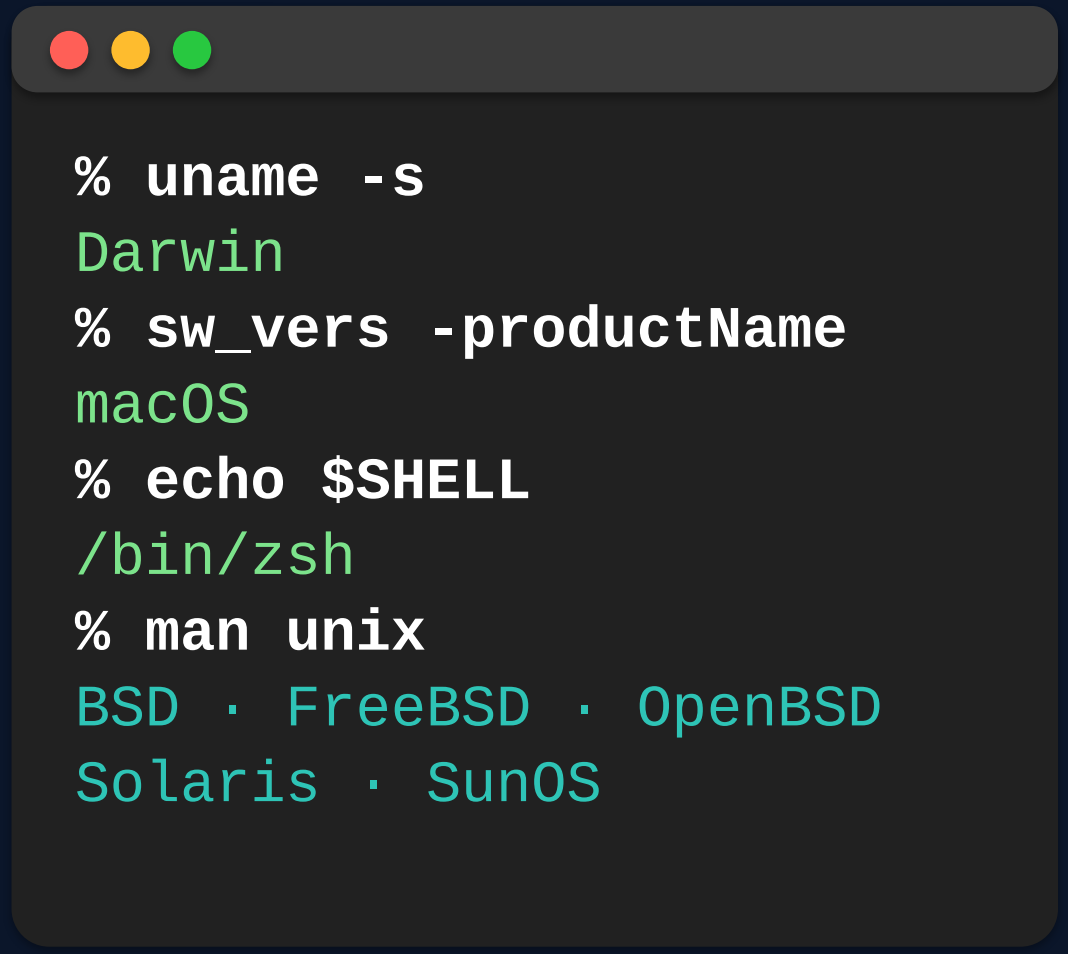


LESSON 4 OF 12

macOS UNIX

Darwin & BSD

Terminal, zsh & the macOS File System

Full Course · macOS 27 Golden Gate

What You Will Learn in Lesson 4

- Terminal, the shells macOS ships, and how to switch
- zsh startup files and the PATH
- Getting help: man, apropos, which, type
- The file system layout and the sealed system volume
- Files, text, permissions, pipes and redirection
- BSD vs GNU differences and macOS-only commands
- zsh power features, and the shells of BSD and Solaris

Terminal and Your Shells

```
% echo $SHELL              # your login shell
/bin/zsh
% cat /etc/shells          # shells you are allowed to use
/bin/bash  /bin/csh  /bin/dash  /bin/ksh  /bin/sh  /bin/tcsh  /bin/zsh
% bash --version | head -1
GNU bash, version 3.2.57 ...    # old: newer bash uses the GPLv3 license
% chsh -s /bin/bash        # change your login shell (asks for password)
% chsh -s /bin/zsh         # change it back
```

Example output. Newer bash: brew install bash (Lesson 5).

zsh Startup Files and the PATH

File	Read when	Put here
~/.zshenv	Every zsh, even scripts	Rarely needed; keep it tiny
~/.zprofile	Login shells (each new Terminal window)	PATH changes, e.g. Homebrew
~/.zshrc	Interactive shells	Aliases, functions, prompt, options
/etc/paths, /etc/paths.d/	By path_helper at login	System-wide PATH entries
~/.bash_profile	bash login shells	If you switch to bash

Getting Help Without Leaving Terminal

```
% man ls                    # the manual page (q to quit, /word to search)
% man -k password           # search all manual pages (same as apropos)
% man 5 crontab             # section 5 = file formats
% which -a python3          # every python3 on your PATH
% type ls                   # alias, builtin, function or file?
% whatis grep               # one-line description
% help                      # zsh has run-help for builtins:  run-help cd
```

The macOS File System Layout

Path	What lives there
/System	macOS itself, on the sealed, read-only system volume
/Library · ~/Library	System-wide and per-user settings, caches, fonts, LaunchDaemons
/Applications · /Users	Apps for all users · home folders (/Users/<name>)
/etc → /private/etc	UNIX configuration files (hosts, shells, paths, sudoers)
/var → /private/var · /tmp	Logs, databases, spools · temporary files
/usr/bin · /bin · /sbin	Apple's UNIX commands (read-only)
/usr/local · /opt/homebrew	Your own software; Homebrew on Apple silicon
/Volumes	Mounted disks, USB drives and disk images

The Sealed System Volume and Firmlinks

```
% ls -l / | grep -E 'etc|var|tmp'
lrwxr-xr-x  ... etc -> private/etc
lrwxr-xr-x  ... tmp -> private/tmp
lrwxr-xr-x  ... var -> private/var

% mount | head -2
/dev/disk3s1s1 on / (apfs, sealed, local, read-only, journaled)
/dev/disk3s5 on /System/Volumes/Data (apfs, local, journaled, nobrowse)

% sudo touch /usr/bin/test     # fails: Read-only file system
```

Example output; disk numbers vary.

Files and Folders: The Daily Commands

```
% pwd;  cd ~;  cd -;  cd ..          # where am I, home, back, up
% ls -laG                           # long list, hidden files, color
% mkdir -p ~/lab/a/b                # make nested folders
% cp -R ~/lab ~/lab-copy            # copy a folder
% mv old.txt new.txt;  rm -i file   # rename; delete with a prompt
% ln -s /etc/hosts ~/lab/hosts      # symbolic link
% file /bin/ls;  stat -x /etc/hosts # what is it; details
% find ~ -name '*.log' -mtime -7    # logs changed in 7 days
% du -sh ~/Library;  df -h /        # folder size; free space
```

Reading and Editing Text

```
% cat /etc/shells                # print a short file
% less /var/log/system.log       # page through (space, b, /search, q)
% head -20 file;  tail -f file   # first lines; follow a growing log
% vim ~/.zshrc                   # vi/vim: i insert, Esc, :wq save+quit
% nano ~/.zshrc                  # simple editor (^O save, ^X exit)
% open -e ~/.zshrc               # edit in TextEdit
% echo 'alias ll="ls -laG"' >> ~/.zshrc;  source ~/.zshrc
```

Permissions in One Slide

```
% ls -l ~/lab/script.sh
-rwxr-xr--@ 1 wahid  staff  120 Nov 17 10:00 script.sh
# type | owner rwx | group r-x | others r-- | @ = extended attributes

% chmod 755 script.sh       # rwx r-x r-x   (programs, folders)
% chmod 644 notes.txt       # rw- r-- r--   (normal files)
% chmod u+x script.sh       # add execute for the owner
% sudo chown root:wheel file
% ls -le@ file              # also show ACLs (+) and xattrs (@)
```

Pipes, Redirection and Text Tools

```
% ls /usr/bin > list.txt          # write output to a file
% date >> list.txt                # append
% ls /nothere 2> errors.txt       # errors only
% ls /usr/bin | wc -l             # count commands
% ps aux | sort -nrk 3 | head -5  # top 5 by CPU
% grep -i error /var/log/install.log | tail
% cut -d: -f1 /etc/passwd | sort | uniq | head
% awk '{print $1}' list.txt | sort | uniq -c | sort -nr | head
```

BSD (macOS) vs GNU (Linux) Tools

Task	macOS / BSD	Linux / GNU
Edit file in place	sed -i '' 's/a/b/' f	sed -i 's/a/b/' f
Yesterday's date	date -v-1d	date -d yesterday
File size with stat	stat -f %z f	stat -c %s f
Colored ls	ls -G	ls --color
Checksum	shasum -a 256 f · md5 f	sha256sum f · md5sum f
Extended regex in find/sed	find -E . ; sed -E	find -regextype … ; sed -E

Commands Only macOS Has

Command	What it does
open · pbcopy · pbpaste	Open files/apps · copy to and paste from the clipboard
mdfind · mdls	Spotlight search · show a file's metadata
defaults · plutil	Read/write app settings · check and convert .plist files
diskutil · hdiutil	Disks and APFS · disk images (Lesson 11)
networksetup · scutil	Network settings · DNS, hostname (Lesson 10)
softwareupdate · sw_vers · system_profiler	Updates · version · hardware report
caffeinate · pmset · screencapture · say	Stay awake · power settings · screenshot · speech

zsh Power Features (~/.zshrc)

```
# ~/.zshrc  — MyWebUniversity lab settings
PROMPT='%n@%m %1~ %# '          # user@host folder %
alias ll='ls -laG'
alias ..='cd ..'
setopt AUTO_CD HIST_IGNORE_DUPS SHARE_HISTORY
autoload -Uz compinit && compinit  # smart Tab completion
mkcd() { mkdir -p "$1" && cd "$1"; }

% ls **/*.log      # recursive glob
% ^R               # Ctrl-R: search your history
```

Shells and Layout on Other UNIX Systems

	macOS	FreeBSD	OpenBSD	Solaris 11.4
Default user shell	zsh	sh	ksh	bash
Root shell	zsh (root is disabled)	sh	ksh	bash (root is a role)
Add-on software	/opt/homebrew	/usr/local	/usr/local	/usr, /opt (IPS)
System config	/etc + plists	/etc/rc.conf	/etc/*.conf, rcctl	SMF properties
Tools flavor	BSD	BSD	BSD	System V + GNU

Lab: Live in Terminal

```
% echo $SHELL; cat /etc/shells; bash --version | head -1
% ls -l / | grep private;  mount | head -2
% mkdir -p ~/lab && cd ~/lab
% ls /usr/bin > cmds.txt;  wc -l cmds.txt
% grep -c '^z' cmds.txt              # commands starting with z
% date -v-1d;  stat -f '%z bytes' cmds.txt
% echo 'alias ll="ls -laG"' >> ~/.zshrc && source ~/.zshrc && ll
% man -k disk | head
```

Summary & Homework

- zsh is the default; /etc/shells lists the others; chsh switches
- .zprofile for PATH, .zshrc for aliases and prompt
- Sealed read-only system volume + Data volume; /etc → /private/etc
- Pipes + grep, sort, uniq, cut, awk answer most questions
- Homework: finish the lab; build your own .zshrc with 3 aliases
- Next: Lesson 5 — Package Management: Homebrew, MacPorts, pkg

Thank You! 🙏

Free videos & PDFs: www.MyWebUniversity.com

Slides for this lesson: MyWebUniversity.com/presentations

YouTube: @MyWebUniversity · @MyWebUniversity-Dari

Wahidullah Lutfy — Founder and Director of IT of MyWebUniversity, and CS teacher

Book: The Direct Path to Linux Ubuntu (Amazon · Barnes & Noble)

Learn it, then pass it on.