university of tyumen

school of advanced studies

Information Technology - basic

Lecture 3
Operating Systems

Fabio Grazioso - *April 2018*

Todays' lecture

computer problem-solving

summary of the lecture

- general definitions of Operative Systems

- discussion of the different User Interfaces

  - Command Line Interfaces

  - Graphical User Interfaces

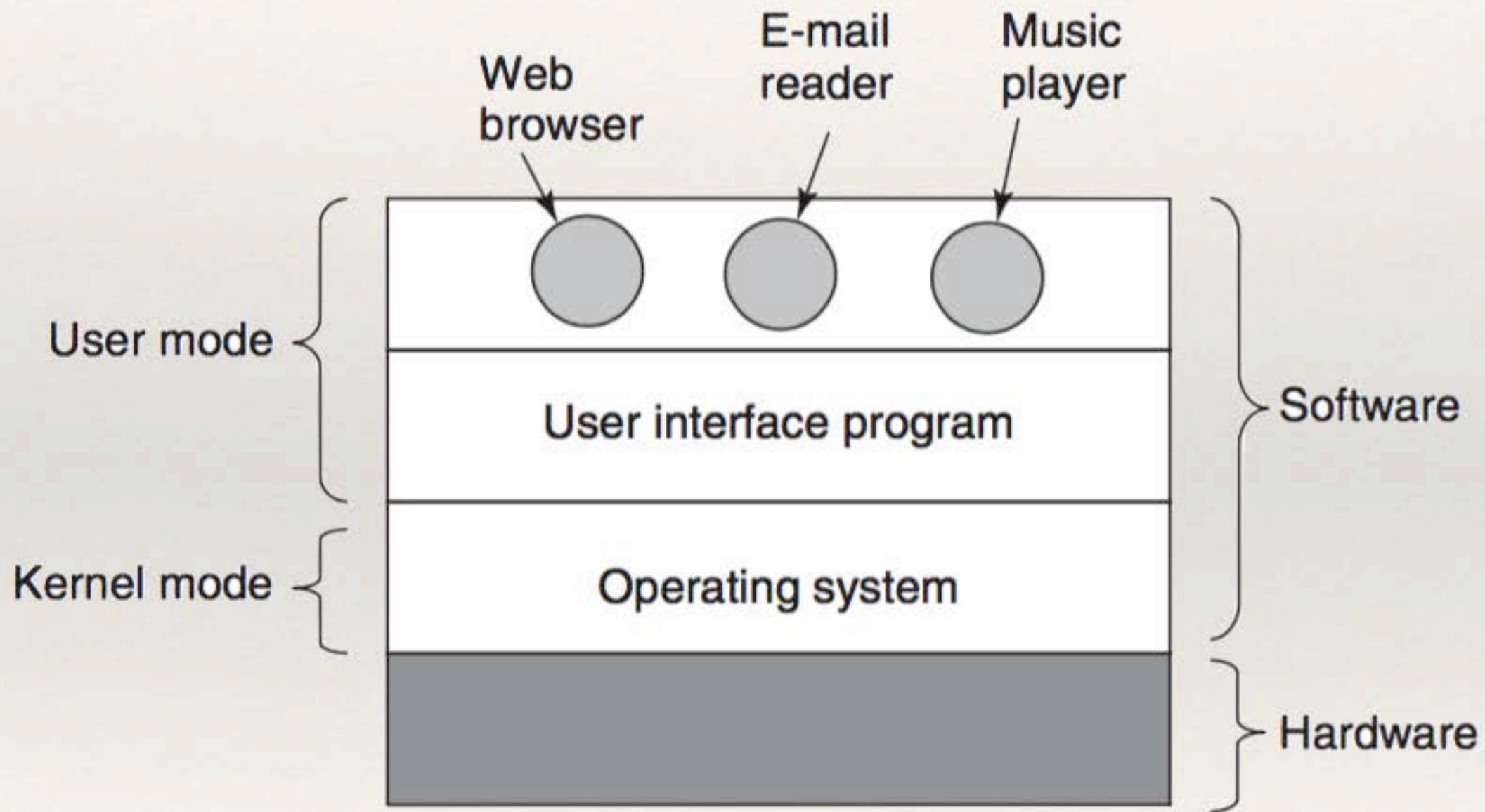- Software interfaces in popular culture

general concepts

structure

- ❖ An operating system acts as an intermediary between the user of a computer and the computer hardware.

- ❖ The purpose of an operating system is to provide an environment in which a user can execute programs in a convenient and efficient manner.

structure

OS abstraction

- The **architecture** of most computers at the machine-language level is primitive and awkward to program, especially for input/output.

- To give an example, consider modern **SATA** (Serial ATA) **hard disks** used on most computers.

- A book (Anderson, 2007) describing an early version of the interface to the disk (the details for a programmer to use the disk) was more than 450 pages long.

- Clearly, no sane programmer would want to deal with this disk at the hardware level.

- Instead, a piece of software, called a **disk driver**, deals with the hardware and provides an interface to read and write disk blocks, without getting into the details.

- Operating systems contain many **drivers** for controlling I/O devices.

- But even this level is much too low for most applications.

- For this reason, all operating systems provide **another layer of abstraction for using disks**: files.

- Using this abstraction, programs can create, write, and read **files**, without having to deal with the messy details of how the hardware actually works.

- This **abstraction** is the **key** to managing all this **complexity**.

Tanenbaum p4

Interfaces

Introduction

UI and GUI

- The Operative System (OS) is the software that lets the user interact with the hardware of a computer.

- How do we communicate with the OS?

- We need an **interface**, something between the user and the OS.

UI and GUI

interface | ˈin(t)ərˌfās |

noun

1. a point where two systems, subjects, organizations, etc., meet and interact: *the interface between accountancy and the law*.

   - *chiefly Physics* a surface forming a common boundary between two portions of matter or space, e.g., between two immiscible liquids: *the surface tension of a liquid at its air/liquid interface*.

2. *Computing* a device or program enabling a user to communicate with a computer.

   - a device or program for connecting two items of hardware or software so that they can be operated jointly or communicate with each other.

UI and GUI

- The generic name for this is the User Interface (UI)

- Historically, the first UIs were commands written in a keyboard, and output written on a printer

CLI

Digital DECWriter II

The LA36 DECwriter II was the company's first commercially successful keyboard terminal and became the de facto market standard.

The LA-36 utilises all solid state logic and has an electronic keyboard.

The printer mechanism uses a dot-matrix technique to print 132 columns of text across standard 14 inch computer forms.
Normal printing speed is 30 characters per second using a communications rate of 300 bps.
LA-36 is capable of printing at a catch-up speed of 60 cps for short periods. Some LA-36es were modified to allow printing at the 60 cps full- time, but in doing this fill characters or delays were required to compensate for print- head return time.

Manufacturer: DEC
Date: 1978
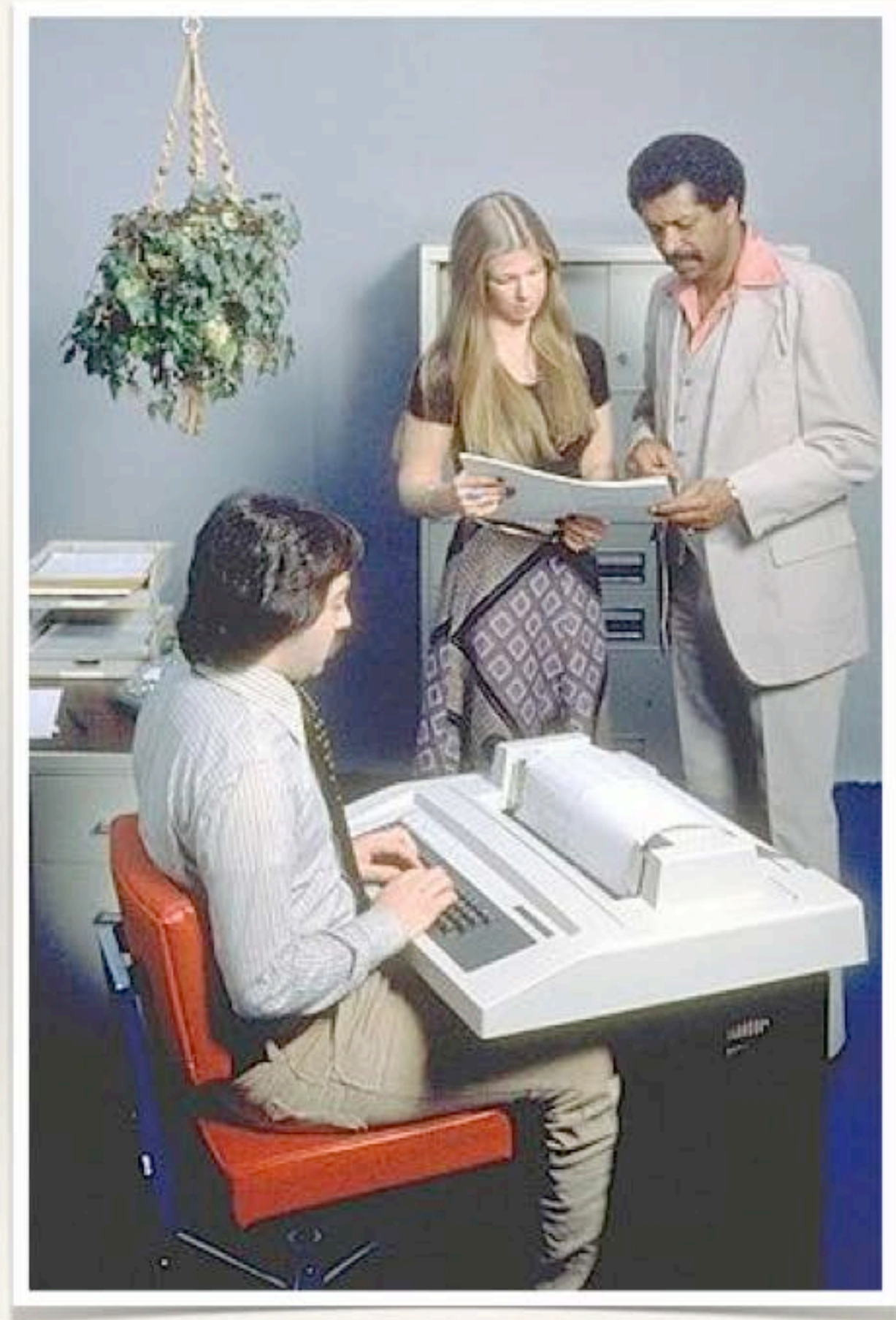
VT100 & VT220 terminals

command-line interface (CLI)

* command-line interface (CLI) has been the typical UI.

* Some well known OS based on CLI were:

    * VAX/VMS (Digital)

    * MS-DOS (Microsoft)
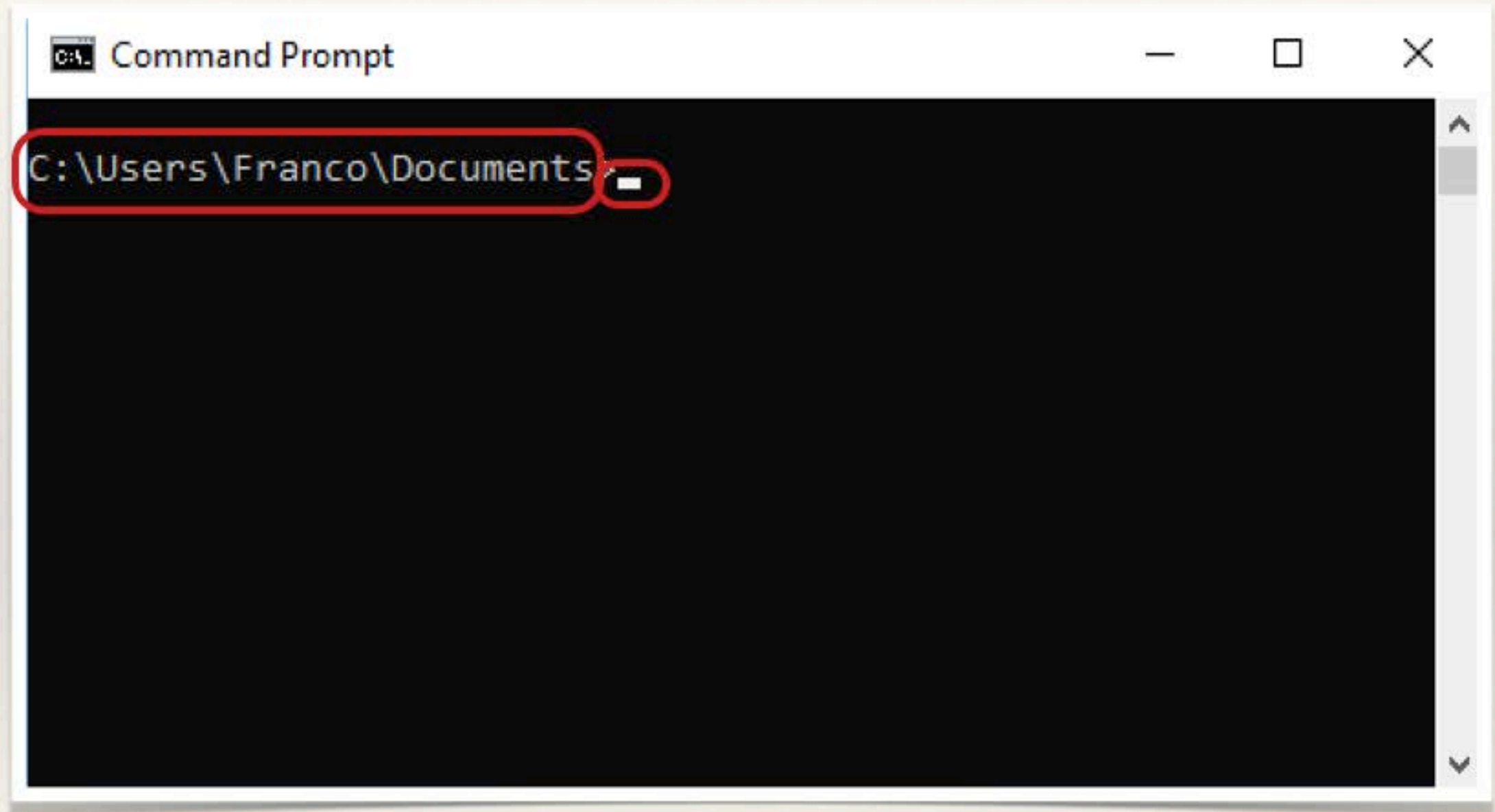
    * ProDOS (Apple)

Windows

Microsoft Windows
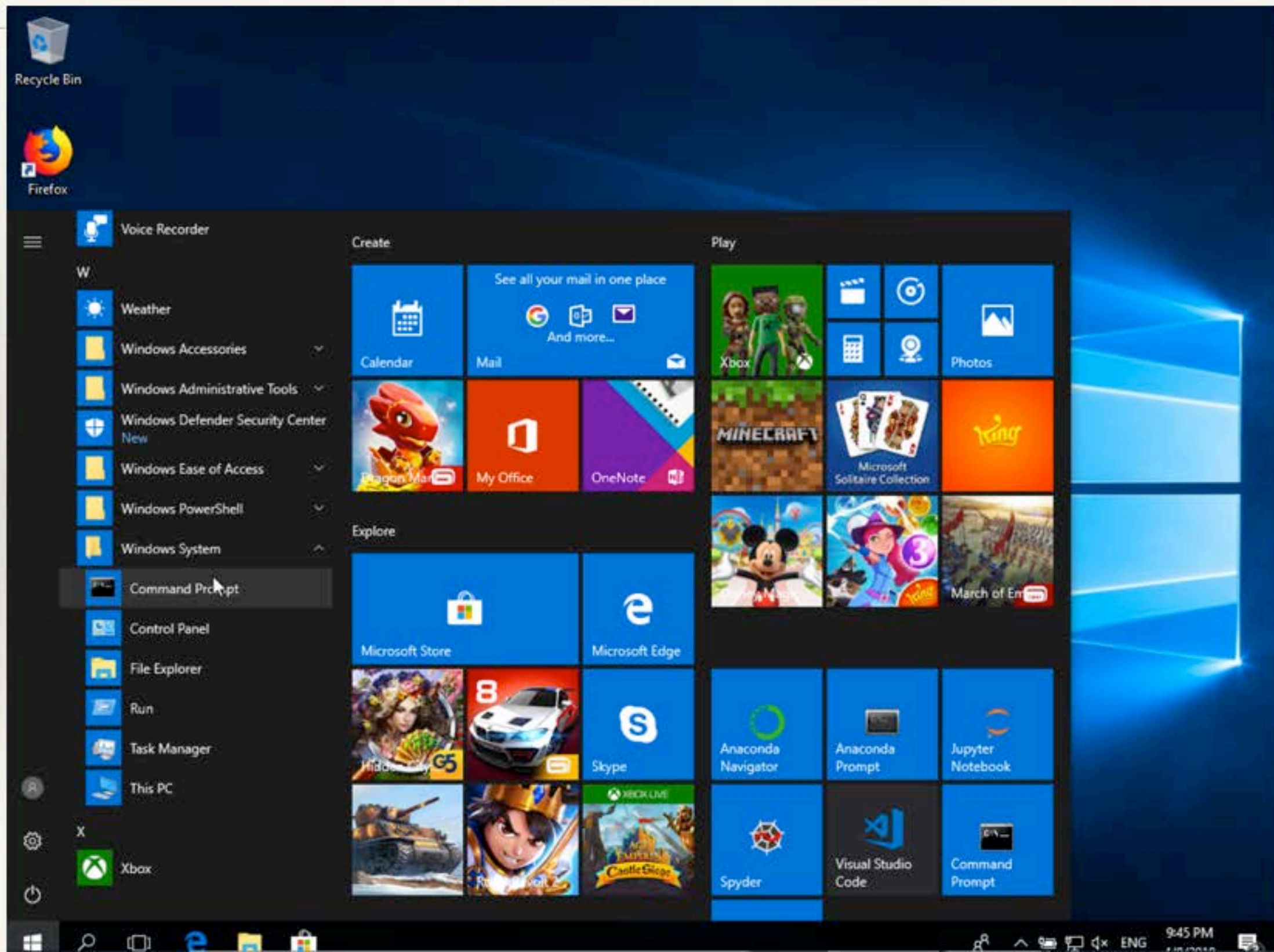
Windows Console
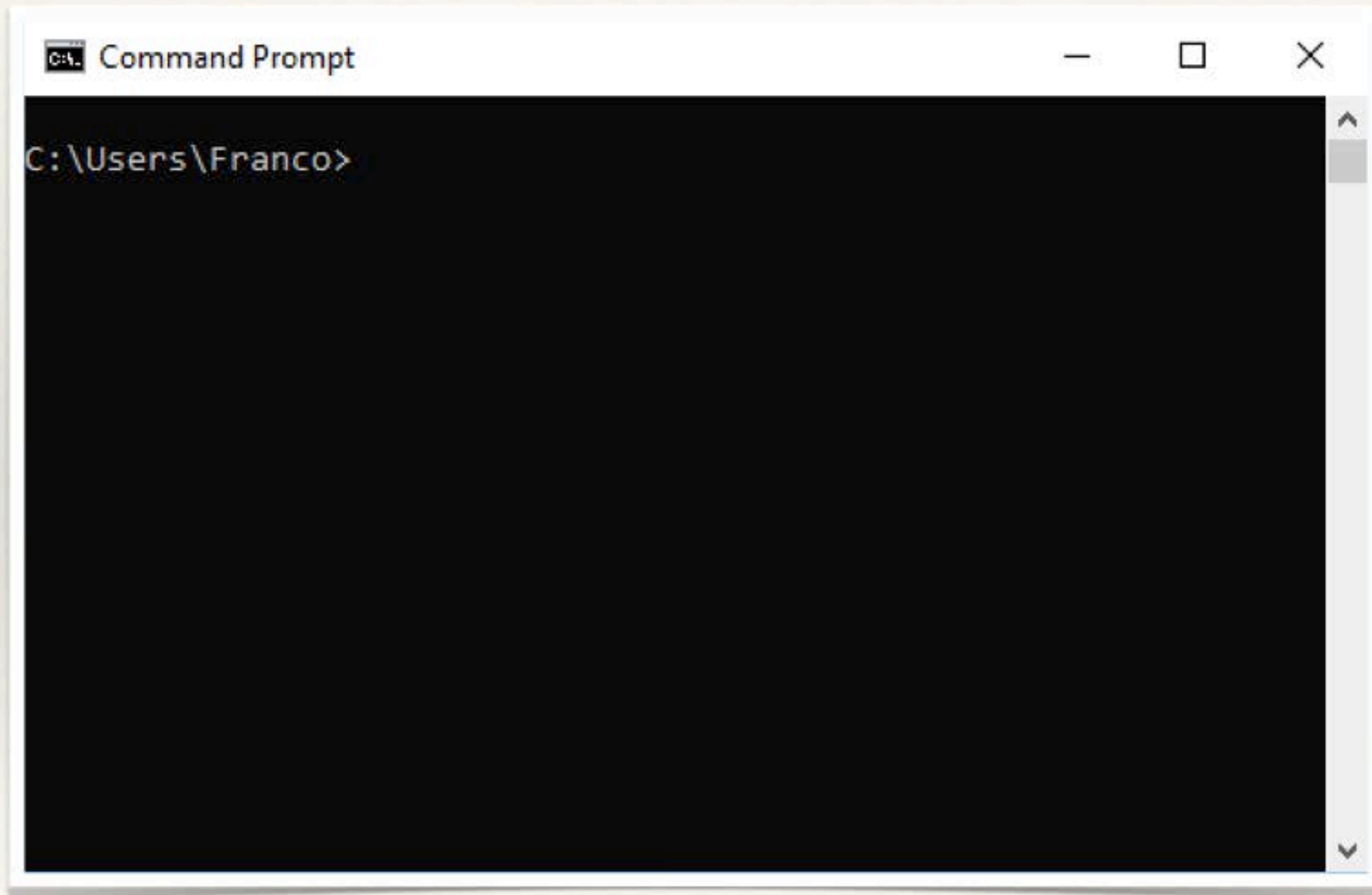
Windows Console
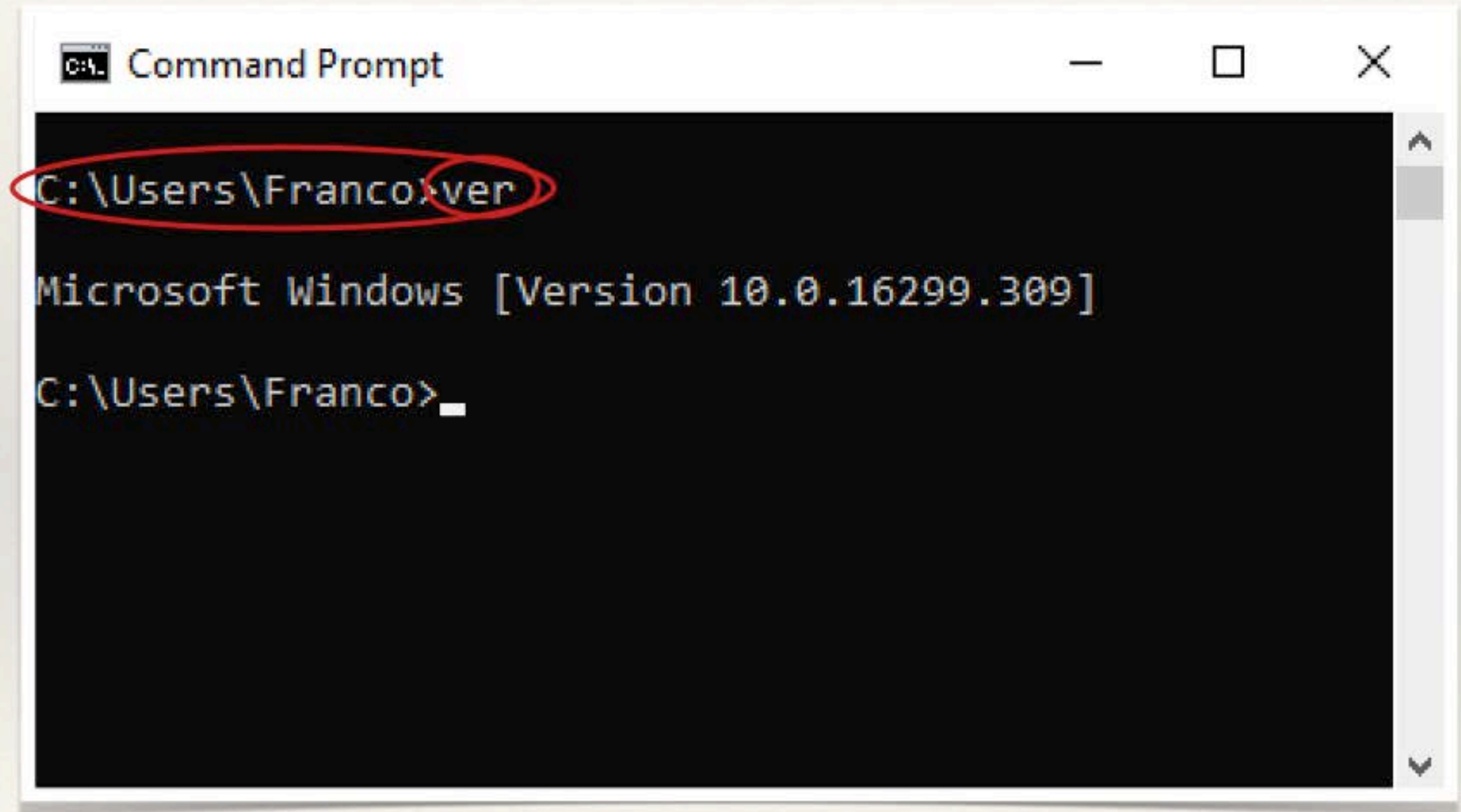
- Working directory

Windows Console

Windows Console

Determine the operating System Version

❖ Not every version of the command processor supports every command and utility. Consequently, you often need to know which version of the command processor is present on the user's machine. To perform this task, type Ver and press Enter. You'll see an operating system version number, such as Microsoft Windows [Version 6.1.7600], which indirectly tells you which version of the command processor is installed. (The command prompt also displays the version number automatically when you open the window.)

Windows Console

Windows Console

- List the files in a directory

Windows Console

The directories tree

change directory

Root directory

Directories

Files

Windows Console

* change directory
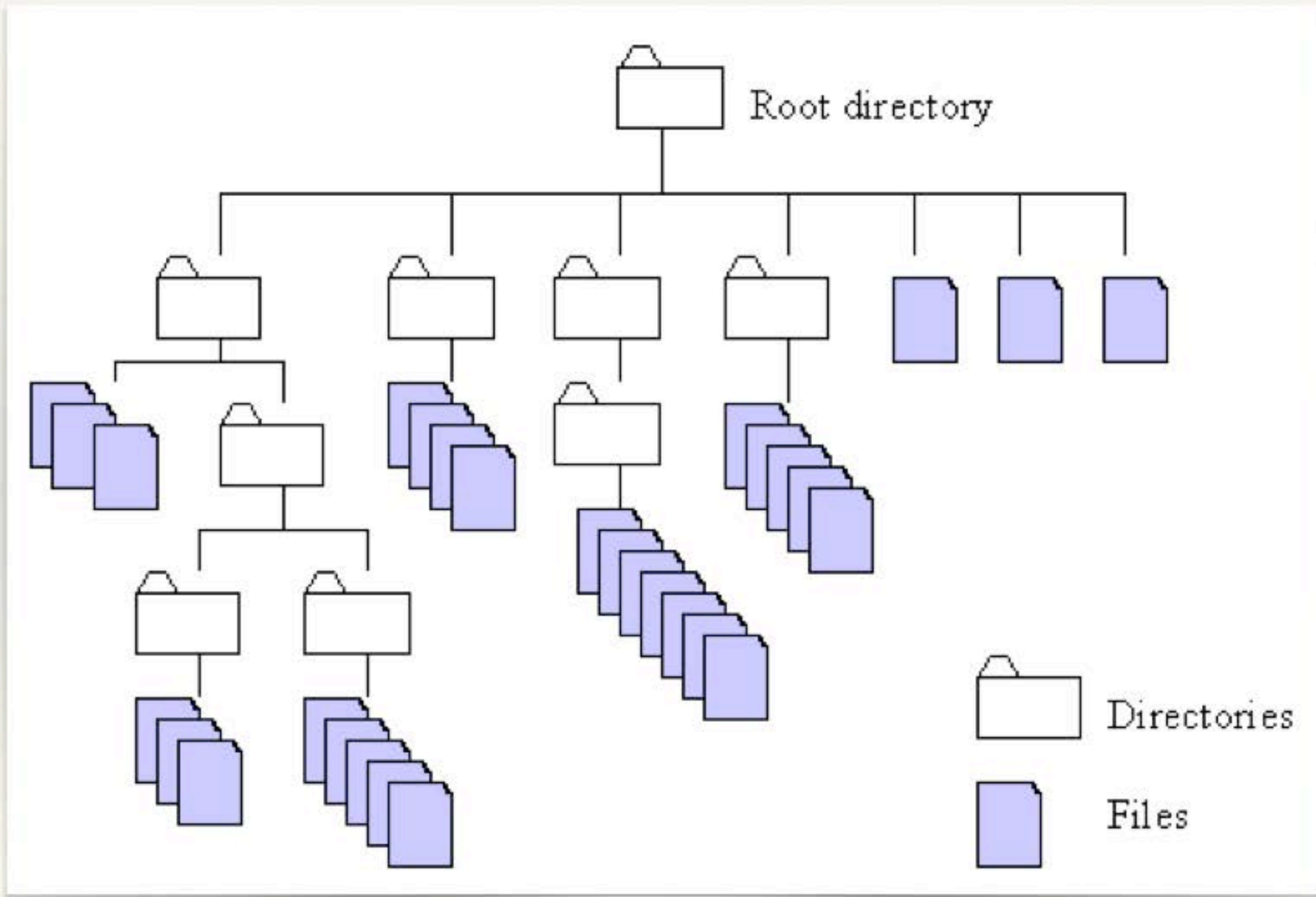
Windows Console


```
C:\Users\Franco\Documents>dir
 Volume in drive C has no label.
 Volume Serial Number is F0D4-1BAC

 Directory of C:\Users\Franco\Documents

04/08/2018  11:28 PM    <DIR>          .
04/08/2018  11:28 PM    <DIR>          ..
04/08/2018  11:28 PM           395,376 Anemone-Flower-5.jpg
04/08/2018  06:49 AM    <DIR>          Python Scripts
               1 File(s)        395,376 bytes
               3 Dir(s)   8,687,894,528 bytes free

C:\Users\Franco\Documents>cd "Python Scripts"
```
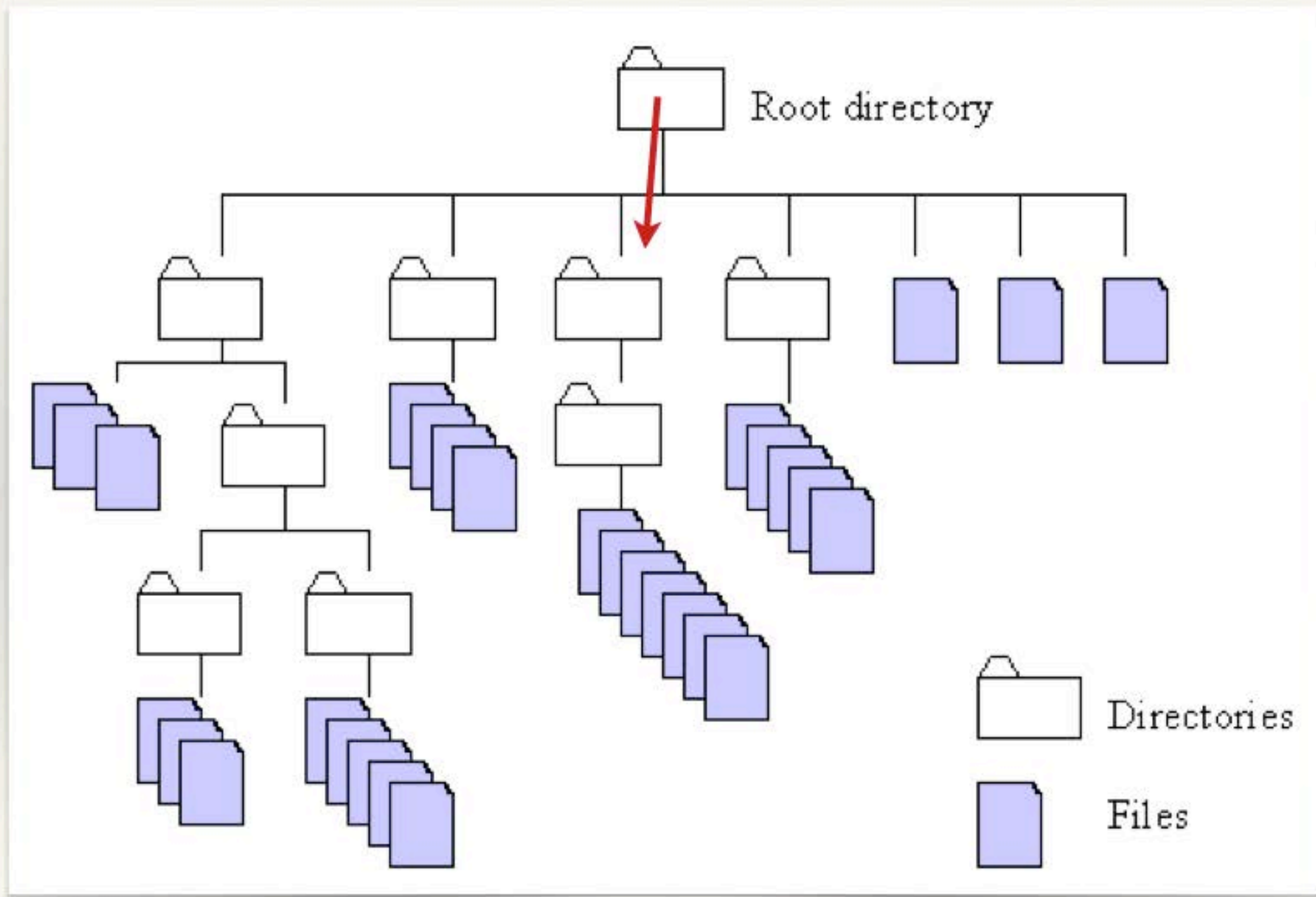
Windows Console

change directory

Windows Console

Windows Console

Windows Console
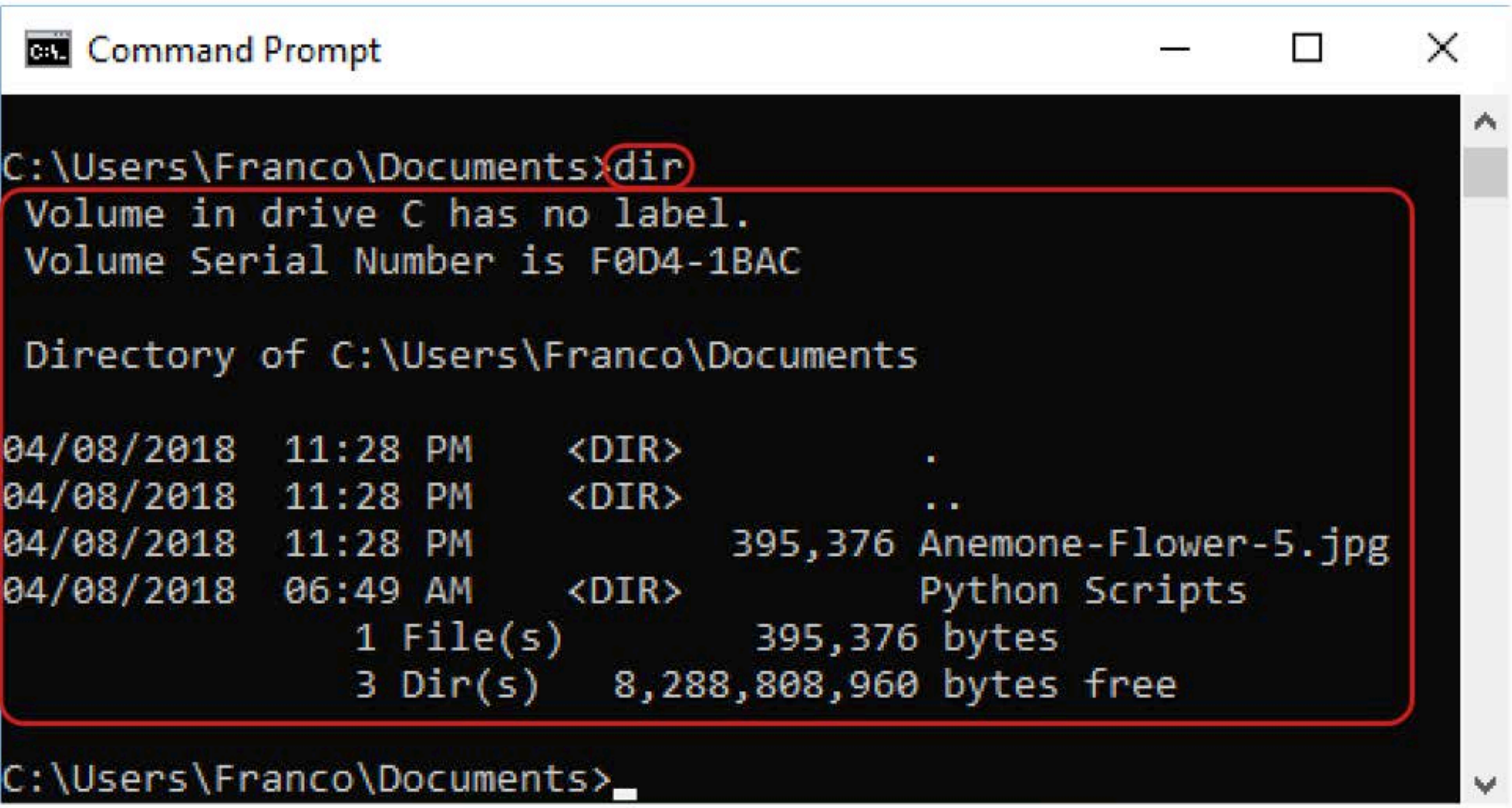

```
Command Prompt                                                   —   □   ✕

C:\Users\Franco\Documents>dir
 Volume in drive C has no label.
 Volume Serial Number is F0D4-1BAC


 Directory of C:\Users\Franco\Documents

04/08/2018  11:28 PM    <DIR>                  .
04/08/2018  11:28 PM    <DIR>                  ..
04/08/2018  11:28 PM            395,376 Anemone-Flower-5.jpg
04/08/2018  06:49 AM    <DIR>              Python Scripts
               1 File(s)         395,376 bytes
               3 Dir(s)    8,288,808,960 bytes free

C:\Users\Franco\Documents>_
```
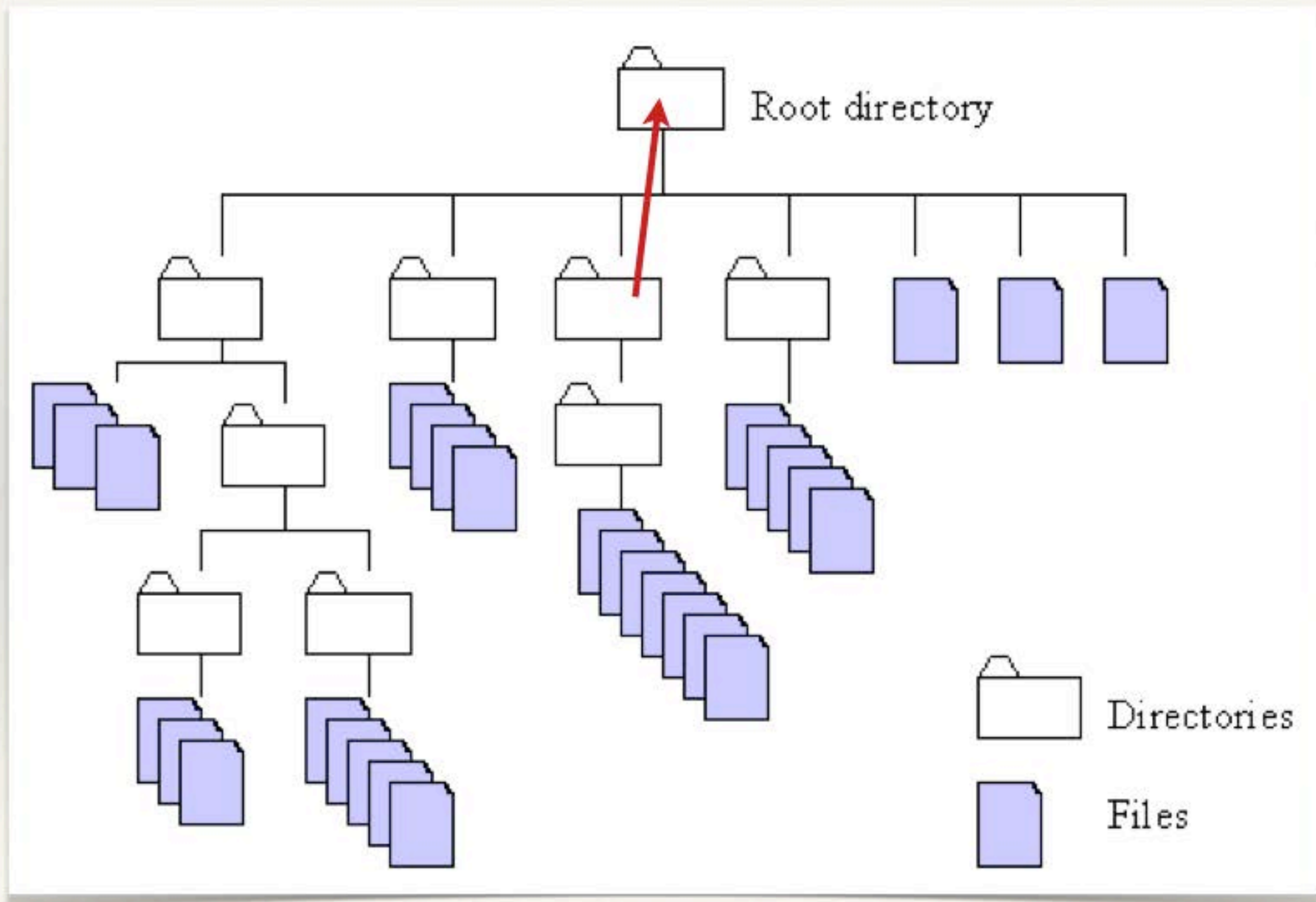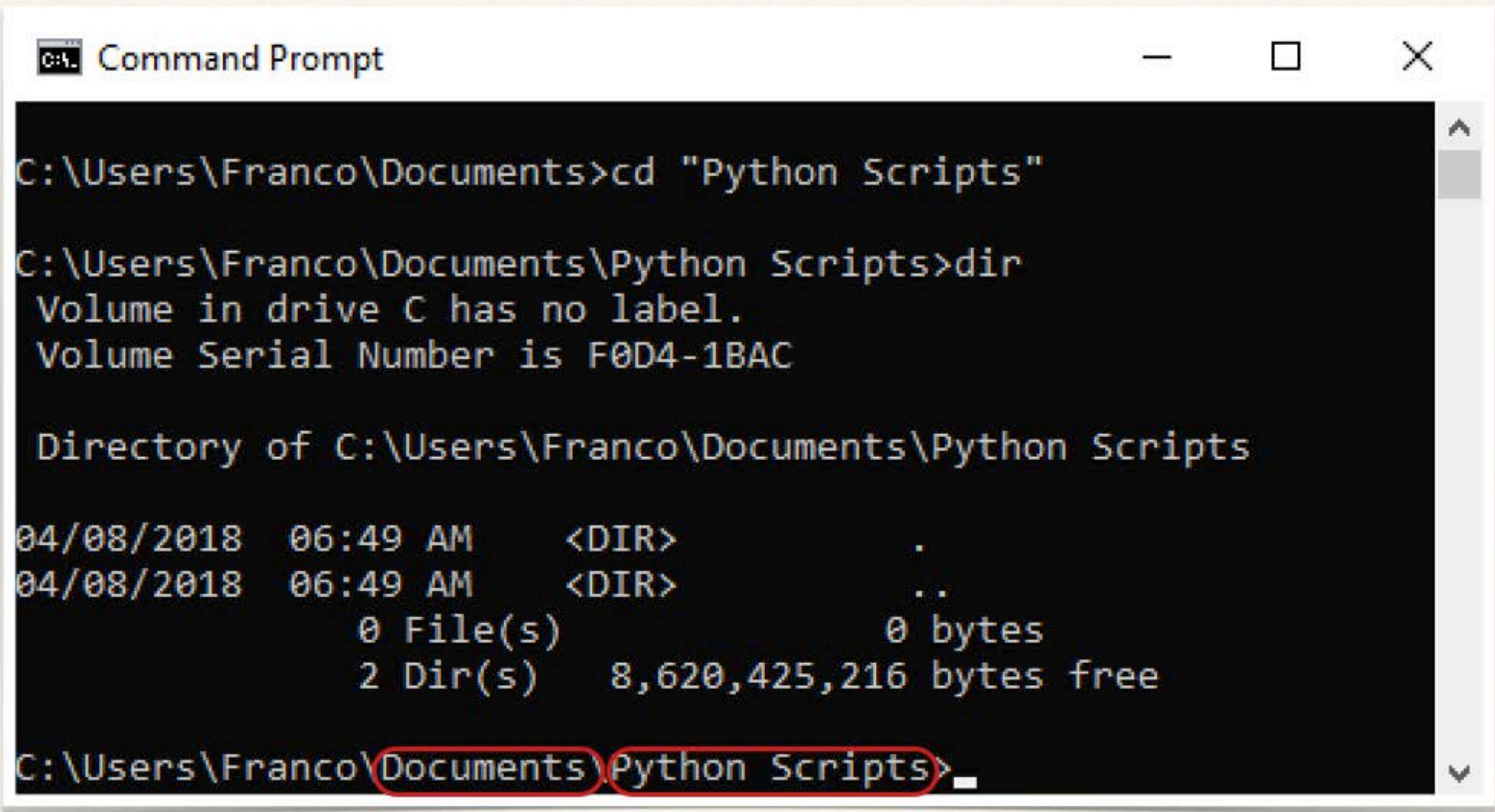
Windows Console

linux

Debian with KDE
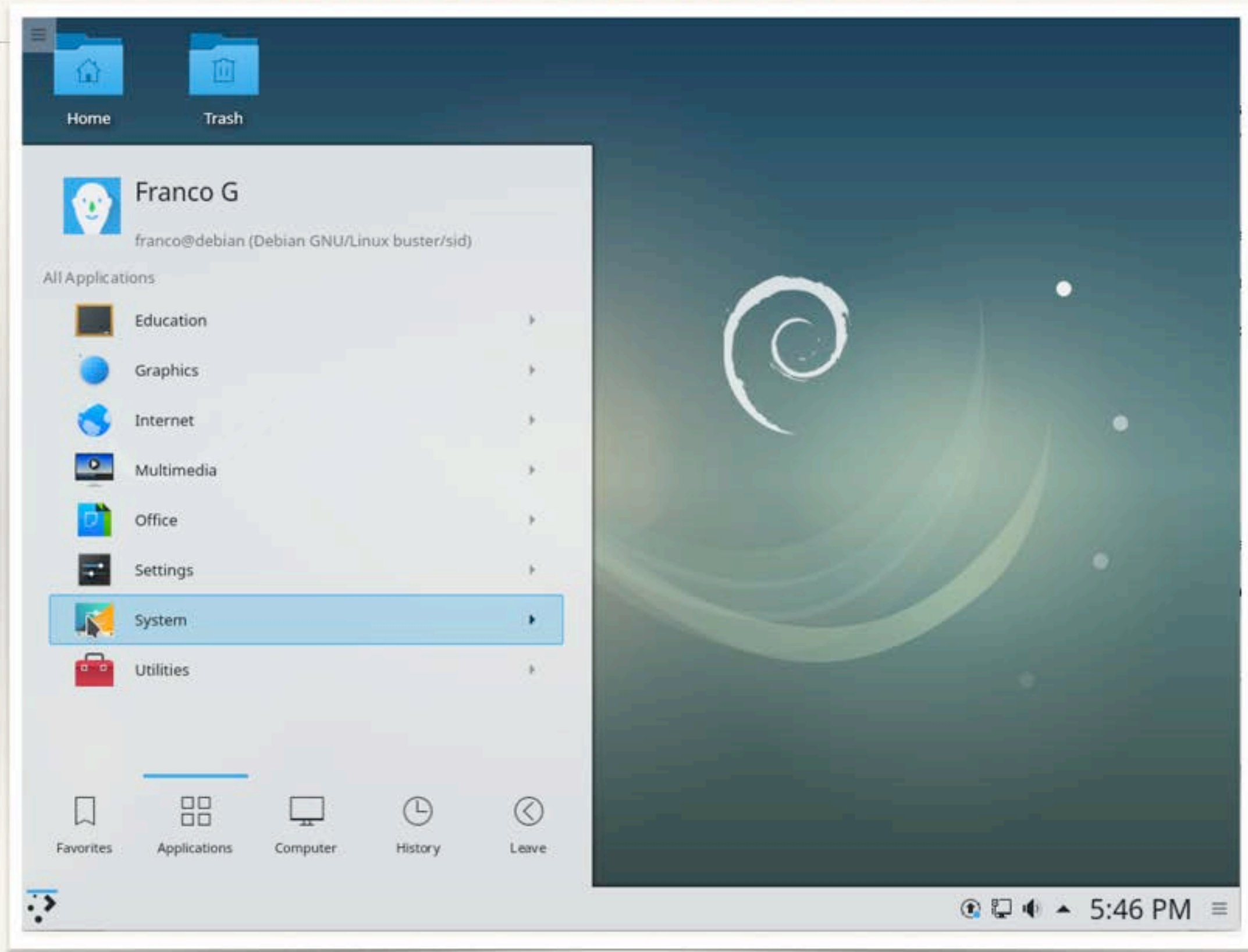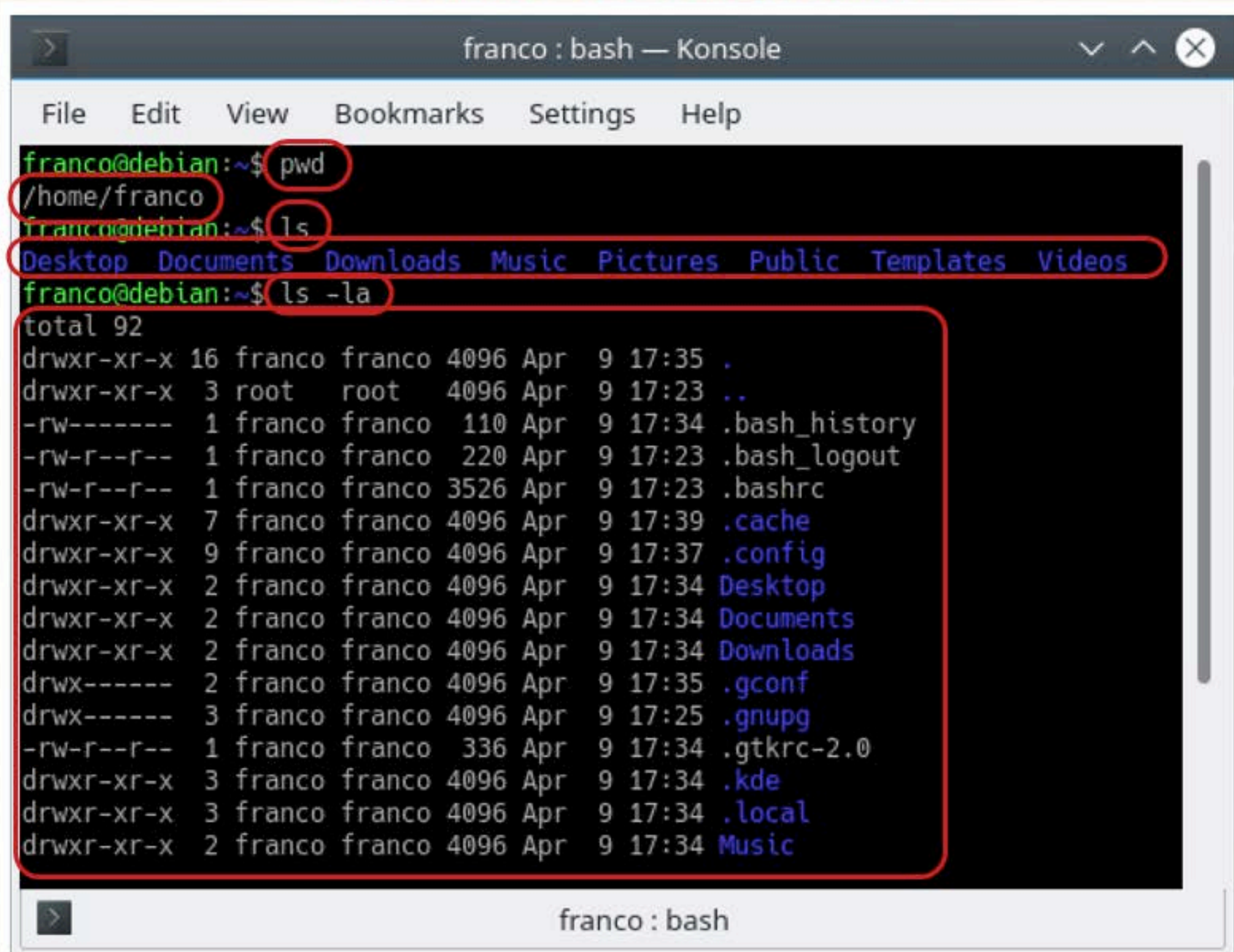
Debian with KDE
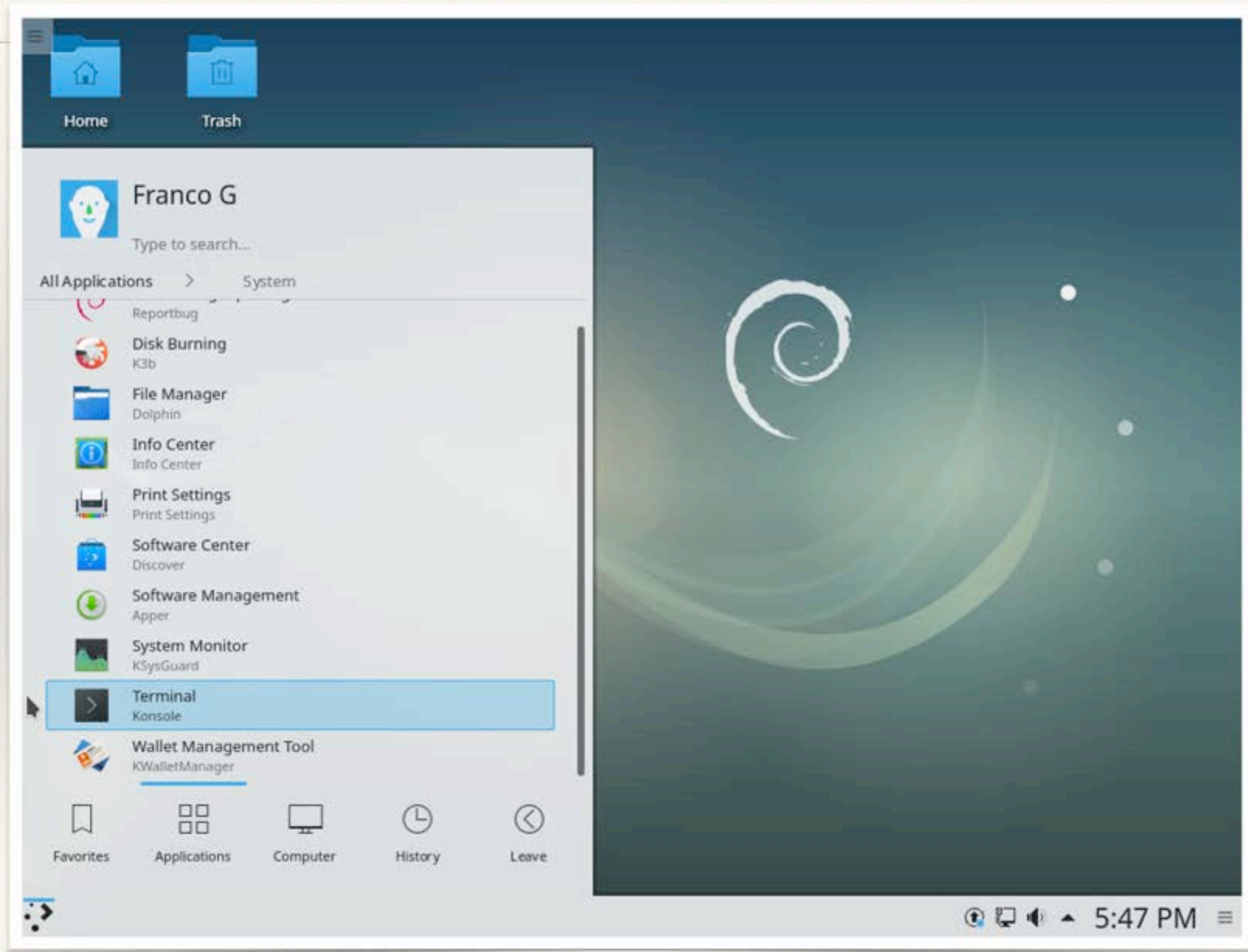
Debian with KDE

linux Console
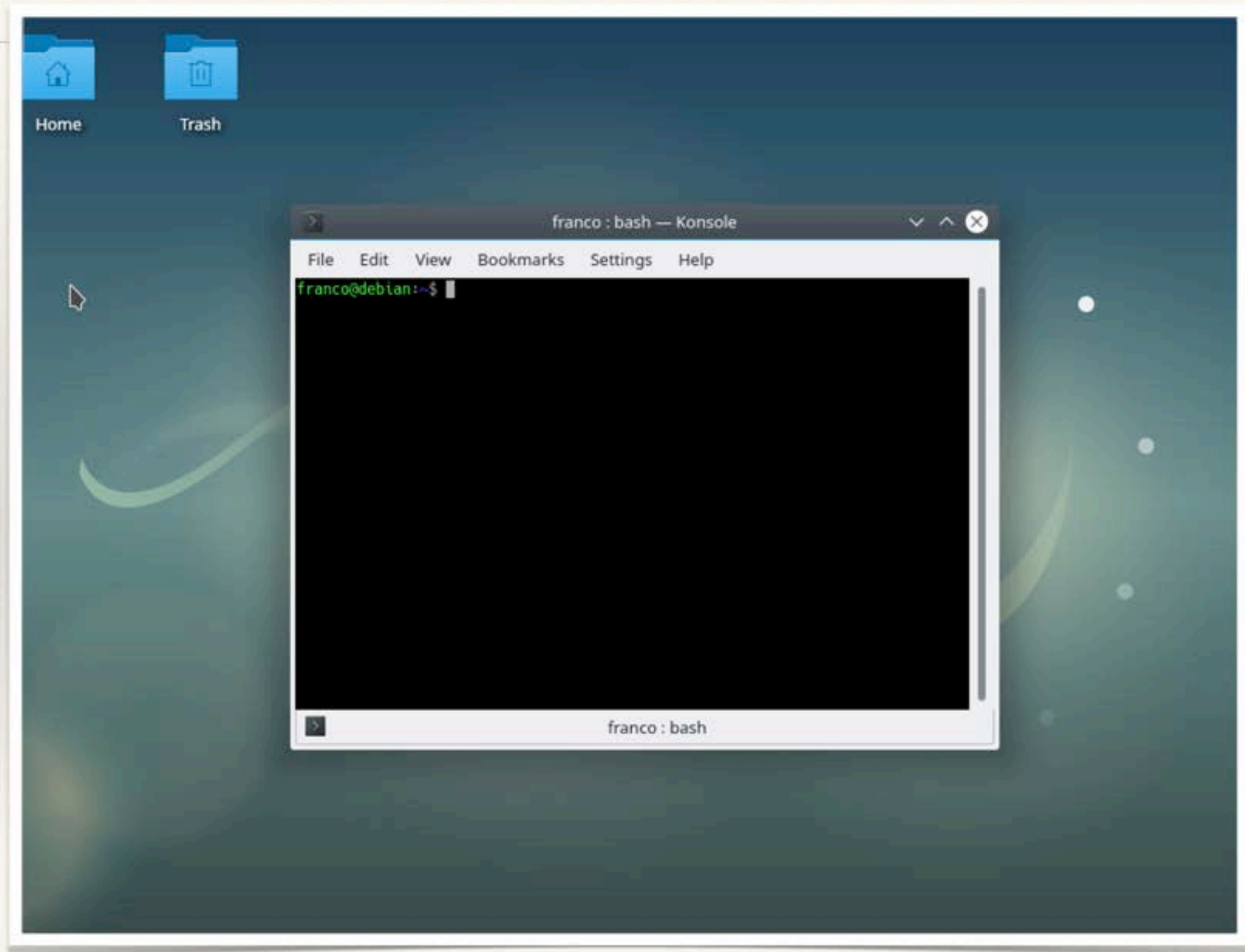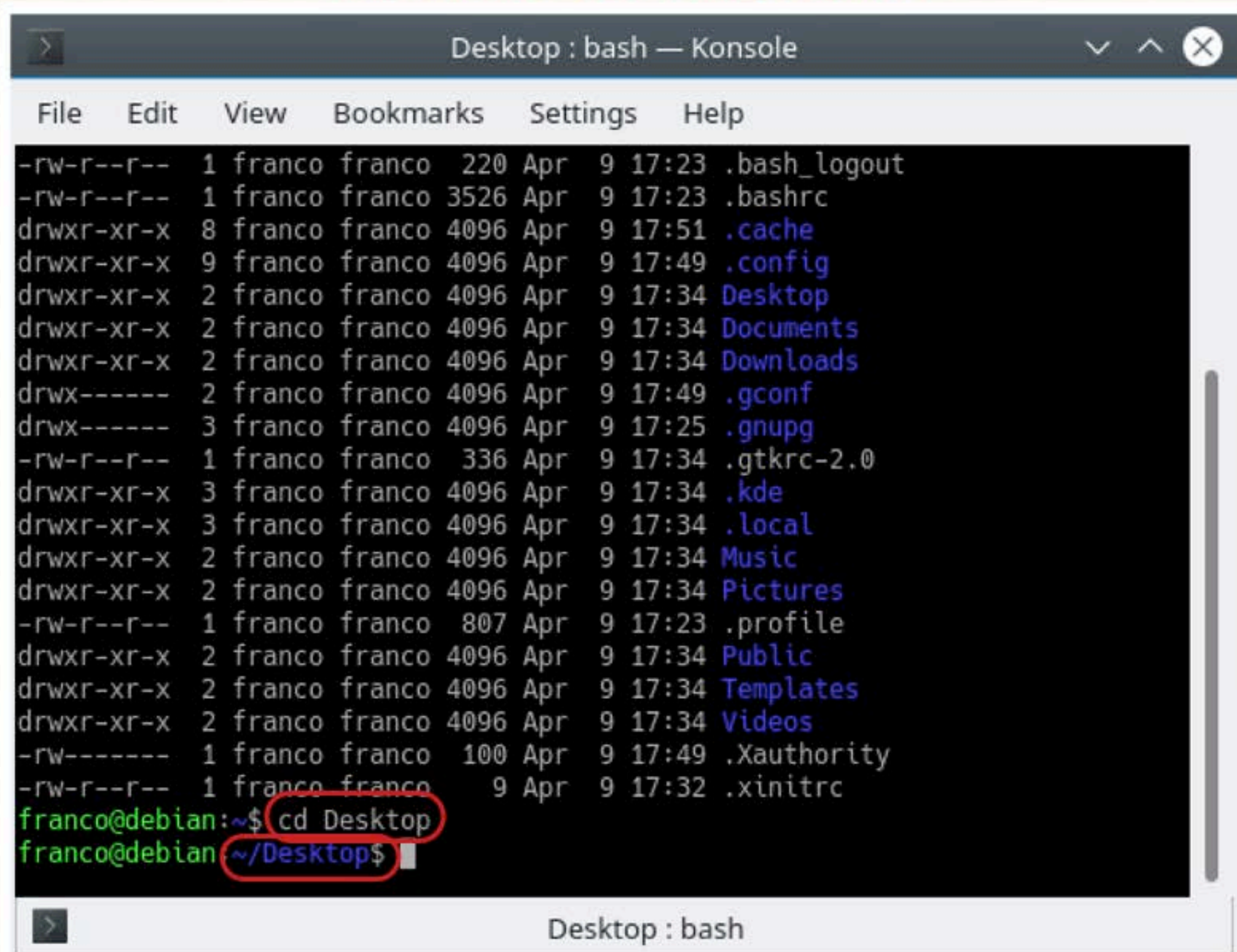
linux Console

linux Console

Desktop : bash — Konsole

File   Edit   View   Bookmarks   Settings   Help

```
drwx------   2 franco franco 4096 Apr  9 17:49 .gconf
drwx------   3 franco franco 4096 Apr  9 17:25 .gnupg
-rw-r--r--   1 franco franco  336 Apr  9 17:34 .gtkrc-2.0
drwxr-xr-x   3 franco franco 4096 Apr  9 17:34 .kde
drwxr-xr-x   3 franco franco 4096 Apr  9 17:34 .local
drwxr-xr-x   2 franco franco 4096 Apr  9 17:34 Music
drwxr-xr-x   2 franco franco 4096 Apr  9 17:34 Pictures
-rw-r--r--   1 franco franco  807 Apr  9 17:23 .profile
drwxr-xr-x   2 franco franco 4096 Apr  9 17:34 Public
drwxr-xr-x   2 franco franco 4096 Apr  9 17:34 Templates
drwxr-xr-x   2 franco franco 4096 Apr  9 17:34 Videos
-rw-------   1 franco franco  100 Apr  9 17:49 .Xauthority
-rw-r--r--   1 franco franco    9 Apr  9 17:32 .xinitrc
franco@debian:~$ cd Desktop
franco@debian:~/Desktop$ ls -la
total 20
drwxr-xr-x  2 franco franco 4096 Apr  9 17:34 .
drwxr-xr-x 16 franco franco 4096 Apr  9 17:49 ..
-rw-r--r--  1 franco franco   50 Apr  9 17:34 .directory
-rw-r--r--  1 franco franco 2460 Apr  9 17:34 Home.desktop
-rw-r--r--  1 franco franco 2908 Apr  9 17:34 trash.desktop
franco@debian:~/Desktop$
```

Desktop : bash

linux Console

MacOS

MacOS Console

```
● ● ●                    🏠 fabio — -bash — 80×24

Last login: Mon Apr  9 22:06:11 on ttys000
Fabio-MacBook:~ fabio$ man ls█
```

MacOS Console

```
● ● ●                    🏠 fabio — less ◂ man ls — 80×24

LS(1)                   BSD General Commands Manual                      LS(1)

NAME
     ls -- list directory contents

SYNOPSIS
     ls [-ABCFGHLOPRSTUW@abcdefghiklmnopqrstuwx1] [file ...]

DESCRIPTION
     For each operand that names a file of a type other than directory, ls
     displays its name as well as any requested, associated information.  For
     each operand that names a file of type directory, ls displays the names
     of files contained within that directory, as well as any requested, asso-
     ciated information.

     If no operands are given, the contents of the current directory are dis-
     played.  If more than one operand is given, non-directory operands are
     displayed first; directory and non-directory operands are sorted sepa-
     rately and in lexicographical order.

     The following options are available:

:▮
```

MacOS Console

```
-@        Display extended attribute keys and sizes in long (-l) output.

-1        (The numeric digit ``one''.)  Force output to be one entry per
          line.  This is the default when output is not to a terminal.

-A        List all entries except for . and ...  Always set for the super-
          user.

-a        Include directory entries whose names begin with a dot (.).

-B        Force printing of non-printable characters (as defined by
          ctype(3) and current locale settings) in file names as \xxx,
          where xxx is the numeric value of the character in octal.

-b        As -B, but use C escape codes whenever possible.

-C        Force multi-column output; this is the default when output is to
          a terminal.

-c        Use time when file status was last changed for sorting (-t) or
          long printing (-l).

-d        Directories are listed as plain files (not searched recursively).
:
```

MacOS Console

Megabyte, Gigabyte, Terabyte and Petabyte in order to reduce the number of digits to three or less using base 2 for sizes.

-i   For each file, print the file's file serial number (inode num-
            ber).

-k   If the -s option is specified, print the file size allocation in
            kilobytes, not blocks. This option overrides the environment
            variable BLOCKSIZE.

-L   Follow all symbolic links to final target and list the file or
            directory the link references rather than the link itself. This
            option cancels the -P option.

-l   (The lowercase letter ``ell''.) List in long format. (See
            below.) If the output is to a terminal, a total sum for all the
            file sizes is output on a line before the long listing.

-m   Stream output format; list files across the page, separated by
            commas.

-n   Display user and group IDs numerically, rather than converting to
            a user or group name in a long (-l) output. This option turns on

:

MacOS Console

```
Last login: Mon Apr  9 22:06:11 on ttys000
[Fabio-MacBook:~ fabio$ man ls
[Fabio-MacBook:~ fabio$ ls -la
total 28488
drwxr-xr-x@  114 fabio   staff         3876  8 Apr 13:25 .
drwxr-xr-x     6 root    admin          204 21 Dec  2015 ..
-rw-r--r--     1 fabio   staff           16 14 Jun  2016 .7486160831680234
drwxr-xr-x     6 fabio   staff          204 15 Feb  2015 .AllDRMRemoval
-r--------     1 fabio   staff            7  1 Nov 19:19 .CFUserTextEncoding
-rw-r--r--@    1 fabio   staff        65540  9 Apr 22:33 .DS_Store
drwxr-xr-x     3 fabio   staff          102 15 Feb  2015 .Epubor
-rw-r--r--     1 fabio   staff        45993  1 Jan  2016 .Soulseek.1451672273056
-rw-r--r--     1 fabio   staff        45993  2 Jan  2016 .Soulseek.1451675873387
-rw-r--r--     1 fabio   staff        45993  2 Jan  2016 .Soulseek.1451678942645
drwxr-xr-x     3 fabio   staff          102 18 Apr  2017 .SoulseekQt
drwxrwxrwt@    3 fabio   staff          102  8 Apr  2014 .TemporaryItems
drwx------     6 fabio   staff          204  9 Apr 19:33 .Trash
drwxr-xr-x     3 fabio   staff          102 15 Feb  2015 .Ultimate
-rw-------     1 fabio   staff          327 27 Nov 00:45 .Xauthority
drwxr-xr-x     4 fabio   staff          136 14 Nov  2013 .adobe
drwxr-xr-x     3 fabio   staff          102 25 Feb  2017 .anaconda
drwxr-x---     4 fabio   staff          136 12 Jul  2017 .android
drwxr-xr-x     3 fabio   staff          102  5 Mar  2015 .astropy
drwxr-xr-x    15 fabio   staff          510 22 Nov  2016 .atom
```

Other bash commands

Program	Typical use
cat	Concatenate multiple files to standard output
chmod	Change file protection mode
cp	Copy one or more files
cut	Cut columns of text from a file
grep	Search a file for some pattern
head	Extract the first lines of a file
ls	List directory
make	Compile files to build a binary
mkdir	Make a directory
od	Octal dump a file
paste	Paste columns of text into a file
pr	Format a file for printing
ps	List running processes
rm	Remove one or more files
rmdir	Remove a directory
sort	Sort a file of lines alphabetically
tail	Extract the last lines of a file
tr	Translate between character sets

the pipe line

- It frequently occurs that the first program in a command line produces output that is used as input to the next program. In the above example, we used the file temp to hold this output. However, Linux provides a simpler construction to do the same thing. In

```
sort <in | head −30
```

- the vertical bar, called the pipe symbol, says to take the output from sort and use it as the input to head, eliminating the need for creating, using, and removing the temporary file. A collection of commands connected by pipe symbols, called a pipeline, may contain arbitrarily many commands. A four-component pipeline is shown by the following example:

```
grep ter *.t | sort | head −20 | tail −5 >foo
```

- Here all the lines containing the string "ter" in all the files ending in .t are written to standard output, where they are sorted. The first 20 of these are selected out by head, which passes them to tail, which writes the last five (i.e., lines 16 to 20 in the sorted list) to foo. This is an example of how Linux provides basic building blocks (numerous filters), each of which does one job, along with a mechanism for them to be put together in almost limitless ways.

GUIs

Ergonomics
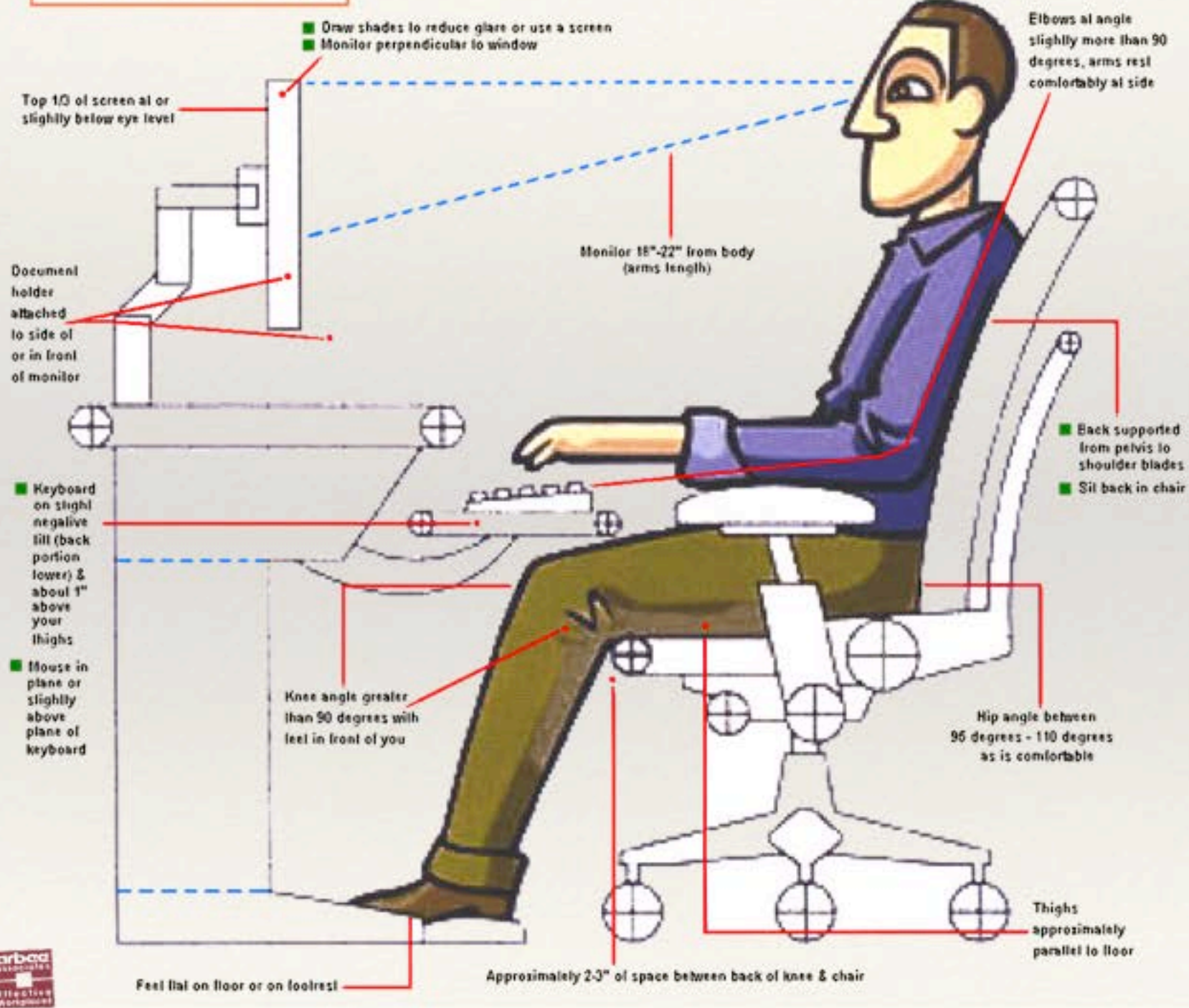
Human-Computer Interaction

- Human-computer interaction (HCI) can be defined in many possible ways.

  - «Human-computer interaction is a discipline concerned with the design, evaluation and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them.»

  - «"Human-computer interaction " is, put simply, the study of people, computer technology and the ways these influence each other. We study HCI to determine how we can make this computer technology more usable by people.»

  - «Human-computer interaction is about designing computer sys at support op so that they can car out their activities productively and safely.»

- The computer is a tool, a complex artifact that can extend our reach. The design discipline of human-computer interaction systematically applies knowledge about human purposes, human capabilities and limitations, and machine capabilities and limitations in order to enable us to do things that we could not do before. Another goal of HCI, as suggested in the definitions given above, is to **enhance the quality of the interaction between people and computers**. We strive, for example, to make technology **easier for people to learn** and **easier for them to use**.

Human-Computer Interaction

- Donald A. Norman, in his book **The Psychology of Everyday Things** (1988), examines the design of a multitude of common objects, such as doors, light switches, water faucets, stove controls, refrigerators, washer–dryers, slide projectors, telephones, and watches. He finds examples of bad design almost everywhere, even for objects far simpler than most human-computer interfaces. Norman then introduces several concepts that he uses in his analyses of both good and bad design:

  - <u>**Affordances**</u> are the perceived properties of an artifact that determine how it could possibly be used. For example, buttons are for pushing, menus are for choosing.

  - <u>**Constraints**</u> are physical, semantic, cultural, and logical factors that encourage proper actions and prevent erroneous ones.

  - <u>**Conceptual models**</u> are mental models of a system which allow users to understand the system, to predict the effects of their actions, and to interpret the results.

  - <u>**Mappings**</u> describe the relationships between controls and their e ects on a system. For example, moving a control to the left should move a corresponding display object left.

  - <u>**Visibility**</u> in the design of a system makes apparent to users the conceptual model of the system and the actions they are allowed to take.

  - <u>**Feedback**</u> from a system provides information about the effects of users' actions.

Human-Computer Interaction

* In the book **The Psychology of Everyday Things** (1988), Donald A. Norman uses the six key concepts defined above in his **prescriptions for user-centered design**:

  * Make it easy to determine **what actions are possible** at any moment (make use of constraints).

  * Make things **visible**, including the conceptual model of the system, the alternative actions, and the results of actions.

  * Make it easy to evaluate **the current state of the system**.

  * Follow **natural mappings** between **intentions** and e **required actions**; between **actions** and e **resulting effect**; and between the **information** that is visible and the interpretation of **the system state**.
  In other words, make sure that (1) the user can figure out **what to do**, and (2) the user can tell **what is going on**.

Metaphors

metaphor | ˈmedəˌfôr ˈmedəˌfər |

noun

a figure of speech in which a word or phrase is applied to an object or action to which it is not literally applicable: *"I had fallen through a trapdoor of depression," said Mark, who was fond of theatrical metaphors* | *her poetry depends on suggestion and metaphor.*

- a thing regarded as representative or symbolic of something else, especially something abstract: *the amounts of money being lost by the company were enough to make it a **metaphor for** an industry that was teetering.*

ORIGIN

late 15th cent.: from French *métaphore*, via Latin from Greek *metaphora*, from *metapherein* **'to transfer.'**

The desktop metaphor

- In computing, the desktop metaphor is an interface metaphor which is a set of unifying concepts used by graphical user interfaces to help users interact more easily with the computer. The desktop metaphor treats the computer monitor as if it is the user's desktop, upon which objects such as documents and folders of documents can be placed. A document can be opened into a window, which represents a paper copy of the document placed on the desktop. Small applications called desk accessories are also available, such as a desk calculator or notepad, etc.

- The desktop metaphor itself has been extended and stretched with various implementations of desktop environments, since access to features and usability of the computer are usually more important than maintaining the 'purity' of the metaphor. Hence we find trash cans on the desktop, as well as disks and network volumes (which can be thought of as filing cabinets—not something normally found on a desktop). Other features such as menu bars, task bars, or docks have no counterpart on a real-world desktop.

Wikipedia

Computer Metaphors

❖ When working on Linux systems through a graphical interface, users may use mouse clicks to run applications or open files, drag and drop to copy files from one location to another, and so on. In addition, users may invoke a terminal emulator program, or xterm, which provides them with the basic command-line interface to the operating system.

Computer Metaphors

- The GUI for Linux is similar to the first GUIs developed for UNIX systems in the 1970s, and popularized by Macintosh and later Windows for PC platforms. The GUI creates a **desktop environment**, a familiar **metaphor** with windows, icons, folders, toolbars, and drag-and-drop capabilities. A full desktop environment contains a window manager, which controls the placement and appearance of windows, as well as various applications, and provides a consistent **graphical interface**. Popular desktop environments for Linux include GNOME (GNU Network Object Model Environment) and KDE (K Desktop Environment).

Computer Metaphors

Open Source Software

Free Software

- The **free software movement** (FSM) or free/open source software movement (FOSSM) or free/libre open source software (FLOSS) is a social movement with the goal of obtaining and guaranteeing certain freedoms for software users, namely the freedom to run the software, to study and change the software, and to redistribute copies with or without changes.

- Regarding the meaning and misunderstandings of the word free, those who work within the free software camp have searched for less ambiguous terms and analogies like "**free beer vs free speech**" in efforts to convey the intended semantics, so that there is no confusion concerning the profitability of free software.

- The two most prominent people associated with the movement, Richard Stallman and Linus Torvalds,

Richard Stallman

GNU project
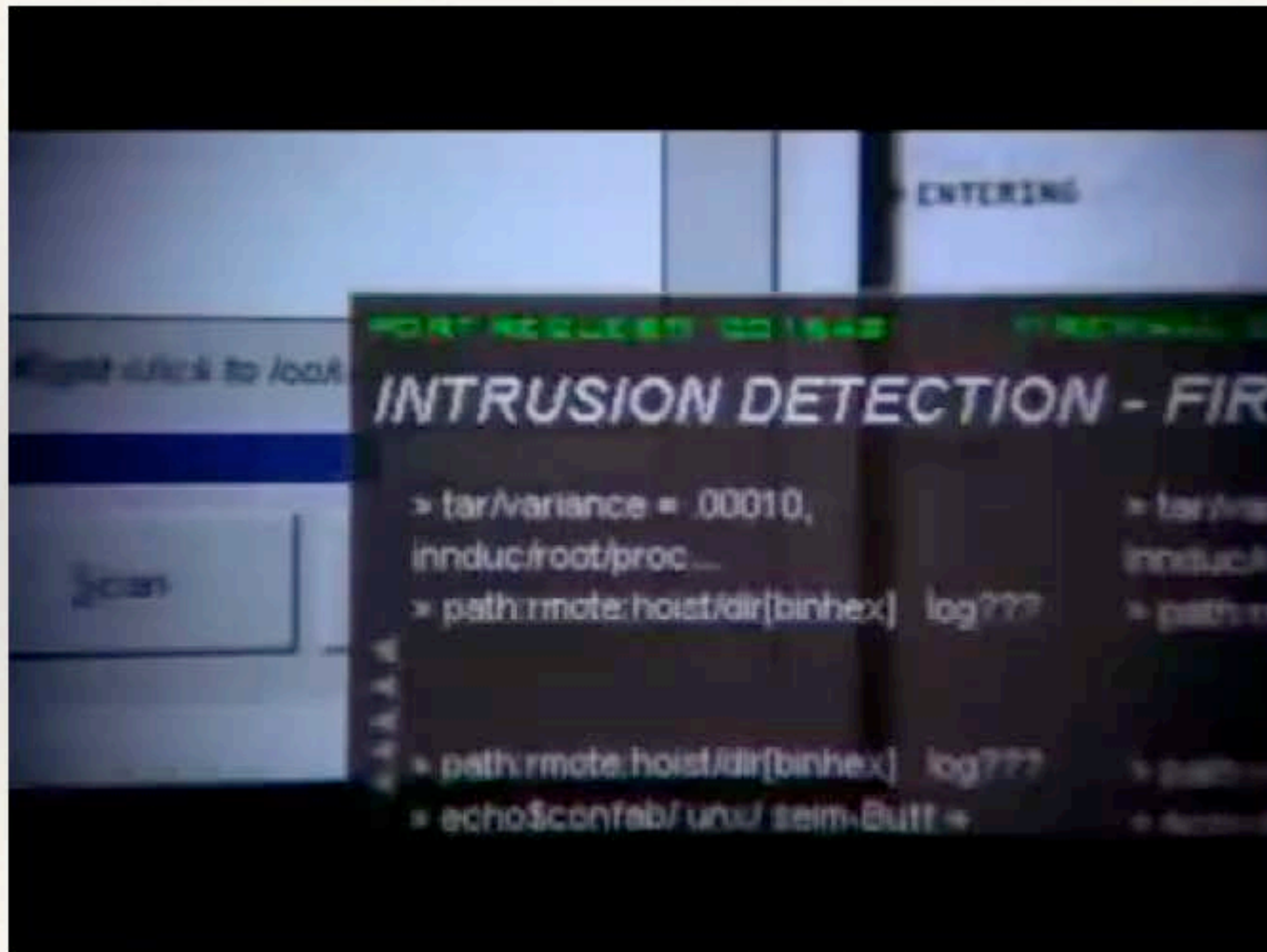

Linus Torvalds

Linux project

Computer interfacing in popular culture

two on keyboard

user interface

user interface