

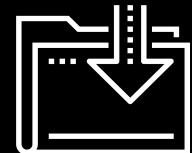


# Introduction to Linux

Cybersecurity

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Linux SysAdmin Fundamentals Day 1



# Class Objectives

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By the end of class, you will be able to:



Name three of the most important Linux distributions.



Navigate the Linux file structure using the command line.



Manage processes with the top, ps, and kill commands.



Install packages using apt.

# So, Why Linux?



# Why Linux

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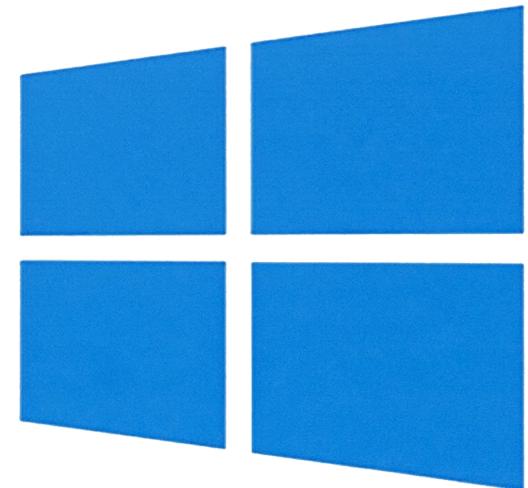
Over 70% of websites run some version of Unix.



# Why Linux

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Unix refers also to Linux and “Linux-like” operating systems.



# Why Linux

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The ubiquity of Linux machines on modern networks makes it a common target for attackers.





Familiarity with the  
operating system is crucial for  
cybersecurity professionals.

# Linux in a Professional Context

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Knowledge is essential for the following technical roles, among others:



Help Desk / IT Support



System Administration



Penetration Testing

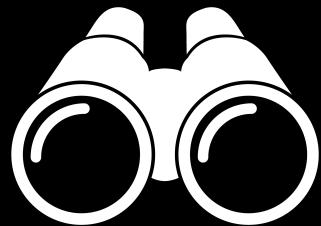


Network Forensics

# Activity Scenario

Throughout today's exercises, you will:

Investigate a malfunctioning Linux server reported to be running more slowly than usual.



Identify suspicious activity on the system and then contain it.



**Methodology will include:**

Auditing files

Auditing processes

Installing security packages

Configuring security services

# Linux History and Distributions

# A (very) Brief History of Linux

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01

In 1969-1970, Dennis Ritchie, Kenneth Thompson and several others at AT&T Bell Labs began developing a small operating system called **Unix**.

02

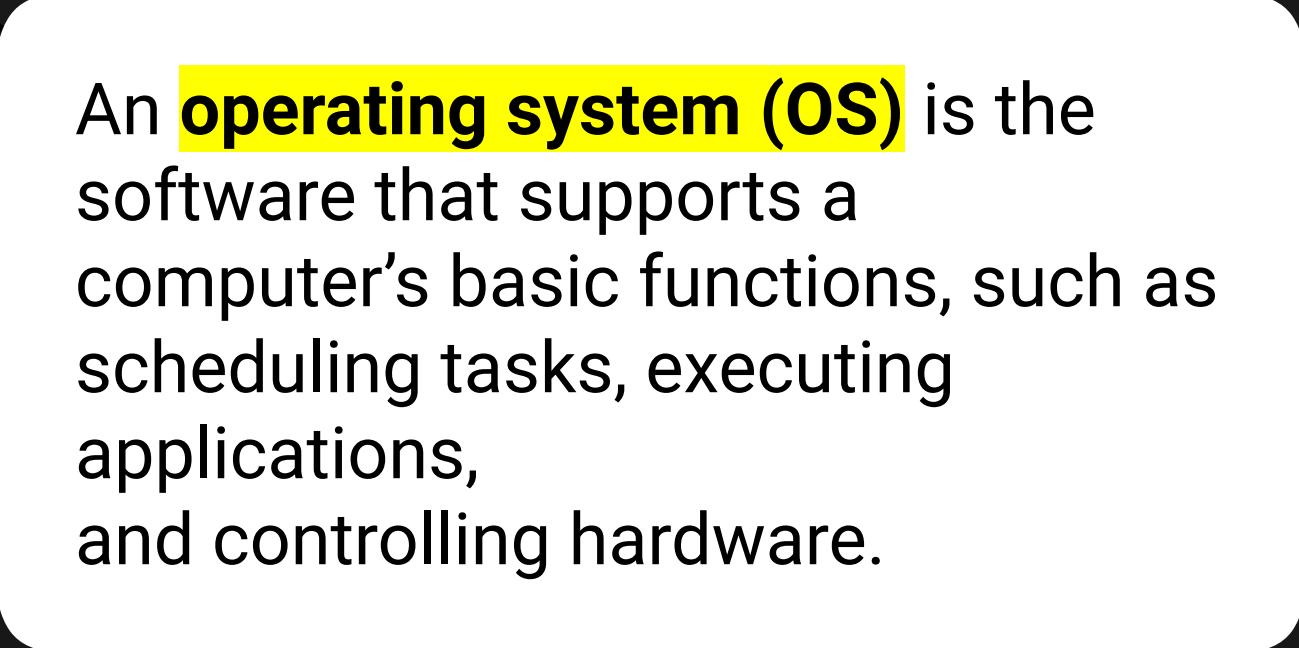
Within the next two decades, different updates and distributions of Unix were created. Most were proprietary.

03

In 1984 Richard Stallman's Free Software Foundation (FSF) started the GNU project, which created a free distribution of the Unix operating system

04

In 1991, Linus Torvalds used many of the components from the GNU project to create a free, open source operating system, which is now known as **Linux**.

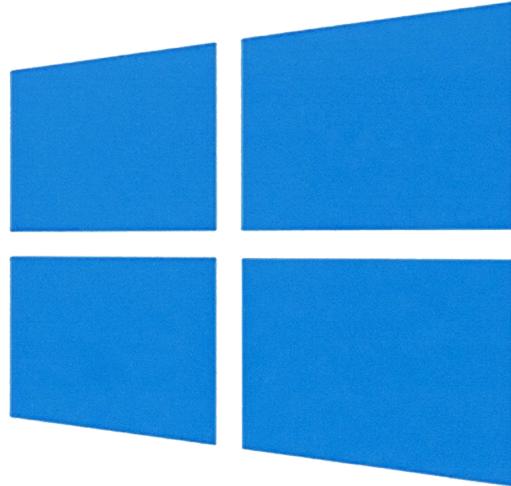


An **operating system (OS)** is the software that supports a computer's basic functions, such as scheduling tasks, executing applications, and controlling hardware.

# An Introduction to Linux

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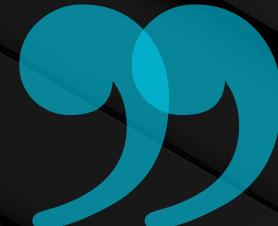
Windows, Mac OS X, and Linux are all examples of operating systems.



By W3Cook's analysis of Alexa's data,  
96.3% of the top one million web  
servers are running Linux.

The remainder is split between  
Windows, 1.9%, and FreeBSD (also  
Unix), 1.8%.

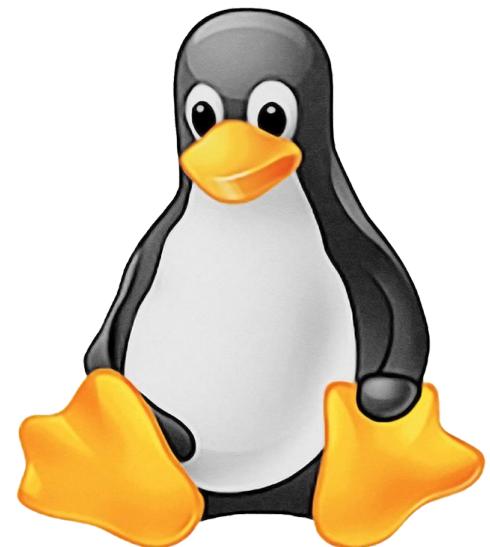
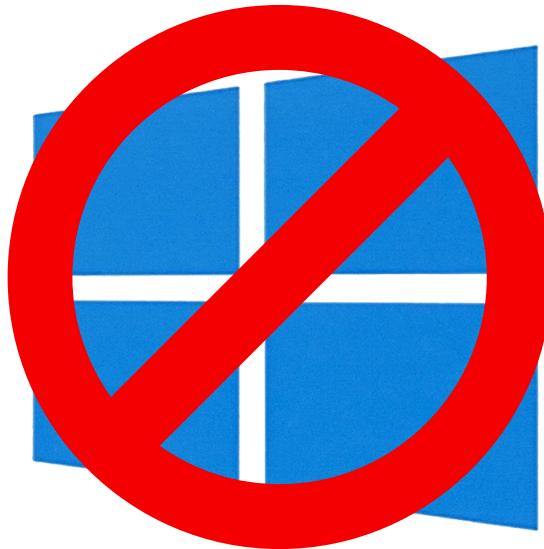
—Steven J. Vaughan-Nichols



Most enterprise networks feature at least one Linux machine.



Unlike Windows and OS X,  
Linux is **Free**, **Open Source** **Software (FOSS)**.



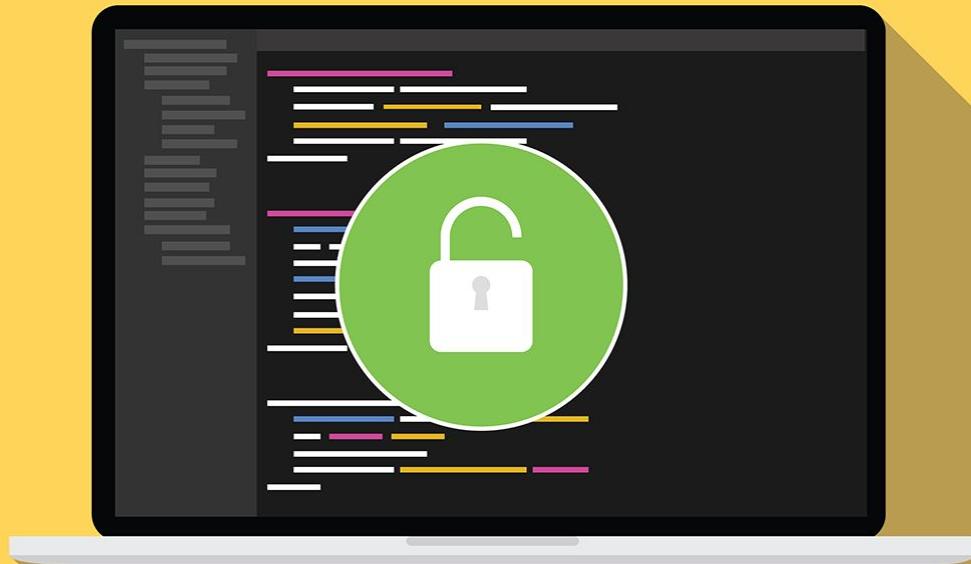
A large, dense crowd of people from various ethnicities and cultures, dressed in a variety of colorful clothing, is gathered together. They are arranged in a way that creates a clear, wide path through the center of the image, which is entirely white. The crowd is positioned at the top, bottom, and sides of this white space, filling the frame.

**Anyone** can modify  
the source code.

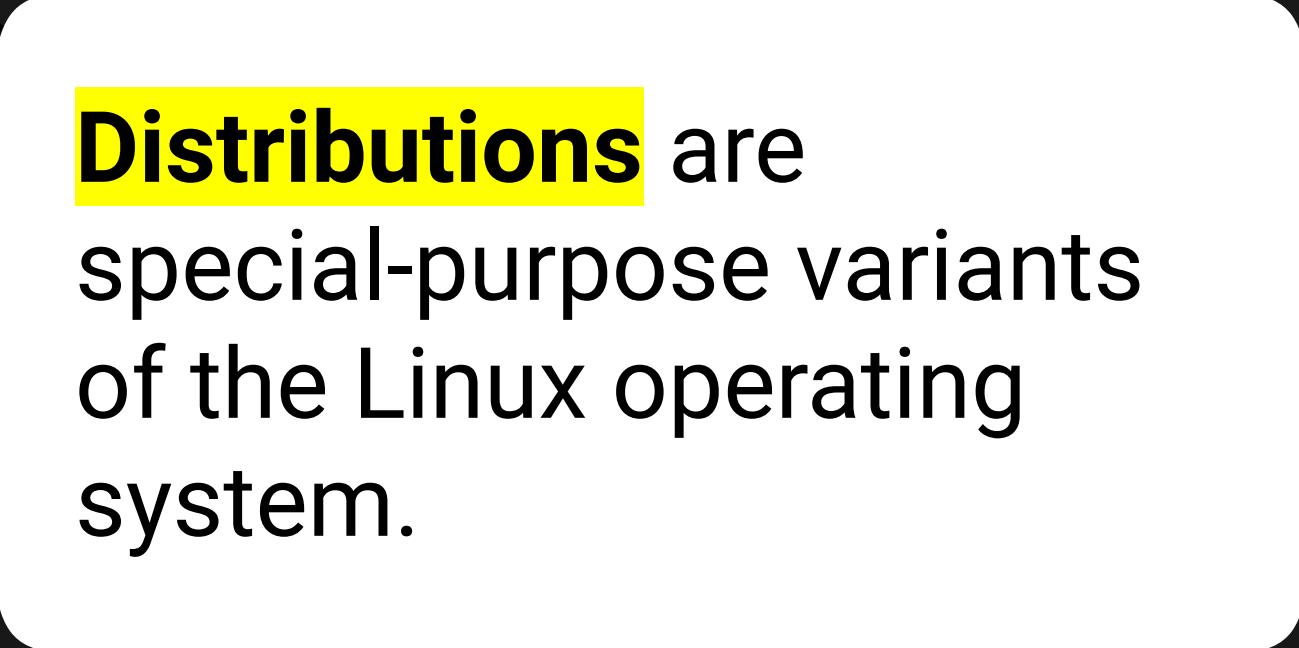
Most tools in the hacker / security community are still published as open source.

Free software and information is prevalent in the industry.

Almost all the tools we'll use in class are open source.



# Distributions



**Distributions** are special-purpose variants of the Linux operating system.

# Linux Distributions

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In this course, we'll use two distributions: Ubuntu and Kali Linux.

01

Ubuntu

**Ubuntu** is geared towards general-purpose users.



ubuntu

02

Kali Linux

**Kali** is designed specifically for security professionals.



# Linux Distributions

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Ubuntu and Kali Linux are both specialized distributions of **Debian**, which is itself a distribution.



**debian**

# Linux Servers

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In order to conserve as many resources as possible, most production Linux servers don't offer a graphical interface.

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**Therefore knowledge of the command-line is essential for understanding Linux.**



These command-line only  
machines are called  
**headless servers**.





# Activity: Distribution Research

You are a system administrator at X Corp, which has recently experienced a number of breaches involving servers running outdated Linux distributions.

- In response, the IT Department has decided to upgrade the affected servers with newer distributions of Linux.
- You must conduct research to determine which distribution is most appropriate for each machine.

Suggested Time:

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15 Minutes



Time's Up! Let's Review.

# Questions?



# Distribution Research Review

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Identify which distribution(s) is most appropriate for each situation.

Central Data Server	
Public Web Server	
IT Audit Workstation	
User Workstation	

# Distribution Research Review

---

Identify which distribution(s) is most appropriate for each situation.

<b>Central Data Server</b>	Stores sensitive human resources data, so should use a secure distribution. <b>Fedora</b> and <b>CentOS</b> use SELinux by default, making them good choices.
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<b>IT Audit Workstation</b>	Should use <b>Kali Linux</b> , because it specifically designed for performing security assessments.
<b>User Workstation</b>	Should use <b>Ubuntu</b> , which comes with a GUI and basic productivity software, such as an email client, web browser, and text editor.



**Which distribution is most flexible  
and best suited for day-to-day  
and administrative tasks?**

Answer



**ubuntu**



Which distribution is built  
specifically for penetration testers?

Answer





Which distribution would you use  
to set up a web or data server?

## Answer

Any will work, but **Ubuntu Server** and **Fedora Server** both have easy-to-configure web services.

---

You could use **Debian** or **CentOS** for more manual tasks.



What is the most widely-used  
Linux desktop environment?

Answer



**ubuntu**



# What is a headless server?

# Answer

A command-line only server, without a desktop environment.





Does Ubuntu have a headless  
server type? Does Fedora? CentOS?

## Answer

**Yes**, all three distributions provide a headless server type.





Which distribution is Ubuntu  
based on? What about Kali?

Answer

They are both based on Debian.



debian



Which distribution is CentOS  
based on? What about Fedora?

Answer

Both distributions are based on RedHat.



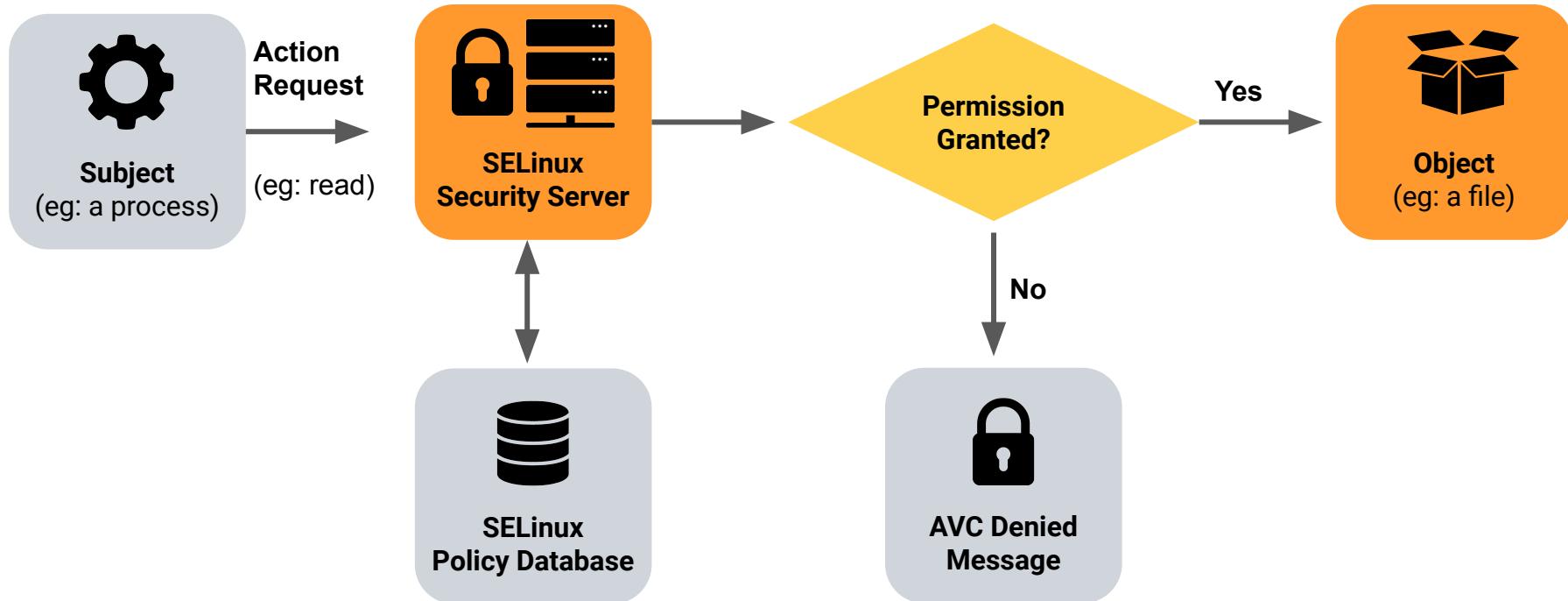
# Red Hat



# What is SELinux?

# What is SELinux?

SELinux is a built-in file permission security enhancement developed by the NSA. CentOS and Fedora have it implemented by default.





You are deciding between versions of Ubuntu Servers. If you want a version that will remain stable over time, which version do you choose?

# Ubuntu Server Versions

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**You would want to choose the “Long Term Support” (LTS) version.**

The latest version will have continual updates and changes.

The LTS version will remain stable and only change approximately once a year.



**ubuntu**



What are some security implications  
of using free and open source  
software or forks of popular  
Linux distributions?

As demonstrated in the Mint OS article, open source means that anyone can contribute.

Therefore, a malicious actor with programming skills will be able to attack somewhat easily.

You must be vigilant of where you download your software.



# Linux File System Structure

# Linux File System Structure

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Each OS maintains certain conventions for where and how they store different kinds of files. For example, Windows and Mac machines typically place images in a ~/Pictures folder.



Linux also has a conventional file system structure.



These conventions are consistent across distributions. For example, user applications are typically stored in /usr/bin, and this will almost always be the case across distributions.



Therefore, we can apply what we learn today to other distributions we encounter, since each distribution will have the files and folders that we will learn about today.



In addition, all popular Linux distributions use the bash shell by default. This means we can use the command line tools we learn here on other distros, as well.

# File Systems

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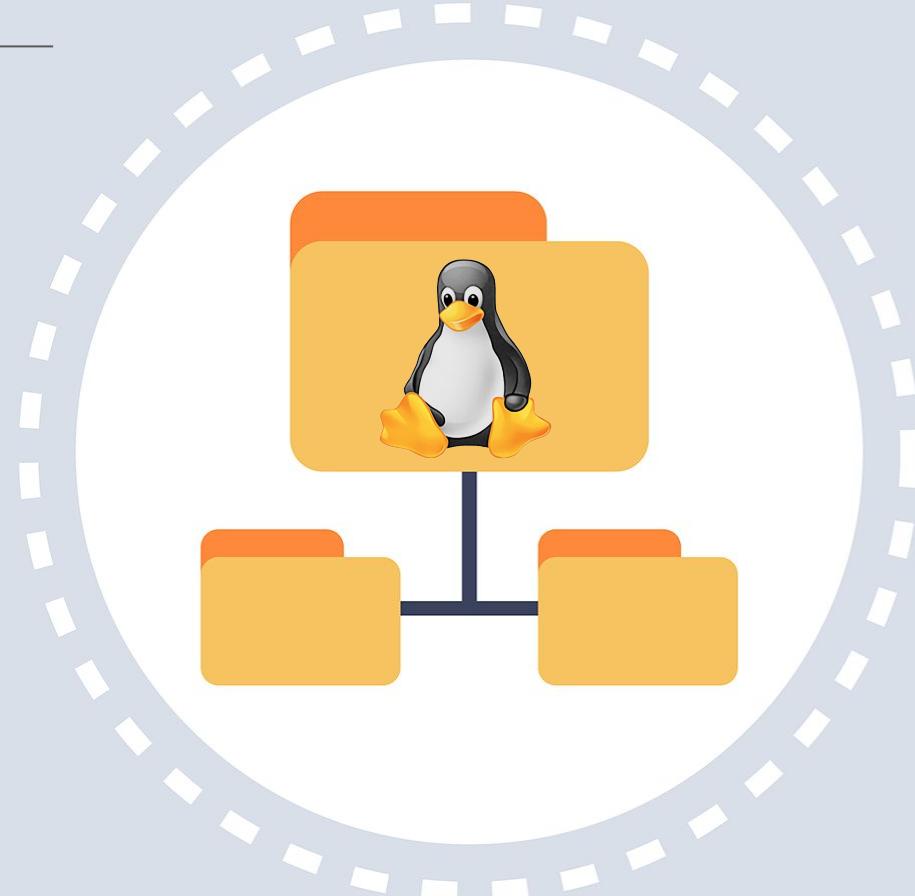
Linux maintains certain conventions for storing files:

/ (root)	The root directory that contains every other directory.
/home	Contains users' private file. Users should not be able to save files elsewhere.
/etc	Contains configuration files, defining how a machine runs and who can use it.
/bin, /sbin	Contain main binary or program files.
/var	Contains files that change over time.
/tmp	Contains files that are only needed for a short period of time.

# Demo Scenario

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Let's launch a terminal and walk through the Linux file system, starting at the top of the directory structure, the Root Directory.





## Instructor Demonstration

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### Navigating Linux File Structures

# Demo Takeaways

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The audit took us to the following directories:

/etc	Stores specific, system-wide configuration files, as well as the most sensitive files on a Linux system.
/var	Stores files that are continually updated.
/home	Stores user home folders.
/tmp	Where applications write temporary files that can be deleted on reboot.
/bin and /sbin	Where the system keeps its main binary or program files.



# Activity: Linux Landmarks

Most technical roles in cybersecurity require comfort with the command line and familiarity with the structure of a Linux file system.

You will use this knowledge to navigate file systems when looking for suspicious activity or administering the machine.

**The next exercise will give you an opportunity to explore the file system and practice using the command line.**

Suggested Time:

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20 Minutes



Time's Up! Let's Review.

# Questions?



*Break*



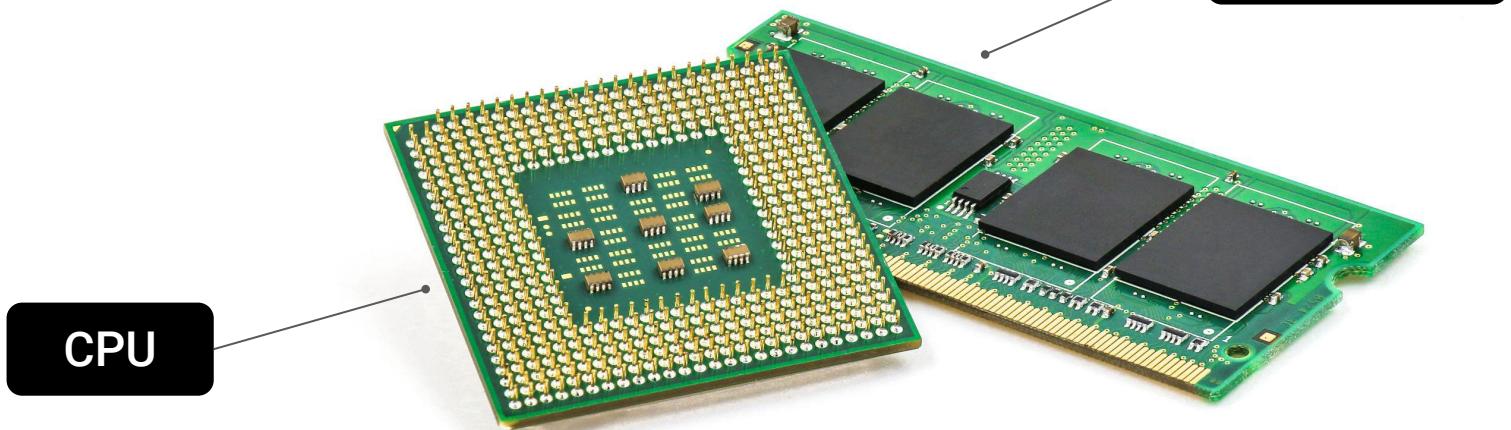
# Resources and Processes

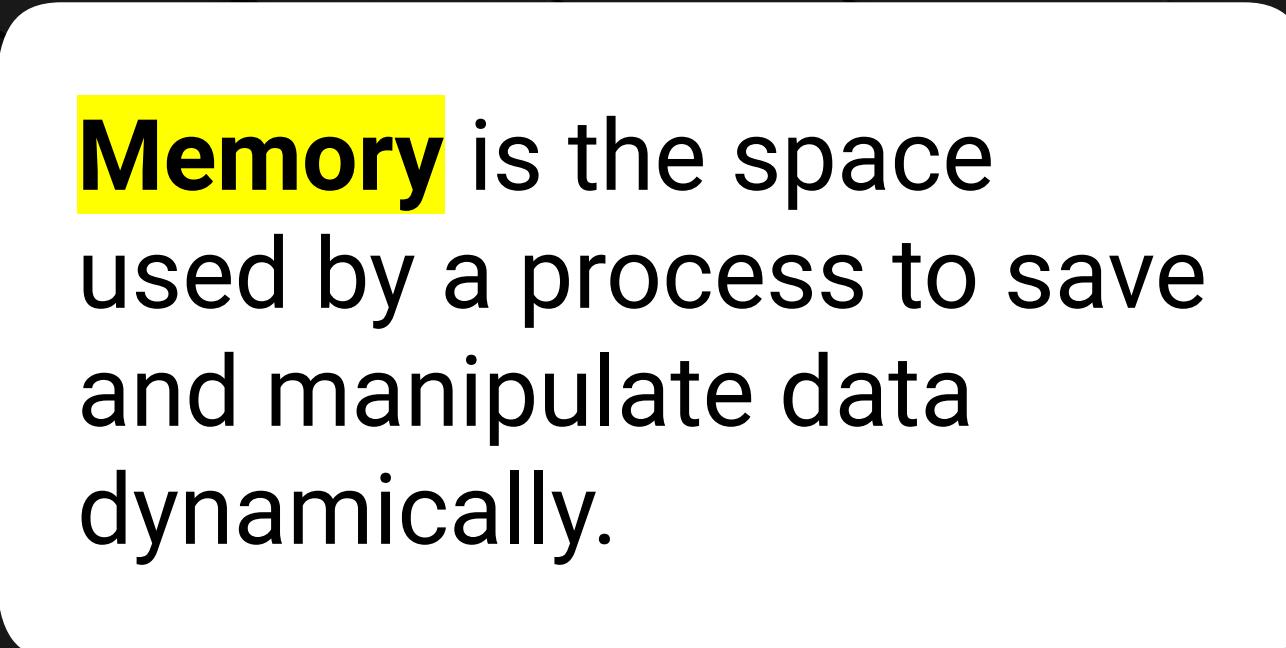
# Introduction to Processes

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When a program runs, it must process data and potentially make changes to the file system. This is why we call a running program a **process**. When these programs process, save and modify data, they consume a computer's resources.

Let's take a look at two of the most important resources: **memory** and the **CPU**.





**Memory** is the space used by a process to save and manipulate data dynamically.

# Memory

---

Memory comes in two forms:

01

RAM

**Random Access Memory (RAM)** is used to run the program's code. RAM is only used while the program is running.

The more work a process does, the more RAM it needs.

02

Disk space

**Disk space** is used to save data permanently.

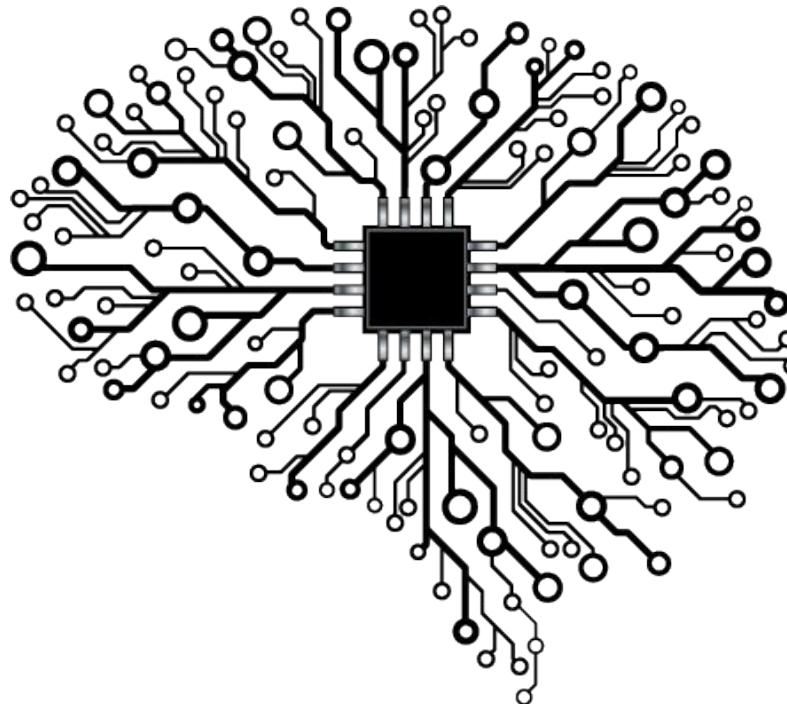
Files saved to a disk persist even after a process ends.

# The Central Processing Unit (CPU)

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The **Central Processing Unit (CPU)** acts as the brain of the system, determining how much work a process has to do, and how difficult that work is.

A difficult task, such as encrypting a large file, will use a lot of RAM and/or CPU.



Easier tasks, like executing the `ls` command, will require only minimal RAM and/or CPU.

# Targeting Resources

---

Attackers can take advantage of a system's finite resources.

- Attackers can perform denial of service (DoS) attacks by launching processes that eat up memory on a target machine.
- This can slow down or crash the machine, making it unavailable to users, thus denying them service.

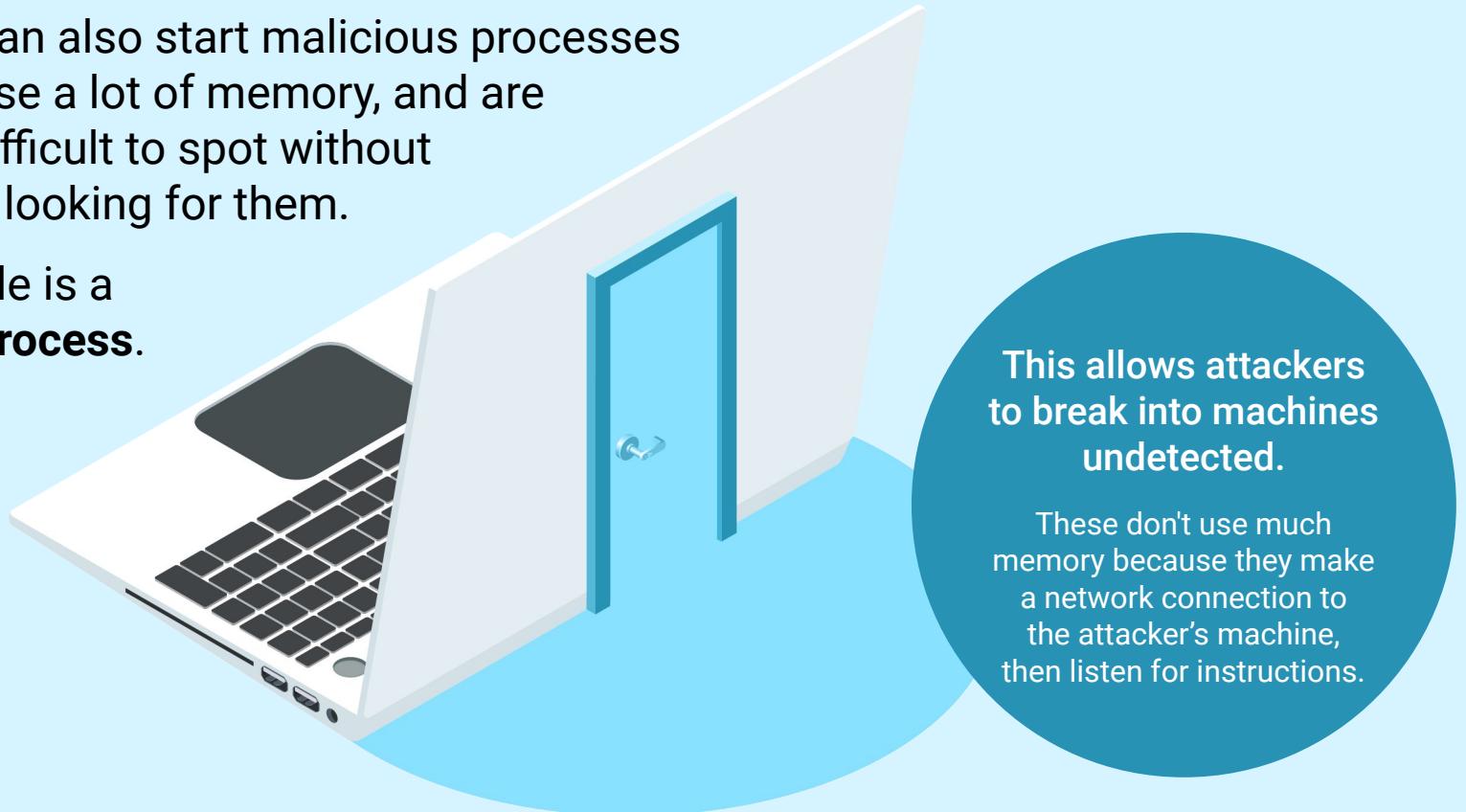


# Targeting Resources

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Attackers can also start malicious processes that don't use a lot of memory, and are therefore difficult to spot without specifically looking for them.

One example is a **backdoor process**.



This allows attackers to break into machines undetected.

These don't use much memory because they make a network connection to the attacker's machine, then listen for instructions.

# Managing Processes

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Linux has several commands for managing processes:

`top`

Allows you to see all running processes in real time. It updates every three seconds to show what's happening on the system.

`ps`

Allows you to take a snapshot of all the running processes on the system. Different arguments allow you to show different subsets of processes and use this output with other commands.

`kill`

Used to stop processes, usually ones causing problems. `kill` attempts to allow a process to finish before it shuts it down.

**Dynamic analysis** is the process of running a potentially malicious script and monitoring its effects.

Let's run a potentially malicious script to determine how it affects system health.





## Instructor Demonstration

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## Inspecting Malicious Files Demo



# Activity: Processing Investigation

In this activity, you will monitor the system for processes that should not be running.

- Your senior admin asked that you record snapshots of processes as well as review processes in real time.
- If you notice anything amiss, kill the process and add your findings to the report.

Suggested Time:

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25 Minutes



Time's Up! Let's Review.

# Questions?



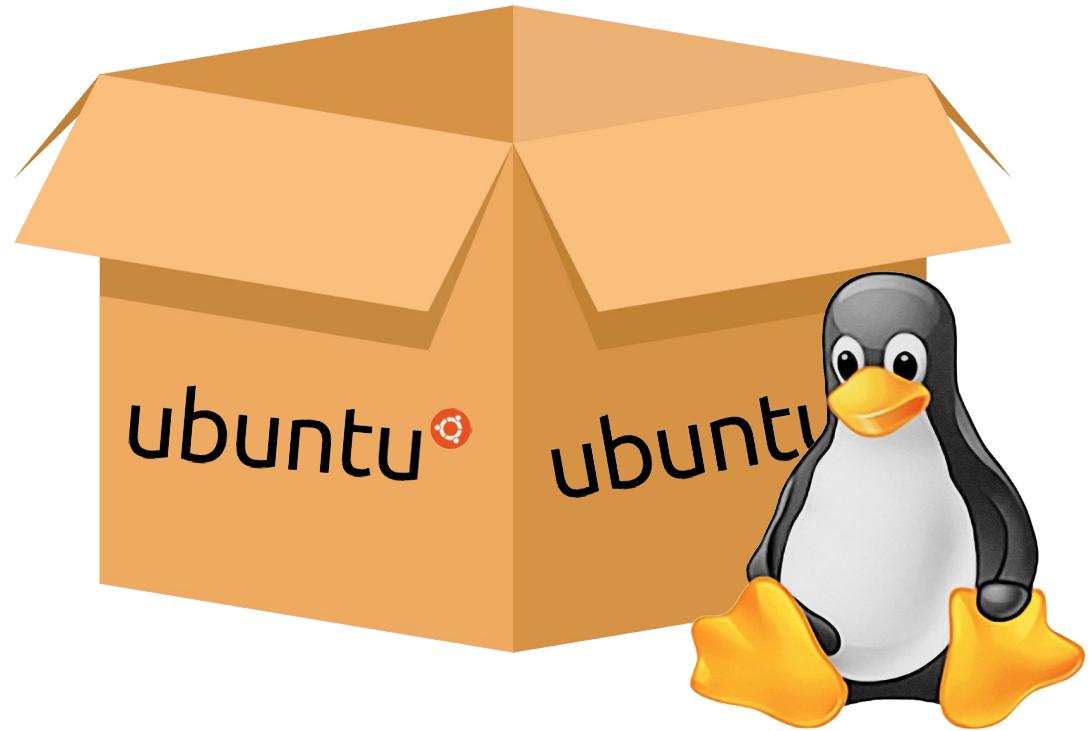
# Installing Packages

# Packages

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Administrators often install additional software to properly harden the machine.

- Linux offers downloadable tools called **packages**.
- New packages are installed with a tool called **package manager**.
- We'll use the Ubuntu package manager, called **aptitude** with the command apt.



# Packages

---

```
sudo apt install <package name>
```



Linux searches databases to find information about <package name>. If found, it will be downloaded.



These databases are known as repositories.



Repositories specifically used to store and distribute packages are known as Personal Package Archives, or PPAs.

# Packages

---

Today, we'll install the following packages.

emacs

is a traditional file editor.

cowsay

is a utility that takes in input, and displays a cow repeating it.



# Take-Home Activity: Installing packages

In this activity, you will install and configure emacs, cowsay, and fortune.

Suggested Time:

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0YO



Time's Up! Let's Review.

# Questions?



*The  
End*