

**HPS**

<https://hps.vi4io.org>

Kevin Lüdemann

## Linux Crash Course

The joy and pain of freedom

# Learning Objectives

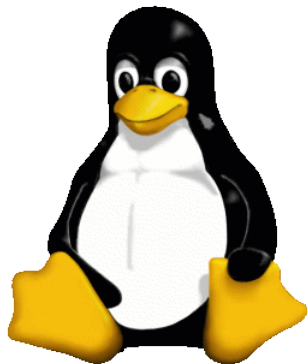
- Become acquainted with the Linux OS
- Get to know some desktops
- Explore Linux and how it handles hardware
- Learn about working with linux

# Table of contents

- 1 Overview
- 2 Linux Desktop
- 3 Linux System
- 4 Compiling Software

# What is a Linux

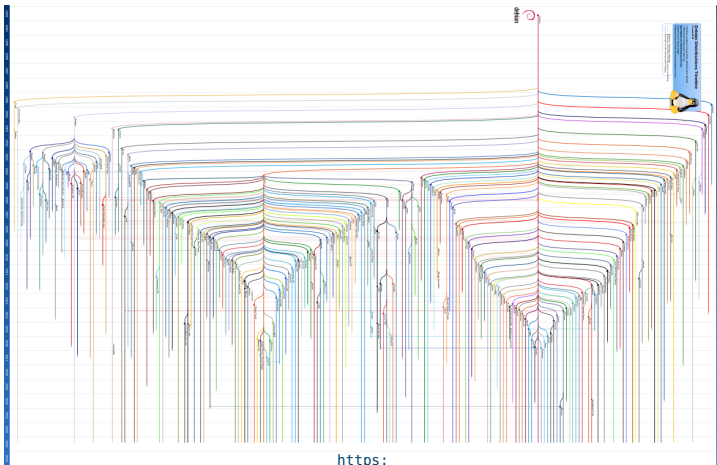
- Originally developed by Linus Torvalds in *1991*
- Open Source operating system  
<https://github.com/torvalds/linux>
- Available under GPL-2.0 license
- Commonly bundled as Linux Distributions (Ubuntu, Debian, Red Hat, Arch, ...)
- Omnipresent in HPC and servers



Tux - Linux mascot

Image source: [https://en.wikipedia.org/wiki/Tux\\_\(mascot\)#/media/File:Tux.png](https://en.wikipedia.org/wiki/Tux_(mascot)#/media/File:Tux.png)

# Debian+Ubuntu Family tree

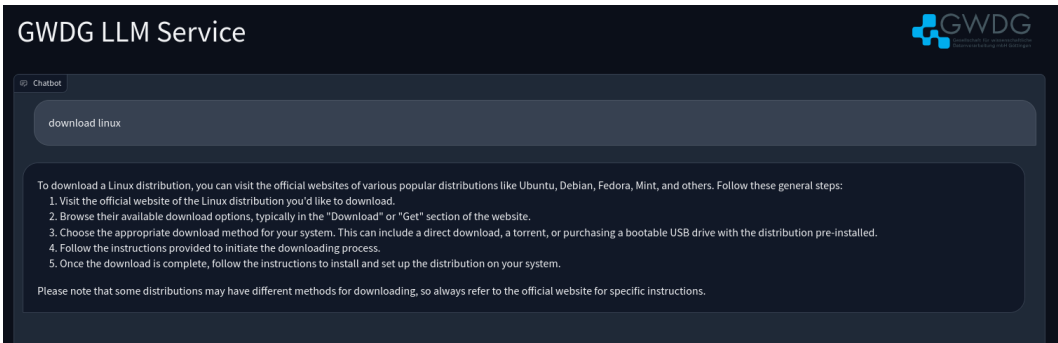


[https://en.wikipedia.org/wiki/List\\_of\\_Linux\\_distributions](https://en.wikipedia.org/wiki/List_of_Linux_distributions)

# Desktop Environment (DE)

- Unlike Windows or Mac, multiple DEs supported
- Most popular: GNOME, KDE
- DE (mostly) independent of Linux distribution
- Highly customizable
  - ▶ Window management and alignment
  - ▶ Replace file explorer, login manager, ...
- Checkout what others use: <https://www.reddit.com/r/unixporn/>

# Linux Desktop - Where to get



**GWDG LLM Service**

Chatbot

download linux

To download a Linux distribution, you can visit the official websites of various popular distributions like Ubuntu, Debian, Fedora, Mint, and others. Follow these general steps:

1. Visit the official website of the Linux distribution you'd like to download.
2. Browse their available download options, typically in the "Download" or "Get" section of the website.
3. Choose the appropriate download method for your system. This can include a direct download, a torrent, or purchasing a bootable USB drive with the distribution pre-installed.
4. Follow the instructions provided to initiate the downloading process.
5. Once the download is complete, follow the instructions to install and set up the distribution on your system.

Please note that some distributions may have different methods for downloading, so always refer to the official website for specific instructions.

**GWDG**  
Geometrisches  
Werkzeugdesign und  
Didaktik

# Linux Desktop - Ubuntu flavors

The screenshot shows the Linux.org website's 'Download Linux' page. The header includes the Linux.org logo and navigation links for Forums, What's new, Linux Tutorials, Members, Download Linux, Newsletter, Credits, and LUGs. A search bar is also present. The main content area is titled '24 Popular Linux Distributions' and includes a sub-header: 'Explore different Linux distributions and find the one that fits your needs. Try distrowatch.com for more options.' Below this, there is a grid of 12 distribution cards, each with a logo, the name, and a 'Download' link. The distributions shown are Ubuntu, CentOS, Debian, Fedora, Slackware, Mint, Xubuntu, Arch, OpenSuse, RedHat, Slackel, and PureOS. A sidebar on the right contains a 'SUPPORT LINUX.ORG MAKE A DONATION TODAY' banner.

Distribution	Download Link
Ubuntu	<a href="#">Download Ubuntu</a>
CentOS	<a href="#">Download CentOS</a>
Debian	<a href="#">Download Debian</a>
Fedora	<a href="#">Download Fedora</a>
Slackware	<a href="#">Download Slackware</a>
Mint	<a href="#">Download Mint</a>
Xubuntu	<a href="#">Download Xubuntu</a>
Arch	<a href="#">Download Arch</a>
OpenSuse	<a href="#">Download OpenSuse</a>
RedHat	<a href="#">Download RedHat</a>
Slackel	<a href="#">Download Slackel</a>
PureOS	<a href="#">Download PureOS</a>



# Linux Desktop - VirtualBox

- Add new - Enter name, Linux, flavor
- Recommended is 2048MB but better is 4096MB RAM
- Create new HDD file now
  - ▶ Choose VDI
  - ▶ Dynamics allocation
  - ▶ At least 20GB of free space
- Later you may want to increase the number of Cores

# Linux Desktop - VirtualBox

The screenshot displays the Oracle VM VirtualBox interface. On the left, a list of virtual machines is shown, with 'PCPCC' selected and its settings window open. The 'Storage' tab is active, showing a storage controller named 'Controller: IDE' with a single disk attached: 'PCPCC-disk1.vdi'. A red '2.' is overlaid on the 'Storage' tab in the settings window.

In the center, the 'Optical Disk Selector' dialog is open, showing a list of available ISO images. A red '3.' is overlaid on the 'Add' button. The list contains the following entries:

Media	Virtual Size	Actual Size
3		
Ubuntu 23.10 [i386] desktop-amd64.iso	4.82 GB	4.82 GB
ubuntu-23.10-desktop-amd64.iso	2.96 GB	2.96 GB

At the bottom right, a file explorer window titled 'Please choose a virtual optical disk file' is open, showing the file 'ubuntu-23.10-desktop-amd64.iso' selected. A red '4.' is overlaid on the file list. The file explorer shows the following details:

Name	Size	Type	Date Modified
ubuntu-23.10-desktop-amd64.iso	4.82 GB	iso file	13.07.24 11:07
ubuntu-23.10-desktop-amd64.iso	2.96 GB	iso file	13.07.24 10:47

The main VirtualBox window shows the 'PCPCC' virtual machine with a 'Preview' window displaying the PCPCC logo.

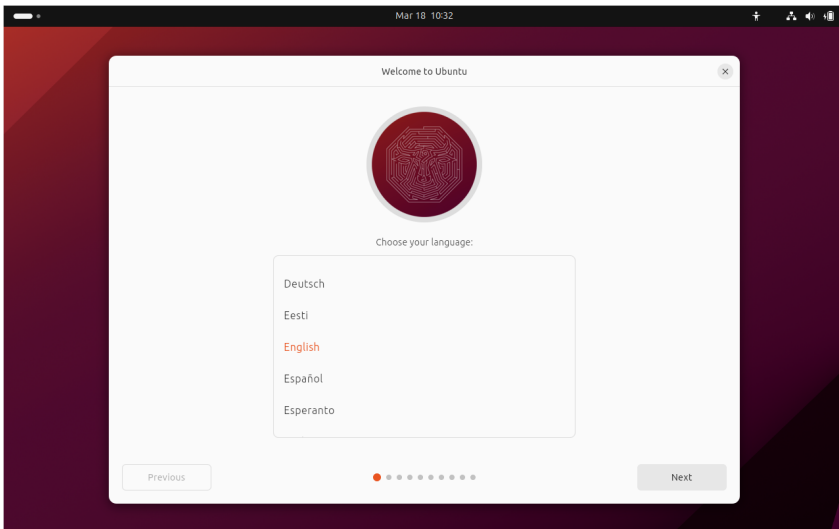
# Linux Desktop - Install

```
GNU GRUB  version 2.12~rc1

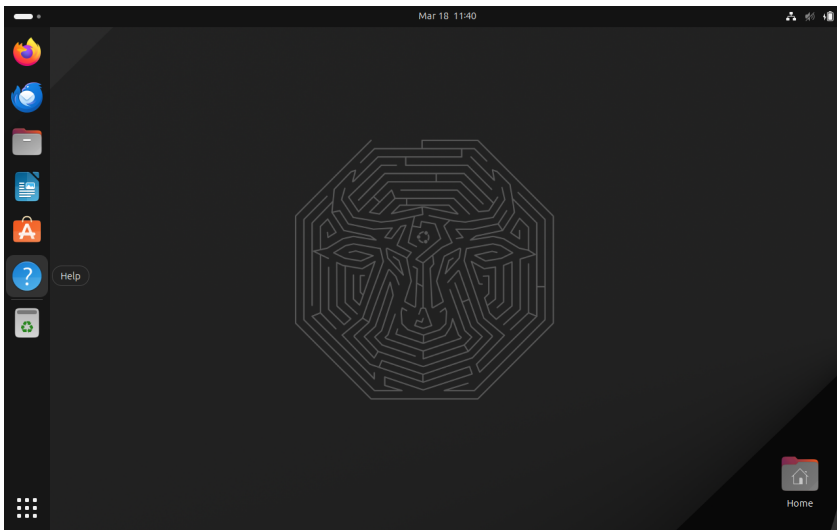
*Try or Install Ubuntu
Ubuntu (safe graphics)
Test memory

Use the ↑ and ↓ keys to select which entry is highlighted.
Press enter to boot the selected OS, 'e' to edit the commands
before booting or 'c' for a command-line.
The highlighted entry will be executed automatically in 26s.
```

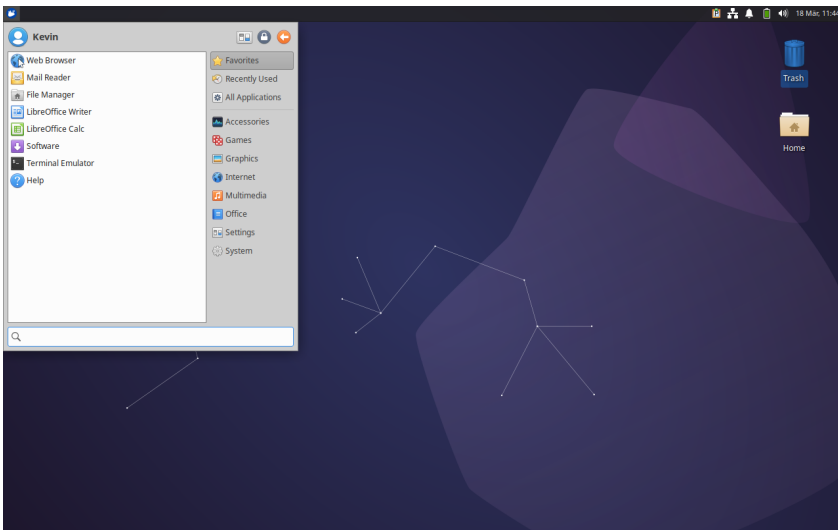
# Linux Desktop - Install



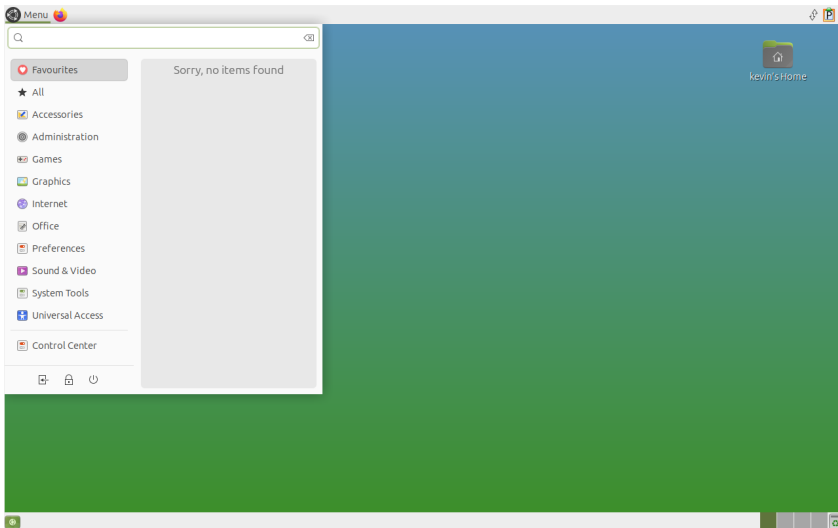
# Linux Desktop - Example desktop: GNOME 3



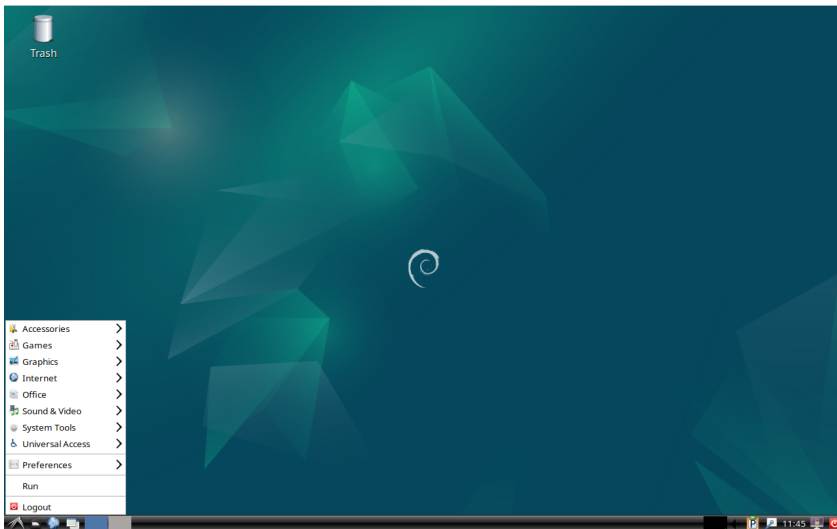
# Linux Desktop - Example desktop: xfce



# Linux Desktop - Example desktop: mate

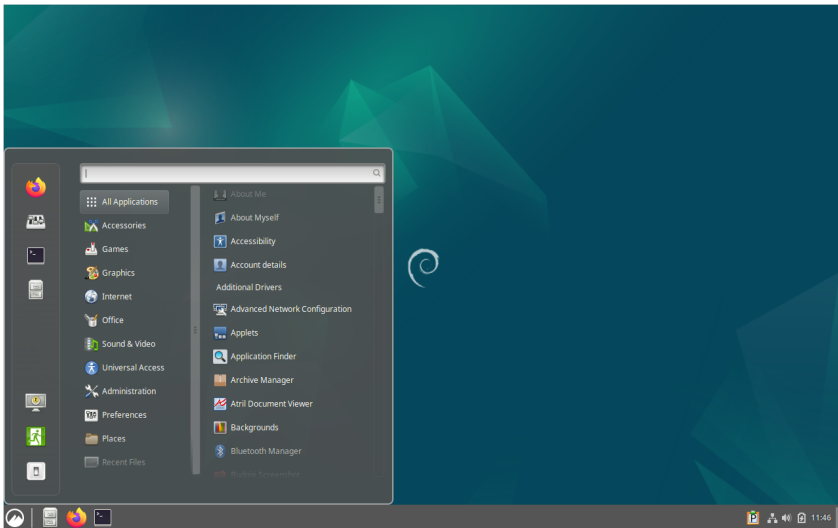


# Linux Desktop - Example desktop: Ixde

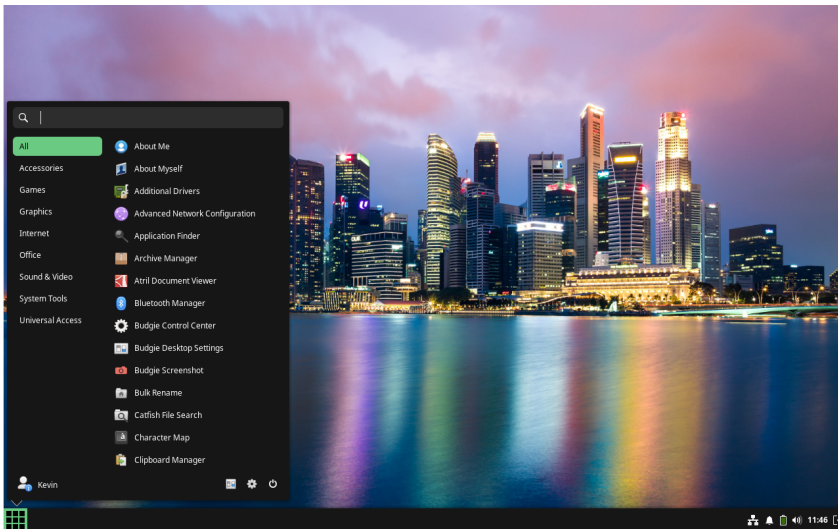




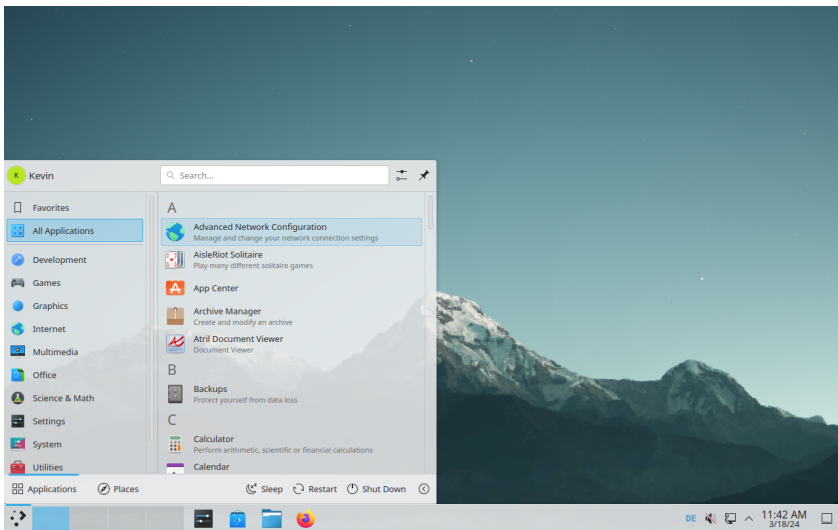
# Linux Desktop - Example desktop: Cinnamon



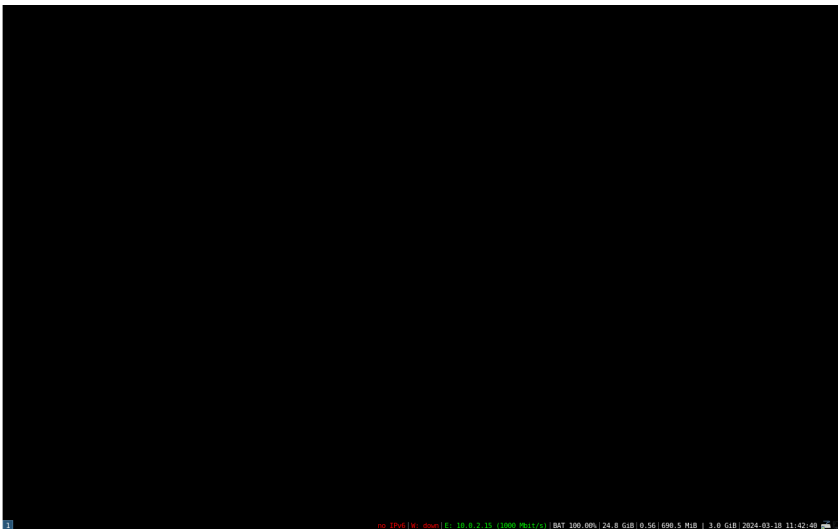
# Linux Desktop - Example desktop: budgi



# Linux Desktop - Example desktop: KDE plasma



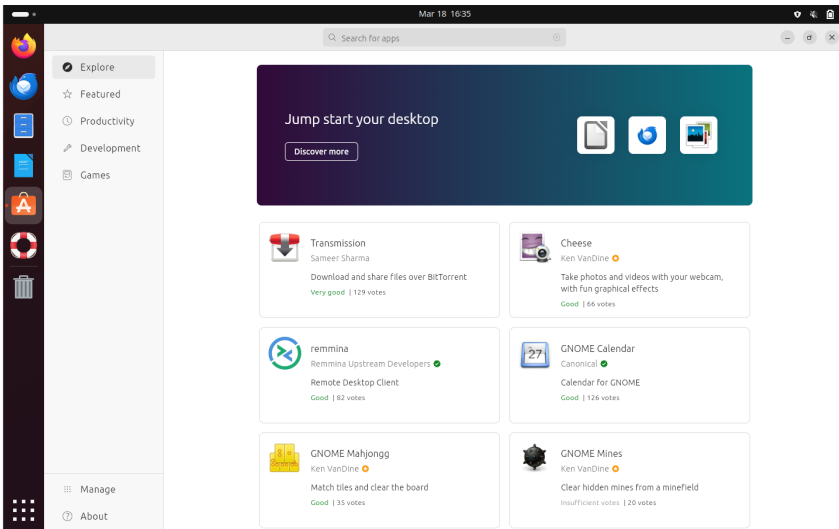
# Linux Desktop - Example desktop: i3 WM



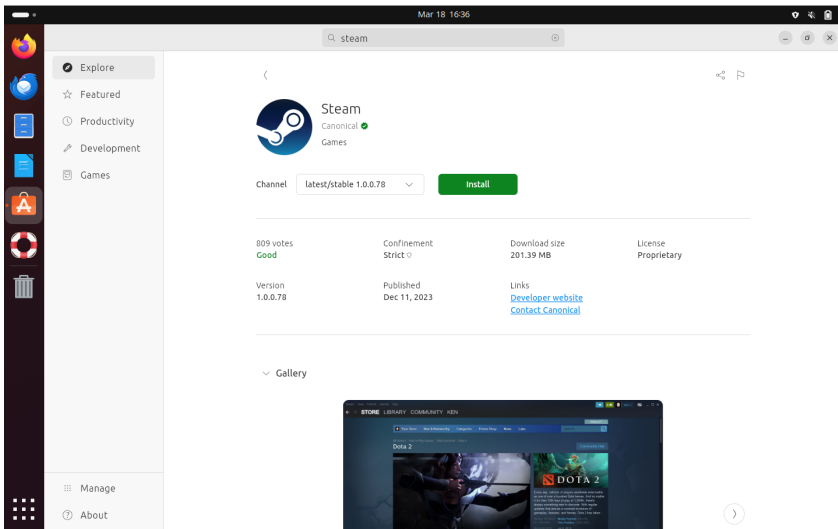
# Linux Desktop - Installing software

- Using package manager
  - ▶ apt, apt-get, packman, yum, dnf
  - ▶ snap and snap packages
  - ▶ flatpack
- Compiling from source (someone said gentoo??)
- Software manager APP

# Linux Desktop - App/Software center



# Linux Desktop - Want to play games



The screenshot shows a Linux desktop environment with a dark theme. On the left is a vertical dock with icons for various applications including a terminal, a file manager, and a game controller. The main window is a web browser displaying the Steam application page. The browser's address bar shows 'steam'. The page content includes the Steam logo, the name 'Steam' by Canonical, a channel selector set to 'latest/stable 1.0.0.78', and a green 'Install' button. Below this, there are statistics: 809 votes with a 'Good' rating, a 'Strict' confinement level, a download size of 201.39 MB, and a 'Proprietary' license. The version is listed as 1.0.0.78, published on Dec 11, 2023. There are links for the 'Developer website' and 'Contact Canonical'. At the bottom of the page, a 'Gallery' section is partially visible, showing a preview of the Dota 2 game interface.

# The Shell

- What is the Shell used for?
  - ▶ Your gateway to HPC power
  - ▶ Managing files and folders
  - ▶ Compiling from source
  - ▶ Running programs
  - ▶ Managing the system even without GUI
- Terminal emulator - improved terminals
- Remove the need for a mouse
- Working with the best editor: VIM



# File System

- Many different file system (FS) implementations exist
- Some support **Journaling**
  - ▶ FS keeps a log (journal) of file operations
  - ▶ Enables consistency in case of crash during write
- Some are better for parallel IO
- NFS for network mounting
- See currently mounted FS via
  - ▶ `df -T`

# File System Types - Examples

## ■ **ext4**

- ▶ Native Linux FS

## ■ **XFS**

- ▶ High-performance FS

## ■ **BeeGFS**

- ▶ High-performance parallel File system

## ■ **NTFS/FAT**

- ▶ Windows FS
- ▶ USB-Sticks, ...

## ■ **HFS+**

- ▶ Mac FS

## ■ **tmpfs**

- ▶ Linux temporary in-memory FS

# Linux File Tree

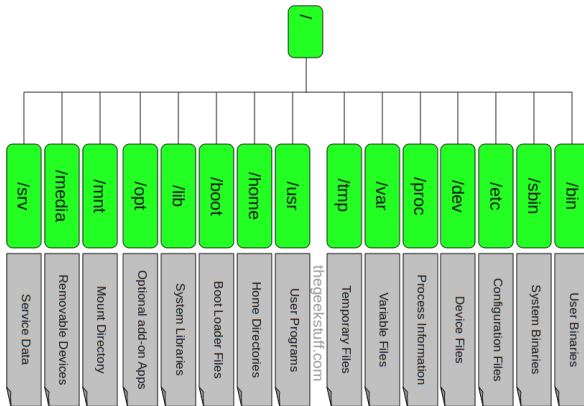


Image source: <https://static.thegeekstuff.com/wp-content/uploads/2010/11/filesystem-structure.png>

# System Logging

- Logs commonly in `/var/log`
  - ▶ Find application and system logs here
  - ▶ Use `tail -f file` to follow changes
- `dmesg` print Kernel ring buffer
- `journalctl` for systemd logs

# Linux Services and systemd

- Service management software (controversial but works)
- Interaction commands are:
  - ▶ `systemctl status`
  - ▶ `systemctl start/stop`
  - ▶ `systemctl enable/disable`
  - ▶ `systemctl --user`
- Try it out for these services
  - ▶ `systemctl status sshd`
  - ▶ `systemctl status ntpd`

# Linux hardware files

## ■ Mounting hard drives and USB Sticks

- ▶ Find devices using `lsblk`
- ▶ Mount a device `mount /dev/sda1 /mnt`
- ▶ Unmount a device `umount /mnt`

## ■ Finding the Battery

- ▶ Could be at `/sys/class/power_supply/BAT0/`
- ▶ Current status `charge_now`

## ■ Finding the CPU `lscpu` / `cat /proc/cpuinfo`

- ▶ Could be at `/sys/devices/system/cpu/cpu0/cpufreq/`
- ▶ Current frequency `scaling_cur_freq`

# Compiling own Software

- Compiling means to create an executable – or a library – from the source code
- Scientific software is often only available as source code
- Compiling on the target system often yields better performance
- Prepackaged software typically requires administrator (root) privileges ...
  - ▶ (on the Cluster `sudo` or `su` won't work)
  - ▶ but you can use Singularity containers!

# Getting and Unpacking the Source Code

- Source code is usually packaged as “tarball”
  - ▶ Look for file extensions “ `tar.gz` ”, “ `tar.bz2` ”, “ `tgz` ”
  - ▶ Naming convention is often `{NAME}-{VERSION}.tar.gz`
- If the tarball is available on the web use “ `wget` ” to download
- Use “ `tar` ” to unpack the tarball
  - ▶ Use “ `tar xvzf` ” for “ `tar.gz` ”, “ `tgz` ”
  - ▶ Use “ `tar xvjf` ” for “ `tar.bz2` ”



## Recipe: `wget` and `tar`

Using `wget` and `tar` to prepare the source code

```
> mkdir $HOME/build  
> cd $HOME/build  
> wget <tarball URL>  
> tar xvzf <name-version>.tar.gz  
> cd <name-version>
```

## Reminder: Connecting with SSH

- Place the SSH key you received per mail in your user folder

- **NN** is the number in the key file name

- In PowerShell or Terminal type the following command

```
ssh -i hpctrainingNN hpctrainingNN@login-mdc.hpc.gwdg.de
```

```
-o ProxyCommand='ssh -W %h:%p hpctrainingNN@login.gwdg.de
```

```
-i hpctrainingNN'
```

- Confirm the connection and enter the SSH keys passphrase **twice**

- The passphrase is in the email you received

- If you are already in the GÖNET, you only need the first line

# Downloading Sourcecode

- create a directory with mkdir
  - ▶ `apps/install/fftw/`
- switch into the directory
  - ▶ `cd apps/install/fftw/`
- download fftw
  - ▶ `wget http://www.fftw.org/fftw-3.3.10.tar.gz`
- you do the extraction with
  - ▶ `tar xvzf fftw-3.3.10.tar.gz`

# Compile the program

- load up the Compiler on the cluster
  - ▶ `module load intel-oneapi-compilers`
- Configure the prefix
  - ▶ `cd fftw-3.3.10`
  - ▶ `./configure CC=icc -prefix=/usr/users/(yourusername)/apps/fftw-3.3.10`
- with the prefix set you can compile the software
  - ▶ `make -j 4`
- now check the installation, and install the program
  - ▶ `make check`
  - ▶ `make install`

## Compile the program

- check the installation with
  - ▶ `ls -alh /apps/fftw-3.3.10/`
- Now we have installed fftw successfully
- Check whether the installation is there
- Check if the permissions to execute are set

# Summary

- You learned the beauty of Linux desktops
- You learned how to install software
- You should be able to:
  - ▶ Find your way around the file tree
  - ▶ Look for hardware and kernel parameters
  - ▶ Compile software