title: Operating Systems and BSD
subtitle: OSs
minutes: 5

# Operating Systems

## Learning objectives

- Explain what operating systems are.
- Explain the history and advantages of Unix.

## Operating Systems and Unix

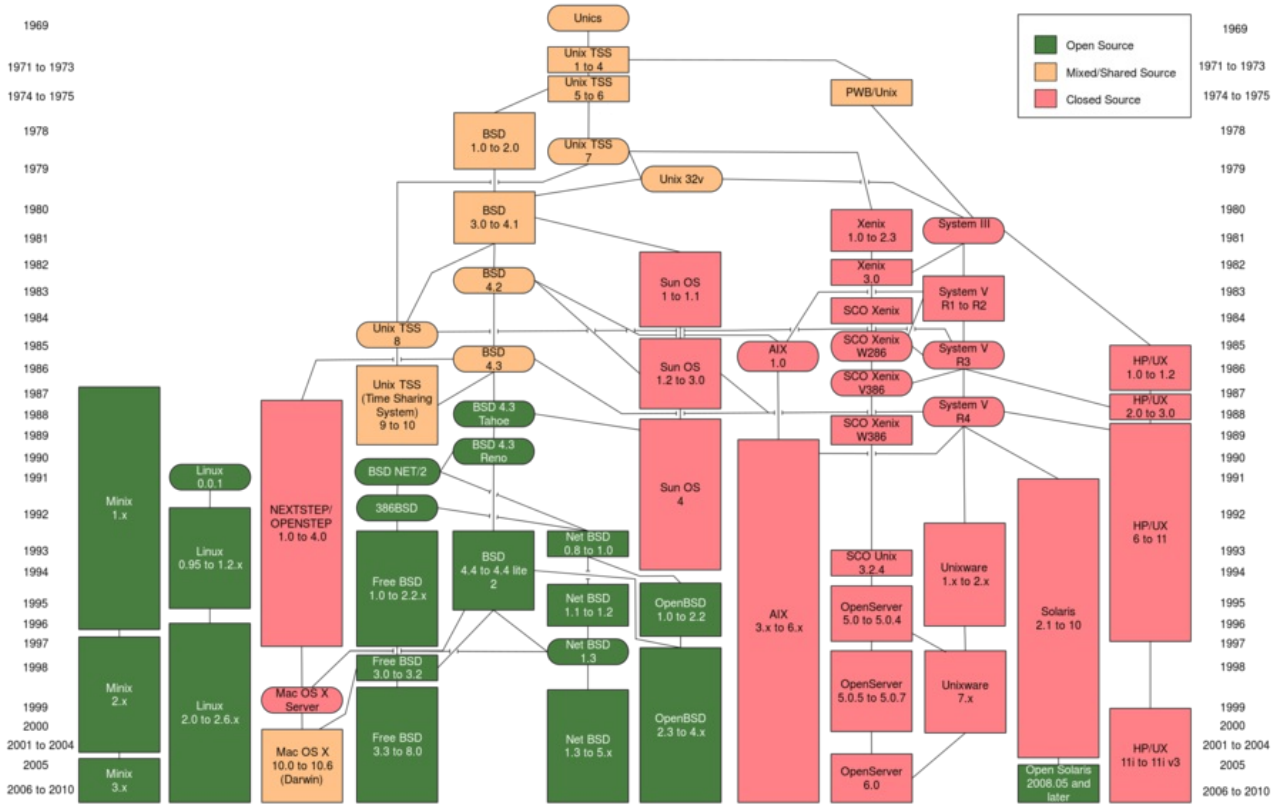
**What is an Operating System?**

An operating system is a suite of programs which make the computer work. It is a stable, multi-user, multi-tasking system for servers, desktops and laptops.

**Unix**

UNIX is an operating system which was first developed in the 1960s, and has been under constant development ever since.

# UNIX HISTORY
## 1969 - 2010




**Unix v. Windows**

Unix has several fundamental differences compared with Windows:

- More rigorous security
- Extremely powerful command-line tools
- Very stable
- Entirely different directory structure

**Unix v. Apple OSX**

OSX *is* Unix: A version called Darwin, based on [BSD (https://en.wikipedia.org/wiki/Berkeley_Software_Distribution)](https://en.wikipedia.org/wiki/Berkeley_Software_Distribution). It comes packaged with all the necessary tools:

- The full suite of command-line tools in the **Terminal**
- An X11() server for graphics
- Secure shell and secure copy for working over networks
- The C and FORTRAN compilers (in the Xcode toolset)

OSX is probably the best-designed commercial Unix variant for consumer use in operation today.

**Unix v. Linux**

Linux is a free and open source (https://en.wikipedia.org/wiki/Free_and_open-source_software) Unix-like operating system. It is the leading operating system on servers and other big iron systems such as mainframe computers and supercomputers, but is used on only around 1% of personal computers. Typically, Linux is packaged in a form known as *Linux distribution* such as the one in Ubuntu (http://www.ubuntu.com/about/about-ubuntu).

## Key Components of Unix

(Adapted from Indiana University (https://kb.iu.edu/d/agat))

Unix has three main components

#### Kernel

The kernel of UNIX is the hub of the operating system: it allocates time and memory to programs and handles the filestore and communications in response to system calls.

#### Shell

The shell is an interactive program that provides an interface between the user and the kernel. The shell interprets commands entered by the user or supplied by a shell script, and passes them to the kernel for execution.

As an illustration of the way that the shell and the kernel work together, suppose a user types `rm myfile` (which has the effect of removing the file *myfile*). The shell searches the filestore for the file containing the program `rm`, and then requests the kernel, through system calls, to execute the program `rm` on *myfile*. When the process `rm myfile` has finished running, the shell then returns the UNIX prompt `%` to the user, indicating that it is waiting for further commands.

We'll talk more about shells in a little bit.

#### File system

Unix and Unix-like operating systems employ a hierarchical (i.e., inverted tree) directory structure, with the root directory (/) at the top.

The standard file system has, among others, the following directories:

| Directory | Description |
|---|---|
| / | The root directory, where the whole tree starts |
| /bin | Contains fundamental executables (i.e., binaries) generally used by all users on the system (e.g., chmod, cp, mv, grep, and tar) |
| /etc | Contains local configuration files, subdirectories containing configuration files for large software packages (e.g., the X11 window system) |
| /lib | Contains shared libraries needed to boot the system and run the commands in the root file system |
| /tmp | Local scratch space for storing temporary files, which may be deleted without notice |
| /usr/bin | The primary directory for most executables used by normal users on the system (e.g., emacs, make, scp, sftp, ssh, and yum) |
| usr/lib | Contains static and dynamic libraries, a few executables that usually are not invoked directly, and subdirectories for complex programs |

We'll also be talking more about files + directories.