Linux Command Line

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Rationale: why we need it?

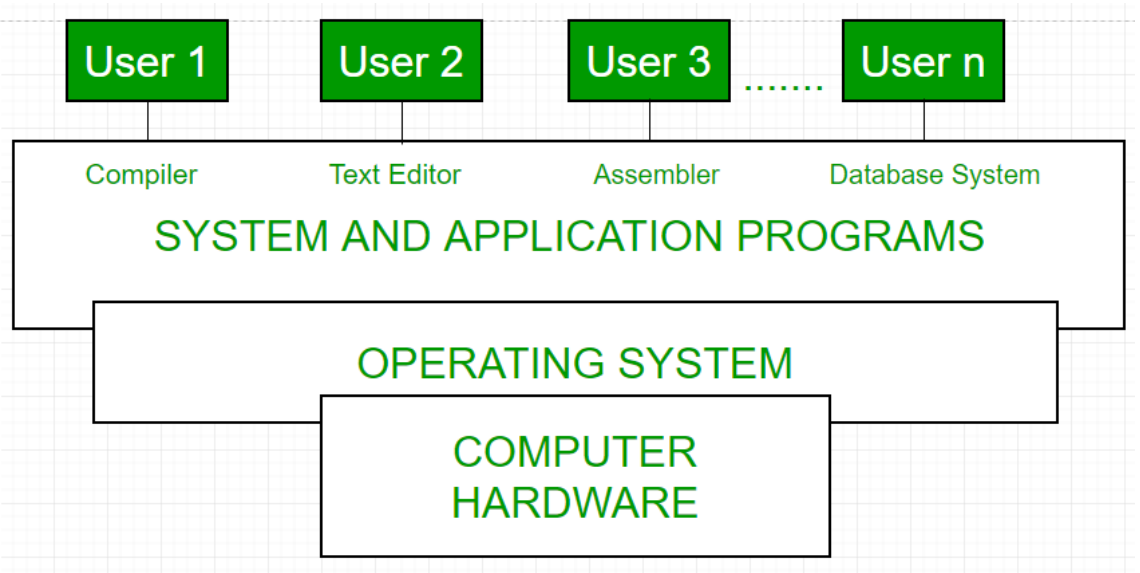
- Computer is the main tool of genomics and bioinformatics
- A bioinformatician should have a good understanding of computer

Computer

- Computer is a machine/device
- Can do arithmetic and logical operations
- Takes input/instructions, process tasks and give outputs

Computer System

- Four components -
  - Hardware
  - Operating system
  - Application programs
  - Users



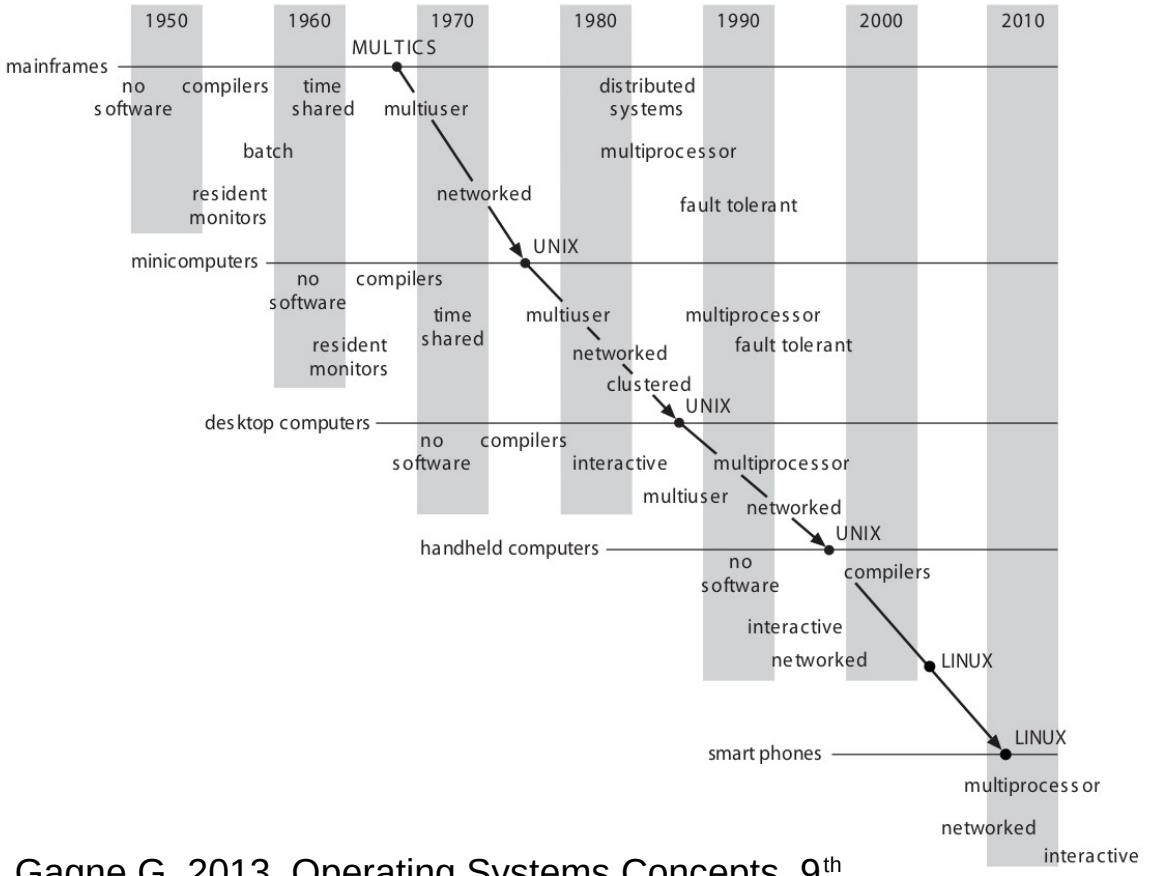
Reference: Silberschatz A, Galvin PB, Gagne G. 2013. Operating Systems Concepts. 9th Edition. USA: John Wiley & Sons, Inc. ISBN:9781118063330

Operating System (OS)

- The evolution of computer from special-purpose to general-purpose gave rise to the operating systems
- Can be defined as an interface between the machine and the user
- OS have many roles and functions to run application programs, to perform common operations (such as controlling I/O devices) and to allocate resources
- OS have two components – kernel and system programs

Operating System

- Unix – developed by AT&T Bell Laboratories in 1970s - written in C language
- Unix was originally developed for research
- Developed by the experts for the experts
- Powerful command language
- Core of a number of modern operating systems



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Contemporary operating Systems

OS name	Kernel	Command line	License
Windows	Windows NT	cmd	Commercial
Mac OS	Darwin (Unix-based)	bash	Commercial
GNU/Linux	Linux (Unix-like)	bash	Open Source

GNU/Linux

- GNU (GNU is Not Unix) – A project that started the free software and open source movement led by Richard Stallman. They have developed a lot of system programs and necessary components for free operating systems
- Linux – Linux is the operating system kernel developed by Linus Torvalds
- Combination of GNU software and Linux kernel made the GNU/Linux OS which is popularly known as Linux in short

GNU/Linux

- Linux distributions – As the Linux source code is open to all, different companies (such as Canonical Ltd., Red Hat Inc. etc.) and programmer communities developed different operating systems using Linux code.
- Those variations of Linux OS are known as Linux distributions. e.g. Debian, Ubuntu, Red Hat, Fedora, Linux Mint, Arch Linux, CentOS, Slackware etc.

System Interface

- OS provides an interactive interface to communicate with the machine
  - Graphical User Interface (GUI)
  - Command Line Interface (CLI)

Command Line Interface (CLI)

- CLI is alternatively termed as Command-line User Interface or Console User Interface (CUI)
- It is also known as shell (=an outer layer, and interpreter)
- Types of shell:
  - sh (Bourne shell, 1979, Unix)
  - csh and tcsh (C shell, 1978, BSD)
  - ksh (Korn Shell, 1983, Unix)
  - zsh (improved sh, 1990, Unix)
  - bash (Bourne-again shell, 1989, GNU/Linux)

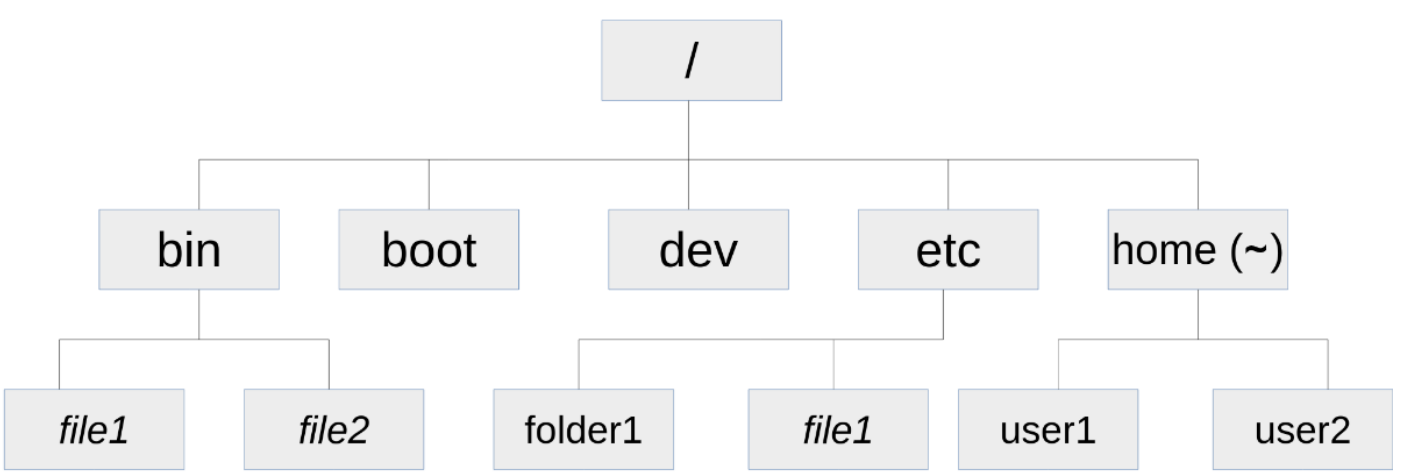
Bash

- A modern command language and shell created by GNU
- Simple syntax
- More utilities (super-set of the previous shells)
- Auto completion feature (using “tab” key)

Linux file system

- Start with root(/) of all directories (=folders).

  [It’s like a tree, where all files are like leaves, which can be referred back to the root.]



Linux file system

- Those are the folders in root(/) directory.
- To mention sub-directories (e.g. gcc folder in lib folder) it can be mentioned like **/lib/gcc**
- In “**/lib/gcc**”, the first slash sign means root, the latter ones means sub-folder.

Note: Do not get confused with the folder name “root” here. It is actually “/root”, which means a sub-directory of root(/). The “/root” is the user-directory for the administrator (= root user).

User home/default directory

- When the Terminal is opened or a computer start in CLI, it starts at the user's home or default directory
- In Linux systems, every user have their directory (by the user-name) under the */home/* directory. e.g., if the user-name is "user101", then it's home folder will be /home/user101/
- In Mac OS, the user's home folder is /Users/user101/
- All the user's files and folders (e.g., Desktop, Downloads etc.) are found in the user's home folder

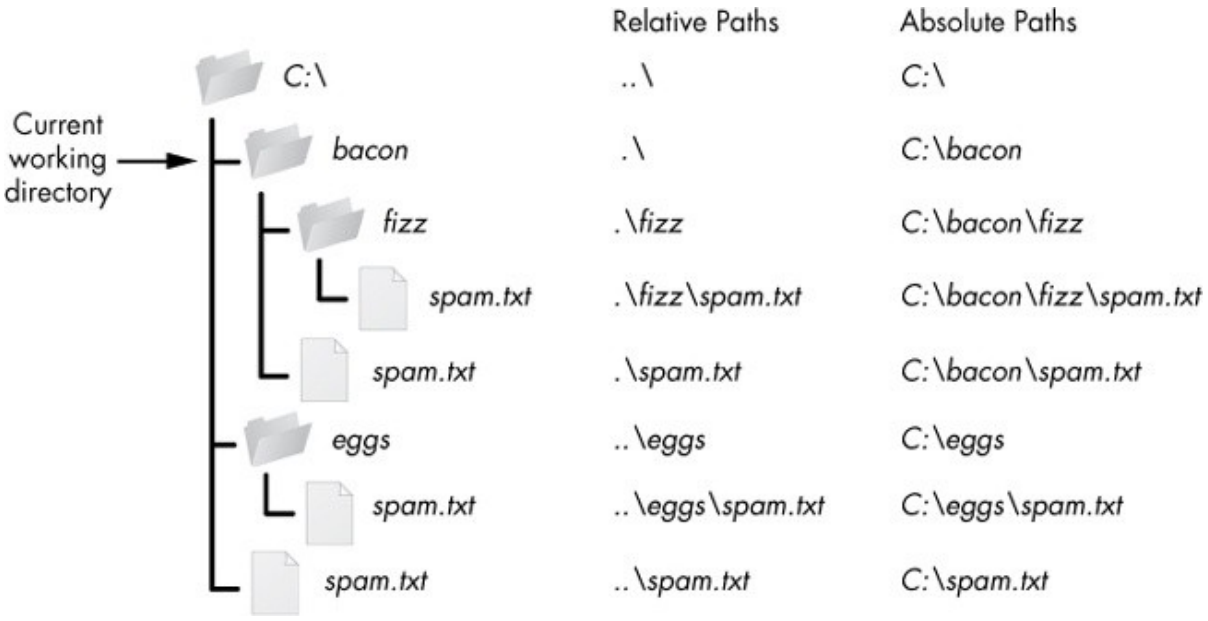
Path

- Absolute path – directory referred from the root (/)
- Relative path – directory referred from home or current working directory directory
- Relative paths references:

  . is current directory

  .. is previous directory

  ~ is home directory



Figure's reference: Sweigart A. 2015. Automate the Boring Stuff with Python. 1st Edition. San Francisco: No Starch Press, Inc. ISBN-10: 1-59327-599-4

Path

- For example, if we have a file named class.txt in a user’s home folder, then -
- It’s absolute path is /home/username/class.txt
- It’s relative path is ~/class.txt