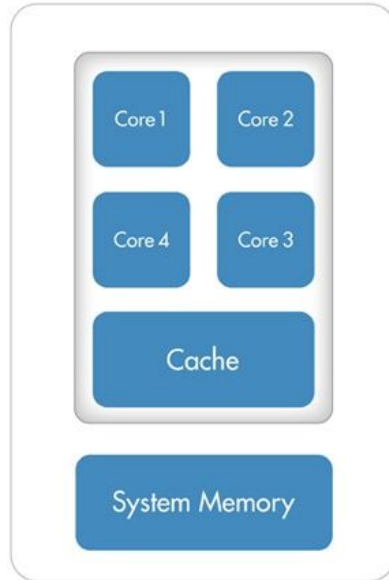


Overview

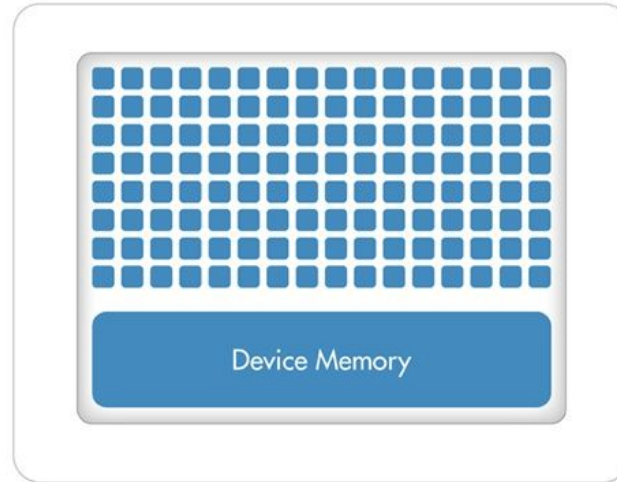
- GPU vs CPU
- What is Linux:
 - History of Linux
 - Linux vs Windows (vs MacOS)
- What do we need Linux for:
 - GPU4EDU
 - Google Colab
- What is the terminal
 - Commands and tools
 - SLURM

CPU vs GPU

CPU (Multiple Cores)



GPU (Hundreds of Cores)



CPU vs GPU



<https://blogs.nvidia.com/blog/2009/12/16/whats-the-difference-between-a-cpu-and-a-gpu/>

DL Frameworks

theano

University of Montreal
No support since 2017



Created by the Google Brain Team
First release 2015 - TensorFlow 2.1 - 2020



Released in 2015
Runs on top of TensorFlow



Released in 2002
Based on Lua



Merged in 2018



Developed by Google
First release on 2022

History of Linux

The Unix operating system was conceived and implemented by Ken Thompson and Dennis Ritchie (both of AT&T Bell Laboratories) in 1969 and first released in 1970.

In 1977, the Berkeley Software Distribution (BSD) was developed by the Computer Systems Research Group (CSRG) from UC Berkeley, based on the 6th edition of Unix from AT&T. Since BSD contained Unix code that AT&T owned, AT&T filed a lawsuit (USL v. BSDi) in the early 1990s against the University of California. This strongly limited the development and adoption of BSD.

Onyx Systems began selling early microcomputer-based Unix workstations in 1980.

Later, Sun Microsystems, founded as a spin-off of a student project at Stanford University, also began selling Unix-based desktop workstations in 1982.

While Sun workstations did not utilize commodity PC hardware like Linux was later developed for, it represented the first successful commercial attempt at distributing a primarily single-user microcomputer that ran a Unix operating system.

In 1983, Richard Stallman started the GNU project with the goal of creating a free UNIX-like operating system. As part of this work, he wrote the GNU General Public License (GPL).

History of Linux

By the early 1990s, there was almost enough available software to create a full operating system. However, the GNU kernel, called Hurd, failed to attract enough development effort, leaving GNU incomplete.

In 1985, Intel released the 80386, the first x86 microprocessor with a 32-bit instruction set and a memory management unit with paging.

In 1986, Maurice J. Bach, of AT&T Bell Labs, published *The Design of the UNIX Operating System*.

In 1987, MINIX, a Unix-like system intended for academic use, was released by Andrew S. Tanenbaum to exemplify the principles conveyed in his textbook, *Operating Systems: Design and Implementation*. While source code for the system was available, modification and redistribution were restricted.

In addition, MINIX's 16-bit design was not well adapted to the 32-bit features of the increasingly cheap and popular Intel 386 architecture for personal computers. In the early nineties a commercial UNIX operating system for Intel 386 PCs was too expensive for private users.

These factors and the lack of a widely adopted, free kernel provided the impetus for Torvalds' starting his project. He has stated that if either the GNU Hurd or 386BSD kernels had been available at the time, he likely would not have written his own.

History of Linux

“Linux began in 1991 as a personal project by Finnish student Linus Torvalds to create a new free operating system kernel. The resulting Linux kernel has been marked by constant growth throughout its history. Since the initial release of its source code in 1991, it has grown from a small number of C files under a license prohibiting commercial distribution to the 4.15 version in 2018 with more than 23.3 million lines of source code, not counting comments, under the GNU General Public License v2 with a syscall exception meaning anything that uses the kernel via system calls are not subject to the GNU GPL.”

- 1991: Linus Torvalds announced Linux:

On 25 August 1991, 21 years old student of Helsinki University sent a mail to a newsgroup on Usenet. He talked about developing a free operating system which in his words were: “just a hobby, won’t be big and professional like gnu”.

- 1992: Linux became Open Source

Linux was not always Open Source. The first few licenses of Linux forbid commercial redistribution. It was with version 0.12 in February '92 that the Linux Kernel was released under GPL. As per Linus Torvalds, open sourcing Linux was the best thing he ever did.

Linux vs Windows

- Linux is an open source operating system so user can change source code as per requirement whereas Windows OS is a commercial operating system so user doesn't have access to source code.
- Linux is very well secure as it is easy to detect bugs and fix whereas Windows has a huge user base, so it becomes a target of hackers to attack windows system.
- Comparing Windows file system vs Linux file system, Linux runs faster even with older hardware whereas Windows are slower compared to Linux.
- Linux peripherals like hard drives, CD-ROMs, printers are considered files whereas Windows, hard drives, CD-ROMs, printers are considered as devices
- Linux files are ordered in a tree structure starting with the root directory whereas in Windows, files are stored in folders on different data drives like C: D: E:
- In Linux you can have 2 files with the same name in the same directory while in Windows, you cannot have 2 files with the same name in the same folder.
- In Linux you would find the system and program files in different directories whereas in Windows, system and program files are usually saved in C: drive.

But why should I know / use Linux?

- GPU4EDU:
 - No “beautiful GUI” only command line
 - Command line can be flexible, efficient, effective
 - NVidia drivers for DL written for linux (+ other optimized software)
- Google Colab:
 - A python interface running on ... Linux
 - Using ! you can invoke shell commands

The Shell

A shell is a computer program that interprets the commands you type and sends them to the operating system. Secondly, it provides a programming environment consisting of environment variables.

Most BU systems, including the BU Linux Cluster, support at least two shells: TCSH and BASH. The default shell for your account is TCSH. The most popular and powerful Linux shell today is BASH.

To determine your shell type:

```
echo $SHELL (shell prints contents of env  
echo "$SHELL" (shell still processes env. variable)  
echo '$SHELL' (shell treats env. variable as simple literal)
```

The complete environment can be printed with `set`, `setenv` (TCSH) and `set` (BASH).

To determine the path to the shell program, type:

```
which bash
```

System Information

`whoami`

`hostname`

`date`

`free`

Commands have three parts: command, options and parameters.

Options have long and short forms. Example:

`date -u`

`date --universal`

Command History and Simple Command Line Editing

The `history` command

Try `<Ctrl><r>` (only works in BASH shell)

Choose from the command history by using the up `↑` and down `↓` arrows

Help with Commands

```
hostname --help
```

```
man hostname
```

```
info hostname
```

the Pipe Symbol “|”

The pipe “|” feeds the OUTPUT of one command into the INPUT of another command. Our first example will use the pipe symbol to filter the output of a command. Try:

```
w
```

```
w | grep 'root'
```

```
ps -e -o ruser,comm | grep 'dimitar'
```

The `ps` command is using both “options (dash)” and parameters

Try both “`man grep`” and “`info grep`”. See the difference?

Editing the Command Line with Shortcuts

<Ctrl-a> go to beginning

<Ctrl-e> go to end

<Alt-f> forward one word

<Alt-b> back one word

<Ctrl-f> forward one character

<Ctrl-b> back one character

<Ctrl-d> delete character

<Alt-d> delete word

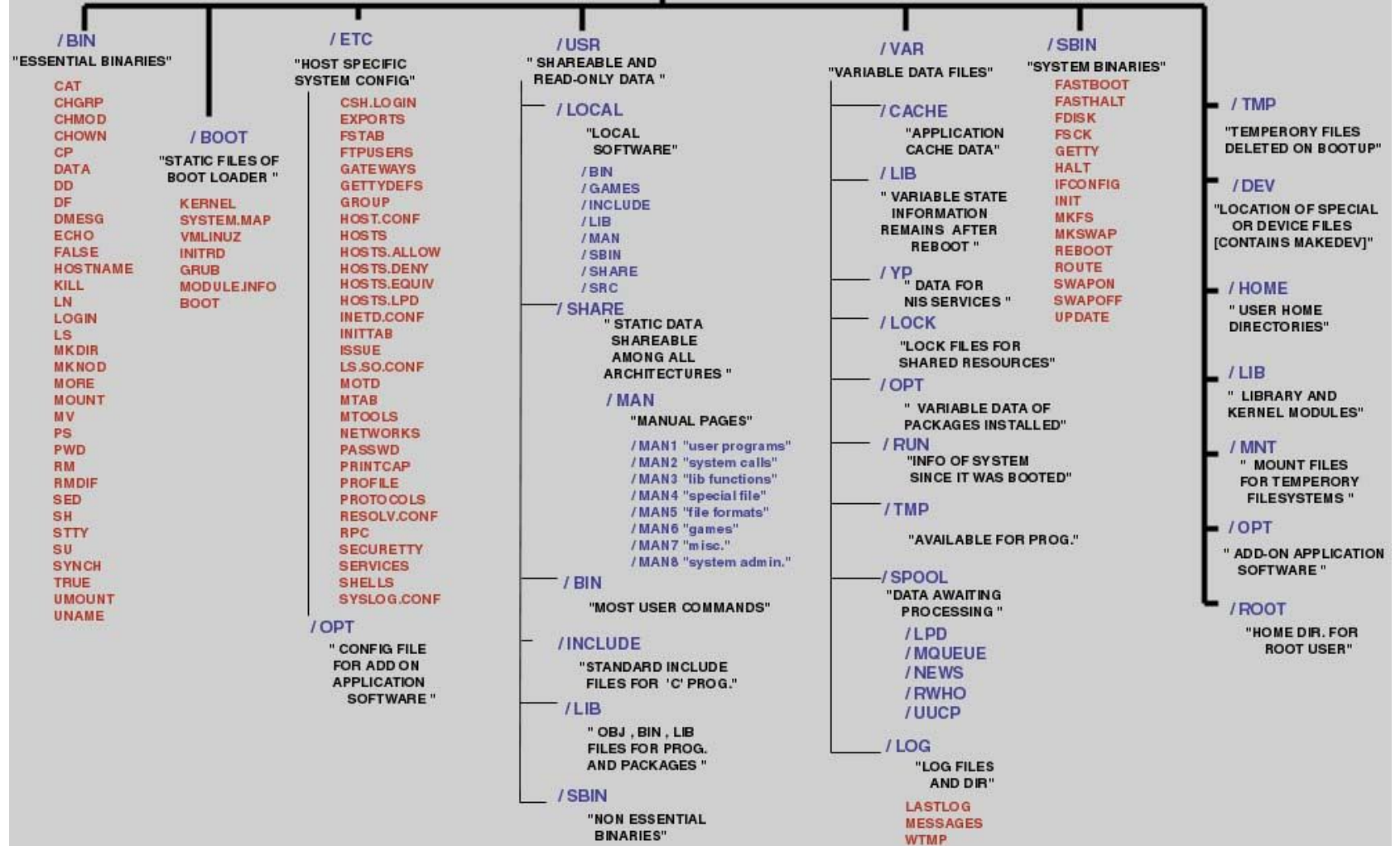
<Ctrl-u> delete from cursor to beginning of line

<Ctrl-k> delete from cursor to end of line

The Linux File System

- The *Nix (Unix or Linux) file system is a hierarchical directory structure
- The structure resembles an upside down tree
- Directories are collections of files and other directories. The structure is recursive with many levels.
- Every directory has a parent except for the root directory.
- Many directories have children directories.
- Unlike Windows, with multiple drives and multiple file systems, a *Nix system only has ONE file system.
- The Linux Standard Base (LSB) specifies the structure of a Linux file system.

/ "ROOT"



Examining the File System

file /bin/alsac then press <tab>

cd ~; pwd (This is your home directory where application settings are kept and where you have write privileges)

ls

mkdir myPics;mkdir myPics/work;mkdir myPics/friends;mkdir myPics/friends/TiU;
mkdir myPics/friends/GPU4EDU

cd myPics/friends/GPU4EDU

Navigating the File System

There are two types of pathnames

Absolute (Abs) – the full path to a directory or file; begins with the root symbol /

Relative (Rel) – a partial path that is relative to the current working directory

Examples

Abs `cd /usr/local/lib`

`echo $HOME` (one of many environment variables maintained by the shell)

Abs `cd `echo $HOME``

`pwd`

Rel `cd ..`

Rel `cd ..`

Abs `cd /lib` (location OS shared libraries)

`ls -d */` (a listing of only the directories in /lib)

Modifying the Linux File System

cd (also takes you to your home directory like cd ~)

mkdir test

echo 'Hello everyone' > test/myfile.txt

echo 'Goodbye all' >> test/myfile.txt

less test/myfile.txt

mkdir test/subdir1/subdir2 (FAILS)

mkdir -p test/subdir1/subdir2 (Succeeds)

mv test/myfile.txt test/subdir1/subdir2

rmdir test (FAILS)

rm -Rv test (Succeeds)

The list command

Useful options for the “ls” command:

ls -a List all file including hidden file beginning with a period “.”

ls -ld * List details about a directory and not its contents

ls -F Put an indicator character at the end of each name

ls -l Simple long listing

ls -lh Give human readable file sizes

ls -lS Sort files by file size

ls -lt Sort files by modification time

Handling files

- `cat` - displaying the content of a file in the terminal
- `nano` - a command line text editor
 - Uses Ctrl+ shortcuts (displayed in the bottom line)
 - Does not have Undo
- `vi` and `vim` - command line text editors
 - more elaborate than nano but require more learning
 - vim Cheat Sheet: <https://vim.rtorr.com/>
- `less` - displays the content but allows you to scroll through the file
- `head` - displays the first 10 lines of a file
 - `head -n X` or `head -n +X` displays the first X lines
 - `head -n -X` starting from the beginning it displays all but the X last lines
- `tail` - displays the last 10 lines of a file
 - `tail -n X` or `tail -n +X` displays the last X lines
 - `tail -n -X` starting from the end displays all but the X first lines

Next time

- Account setup
- Connecting to the GPU4EDU
- Running experiments