Introduction to C/C++ Programming

C/C++ Programming in UNIX
Fundamentals of Programming

What is Programming?

- **Computers are dumb machines:**
  - ▫ Do only what they are told to do so
  - ▫ Basic operations: instruction set
  - ▫ Example: add number, compare with zero,…
- **How to solve a problem using computer?**
  - ▫ Express in terms of instructions → a program
- **Program:**
  - ▫ Collection of instructions
  - ▫ Approach/Method used to solve a problem: ALGORITHM
  - ▫ Example: test if a number is odd or even
- **Programming:**
  - ▫ Write the instructions necessary to implement the algorithm using programming language

Programming Language

- **Express the computer instructions in particular statements**
- **Early ages:**
  - ▫ Binary numbers: directly correspond to specific machine instructions → machine language
- **Next:**
  - ▫ Use symbolic names to replace machine language → assembly language
  - ▫ Need an assembler to convert to machine language
  - ▫ Not portable, machine dependant
- **High level language:**
  - ▫ Similar to everyday English
  - ▫ Use common mathematical notations
  - ▫ Consist of statements, accomplish substantial tasks
  - ▫ Need compiler/translator: convert to a form which is understandable to particular computer
  - ▫ Example: C, C++, C#, Visual Basic…
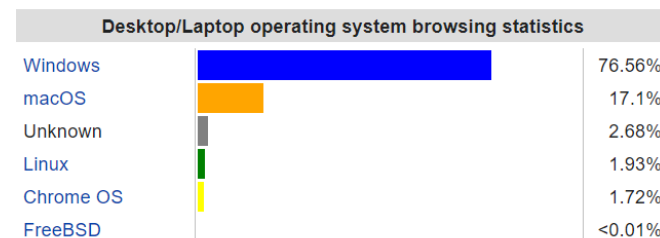
Operating Systems

- Special software/program
- Interface between hardware and software
- Control the entire operations of a computer system:
  - Manage input/output
  - Manage system resources
  - Handle execution of programs
- Example of OS: UNIX, Linux, Windows, DOS,…
- Multitasking

Introduction to UNIX

- **History of UNIX:**
  - 1960s: Experimental OS called Multics by MIT, Bell Labs and GE. Support multi users, for mainframes. Assembly language was used
  - 1970s: Unics then Unix
  - 1973: Unix was rewritten in C
  - 1980s: AT&T licensed the source code
- **Advantages:**
  - Direct interaction
  - Running on various types of hardware
  - Easy to move to different machine
  - Free versions
- **Free BSD, Solaris, HP UX,…**

Free UNIX-like OS

- 1983: Richard Stallman announced GNU project.

  "*everyone who received a copy of software would be free to use, study, modify, and redistribute it*"

- 1990s: Linus Torvalds wrote the Linux Kernel → UNIX-like OS

- Linux distributions (distros): Ubuntu, Suse, Fedora core, Redhat, Debian,…

- Servers, mainframes and super computers

- Embedded devices: PDA, smart phones (Google Android, a modified version of Linux Kernel)

- Desktop

Desktop/Laptop operating system browsing statistics

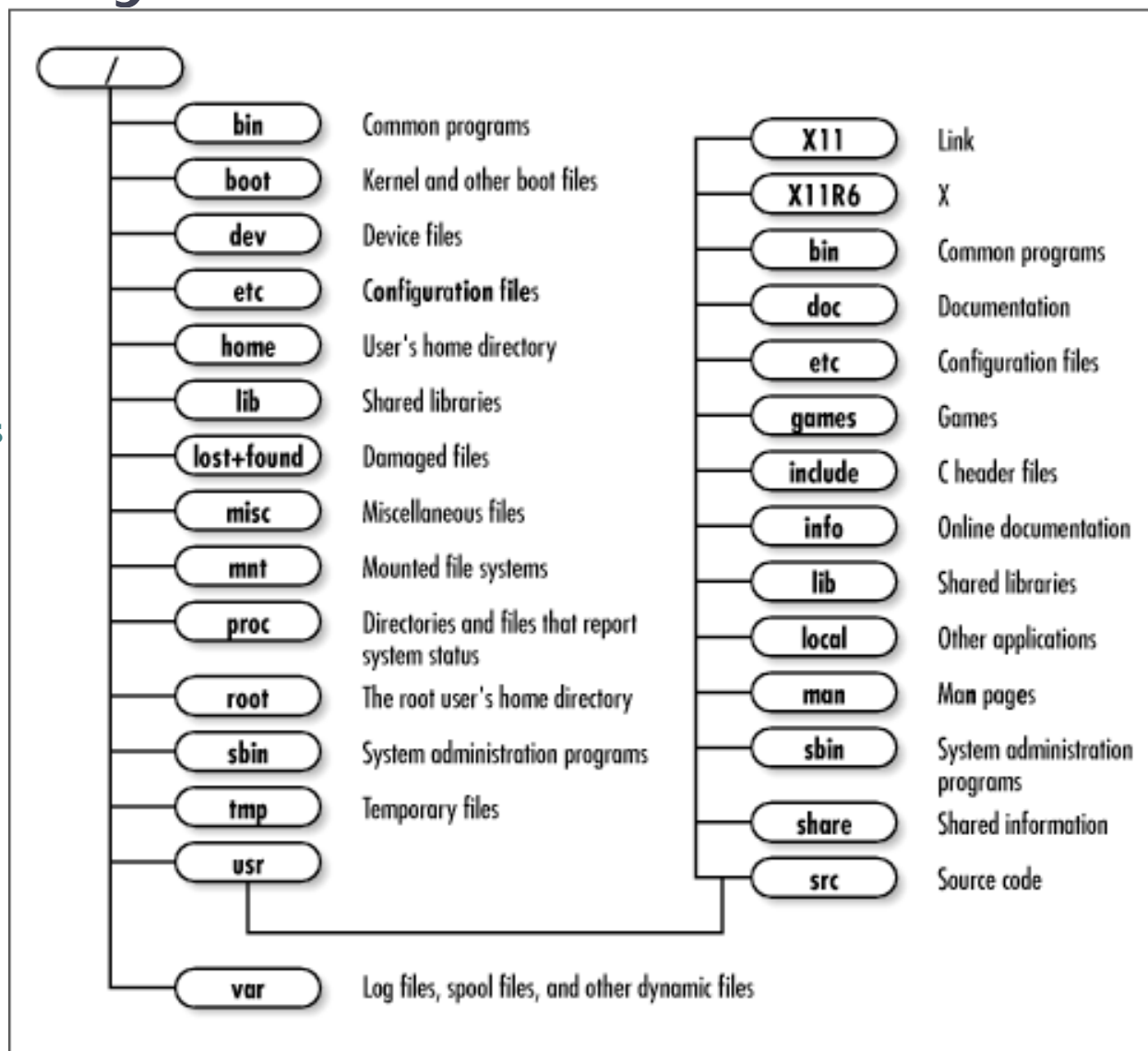| OS	Share
Windows	76.56%
macOS	17.1%
Unknown	2.68%
Linux	1.93%
Chrome OS	1.72%
FreeBSD	<0.01%

Desktop OS market share according to StatCounter for December 2020.[63] Chrome OS is also based on the Linux kernel.

Linux directory structure

- Some linux commands:
  - **ls**: list file and directory (#dir in windows)
  - **cd**: change directory
  - **mkdir**: create a new directory
  - **vi**: view a file
  - **rm**: remove directory entries
  - **pwd**: show current directory
  - **man <name of command>**: show manual page for a command

Directory	Description
bin	Common programs
boot	Kernel and other boot files
dev	Device files
etc	Configuration files
home	User's home directory
lib	Shared libraries
lost+found	Damaged files
misc	Miscellaneous files
mnt	Mounted file systems
proc	Directories and files that report system status
root	The root user's home directory
sbin	System administration programs
tmp	Temporary files
usr	
var	Log files, spool files, and other dynamic files

Subdirectory	Description
X11	Link
X11R6	X
bin	Common programs
doc	Documentation
etc	Configuration files
games	Games
include	C header files
info	Online documentation
lib	Shared libraries
local	Other applications
man	Man pages
sbin	System administration programs
share	Shared information
src	Source code

The C Programming Language

- **Developed in 1972 by Dennis Ritchie @ Bell Labs. Derived from B language**
- **To use with UNIX OS**
- **Were designed for system software, later also for application software**
- **1983: ANSI C, 1990: ISO C**
- **Most popular programming language**
- **Powerful programming language: fast, code portability and ability to access hardware**
- **C related languages:**
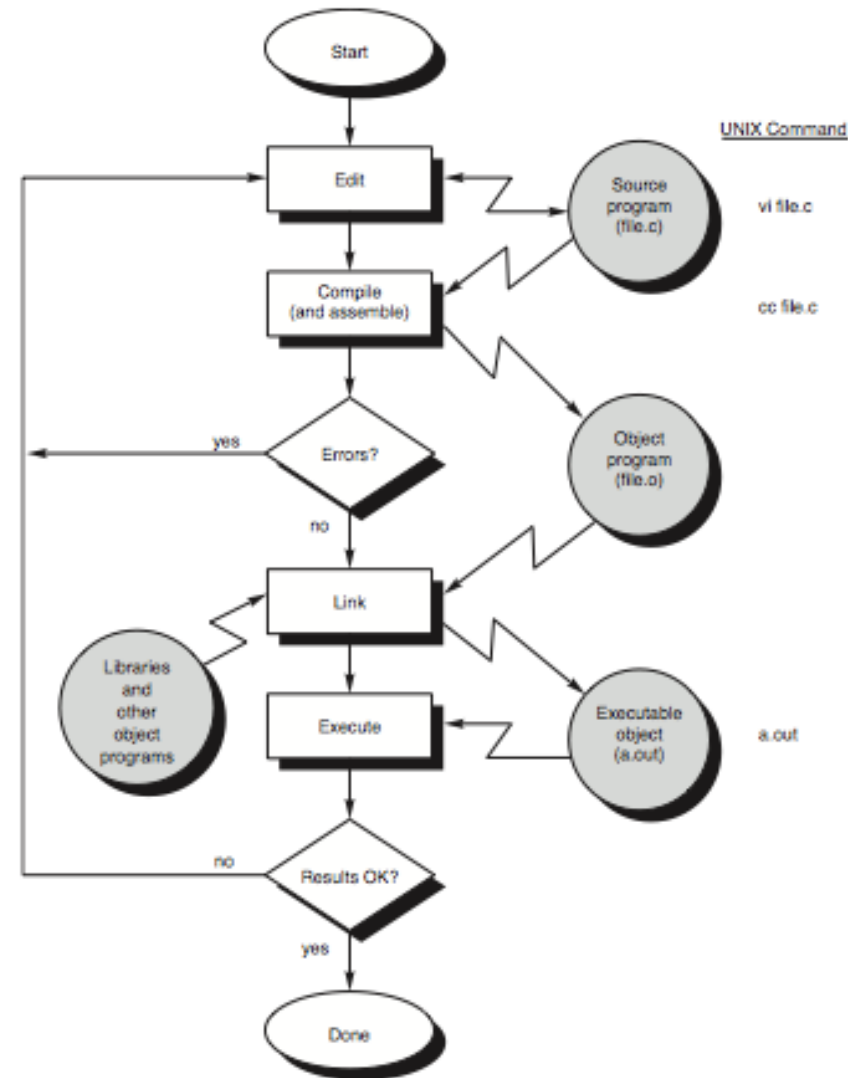 - **C++, Objective-C, C#, C Shell**
  - **Java, Perl, PHP, Java Script, Python**
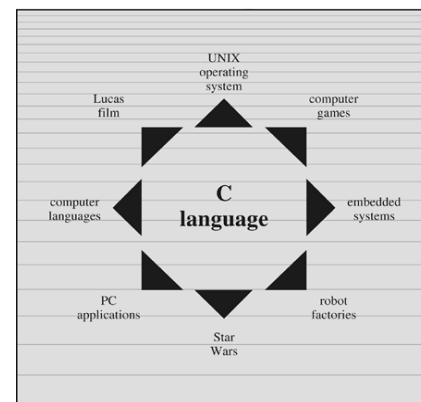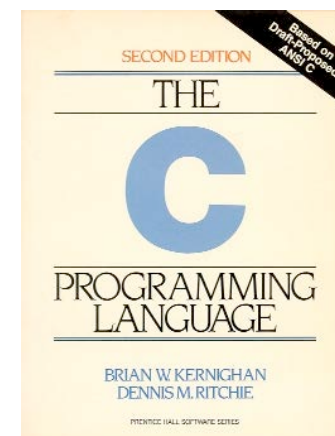
Timeline of language development

Year	C Standard
1972	Original
1978	Brian Kemighan & Dennis Ritche first edition "*The C Programming Language*" K&R C version
1989/ 1990	ANSI C (C89) ISO C (C90)
1999	C99
2011	C11
2017	C17
2021 (delayed)	C2x

Compiling C Program

- Editor: write your C program (vi, gedit)
- Compiler: translate program into executable form on particular computer system (gcc)
- Run the executable output file

Windows IDEs

- VS Code + MinGW
  - https://code.visualstudio.com/docs/cpp/config-mingw
- DevCpp

Mac OSX IDEs

- VS Code + clang
  - ▫ https://code.visualstudio.com/docs/cpp/config-clang-mac
- Apple Xcode
- CodeRunner (paid)