**Introduction**

**What is a Computer?**

* A computer is a "computing machine".
* The first known computer is the Difference Engine built by Charles Babbage. Ultimately a steam powered calculator.
  + Babbage did have designs for another, more powerful, generalized computer called the Analytical Engine, but it never came to be built.
  + Both the Difference Engine and Analytical Engine used gears as their "circuits".
* Modern Computers make use of circuitry as opposed to gears, but the principles stay the same.
* Modern Machines follow Von Neumann Architecture, consisting of:
* Input
* A Central Processing Unit, containing:
  + A Control Unit
  + An Arithmetic / Logic Unit
* A memory Unit
* An Output device
* Ultimately, a computer is a machine that has a series of stored programs that fetch instructions that build off of other stored programs that build off of other stored programs.

**What is an Operating System?**

* All modern computers are run with an operating system.
* *The operating system controls a computer and makes it usable. It brings life to the innate electronic hardware components and orchestrates all activities on a computer. The same hardware under a different operating system is literally a different computer.*

-Wang, P (Ed). (2018). Mastering Modern Linux (pp. 30) Boca Raton: CRC Press

As of July 2023, data from the Global Stats' Stats Counter show the market share for operating systems used around the world are



In this course we'll be focusing on the Linux operating system. While it may not appear entirely relevant from the statistics above, Linux is a very powerful open source operating system that is widely used in the world of Computer Science and Software Engineering (among many other technical professions).

**What Is Linux?**

* Linux is a free and open-source operating system that works, in many respects, just like UNIX. Linux became popular as a widely preferred server platform for Web hosting, cloud computing, and other purposes.

-Wang, P (Ed). (2018). Mastering Modern Linux (pp. 22) Boca Raton: CRC Press

* Because of its open source nature, the Linux operating system is one that runs on all sorts of servers around the world, from university servers to cloud service providers like Amazon Web Services, Google Kubernetes.
* Linux is open source, which means that anyone and everyone in the community can contribute to the source code, or even fork it and create an entirely new operating system themselves.

**Linux History**

* The Linux Kernel (that is, the core of an operating system), was released by ***Linux Torvalds*** in 1994. From there, contributions were made to the kernel to create what is now known as the Linux (or arguably should be referred to as GNU/Linux) operating system.
* ***“When you are talking about Linux as a OS, you should refer to it as GNU/Linux. Linux is just the kernel. All the tools that make Linux an OS have been contributed by GNU movement and hence the name GNU/Linux."***
* *Calling the whole system "Linux" leads people to think that the system's development was started* ***in 1991 by Linus Torvalds****. That is what most users seem to think. The occasional few users that do know about the GNU Project often think we played a secondary role — for example, they say to me, 'Of course I know about GNU — GNU developed some tools that are part of Linux'.*
  + - Richard Stallman
* Linux systems have become extremely pervasive throughout the developer communities over the past few decades. Linux can be found on embedded systems running all over the world, running on servers which host a vast number of websites and apps, to normal people using Linux as an operating system on their personal machines.
* Linux systems are widely used by individuals, academic institutions, corporations, and service providers such as Web hosts, data centers, and cloud servers.
* *GNU is a recursive acronym for "GNU's Not Unix!" chosen because GNU's design is Unix-like, but differs from Unix by being free software and containing no Unix code.*

**Linux Versions**

* When we speak of Linux, we often do so by just calling the system a "Linux" system, but that is a mild misnomer. While the system is a "Linux" system, there are many different versions of it. Widely used Linux versions include:

1. **Ubuntu:** “Ubuntu” means “humanity” in Zulu. Ubuntu Linux started as a version of the popular Debian GNU/Linux. All versions of Ubuntu Linux are free, and there is no charge.
2. **Red Hat Enterprise Linux**—The original Red Hat Linux started in 1994 and was discontinued by Red Hat Inc. in 2004. The company now focuses on Red Hat Enterprise Linux (RHEL) for business environments and on Fedora as a community-supported software project for home, personal, and educational use.
3. **CentOS—RHEL** largely consists of free and open-source software, but the executables are made available only to paying subscribers. CentOS (Community ENTerprise Operating System) is a completely free version of RHEL (minus the Red Hat logos) made available to users as new versions of RHEL are released.
4. **Debian—**Debian Linux consists entirely of free and open-source software. Its primary form, Debian GNU/Linux, is a popular and influential Linux distribution. Debian is known for an abundance of options. Recent releases include over 26,000 software packages for all major computer architectures. Ubuntu is a derivative of Debian.
5. **Fedora—**Fedora is a leading-edge Linux distribution where new features and improvements are tested before being included in RHEL/CentOS.
6. **Mint—Linux** Mint, a newcomer, is a reliable and popular desktop distribution. It adopts a conservative approach to software updates and is based on Debian and Ubuntu.
7. **Raspbian—Based** on Debian, Raspbian is Linux optimized for the Raspberry Pi, a credit-card-sized computer for education as well as practical uses.

**Linux Philosophy**

* Small is Beautiful
* The Linux philosophy stems from the Unix philosophy, developed in Bell Labs. The core:
* Keep Programs Small: Write a program to do one well-defined task; do it efficiently, and do it well.
* Avoid Verbosity: Perform no unessential output from any programs; use short names for commands and command options
* Make Programs Modular: Build small, independent, and self-sufficient program parts, with each serving a specific function.
* Compose Programs Through Interfaces: Write programs that are easy to interface with other programs.
* It's not always the easiest to follow these tenants, but if you do, your programs will be able to not only be easily understandable by others, but also, they can easily interact with other Linux programs!

**Linux Features:** Linux's main features are:

* Multi-User and Multi-Processing
* Graphical User Interface
* **Package Management:** A package contains the executable program and metadata specifying its title, version, purpose, author/vendor, dependencies (on other packages), etc.
* **Shells:** A Shell is a command-line interface (CLI) to the operating system.
* Hierarchical File System: The entire file system is tree structured and is anchored at a single directory called the root. The root directory contains files and other directories that, in turn, contain more files and directories.
* File Access Control
* Concurrent Processes
* Serving the Internet
* Utilities

The Linux kernel, the central part of the operating system which provides a programming interface to the hardware, is robust and highly efficient.

