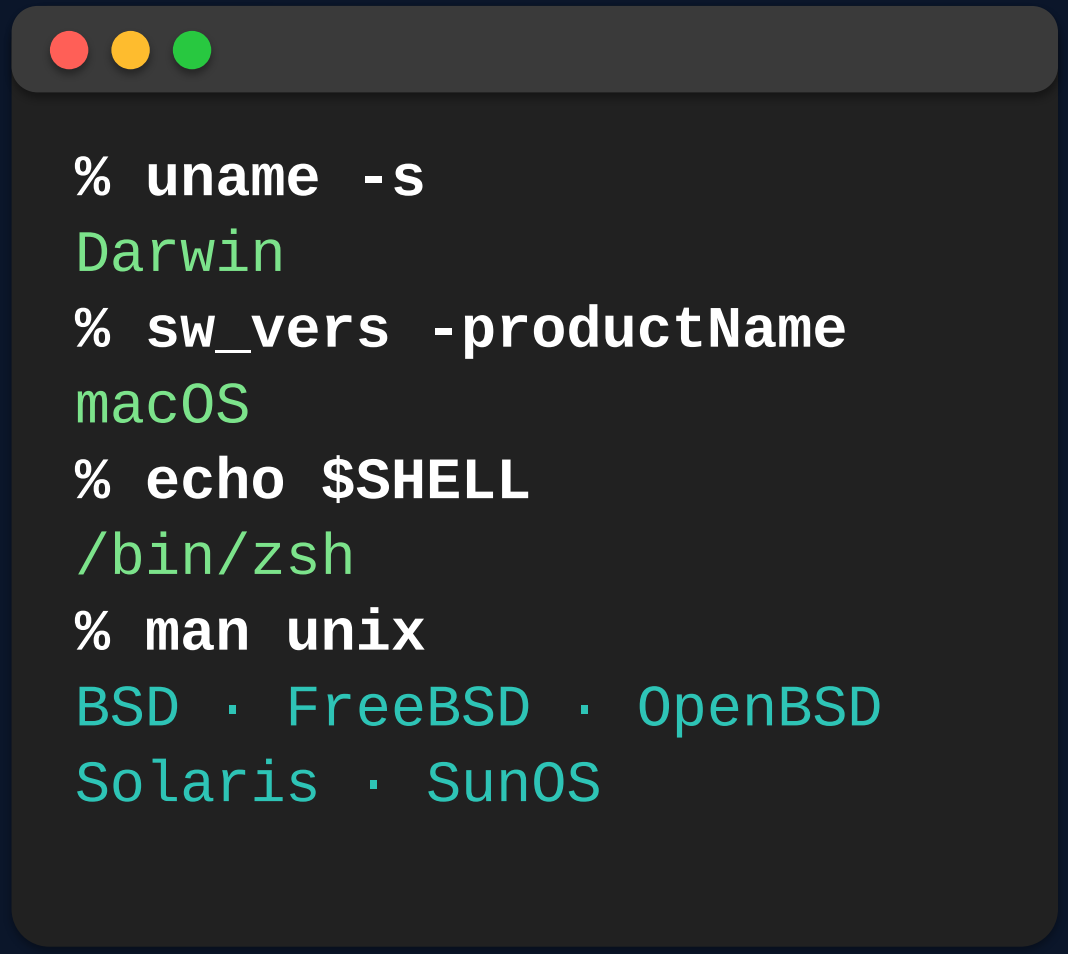


LESSON 9 OF 12

macOS UNIX

Darwin & BSD

Process & Service Management: ps, top, kill & launchd

Full Course · macOS 27 Golden Gate

What You Will Learn in Lesson 9

- Processes, PIDs, parents and launchd (PID 1)
- ps, top, pgrep and Activity Monitor
- Signals: kill, pkill, killall; jobs, nice and nohup
- Who uses what: lsof, vm_stat, fs_usage
- launchd: daemons vs agents, and the plist format
- launchctl: bootstrap, bootout, print, kickstart; launchd vs cron
- Unified logging, and services on FreeBSD, OpenBSD and Solaris

Processes and launchd, PID 1

```
% ps -o pid,ppid,user,command -p 1
  PID  PPID USER  COMMAND
    1     0 root  /sbin/launchd

% ps aux | head -5                    # every process, BSD style
% ps -ef | grep -i finder              # System V style also works
% ps -o pid,ppid,%cpu,%mem,command -U $USER | head
% pgrep -lf Safari                     # PIDs by name
% sysctl hw.ncpu hw.memsize            # how many CPUs, how much RAM
```

top: Live View

```
% top -o cpu                    # sort by CPU (q to quit)
% top -o mem -n 10              # top 10 by memory
% top -l 1 | head -12          # one snapshot, good for scripts
Processes: 512 total, 3 running, 509 sleeping, 2201 threads
Load Avg: 1.52, 1.31, 1.20  CPU usage: 6.1% user, 4.0% sys, 89.8% idle
PhysMem: 7210M used (1302M wired), 802M unused.

% vm_stat;  memory_pressure  # memory details
% uptime                     # load averages: 1, 5, 15 minutes
```

Example output.

Signals: Talking to Processes

Signal	Number	Meaning	Example
TERM	15	Please exit (default; can clean up)	kill 4242
INT	2	Interrupt (what Ctrl-C sends)	kill -INT 4242
HUP	1	Hang up; many daemons reload config	kill -HUP 4242
KILL	9	Stop immediately (no clean-up!)	kill -9 4242
STOP / CONT	17 / 19	Pause / resume	kill -STOP 4242

Name-based: pkill -x Safari · killall Safari · pkill -u student1 · list all: kill -l

Jobs, Priority and Background Work

```
% sleep 300 &                    # run in the background
[1] 5120
% jobs;  fg %1;  ^Z;  bg %1     # list, foreground, suspend, background

% nice -n 10 ./backup.sh        # start with lower priority (-20..20)
% sudo renice -n 5 -p 5120      # change a running process

% nohup ./long-job.sh > job.log 2>&1 &   # survives closing Terminal
% caffeinate -i ./long-job.sh            # keep the Mac awake meanwhile
```

Who Uses What? lsof, fs_usage, sample

```
% lsof -p 5120 | head              # files and sockets a process has open
% lsof -i :8080                   # who uses port 8080?
% lsof +D ~/lab                   # who has files open in a folder
% sudo lsof /Volumes/MyUSB        # why can't I eject this disk?

% sudo fs_usage -w -f filesys Safari | head   # live file activity
% sample Safari 5 -file /tmp/safari.txt      # what is it doing? (5 s)
% sudo spindump                              # report on hung apps
```

launchd: Daemons vs Agents

Type	Runs as	Starts	Folder
LaunchDaemon (Apple)	root or a service user	At boot, no login needed	/System/Library/LaunchDaemons
LaunchDaemon (yours)	root or UserName	At boot	/Library/LaunchDaemons
LaunchAgent (all users)	Each logged-in user	At login	/Library/LaunchAgents
LaunchAgent (one user)	That user	At that user's login	~/Library/LaunchAgents

Never edit /System: it is on the sealed volume. Your own jobs go in /Library or ~/Library.

A launchd Job: ~/Library/LaunchAgents/com.mwu.diskalert.plist

```
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE plist PUBLIC "-//Apple//DTD PLIST 1.0//EN" "http://www.apple.com/DTDs/PropertyList-
1.0.dtd">
<plist version="1.0"><dict>
  <key>Label</key>             <string>com.mwu.diskalert</string>
  <key>ProgramArguments</key>  <array><string>/Users/wahid/bin/disk-alert.zsh</string></array>
  <key>StartCalendarInterval</key> <dict><key>Hour</key><integer>9</integer>
                                   <key>Minute</key><integer>0</integer></dict>
  <key>RunAtLoad</key>         <true/>
  <key>StandardOutPath</key>   <string>/tmp/diskalert.out</string>
  <key>StandardErrorPath</key> <string>/tmp/diskalert.err</string>
</dict></plist>
```

Other keys: StartInterval (seconds) · KeepAlive (restart if it exits) · WorkingDirectory · UserName (daemons)

launchctl: Load, Inspect, Run, Unload

```
% plutil -lint ~/Library/LaunchAgents/com.mwu.diskalert.plist   # check syntax
% launchctl bootstrap gui/$(id -u) ~/Library/LaunchAgents/com.mwu.diskalert.plist
% launchctl list | grep mwu                      # PID, last exit status, label
% launchctl print gui/$(id -u)/com.mwu.diskalert | head -20
% launchctl kickstart -k gui/$(id -u)/com.mwu.diskalert   # run (restart) now
% launchctl bootout gui/$(id -u)/com.mwu.diskalert         # unload

# Daemons use the system domain (plist owned by root:wheel, mode 644):
% sudo launchctl bootstrap system /Library/LaunchDaemons/com.mwu.web.plist
```

launchd vs cron

- cron still works on macOS: crontab -e (min hour day month weekday)
- Apple recommends launchd for new jobs
- launchd runs a missed calendar job when the Mac wakes; cron skips it
- launchd can restart crashed programs (KeepAlive) and start on demand
- Output, environment and user are set per job in the plist
- brew services writes launchd plists for you (Lesson 5, 7)

Unified Logging: log and Console

```
% logger "MWU test message"                    # write to the system log
% log show --last 5m --predicate 'eventMessage CONTAINS "MWU"'
% log show --last 1h --predicate 'process == "sshd"' --style compact
% log stream --predicate 'process == "launchd"' --level info   # live
% log show --last boot | grep -i error | head

% ls /var/log;  tail -f /tmp/diskalert.err      # classic text logs
```

Services on Other UNIX Systems

Task	macOS	FreeBSD	OpenBSD	Solaris 11.4
PID 1	launchd	init	init	init + SMF
Enable at boot	plist in LaunchDaemons	sysrc nginx_enable=YES	rcctl enable nginx	svcadm enable nginx
Start / stop	launchctl bootstrap / bootout	service nginx start / stop	rcctl start / stop nginx	svcadm enable -t / disable
Status	launchctl print	service nginx status	rcctl check nginx	svcs -x nginx
Process tools	ps, top, lsof	ps, top, procstat	ps, top, fstat	ps, prstat, ptree, pfiles

Lab: Your First launchd Service

```
% mkdir -p ~/bin && cp ~/lab/disk-alert.zsh ~/bin/ && chmod +x ~/bin/disk-alert.zsh
% vim ~/Library/LaunchAgents/com.mwu.diskalert.plist    # from the slide
% plutil -lint ~/Library/LaunchAgents/com.mwu.diskalert.plist
% launchctl bootstrap gui/$(id -u) ~/Library/LaunchAgents/com.mwu.diskalert.plist
% launchctl list | grep mwu;  cat /tmp/diskalert.err
% sleep 600 &
% pgrep -lf sleep;  kill %1
% top -l 1 -o cpu | head -15;  lsof -iTCP -sTCP:LISTEN -n -P
% launchctl bootout gui/$(id -u)/com.mwu.diskalert
```

Summary & Homework

- launchd is PID 1; ps, top, pgrep, lsof show what runs
- Signals: TERM first, KILL last; pkill / killall by name
- Daemons (boot, root) vs agents (login, user) — choose the folder
- launchctl bootstrap / print / kickstart / bootout; plutil -lint first
- Homework: do the lab; change the job to run every 30 minutes
- Next: Lesson 10 — Network Configuration, Firewall & SSH

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.