



Introduction to Linux

Linux Fundamentals

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Welcome to Introduction to Linux.

What you will learn

At the core of the lesson

You will learn how to:

- Define Linux
- Describe the main features and components of the Linux operating system
- Distinguish the different Linux user interfaces
- Use the built-in Linux documentation
- List different Linux distributions



In this lesson, you will learn how to:

- Define Linux
- Describe the main features and components of the Linux operating system (OS)
- Distinguish the different Linux user interfaces
- Use the built-in Linux documentation
- List different Linux distributions

What is Linux?

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First, define what Linux is.

Hardware and operating systems

Hardware

- Central processing unit (CPU)
- Random access memory (RAM)
- Storage
- Networking

Operating system

- Interface between user and hardware
- Runs applications

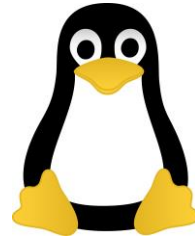
Computers consist of hardware and software.

Hardware refers to a computer's physical components, such as its central processing unit (CPU), memory, storage drive, and network card.

Software is the collection of applications and programs that are installed on the computer. One key type of software that computers require is an operating system. An operating system manages a computer's hardware and software resources and runs applications.

The Linux operating system

- Is open source
 - Code is publicly available, and users can modify and expand it
- Supports multiple users and multi-tasking
- Is built to handle networking
- Provides system tools and utilities



Linux is an operating system that is freely distributable under the terms of the GNU General Public License (GPL). It is open source because it provides the source code for the core functionality of an operating system, called a **kernel**, and users can modify and expand it. As a result, many **distributions** of Linux are available today.

With Linux, multiple people can use the same computer at the same time and can run multiple applications simultaneously. It also supports network functionality and provides system tools and utilities to increase usability.

Linux history and benefits

Was created in 1991 by Linux Torvalds

Is modular

Is stable

Is commonly used as a server operating system

Is also used as a desktop operating system

Linus Torvalds, a graduate student at the University of Helsinki in Finland, created Linux in 1991. Linux is similar to another operating system that is called **Unix**, which was developed in the late 1960s.

In addition to being open source, Linux is modular, which means that you can extend it. It is also stable and does not experience frequent system freezes that require computer restarts. Because of these benefits, you can use Linux both as a desktop system and a server operating system.

Distributions

Definition

A **distribution** or **distro** is a packaged version of Linux.

- Because Linux is open source, anyone can make a distribution and tailor it for a given purpose.
- A distribution is typically downloaded and can be installed by using various formats.
 - For example, by using an **Amazon Machine Image (AMI)** for **Amazon Linux 2**
- Examples:
 - Amazon Linux 2
 - Red Hat Enterprise Linux (RHEL)
 - Debian
 - Ubuntu



A **Linux distribution** is a packaged version of Linux that a group of individuals or a company develops. It includes the core operating system functionality (**kernel**) and additional complementary tools and software applications.

Distributions are typically downloaded but can also be installed by using various media and formats. Examples include compact disk (CD), Universal Serial Bus (USB) device, and downloadable International Standardization for Organization (ISO) image.

Examples of Linux distribution include Amazon Linux 2, Red Hat Enterprise Linux (RHEL), Debian, and Ubuntu.

In the AWS Cloud, the Amazon Linux 2 operating system is readily distributed by using an Amazon Machine Image (AMI). An AMI contains an operating system and other pre-installed software relevant to the image. You will learn more about Amazon Linux 2 in a later section.

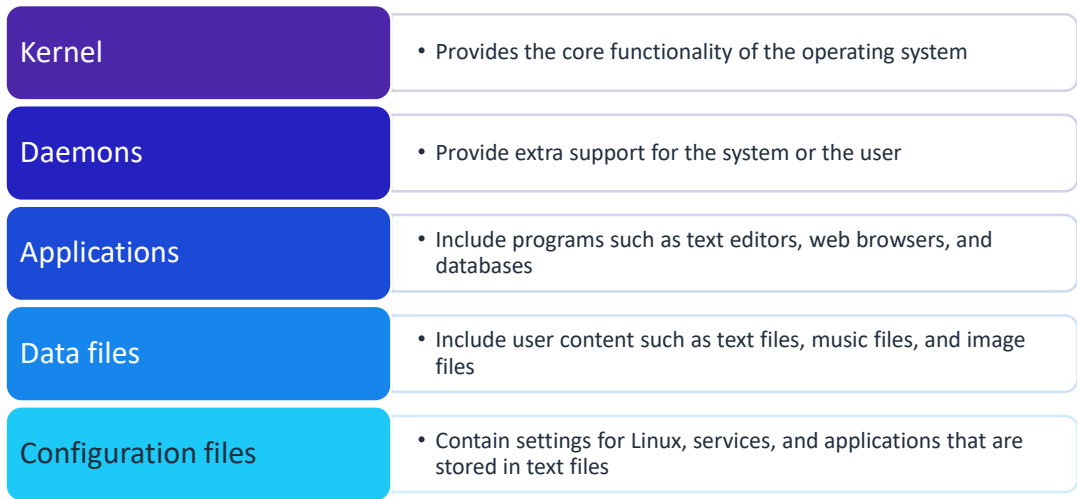


Linux components

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This section describes the main features and components of the Linux operating system.

Major components of Linux



The major components of a Linux distribution consist of a kernel, daemons, applications, data files, and configuration files. You will review them in more detail in the next slides.

The Linux kernel

- An operating system kernel is:
 - A computer program
 - A controller of everything in the operating system
- The Linux kernel manages:
 - Scheduling of processor time
 - Memory allocation for the operating system and for applications
 - Access to peripheral devices (sound card, hard disk drive, network card, and others)

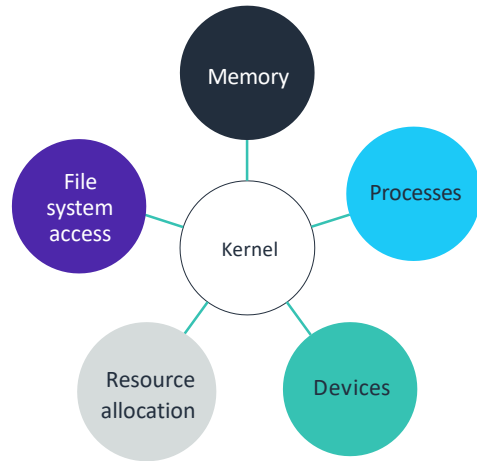
The kernel refers to the core component of an operating system. It controls everything in the operating system, including the allocation of CPU time and memory storage to running programs, and access to peripheral devices.

Functions of the Linux kernel

What does the kernel do?

- The kernel manages the running of multiple applications and the sharing of resources among multiple users.

Kernel management as a map



The Linux kernel manages the running of multiple applications and the sharing of resources among multiple users. It also controls the interface to the input/output (I/O) devices that are connected to the computer, and it manages files and directories.

Daemons

- Are computer programs that run in the background
- Are not under the control of an interactive user
- Typically provide a system service
- Process names that traditionally end with the letter *d*
- Examples:
 - `syslogd`
 - `sshd`



A daemon is computer program that runs in the background and is not under the control of an interactive user. It typically provides a service to other running programs.

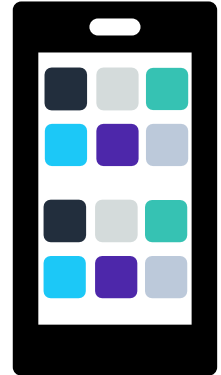
Examples of daemons include the following:

- **syslogd**: When system or user applications generate messages, the *syslogd* daemon captures the messages and stores them to a file, which is called a *log*.
- **sshd**: The *sshd* daemon handles Secure Shell (SSH) connections to the computer. This type of connection uses encryption to secure the communication between the client and the server.

You will learn more about daemons in the *Managing Processes* lesson.

Applications

- Are software that provides a set of functions that help a user perform a type of task or activity
- Examples:
 - Word processor
 - Web browser
 - Email client
 - Media player



An application, is a computer program that provides functions that help users perform a type of task or activity. For example, with a word processor app, users can create and edit text content, and this type of app facilitates document authoring and modification. Likewise, with a web browser app, users can access the internet and visit websites.

Data files



What are data files?

- Files contain the information that programs use and can have different types of data.
 - Examples: music file, text file, and image file
- Files can be grouped in directories.

How to name a file?

- Files have a name that uniquely identifies them and has the following format:

`[directoryName] fileName[.extension]`

- Examples:
 - myFile
 - /pictures/dog.gif

A file contains information, or data, that the user has created or captured. Files can be of different types depending on the type of data that they contain. A program can process the data in a file. Examples of data files include music, text, or image files. Files are also typically grouped in directories for organizational purposes.

A file has a name that uniquely identifies it. The format of a complete file name consists of an optional **directoryName**, the actual **fileName**, and an optional *extension*. A **period precedes the extension**.

In the last file name example that is shown:

- /pictures is the directory name.
- dog is the file name.
- .gif is the extension.

Configuration files

- Configuration files are a special type of file that contains initial settings or stores values for a system program.
 - Example: The **/etc/group** file contains the list of users that are allowed to use the system.
- Some configuration files run a set of commands at startup.
- Common configuration file name extensions are:
 - **.cnf**
 - **.conf**
 - **.cfg**
 - **.cf**
 - **.ini**



A Linux configuration file is a special type of file that stores initial settings or important values for a system program. These values configure the behavior of the associated program or capture the data that the program uses. For example, the **/etc/group** configuration file contains the list of authorized users for the system.

Some configuration files are used to run a set of commands when the system is started or when the user logs in. With these commands, the Linux environment can be customized to the specific preferences of the user.

Configuration file names use a common set of extensions, including **.cnf** and **.conf**.

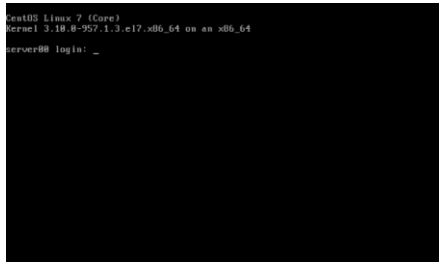
Linux user interface

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This section covers the different Linux user interfaces.

How to interface: CLI compared with GUI

Command line interface (CLI)



- It consumes fewer hardware resources.
- It can be automated with scripts.
- It provides more options.
- Most Linux servers use only the CLI.

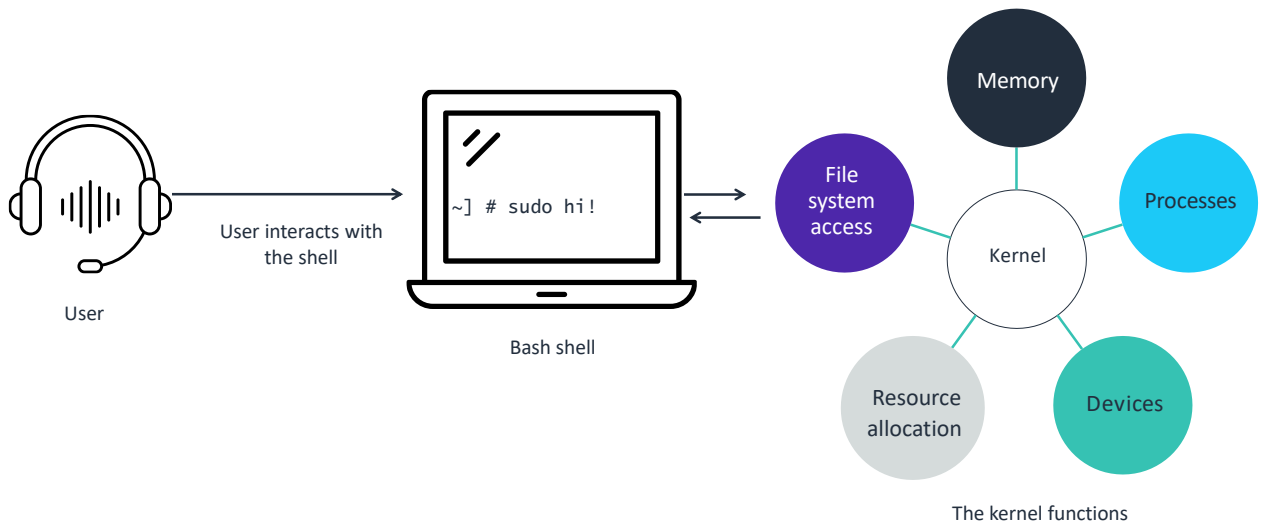
Graphical user interface (GUI)



- It is visual and intuitive to navigate.
- It is similar in Linux, Microsoft Windows, and macOS.
- Most user workstations use the GUI.

You can use either the CLI or GUI based on your preference.

The shell



When you use the CLI, the **shell** that you select defines the list of commands and functions that you can run. A shell interprets the command that you type and invokes the appropriate kernel component that runs the command.

You can use many types of shells, and each Linux distribution defines the types that it can support.

Shell types

Different shell types


Shell	Description
sh	The original Bourne shell for Unix
bash	The Bourne-again shell and the default Linux shell
ksh	The KornShell, a common Unix shell

Features of shell types

- Each shell has its own syntax or way of formatting commands.
- The shell provides the command prompt.
- **Note: Bash Shell** is the default Linux shell.
 - It is typically the only shell that you must know for Linux.
 - It is the only shell that is covered in this course.

```
CentOS Linux 7 (Core)  
Kernel 3.10.0-957.1.3.el7.x86_64 on an x86_64  
server00 login: _
```

There are different shell types, but the only one you need to know for Linux is the Bash Shell. An upcoming lesson will detail how to use the Bash Shell.



Linux documentation

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In this section, you learn to use the built-in Linux documentation.

Manual pages

- The Linux manual pages, or **man pages**, contain the documentation for Linux commands.
- The man pages provide a brief summary of the purpose, syntax, and options that are associated with a particular command.
- You access the man pages by using the **man** command.

When you ask a Linux person for help:

I'm lost and don't understand this command!

Did you check the man pages?

The primary source of Linux documentation is the manual pages. They contain a description of the purpose, syntax, and options for a Linux command.

When you ask a Linux person for help, the most likely first answer that you will get is, “Did you check the man pages?”

You access the man pages by using the **man** command.

The man command

What is the man command?

- You view the manual page for a command
- The following is common information that is displayed for a command:
 - Name
 - Synopsis
 - Description
 - Options

Linux syntax: `man <commandName>`

Understanding the syntax

The command: `man man`

The output that is displayed

```
MAN(1) Manual pager utils
NAME
    man - an interface to the on-line reference manuals
SYNOPSIS
    man [-C file] [-d] [-D] [--warnings[=warnings]] [-R encoding] [-L locale]
    [--regex|--wildcard] [--names-only] [-a] [-u] [--no-subpages] [-P pager] [f
    igation] [-p string] [-t] [-T[device]] [-H[browser]] [-X[dpi]] [-Z] [[sec
    tion]
    man -k [apropos options] regexp ...
    man -K [-w|-W] [-S list] [-i|-I] [--regex] [section] term ...
    man -f [whatis options] page ...
    man -l [-C file] [-d] [-D] [--warnings[=warnings]] [-R encoding] [-L local
    [-T[device]] [-H[browser]] [-X[dpi]] [-Z] file ...
    man -w|-W [-C file] [-d] [-D] page ...
    man -c [-C file] [-d] [-D] page ...
    man [-?V]
DESCRIPTION
    man is the system's manual pager. Each page argument given to man is norma
    page associated with each of these arguments is then found and displayed.
    section of the manual. The default action is to search in all of the avail
    only the first page found, even if page exists in several sections.
Manual page man(1) line 1 (press h for help or q to quit)
```

The man command displays documentation information for the command that you specify as its argument. This information includes the following:

- **Name:** The name and a brief description of the purpose of the command
- **Synopsis:** The syntax of the command
- **Description:** A detailed description the command's usage and functions
- **Options:** An explanation of the command's options

The example screen capture shows the output of the **man** command.

Command features of the man command

- You typically use the man command to determine a command's syntax and available options.
- You can navigate through the multiple pages of documentation by using keyboard keys:
 - **Up** or **Down arrow** key: Scrolls up or down one line, respectively
 - **Page-up** or **Page-down** key: Scrolls up or down one page, respectively
 - **Space bar**: Scrolls down one page
- To search for a string in the documentation, use the forward slash key:
 - **/<searchString>**
- Enter **q** to exit the documentation.

Using the man command, you can determine the syntax of a particular command. It is also very useful in understanding a command's options.

The documentation that is displayed for a command will typically consist of many pages. To navigate through the pages, use the following keyboard keys:

- **Up arrow** or **Down arrow** key: Scrolls up or down one line, respectively
- **Page-up** or **Page-down** key: Scrolls up or down one page, respectively
- **Space bar**: Scrolls down one page

You can also search a command's man page by using the forward slash (/) character:
/<searchString>

To exit the manual pages, enter **q**.



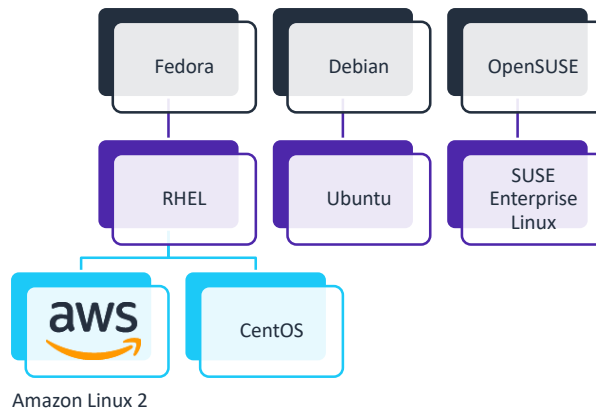
Linux distributions

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This section lists the different Linux distributions.

Sources of major distributions

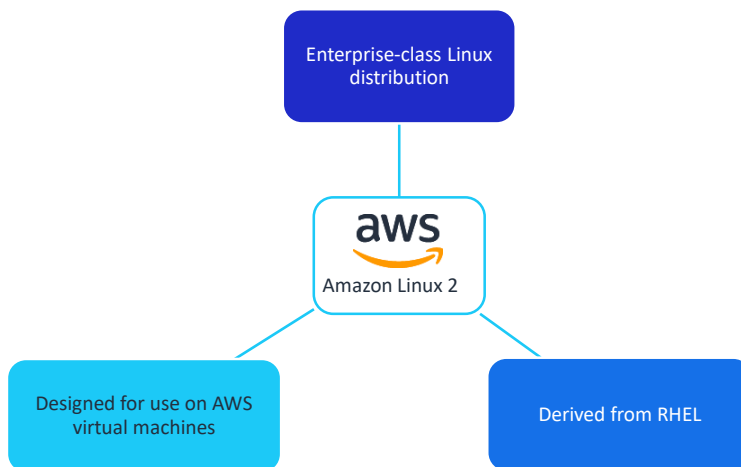
A distribution includes the Linux kernel and complementary tools and software applications.



A Linux distribution includes the Linux kernel and the tools, libraries, and other software applications that the vendor has packaged. Most widely used distributions are derived from the following sources:

- **Fedora:** Red Hat, an IBM company, mainly sponsors this distribution. Fedora is used to develop, test, and mature the Linux operating system. Fedora is the source of the commercially distributed RHEL from which the Amazon Linux 2 and CentOS distributions are derived.
- **Debian:** This Linux distribution adheres strongly to the free software principles of open source. The Ubuntu distribution is derived from Debian, and the British company Canonical Ltd. maintains it.
- **OpenSUSE:** The German company SUSE sponsors this distribution, which is used as the basis for the company's commercially supported SUSE Enterprise Linux offering.

Amazon Linux 2



Amazon Linux 2 is the latest Linux operating system that AWS offers. It is designed to provide a stable, secure, and high-performance runtime environment for applications that run on Amazon Elastic Compute Cloud (Amazon EC2). It supports the latest EC2 instance type features and includes packages that facilitate integration with AWS.

Amazon Linux 2 enhances security by automatically applying critical or important security updates when an instance is booted.

For more information on Amazon Linux 2, see <https://aws.amazon.com/amazon-linux-2/>.

CentOS

Stands for Community Enterprise Operating System

Is an enterprise-class Linux distribution

Is derived from RHEL

Was replaced by **CentOS Stream** as of December 2020

CentOS (or Community Enterprise Operating System) is a free Linux distribution and is functionally compatible with its upstream source, RHEL.

CentOS is currently used in the lab environment for this course.

As of December 2020, Red Hat has cancelled any further development for CentOS Linux and replaced it with CentOS Stream.

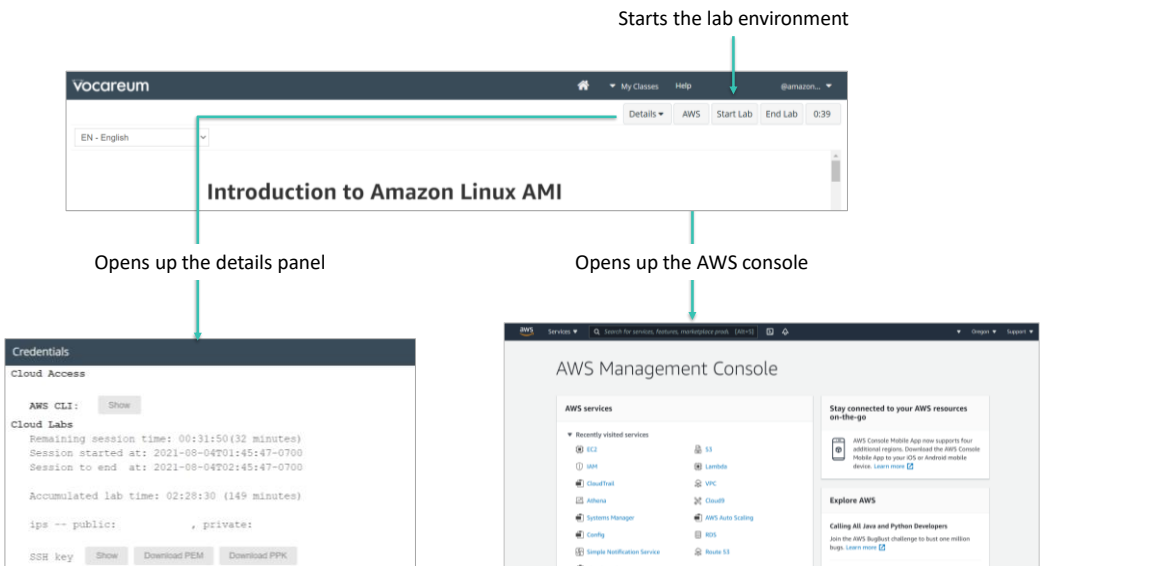


Connecting to a remote Linux server

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This section discusses how to connect to a remote Linux server.

Lab environment



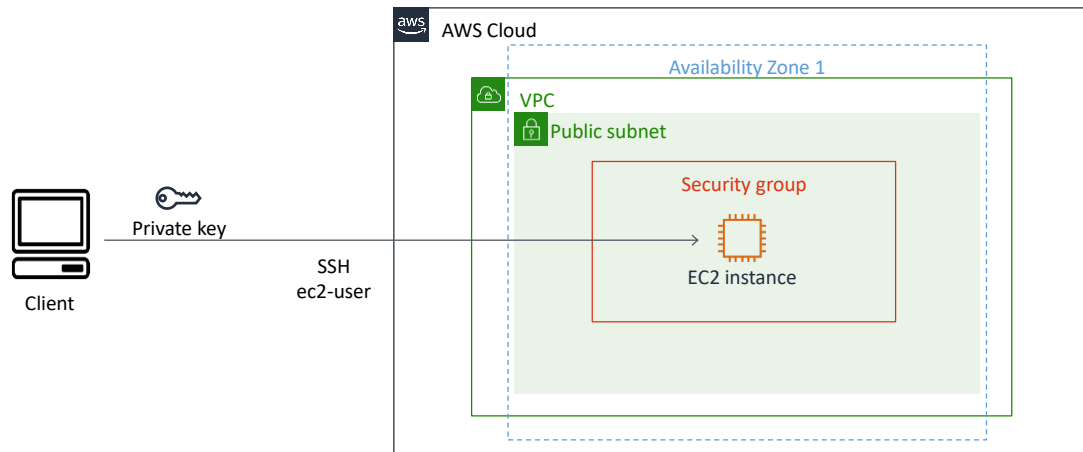
You will connect to Vocareum to work on your labs. The interface offers all the lab information and steps as well as buttons to start the AWS instance you will work with.

The **Start Lab** button will generate your **AWS** working environment.

The **Details** pane displays information such as the IP address of the EC2 instance that you will work with. It also displays the URL to download the private SSH connection key.

The **AWS** button opens up the AWS console. You will not need to access this console when working on the Linux labs. However, you should get familiar with it because you will use it later.

Lab architecture



When starting to work on your labs, an Amazon Linux 2 EC2 instance instantiates automatically.

You will download a key to connect securely to this instance through Secure Shell (SSH) with the user **ec2-user**.

SSH is a network protocol that provides a secure way to access a computer. To connect to a host by using SSH, you need an SSH client. MacOS or Linux usually gives you access to an SSH client directly from the terminal. On Windows, you can use a tool that is called **PuTTY**, which has a graphical interface.

The SSH connection usually uses port 22. The security group that is linked to the EC2 instance opens up this port.

Additional details

- Linux instances come with a default user.
- For the Amazon Linux 2 instance that you will use, the default user is `ec2-user`.
- To connect to the instance, you need a private key that is automatically generated for you.
- The format of the key is the `.pem` format, which stands for Privacy Enhanced Mail.

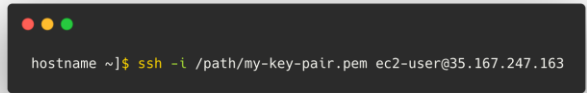
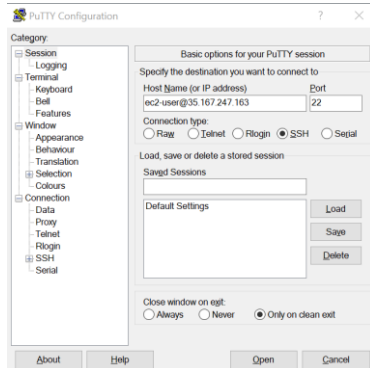
```
-----BEGIN RSA PRIVATE KEY-----
MIIEogIBAAKCAQEAiusIsGUxYX0Wq/djH5FcVj7pNTbVTIxxvLG7Pa8gCqRzg5gmj
g0iDu9Zs1SpnT8FUULecgrKQzF1aGRrQgMNGTquOpQrINLXG/kxm/IN5IfwqzXh1
QDkELMIUrj69ZLYovtgXVMNod14DhUsx/fVAYUFCTSaOPEP05S08m1fgXdqjms2m
zU7gvG5y6L9UgSJFdhTxsN0pgrCmmnvYYy8ceRnoqUcL/K1G50eqqpQEvdQdRj0H
jAuiEB0EDTJCT9qDRB5dCg0zY1gddcDNXRyqM34tVip6w8InfN5/1Cq1v4i1i30F
dPhRq1DTIs50Y7q5rs8/Q1o1tCkxvcsFsf0fPwIDaMP4tRA5+PpalyIuWw4Rq
ah/FAGGAFAxd00vXhm/KgD6S4tGVFS1jSPMBa1YCaHk8/b8nqcNPJUn1/SnhDf1
ms1cyAqF171X/OH3HP50K7CkHj1cI4Fg3DVqpTe60EwoFIWFiuH7N2y90Gjmhste
FgC69F6p89eARu3C1y0KrZhr6edZIDZXgwMZtFncSE0KsjA+i6I=
-----END RSA PRIVATE KEY-----
```

On Windows, PuTTY uses a slightly different format, the `.ppk` (which stands for PuTTY private key) format.

PuTTYgen is a tool that can convert a `.pem` key into a `.ppk` key.

Both `.pem` and `.ppk` keys are provided in the lab.

How to access Linux AMI



- Use PuTTY if you are using a Windows machine.
- Use SSH if you are using a Mac or Linux machine.

After you launch an EC2 instance, you can connect to it and use it the way you'd use a computer sitting in front of you. Depending on the computer system, you have two ways to access the EC2 instance.

The first way to connect is by using a client called PuTTY. PuTTY is an open-source SSH and telnet client. PuTTY allows you to connect to your instance from a Windows machine.

If you are using a macOS or Linux machine, you access the EC2 instance differently. If you are using a Mac or Linux computer, it most likely includes an SSH client by default. You can check for an SSH client by entering `ssh` at the command line.

Checkpoint questions

What is a Linux distribution?

True or false: The bash shell is the default shell for most Linux distributions.

Which command provides help for Linux commands?

What is a Linux distribution?

- **A Linux distribution is a packaged version of Linux that a group of individuals or a company develops. It includes the core operating system functionality (kernel) and additional complementary tools and software applications.**

True or false: The bash shell is the default shell for most Linux distributions.

- **True**

Which command provides help for Linux commands?

- **man**

Key takeaways



- Linux is an operating system that is similar to Unix. It is **free and open source**, and **users can expand it**.
- A Linux **distribution** combines the Linux kernel with other software applications to provide a complete operating system environment.
- All Linux distributions come with a **CLI**. Some also offer a **GUI**.
- The **bash** shell is the default shell in Linux.
- You can use the **man** command to read the Linux manual pages.

Some key takeaways from this lesson include:

- Linux is an operating system that is similar to Unix. It is free and open source, and users can expand it.
- A Linux distribution combines the Linux kernel with other software applications to provide a complete operating system environment.
- All Linux distributions come with a CLI. Some also offer a GUI.
- The bash shell is the default shell in Linux.
- You can use the man command to read the Linux manual pages.



Thank you

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Thank you.