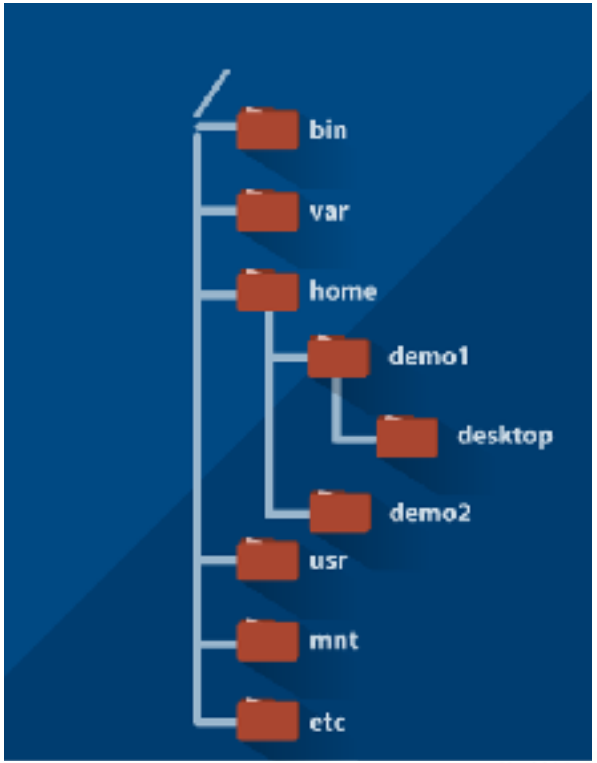
- Using a pipe - (|)
- Interprocess communication
- Process groups
- Internal buffers

Demo

- I/O Redirection
- Text Based Pipelines

The Linux File System

- Everything is a file - No really, EVERYTHING!
- File system tree
  - The most common analogy
- Filesystem Hierarchy Standard (FHS)
  - The standard UNIX filesystem layout
- Mounts



Standard Directories

- `/`
  - Top level of the file system, all resources are attached here
- `/boot`
  - Required to boot the system, kernel and boot configuration
- `/etc`
  - System configuration files
- `/root`
  - The root user's home directory

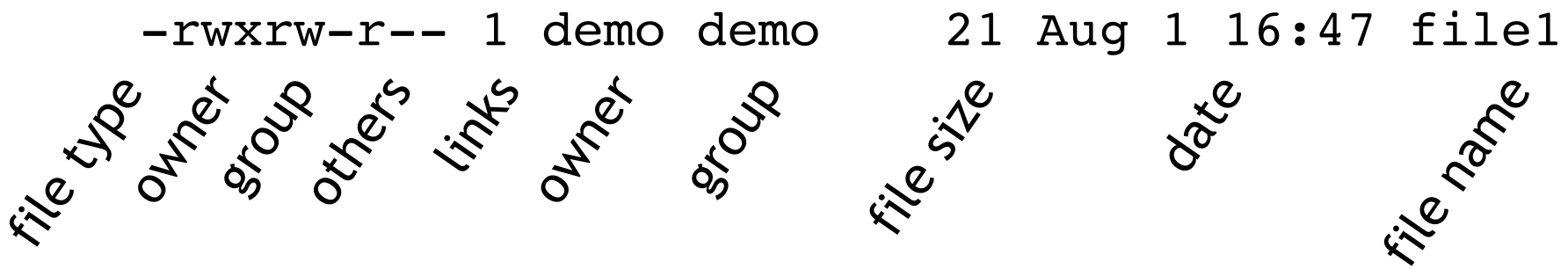
Standard Directories

- `/usr`
  - Programs, configuration, headers, libraries, and more
- `/usr/bin`
  - Critical binaries for operating the system
- `/usr/sbin`
  - System administration binaries for administering the system
- `/var`
  - Variable data, print spools, mail, logs, temp files and more

Special Directories - Virtual File System

- `/dev`
  - Shows all connected devices. Character and block modes
- `/proc`
  - Runnings state of the kernel on the system. You can see processes, hardware and memory information
- `/tmp`
  - A temporary space for any application (not like swap space)

File and Directory Permissions



Changing File and Directory Ownership

```
-rw-rw-r--. 1 demo demo    21 Aug 1 16:47 file1
```

owner

group

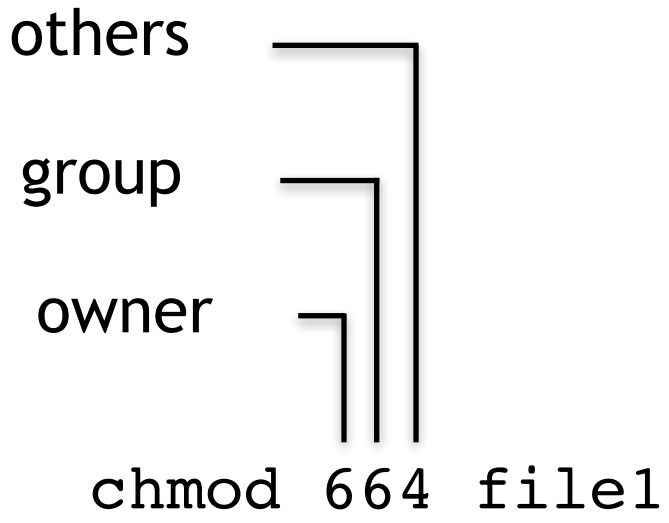
`chown` - change file ownership and group

`chgrp` - change group ownership

Octal Notation

- 3 bits - Used to represent permissions
- 2^3 = 8 possible permissions, 0 through 7

Read	Write	Execute		
4	**2**	**1**	**Octal**	**Permission**
0	0	0	0	No Access
0	0	1	1	Execute
0	1	0	2	Write
0	1	1	3	Write and Execute
1	0	0	4	Read
1	0	1	5	Read and Execute
1	1	0	6	Read and Write
1	1	1	7	Full Control



Examples in Octal Notation

- Everyone read, write and execute
  - `chmod 777 file1`
- Read and write only to the owner
  - `chmod 600 file1`
- Read and write to the owner and group and execute to other
  - `chmod 661 file1`

Common File and Directory Operations

- **File Operations**
  - **Create**
    - `touch`
  - **Delete**
    - `rm`
  - **Move/Rename**
    - `mv`
  - **View Contents**
    - `cat`
    - `less/more`
    - `head/tail`
- **Directory Operations**
  - **Create**
    - `mkdir`
  - **Delete**
    - `rm`
    - `rmdir`
  - **Move/Rename**
    - `mv`
  - **View Contents**
    - `ls`

Demo

- The Linux File System
- File and Directory Permissions

Break Time

- 15 Minutes
- Restarting at 3:45

Working with PowerShell on Linux

- Y'all are Windows admins, right…PowerShell!
- PowerShell Core - Available now in Beta5 (monthly)
- Windows PowerShell - Version 5.1
- Goal is to be cmdlet compatible with Windows PowerShell
  - .NET Core 2, implements .NET Standard
    - 99% of .NET Full CLR is now available
- Installation instructions here - http://bit.ly/2hvf5vy
- PowerShell can be used as your default Linux shell
  - http://bit.ly/2iFOKuN

Demo

- Building command pipelines in PowerShell
- Heterogenous Pipelines

RPM Package Manager (RPM)

- Package Management System
- A package is a collection of programs, scripts and meta data
- Suite of management tools
- Used to install/upgrade/remove packages
- Does not provide dependency management
- apt

yum

- Package manager
- Dependency management
- Software is stored in repositories
- Software publishers {RedHat, CentOS}
- Third Party {EPEL, RPMForge}
- Your own
- System wide updates
- apt

Demo

- Package management with `yum`
- Install SQL Server on Linux from Microsoft's yum repository

How Does a Linux System Boot?

- BIOS/UEFI
- Bootable Device (MBR/GPT)
- Boot loader (GRUB)
- Kernel
- init - pid 1

What is init?

- First “user” process on the computer
- Parent to all processes
- Responsible for the orderly startup of services
- Controls the state of the system
- Presents a usable system to the user

init Systems

- System V (initd)
- systemd

systemd Features and Capabilities

- Service Control - systemctl
- Verifying Services are Running
- Units and Unit Files
- Dependencies before/after
- Viewing Logs - journalctl
- Control Groups

Demo

- `systemctl`
  - `status`
  - `stop`
  - `start`
  - `enable`
  - `disable`

System Resource Management

- CPU
  - Load average and run queues
- Disk
  - Space and latency, IO waits
- Memory
  - Memory pressure and swapping
- Network
  - Throughput, latency and reliability

Basic Tools for Monitoring

- Included with your OS or it's repositories
- `top`
- `free -m`
- `vmstat`
- `du -chs ./dir`
- `df -h`
- `netstat -s`

Tools for Monitoring Performance

- sysstat
  - `iostat, cifsiostat, nfsiostat`
  - `sar` - system activity reporter
- `dstat`
  - Used to measure resource statistics in a single package
  - Performance Swiss Army Knife

Perfomance Monitoring

System	Windows	Linux Tool	Linux
CPU	%Processor Time	`top`	CPU usage, load average
Memory	%Committed bytes in use	`free -m`	Total, used, free, cache
Disk - Space	%Free Space	`df -h`	Total, used, available, mount
Disk - IOs	Disk Transfers/sec	`iostat -dx`	tps, r/s, w/s
Disk - Latency	Avg. Disk Sec/ Transfer	`iostat -dx`	svctm***
Disk - IO Size	Avg. Disk Bytes/ Transfer	`iostat -dx`	avgrq-sz
Interface	Bytes/Sec	`ifstat/bwm-ng/ nload/netstat -s`	Packets/sec, bits/sec

Demo

- System Resource Management
  - `top` and `ps`
  - `free -m`
  - `vmstat`
  - `dstat`

Getting Help

- man pages
- Local documentation
  - /usr/share/doc
    - Documentation about all of the install packages on your system
    - Help files
    - Example and default configuration files

Demo

- `man` pages
- `/usr/share/doc`

Key Takeaways

- It’s just an operating system, once you get over the syntax and environmental changes
- A lot of the concepts are the same
- Architecture
- I/O redirection and text based pipelines
- File system basics

Key Takeaways (con't)

- PowerShell on Linux
- Packages
- systemd
- System resource management

Additional Resources

- Pluralsight
  - **Understanding and Using Essential Tools for Enterprise Linux 7**
    - Installation, command execution, managing files
    - Using VI, Advanced Shell Topics and Pipelining
  - **LFCE - Advanced Network and System Administration**
    - Managing services, performance monitoring, package management, NFS and Samba
- **Play by Play: Microsoft Open Source PowerShell and Linux and Mac**
  - Where PowerShell fits in a heterogenous data center
  - Remoting, Linux management tasks, PowerShell functions and DSC

Need more data or help?

http://www.centinosystems.com/blog/talks/

Links to resources
Demos
Presentation

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TECHMENTOR

Questions

- ???

Dinner?

- Dine Around
  - 6:30PM - Hyatt Regency Bellevue
  - 7:30PM - Lot No. 3
  - Limited to 8 attendees, 2 confirmation so far!
  - Topic - OpenSource, Linux, PowerShell and SQL Server

Thank You!

Please fill out those evaluations