The History of Unix

OPCUG & PATACS

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February 15, 2025

Outline: Topics to Be Covered

- Bell Labs
- Bellcore
- Computer operating systems
- Birth of Unix
- Unix timeline
- The Unix Wars 1984-1993
- A minor diversion

Outline (cont.)

- C Programing Language
- A little taste of Unix
- Unix time
- Relationship of macOS to Unix

  and finally...
- macOS Terminal.app

Bell Labs

- Late 19th century—began as the "Western Electric Engineering Department" in NYC
- 1925—became "Bell Telephone Laboratories, Inc."
  - ✓Owned by AT&T*
- 1960s—Bell Labs moved to Murray Hill, New Jersey

* AT&T = American Telephone & Telegraph Company

Active links

Breakup of Bell System

- 1974—U.S. Justice Department sued AT&T (for monopolistic practices)
- 1982—Consent decree accepted
  - ✓AT&T lost control of Bell operating companies[1]
  - ✓AT&T prohibited from using the Bell name or logo (except Bell Labs)
  - ✓AT&T could provide long-distance service
  - ✓AT&T could sell computers[2]

[1] The “Baby Bells” which provided local telephone service

[2] Through a subsidiary called AT&T Information Systems

Breakup of Bell System (cont.)

- 1984 Bell Labs became a subsidiary of AT&T Technologies (funding greatly decreased)
- 1996 Bell Labs was spun off to Lucent Technologies, which included:
  - ✓ Western Electric
  - ✓AT&T Technologies business unit
  - ✓ Bell Labs
- 2006 Alcatel SA acquired Lucent
- 2016 Nokia* acquired Alcatel-Lucent

* Nokia is a Finish telecommunications company

Bell Labs Accomplishments

- Eleven Nobel Prize winners and five Turing Awards
- 1947—The transistor (Bardeen, Brattain & Shockley)
- 1948—Claude Shannon published “A Mathematical Theory of Communication”*
- 1954—First transistorized computer

* The basis for information theory

Bell Labs Accomplishments (cont.)

- 1954—First modern solar cell
- 1958—Technical paper by Schawlow and Townes described the first laser
- 1969—Unix created by Ken Thompson, Dennis Ritchie (and others)

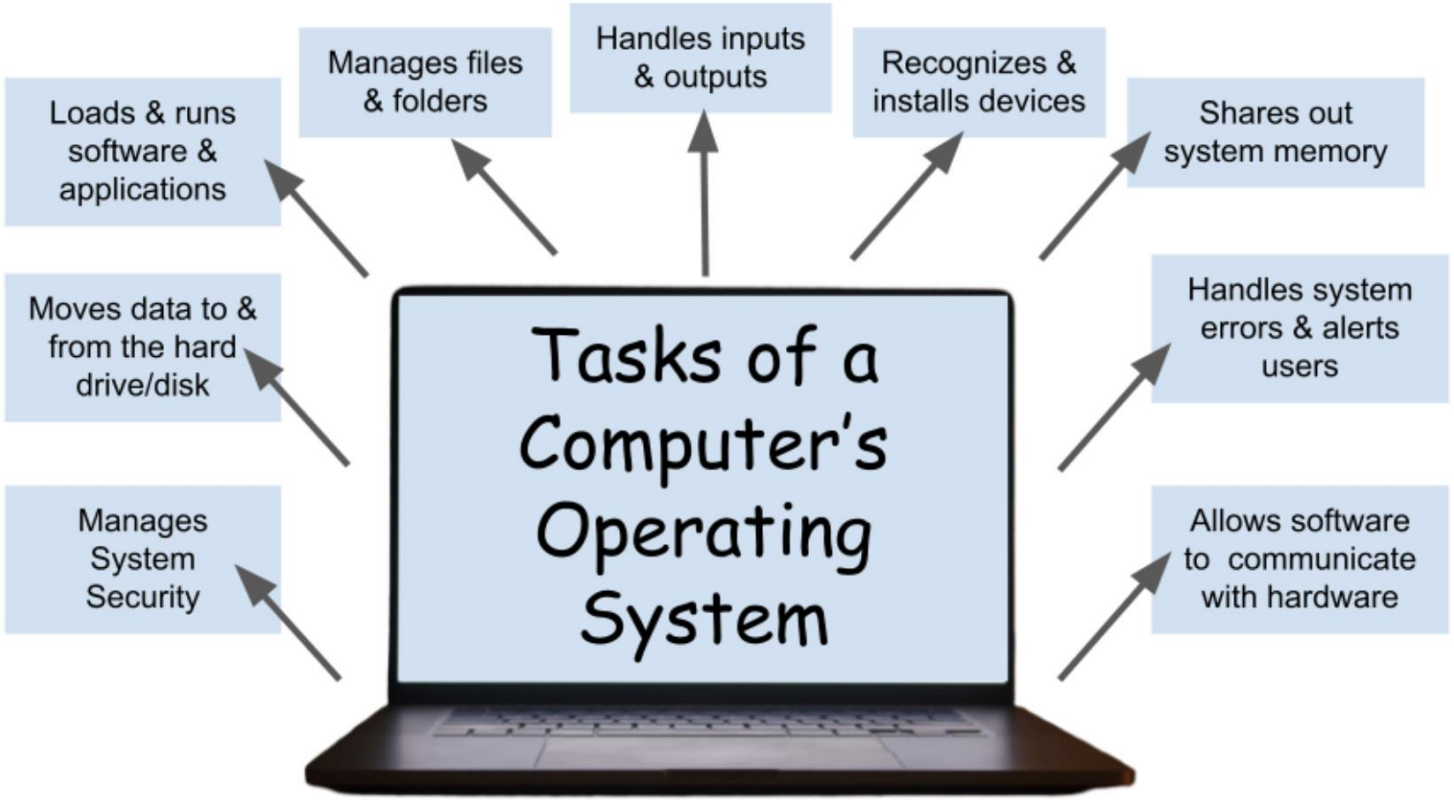
Bellcore

- 1984—Bellcore created to serve the seven regional Bells (a “baby Bell Labs”)
- 1996—Science Applications International Corp. (SAIC) acquired Bellcore
- 1997—Telcordia Technologies, Inc. acquired Bellcore

Bellcore

- 2012—Ericsson acquired Telcordia technologies
- 2013—Telcordia restructured and rebranded as “iconectiv” 

Operating System Functions

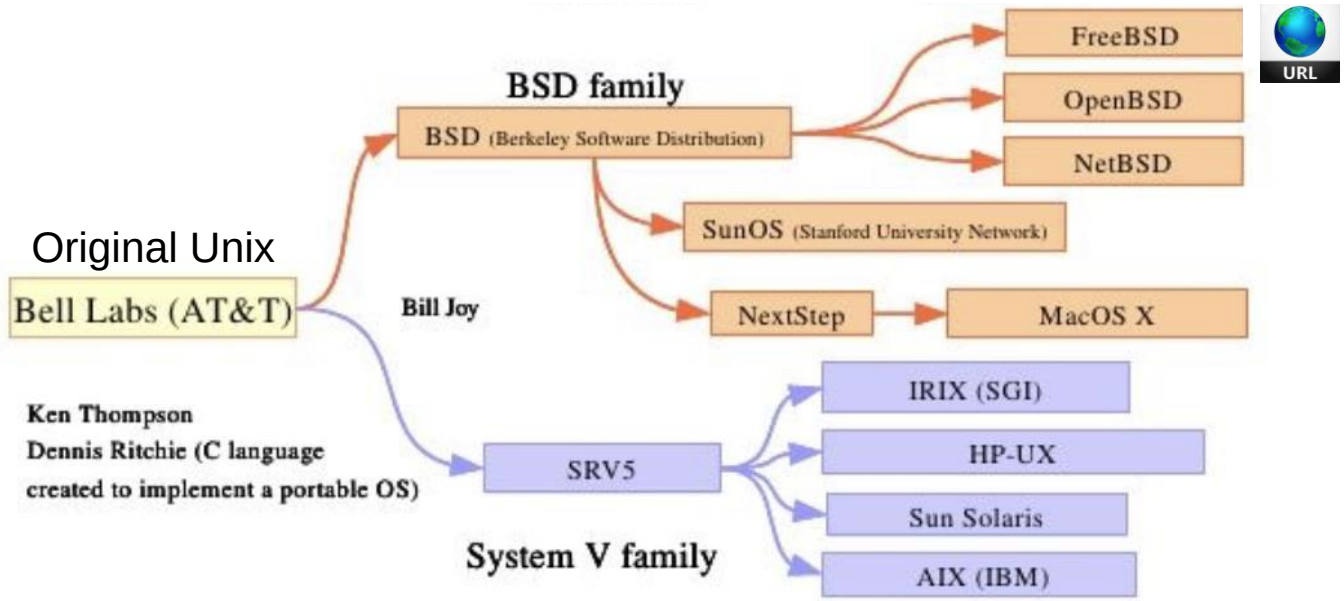


For a historical timeline of operating systems see URL

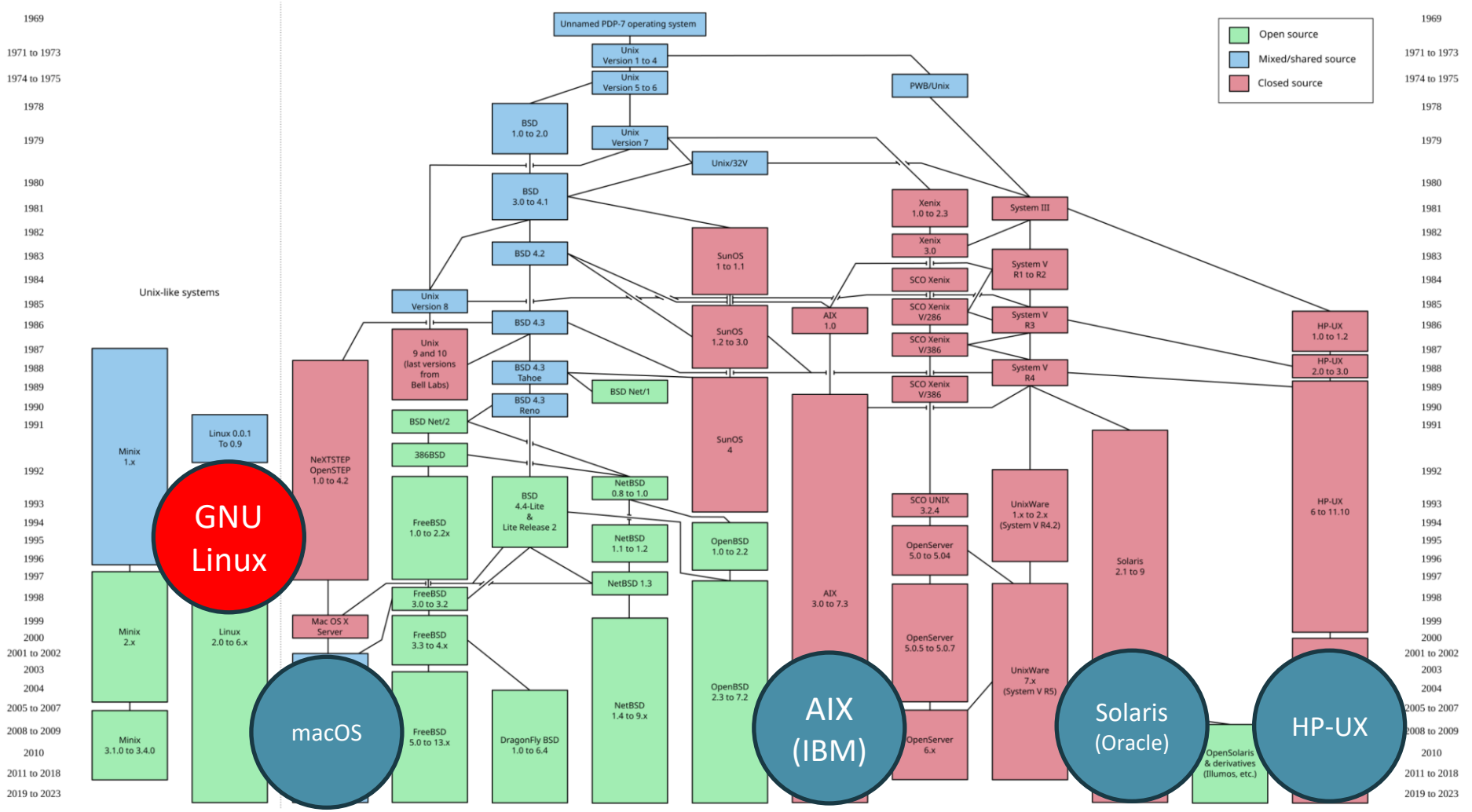
And much more URL URL URL

Unix family Tree

GNU stands for "GNU's Not Unix”



Unix—Progenitor of Many Operating Systems



From *Wikipedia* URL

Is Linux Unix?

- Answer—They sound the same, but **No**
- Linux is a Unix-like operating system deriving much of its basic design from Unix 

- The Linux kernel* was developed by Linus Torvalds and released in 1991 

* The Linux kernel is the main component of the Linux operating system

History of **Unix**

Multics — 1960s

- Cooperative effort of Bell Labs, MIT and General Electric
- Objective to develop a time-sharing system for the GE-645 mainframe*
- The project bogged-down and Bell Labs withdrew

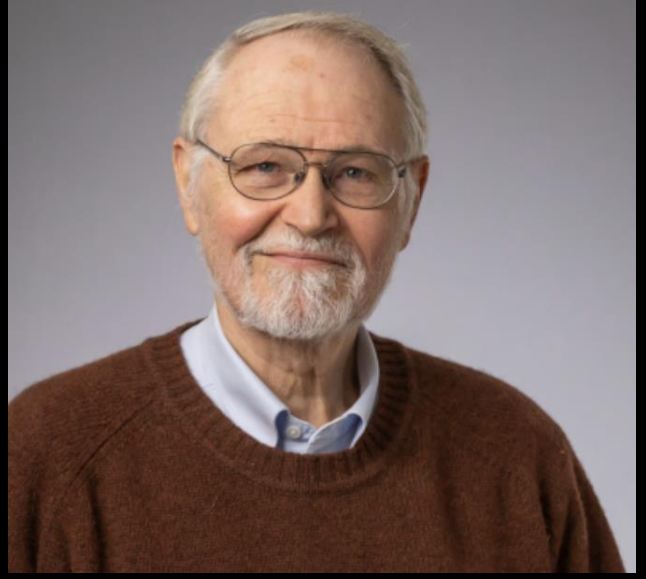
* IBM computers had time-sharing since the early 1960s

Turing Award 1983 URL

National Metal of Technology and Innovation 1998 URL

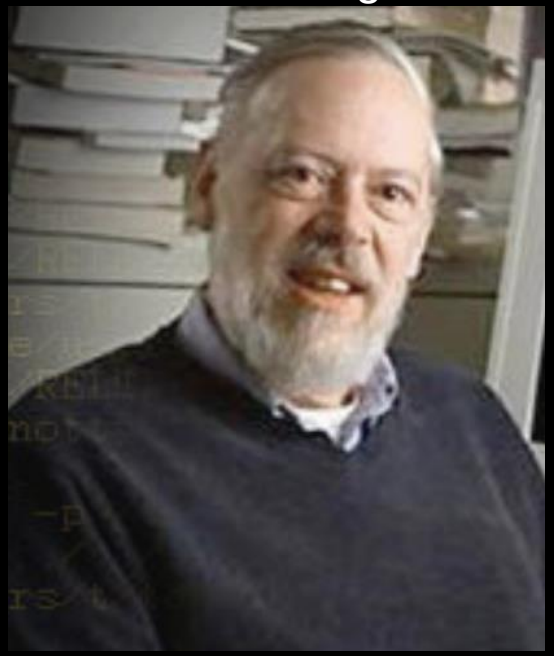
Induction into National Inventors Hall of Fame 2019 URL

Michael Lesk



Brian Kernighan

Douglas McLloroy



Joe Ossanna

Space Travel Game — 1969

- Ken Thompson created Space Travel on a small GM-635
- Typical game cost $75 to run ($645 in 2025 money)
- Thompson re-wrote Space Travel for an under-used DEC PDP-7
- **Management doesn't support this effort**

Birth of Unix—1969 (cont.)

- Ken Thompson wrote a program to interface with the PDP disk drive*
- Thompson estimated he could write an operating system kernel in three weeks:
  - ✓One week for a new editor
  - ✓One week for an assembler
  - ✓One week for a prototype kernel 

Took about a year ↑

*** This led Thompson to realize that he had essentially created the foundation for an operating system by building this low-level disk access interface**

Birth of Unix—1969 (cont.)

- Unix was initially named "Unics"
  - ✓**uni**plexed instead of **multi**plexed
- Brian Kernighan is generally credited with the final name "Unix"
- For more information see URL URL

Unix Timeline: 1969 to 2010

- 1969: Work started on the little used PDP-7
- 1973: Unix is rewritten in “C”
- 1975: Unix spreads from Bell Labs; BSD emerges
- 1979: Unix ported to DEC’s VAX
- 1980: Microsoft introduces Zenix—still used in 1995
- 1983: Unix System V released* [45,000 systems]

* Unix System V was the first commercial version of Unix

Unix Timeline: 1969 to 2010 (cont.)

- 1984: System V Release 2, 100,000 systems
- 1987: System V Release 3, 750, 000 systems
- 1989: System V Release 4, 1.2 million systems
- 1991: Linus Torvalds starts Linux development
- 1991: Solaris 1.0 debuts (Sun Microsystems)

Unix Timeline: 1969 to 2010 (cont.)

- 1993: AT&T sold Unix System Laboratories to Novell
- 1993: Novell transfered Unix trademark to X/Open
- 1994: Single Unix specification established
- 1996: The Open Group formed as a merger of X/Open and Open Science Framework (OSF)

Unix Timeline: 1969 to 2010 (cont.)

- 1997: The Open Group introduces the ”Single Unix Specification” (SUS) Version 2
- 1999: Unix 30th anniversary
- 2001: “Single Unix Specification” (SUS) Version 3 introduced
- 2001: Procurement of Unix brands exceeded $25 billion

Unix Timeline: 1969 to 2010 (cont.)

- 2001-2003: Dot-com bubble leads to consolidation of many versions of Unix
- 2007: Apple Mac OS X certified to Unix 03
- 2008: Unix brand sales at $69 billion
- 2010: Apple reports sales of 50 million desktop computers, all Unix certified
- 2003-2010: Numerous lawsuits among various Unix and Linux vendors

The Unix Wars 1984-1993

- The contestants:
  - ✓ AT&T
  - ✓ AT&T with Sun Microsystems
  - ✓ Berkeley Software Design
  - ✓ Berkeley Software Distribution
  - ✓ The Hamilton Group
  - ✓ Open Software Foundation
  - ✓ Unix International
  - ✓ Unix System Laboratories*

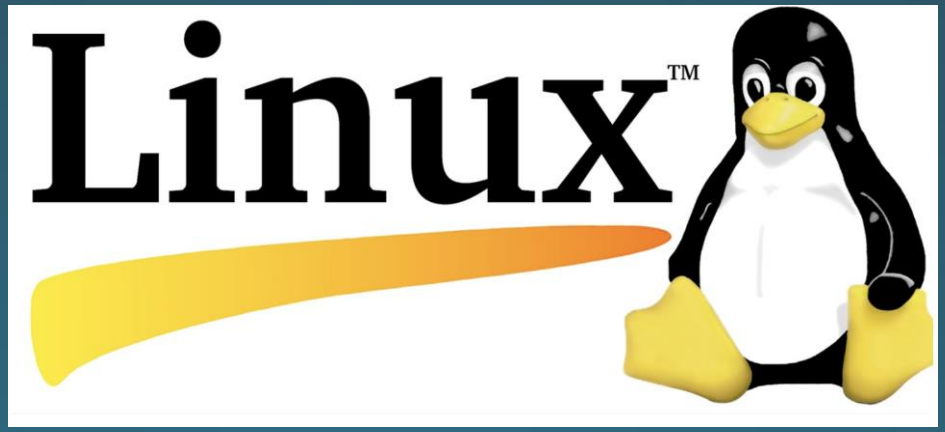
Two goals — to Standardize and Control Unix

Result?

Goals not achieved

* Originally a subsidiary of AT&T

Who won the war?



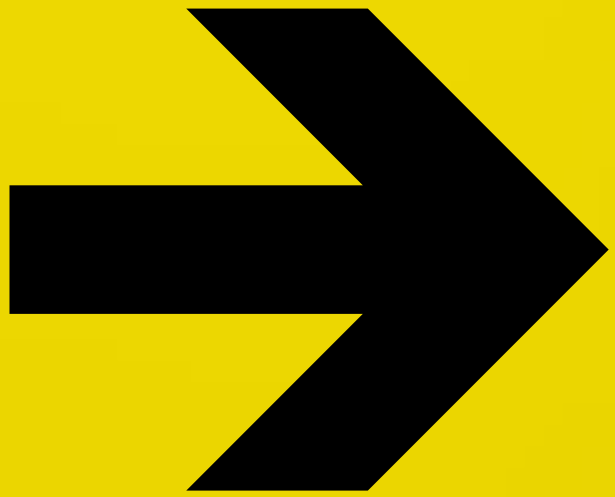
- 1000s of distros (distributions) URL
- All distros share the same kernel*
- "How Linux Killed Unix" see the video URL

* Not infrequently some changes are made to the kernel

Unix After 2010

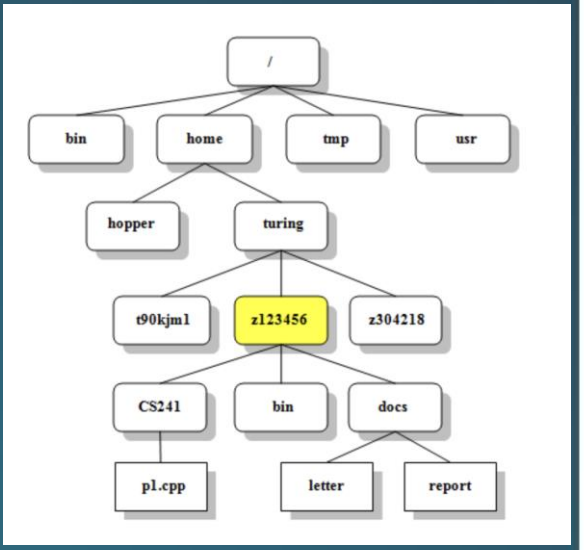
- Ongoing development and refinement of existing Unix-like variants such as Linux and Oracle Solaris (Unix)
- In Cloud computing Linux has replaced Unix to a great extent, for example:
  - ✓Amazon Web Services (AWS)
  - ✓Microsoft Azure

A Minor Diversion



1971 — Bell Labs Patent Office

- Request is made for help
- The following was developed:
  - ✓ a hierarchical file system
  - ✓ fork() (create a new process)
  - ✓ ed (a line editor) URL
  - ✓ roff (a typesetting markup language)* URL



* Used in printing the man pages of Unix (versions 1-3)

Descendents of roff

- nroff (1972) 
  - ✓ text-formatting program for roff encoded text
  - ✓ output to printers and terminals
- troff* (1983) 
  - ✓ fonts, spacing, paragraphs, margins, footnotes, tables, diagrams, math, etc. 
  - ✓ output to typesetting systems

* troff is considered a composition system

Composition Systems[1]

- ArborText URL
- Datalogics URL
- Interleaf URL
- TeX & LaTeX[2] URL URL
- Xyvision URL URL URL URL

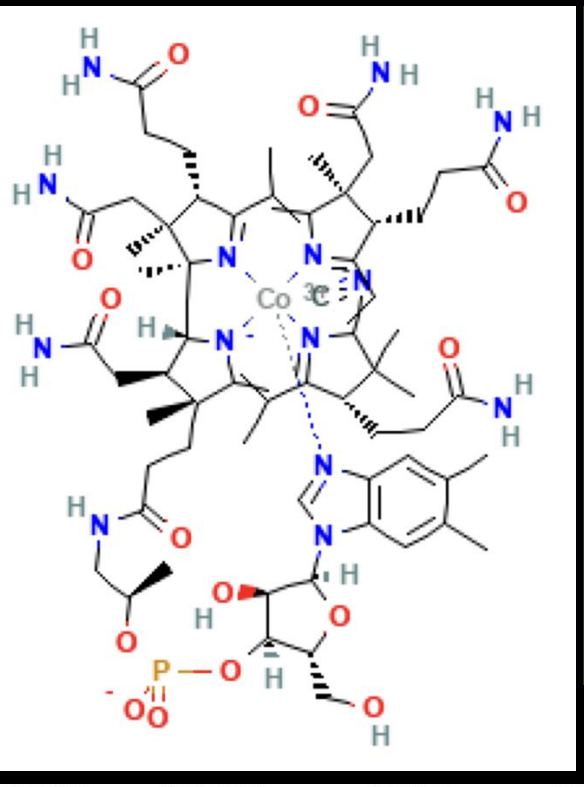
[1] Think Microsoft Word on **steroids**!

[2] Microsoft Word can accommodate LaTeX encoded equations

Science Journal Publisher*

- Publishes 100 journals
- Each journal published monthly
- 250 pages/issue
- 300,000 pages/year
- 260 work-days/year
- Thus, processing 1,150 pages/work-day
- 4.6 journal issues/work-day

* Rough estimates for a small to medium size publishing operation



$$\sqrt{a^2} = |a| = \begin{cases} a, a \geq 0 \\ -a, a < 0 \end{cases} \qquad u_i = R_i i_i + \sum_{j=1\alpha}^{j=2q} L_{i,j} \frac{di_j}{dt} + \omega \sum_{j=1\alpha}^{j=2q} i_j \frac{dL_{i,j}}{d\varphi}$$

$$(a-b)(a^2+ab+b^2) = a^3 - b^3 \qquad \int x^{\alpha} \cdot dx = \frac{x^{\alpha+1}}{\alpha+1} + c \qquad \sqrt{\sum_{i=1}^{n} (x_i - y_i)^2}$$

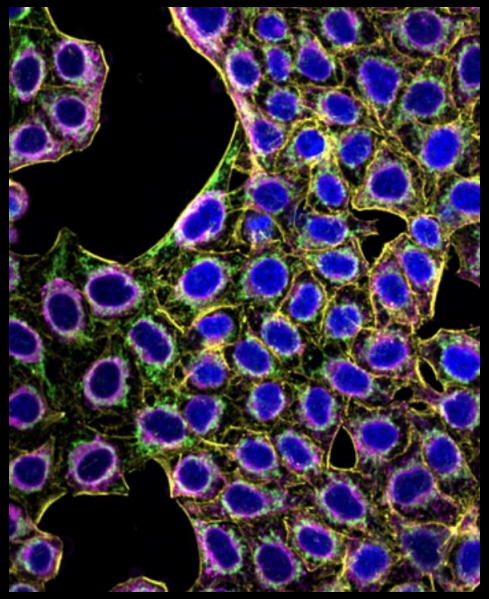
$$\sin\alpha = 2\sin\frac{\alpha}{2} \cdot \cos\frac{\alpha}{2} \cdot \sqrt{\sum_{i=1}^{n} (x_i - y_i)^2} \qquad (x^n)' = nx^{n-1} \qquad \frac{\sqrt[n]{a}}{\sqrt[n]{b}} = \sqrt[n]{\frac{a}{b}}$$

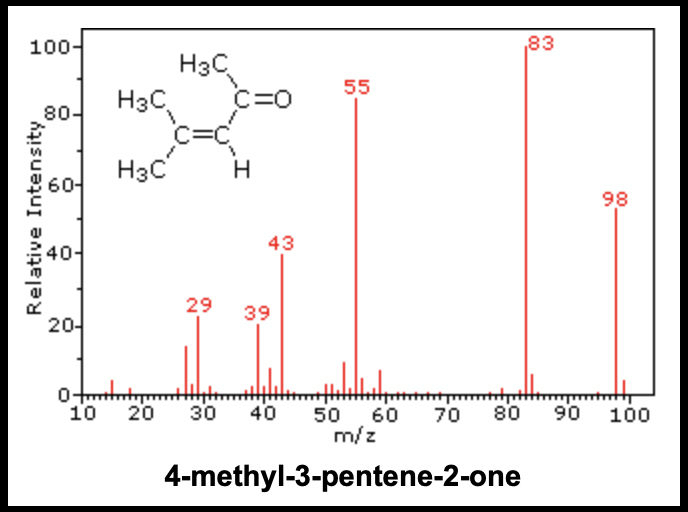
$$M = \frac{1}{2} \sum_{i=1\alpha}^{i=2q} i_i \sum_{j=1\alpha}^{j=2q} i_j \frac{dL_{i,j}}{d\varphi} \qquad \frac{\pi}{2} - ArcSin(x) \qquad u_i = R_i i_i + \sum_{j=1\alpha}^{j=2q} L_{i,j} \frac{di_j}{dt} + \omega \sum_{j=1\alpha}^{j=2q} i_j \frac{dL_{i,j}}{d\varphi}$$

$$y = x \times 2 \qquad (a+ab+b) = a-b'$$

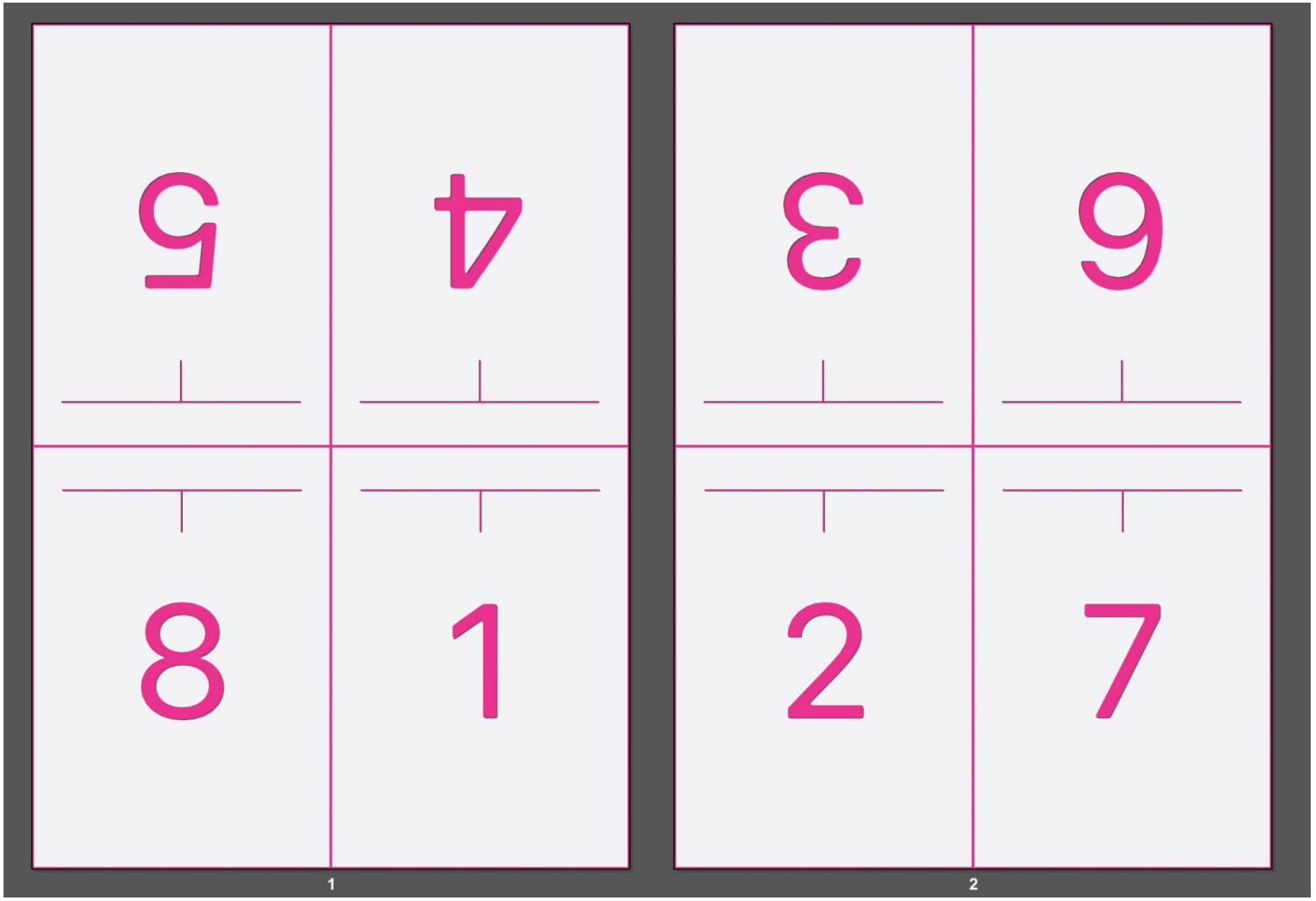
$$\sin\alpha = 2\sin\frac{\alpha}{2} \cdot \cos\frac{\alpha}{2} \cdot \qquad ctg\alpha + ctg\beta = \frac{\sin(\alpha+\beta)}{\sin\alpha \sin\beta} \qquad x_{1,2} = \frac{-b \pm \sqrt{D}}{2a}$$

Group of atoms	Sum of components	Group of atoms	Sum of components
$-CH_3$	$C_1 + 3H$	$-NO$	$N_6^{5H)} + O_9$
$-CH_2-$	$C_1^{1\rho)} + 2H$	$>N-NO_2$	$N_2^{6H)6,7\rho)} + N_6 + O_9$
$-CH=CH_2$	$2C_2 + 3H$	$-ONO_2$	$O_5 + N_6 + O_2 + O_9$
$>C=C<$	$2C_2$	$-S-$	S
$-C\equiv CH$	$2C_2 + H$	$-SO$	$S + O_2$
$R-O-R$	$O_3^{(H)2\rho)}$	$-SO_2$	$S + 2O_2$
$-OH$	O_1	$-F$	F
$-O-OH$	$O_3 + O_1 + H$	$-Cl$	Cl
$R-O-O-R$	$2O_3$		$6C_2 + 5H$
$-NH-NO_2$	$N_5 + N_6 + O_2 + O_9 + H$		
	$C_2 + O_9^{2H)}$		$5C_2 + N_8$
	$C_2 + O_9^{2H)} + N_1^{2H)3\rho)} + 2H$		
	$C_2 + O_9^{2H)}$		$5C_2 + N_8 + O_2$
	$C_2 + H + O_1 + O_9^{4\rho)}$		
$-C\equiv N$	$C_3 + N_7$		$3C_2 + H + N_2 + N_8$
$-C\equiv N \rightarrow O$	$C_3 + N_7 + O_2$		
$-NH_2$	$N_1^{3H)5\rho)} + 2H$		$4C_2 + O_3$
$-NH \cdot NH_2$	$2N_1 + 3H$		
$-N=N-$	$2N_6^{4H)}$		$3C_2 + N_8 + S$
$-N_3$	$N_6 + N_7 + N_8$		
$-C=N-OH$	$C_2 + N_3^{4H)} + O_1 + H$		$2C_2 + 2N_8 + O_8$





Signatures URL

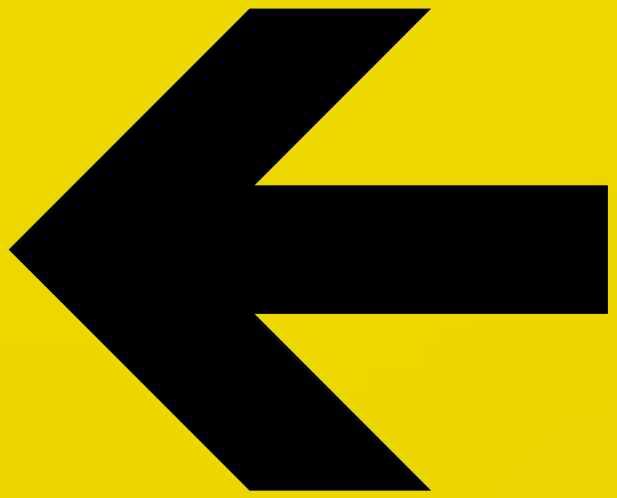


8-page signature

For information of offset printing see URL

End of…

A Minor Diversion



THE C PROGRAMMING LANGUAGE

BRIAN W. KERNIGHAN
DENNIS M. RITCHIE

PRENTICE HALL SOFTWARE SERIES

C Programming Language

- In the beginning was “B”— created by Ken Thompson
  - ✓ “B” was enhanced by Dennis Ritchie to become “new B” (NB)
  - ✓ “NB” was renamed “C”
- For information about “C” see

Unix Editors

- ed (line editor, 1971) URL
  - ✓ user unfriendly and terse
  - ✓ ed useful in some shell scripts [grep | ed | troff]
- vi (full screen editor, 1976) URL
  - ✓ *de facto* standard Unix editor
  - ✓ still widely used
- Emacs (1984) URL
  - ✓ competes with vi
  - ✓ GNU Emacs most popular Unix editor URL

C Programming Language

- Powerful, difficult to learn and use
- Portable — runs on many systems
- Rich library of functions
- Dynamic memory allocation*
- Uses pointers—improves performance
- Lacks features of more modern languages (object oriented programming)

* A process that allocates memory for variables and data structures

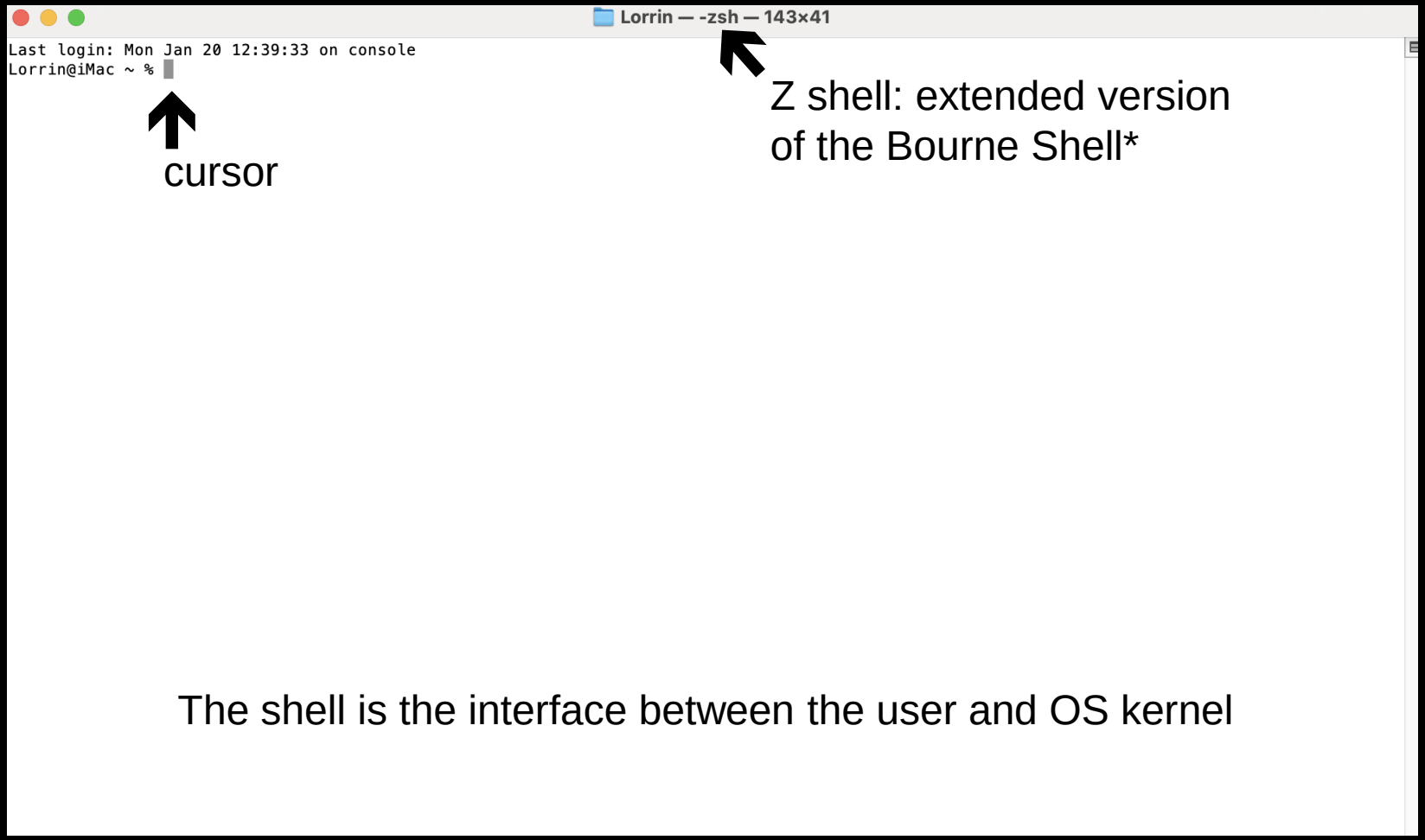
Modern Languages Derived from "C"

- C++ Adds objective-oriented capabilities
- C# Adds objective-oriented capabilities
- Java A simplified subset of C
- JavaScript
- Objective-C Adds objective-oriented capabilities
- Perl
- PHP
- Python

And about 60 more!

A Little Taste of Unix

Unix Command Line



* The Bourne shell (sh) was the original Unix shell URL

What does a Unix terminal look like?

```
[Europa:/Users/Mike_Lee]$ mkdir my-bin
[Europa:/Users/Mike_Lee]$ cd my-bin
[Europa:/Users/Mike_Lee/my-bin]$
[Europa:/Users/Mike_Lee/my-bin]$ cat >> what-time-is-it.sh << 'EOF'
> #!/bin/bash
>
> current_time=$(date | tr -s " " "\t" | cut -f 4 | cut -d ":" -f 1,2)
>
> echo "The time is $current_time.
> I'm glad to see you're making good use of it :)"
>
> EOF
[Europa:/Users/Mike_Lee/my-bin]$
[Europa:/Users/Mike_Lee/my-bin]$ chmod +x what-time-is-it.sh
[Europa:/Users/Mike_Lee/my-bin]$
[Europa:/Users/Mike_Lee/my-bin]$ ls
what-time-is-it.sh
[Europa:/Users/Mike_Lee/my-bin]$ cat what-time-is-it.sh
#!/bin/bash

current_time=$(date | tr -s " " "\t" | cut -f 4 | cut -d ":" -f 1,2)

echo "The time is $current_time.
I'm glad to see you're making good use of it :)"

[Europa:/Users/Mike_Lee/my-bin]$
```

System Information

Unix Commands 

These provide information about your Unix machine.

COMMAND	DESCRIPTION
`uname`	Show the Unix system information.
`uname -a`	Detailed Unix system information
`uname -r`	Kernel release information, such as kernel version
`uptime`	Show how long the system is running and load information.
`who`	Display who is logged in.
`w`	Display what users are online and what they are doing.
`users`	List current users.
`whoami`	Display what user you are logged in as.
`su`	Superuser; use this before a command that requires root access e.g. `su shutdown`
`cal`	Show calendar where the current date is highlighted.
`date`	Show the current date and time of the machine.
`halt`	Stop the system immediately.
`shutdown`	Shut down the system.
`reboot`	Restart the system.
`last reboot`	Show reboot history.
`man COMMAND`	Shows the manual for a given `COMMAND`. To exit the manual, press “q”.

Search and Filter

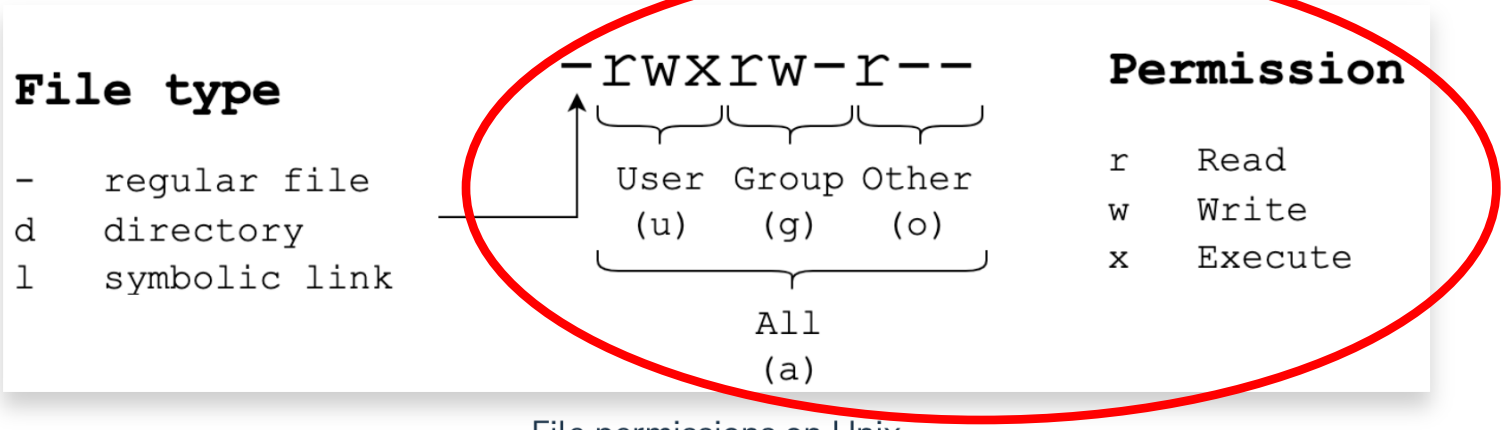
Unix Commands

COMMAND	DESCRIPTION
`grep patt X`	Search for a text pattern `patt` in `X`. Commonly used with pipe e.g. `ps aux | grep python3` filters out the processes containing `python3` from all running processes of all users.
`grep -v patt X`	Return lines not matching the specified `patt`.
`grep -l patt X`	Only the names of files containing `patt` are written to standard output.
`grep -i patt X`	Perform case-insensitive matching. Ignore the case of `patt`.
`find`	Find files.
`find /path/to/src -name "*.sh"`	Find all files in `/path/to/src` matching the pattern "`*.sh`" in the file name.
`find .. -size +2M`	Find all files in the parent directory larger than 2MB.
`locate name`	Find files and directories by `name`.
`sort X`	Arrange lines of text in `X` alphabetically or numerically.

File Permissions

Unix Commands

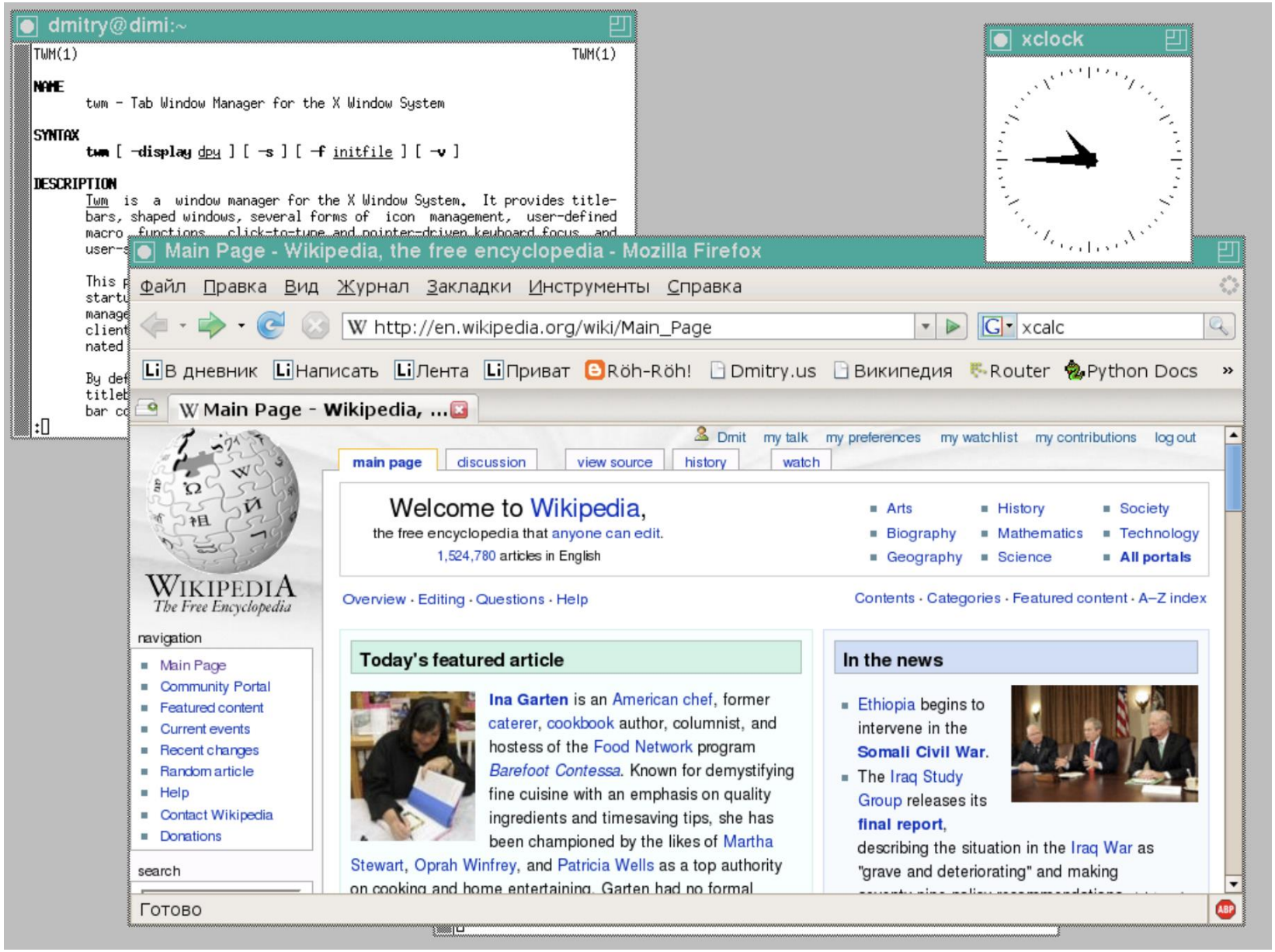
Not all files are equally accessible. To prevent unwanted tampering, some files on your device may be read-only. For more information about file permissions on Unix, refer to our **Linux File Permissions Cheat Sheet**, as the same content applies to Unix.



File permissions on Unix

COMMAND	DESCRIPTION
`chmod permission file`	Change permissions of a file or directory. Permissions may be of the form `[u/g/o/a][+/-/=][r/w/x]` (see examples below) or a three-digit octal number.
`chown user2 file`	Change the owner of a file to `user2`.
`chgrp group2 file`	Change the group of a file to `group2`.

X GUI for Unix



GUIs for Unix

- CDE: 1993
- GNOME: 1999 (the most popular)
- Java Desktop: 2005
- KDE: 1996
- LXDE: 2006
- OpenBox: 2002
- Xfce: 1997
- X (X Window) 1984 (the first)

Unix Time

- A time stamp widely used in many types of computers
- The time in seconds since January 1, 1970[1]
- Unix time is also known as the Unix epoch
- Year 2038 problem—when the 32-bit storage[2] for Unix time overflows (remember Y2K)
- Want the current time in Unix time? See

[1] The time function can be extended to provide milliseconds
[2] A signed 32-bit integer

Is macOS related to Unix?

- Yes—macOS is a Unix-like operating system
- BSD Unix ➔ NeXTSTEP* ➔ macOS
- Some examples of the “Unix-like” command line interface ” on a Mac…

* NeXTSTEP was created by NeXT Computer company

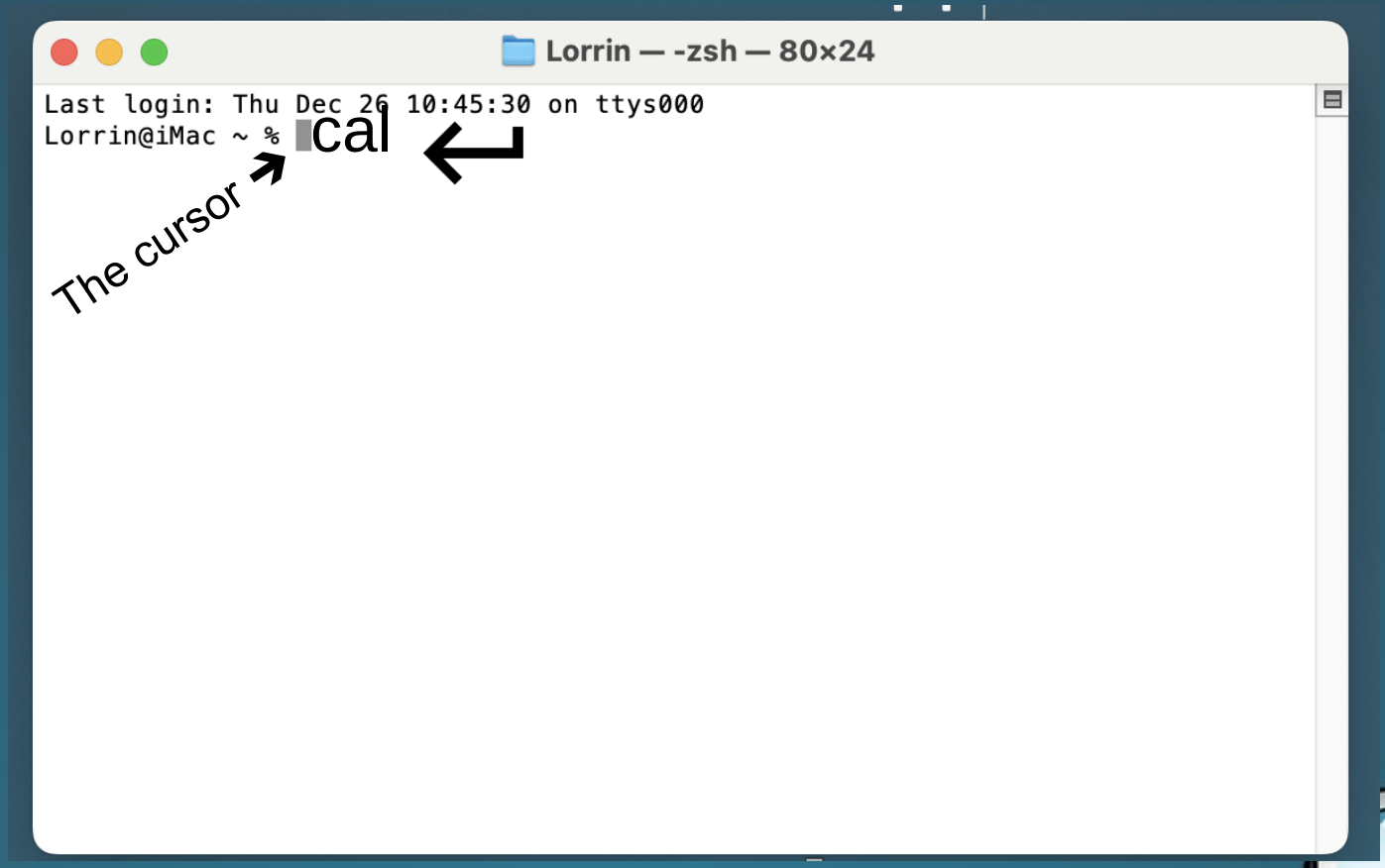
macOS Terminal App*

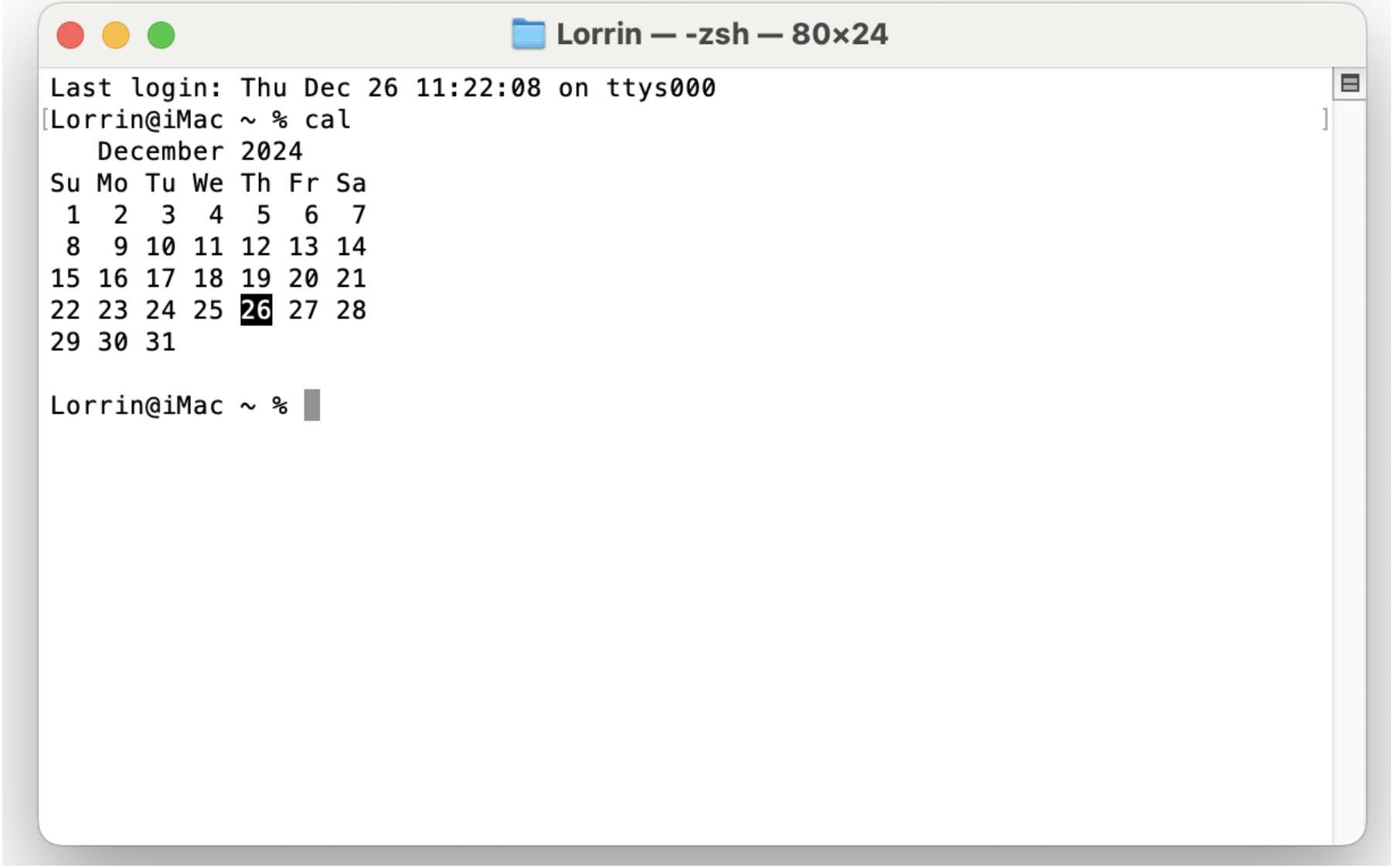
- Utilities ➔ Terminal.app

Absolute Beginner Guide to the macOS Terminal (video) see URL

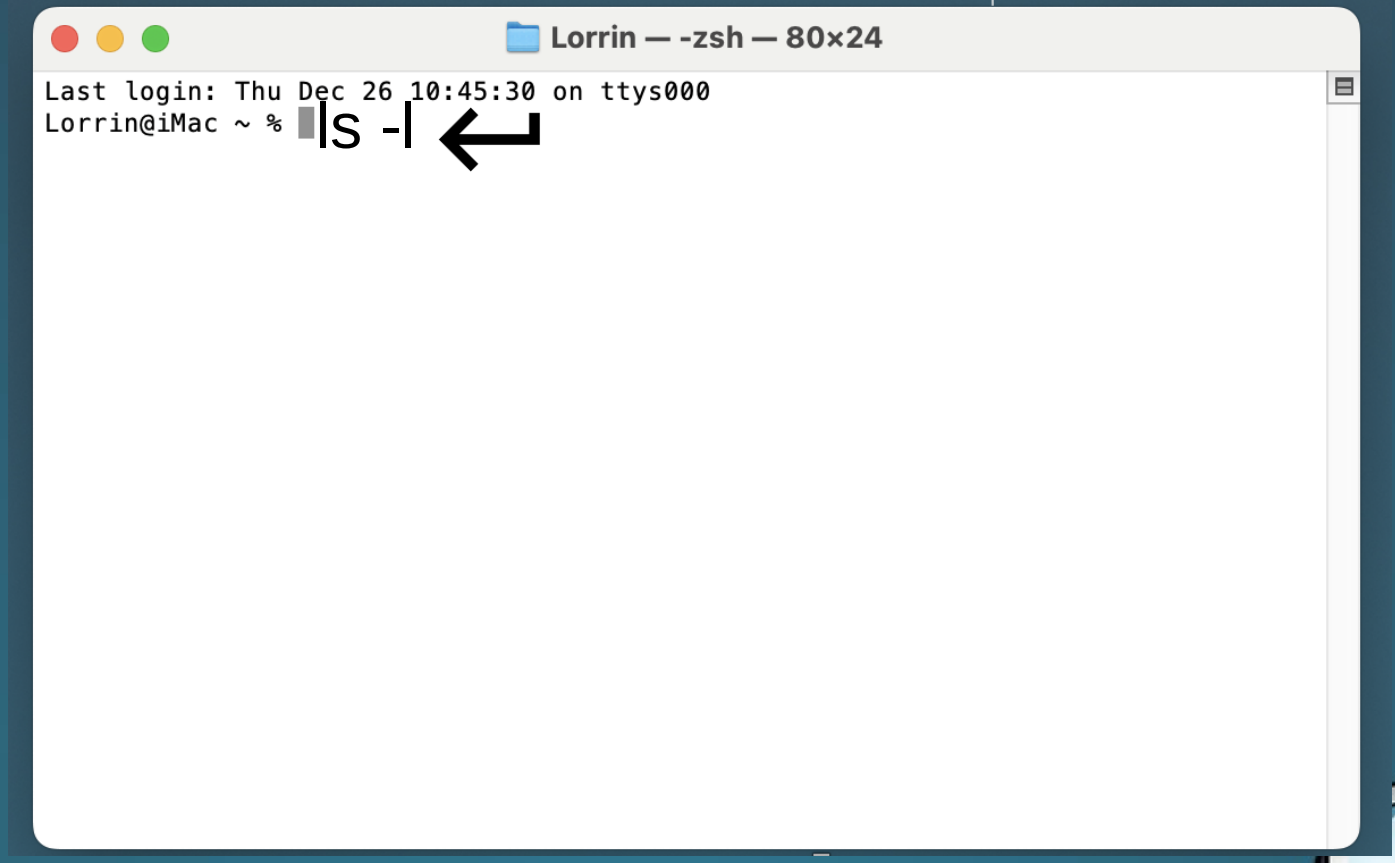
* A command-line interface (CLI)

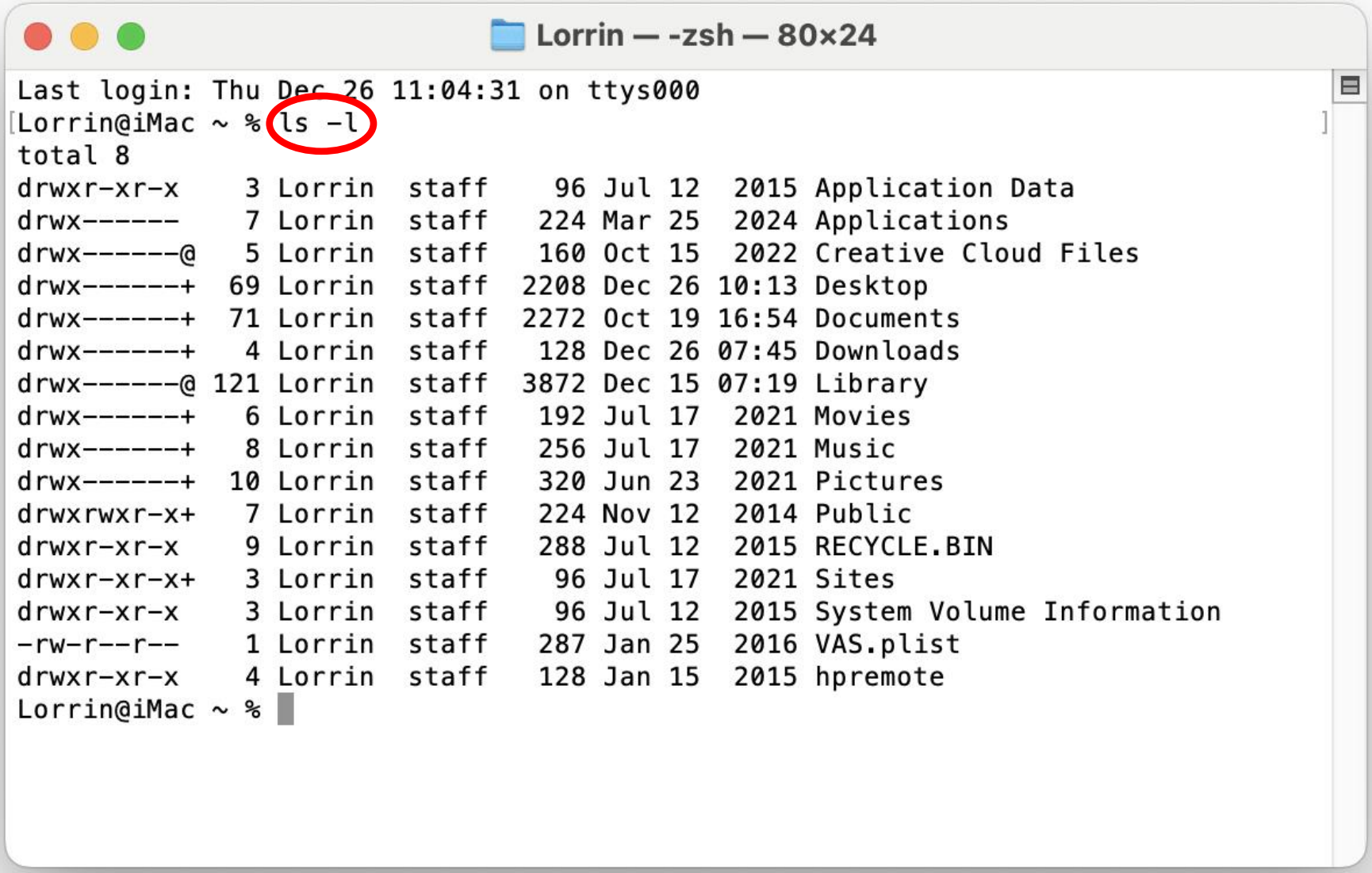
macOS and Unix (cont.)



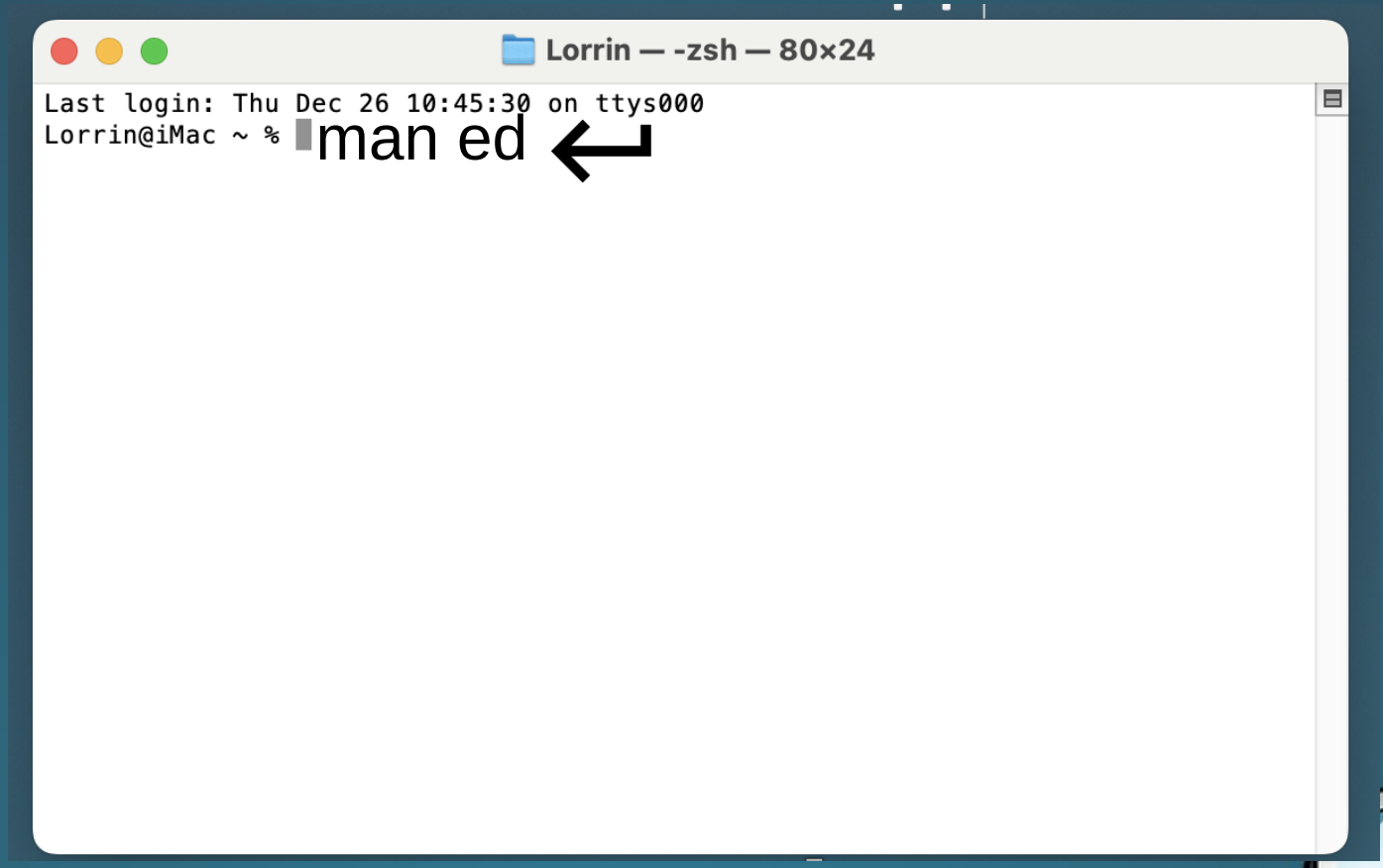

Lorrin — -zsh — 80×24
Last login: Thu Dec 26 11:22:08 on ttys000
Lorrin@iMac ~ % cal
December 2024
Su Mo Tu We Th Fr Sa
1 2 3 4 5 6 7
8 9 10 11 12 13 14
15 16 17 18 19 20 21
22 23 24 25 26 27 28
29 30 31
Lorrin@iMac ~ %

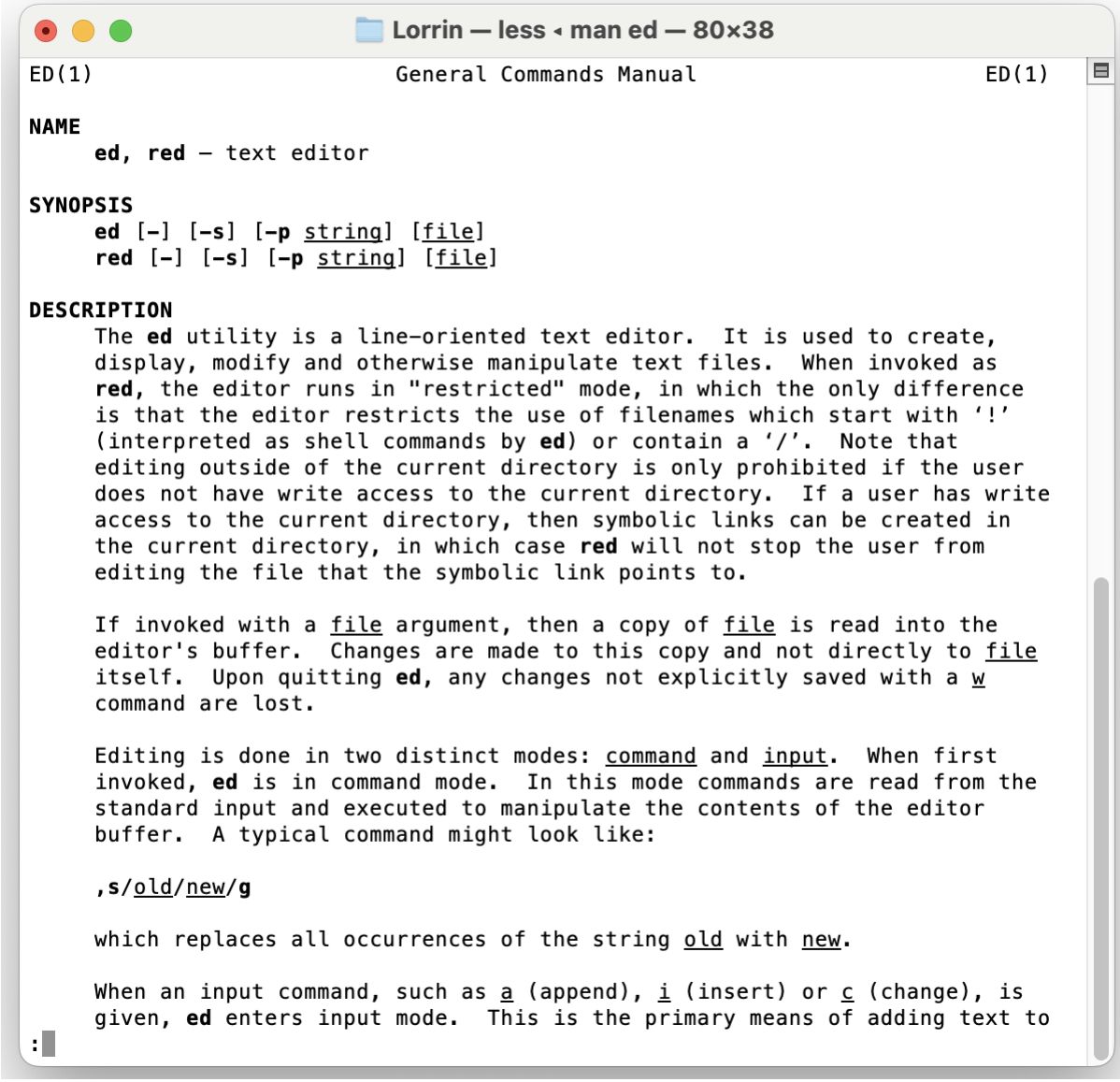
macOS and Unix (cont.)



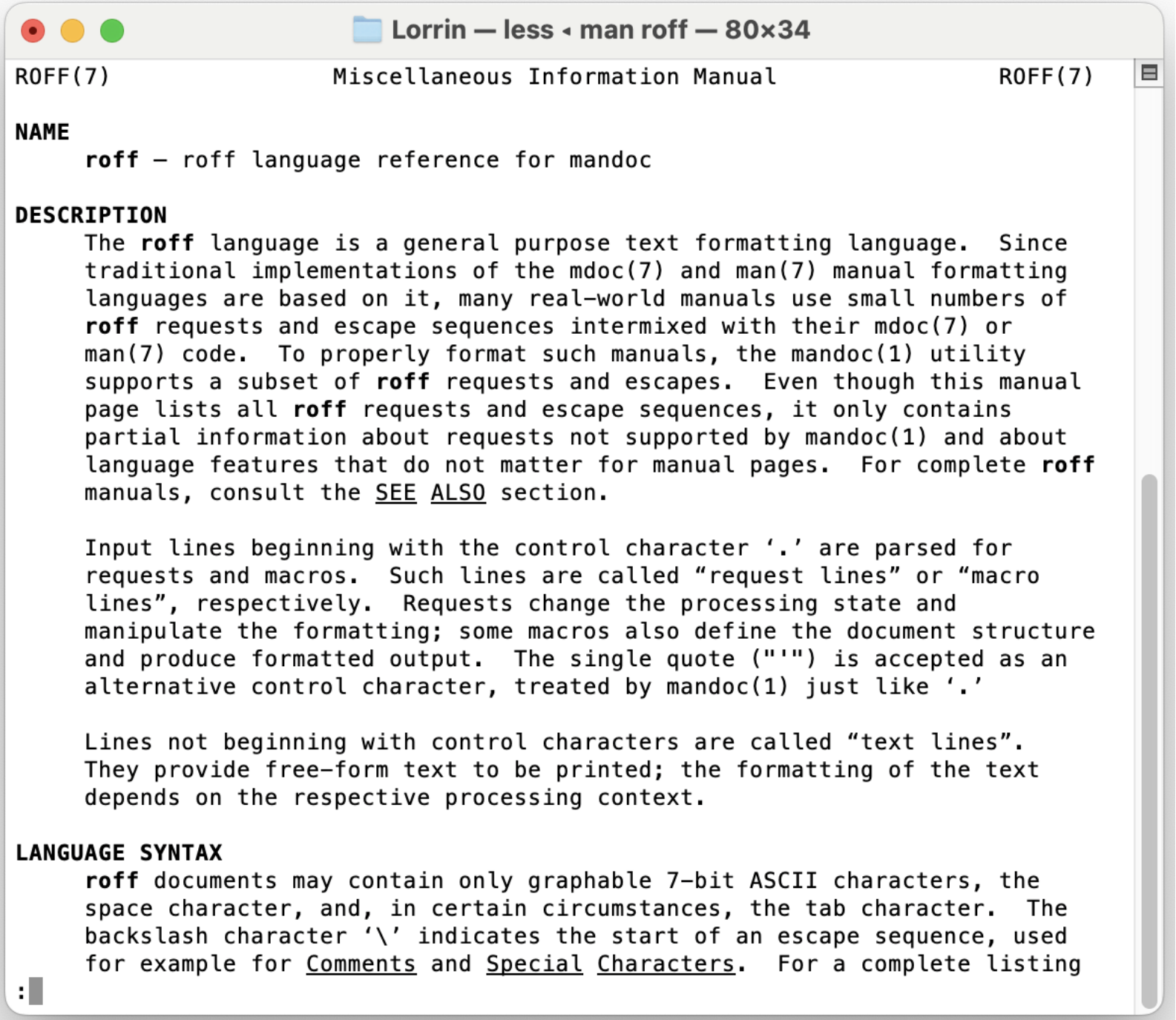

Lorrin — -zsh — 80×24
Last login: Thu Dec 26 11:04:31 on ttys000
Lorrin@iMac ~ % ls -l
total 8
drwxr-xr-x   3 Lorrin staff   96 Jul 12 2015 Application Data
drwx------   7 Lorrin staff   224 Mar 25 2024 Applications
drwx------@   5 Lorrin staff   160 Oct 15 2022 Creative Cloud Files
drwx------+ 69 Lorrin staff 2208 Dec 26 10:13 Desktop
drwx------+ 71 Lorrin staff 2272 Oct 19 16:54 Documents
drwx------+   4 Lorrin staff   128 Dec 26 07:45 Downloads
drwx------@ 121 Lorrin staff 3872 Dec 15 07:19 Library
drwx------+   6 Lorrin staff   192 Jul 17 2021 Movies
drwx------+   8 Lorrin staff   256 Jul 17 2021 Music
drwx------+ 10 Lorrin staff   320 Jun 23 2021 Pictures
drwxrwxr-x+   7 Lorrin staff   224 Nov 12 2014 Public
drwxr-xr-x   9 Lorrin staff   288 Jul 12 2015 RECYCLE.BIN
drwxr-xr-x+   3 Lorrin staff   96 Jul 17 2021 Sites
drwxr-xr-x   3 Lorrin staff   96 Jul 12 2015 System Volume Information
-rw-r--r--   1 Lorrin staff   287 Jan 25 2016 VAS.plist
drwxr-xr-x   4 Lorrin staff   128 Jan 15 2015 hpremote
Lorrin@iMac ~ %

macOS and Unix (cont.)

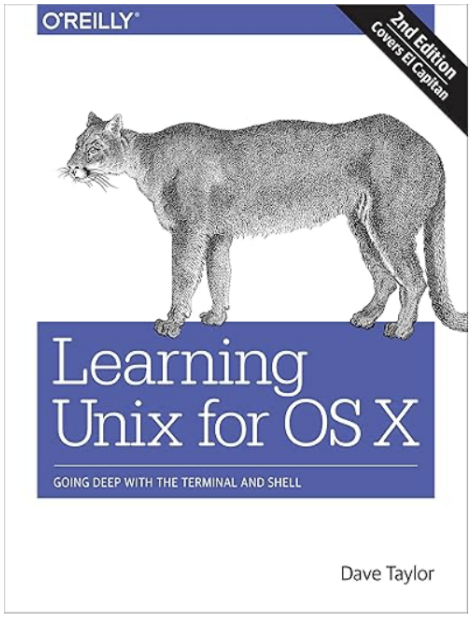



Lorrin — less ◂ man ed — 80×38
ED(1) General Commands Manual ED(1)
NAME
ed, red – text editor
SYNOPSIS
ed [-] [-s] [-p string] [file]
red [-] [-s] [-p string] [file]
DESCRIPTION
The ed utility is a line-oriented text editor. It is used to create, display, modify and otherwise manipulate text files. When invoked as red, the editor runs in "restricted" mode, in which the only difference is that the editor restricts the use of filenames which start with '!' (interpreted as shell commands by ed) or contain a '/'. Note that editing outside of the current directory is only prohibited if the user does not have write access to the current directory. If a user has write access to the current directory, then symbolic links can be created in the current directory, in which case red will not stop the user from editing the file that the symbolic link points to.
If invoked with a file argument, then a copy of file is read into the editor's buffer. Changes are made to this copy and not directly to file itself. Upon quitting ed, any changes not explicitly saved with a w command are lost.
Editing is done in two distinct modes: command and input. When first invoked, ed is in command mode. In this mode commands are read from the standard input and executed to manipulate the contents of the editor buffer. A typical command might look like:
,s/old/new/g
which replaces all occurrences of the string old with new.
When an input command, such as a (append), i (insert) or c (change), is given, ed enters input mode. This is the primary means of adding text to
:

macOS and Unix (cont.)


Lorrin — less ◂ man roff — 80×34
ROFF(7) Miscellaneous Information Manual ROFF(7)
NAME
roff – roff language reference for mandoc
DESCRIPTION
The roff language is a general purpose text formatting language. Since traditional implementations of the mdoc(7) and man(7) manual formatting languages are based on it, many real-world manuals use small numbers of roff requests and escape sequences intermixed with their mdoc(7) or man(7) code. To properly format such manuals, the mandoc(1) utility supports a subset of roff requests and escapes. Even though this manual page lists all roff requests and escape sequences, it only contains partial information about requests not supported by mandoc(1) and about language features that do not matter for manual pages. For complete roff manuals, consult the SEE ALSO section.
Input lines beginning with the control character '.' are parsed for requests and macros. Such lines are called "request lines" or "macro lines", respectively. Requests change the processing state and manipulate the formatting; some macros also define the document structure and produce formatted output. The single quote ("'") is accepted as an alternative control character, treated by mandoc(1) just like '.'
Lines not beginning with control characters are called "text lines". They provide free-form text to be printed; the formatting of the text depends on the respective processing context.
LANGUAGE SYNTAX
roff documents may contain only graphable 7-bit ASCII characters, the space character, and, in certain circumstances, the tab character. The backslash character '\' indicates the start of an escape sequence, used for example for Comments and Special Characters. For a complete listing
:

‹ Back to results



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} ← Note the word "Mac"

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