

**HPS**

<https://hps.vi4io.org>

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## Linux Crash Course

The joy and pain of freedom

# Learning Objectives

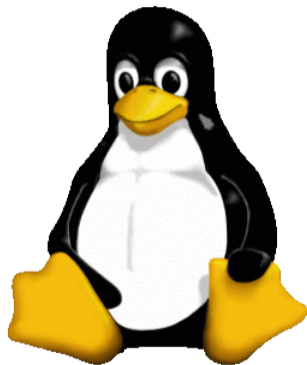
- Become acquainted with the Linux OS
- Get to know some desktops
- Explore Linux and how it handles hardware
- Learn about working with linux

# Table of contents

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

# What is a Linux

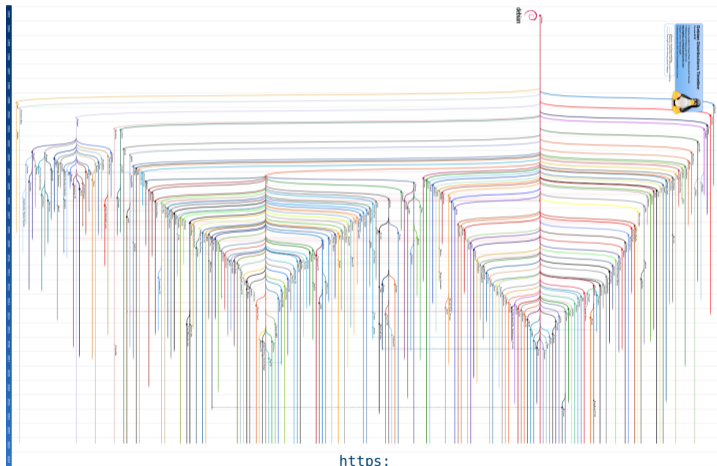
- Originally developed by Linus Torvalds in *1991*
- Open Source operating system  
<https://github.com/torvalds/linux>
- Available under GPL-2.0 license
- Commonly bundled as Linux Distributions  
(Ubuntu, Debian, Red Hat, Arch, ...)
- Omnipresent in HPC and servers



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 - 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.

**LINUX.ORG**













Forums | What's new | Linux Tutorials | Members | Download Linux | Newsletter | Credits | LUGs | Log in | Register | Search

Download Linux

Links to popular distribution download pages

### 24 Popular Linux Distributions

Explore different Linux distributions and find the one that fits your needs. Try [distrowatch.com](#) for more options.

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

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MAKE A DONATION TODAY

# 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 highlighted in blue. The 'PCPCC - Settings' dialog box is open, showing the 'Storage' tab. The 'Storage Devices' section is expanded to show 'Controller: IDE' and 'Storage'. A red '2.' is placed over the 'Storage' tab in the settings dialog.

The 'PCPCC - Optical Disk Selector' dialog box is open, showing a list of optical disk files. A red '3.' is placed over the 'Add' button. The list contains the following entries:

Media	Virtual Size	Actual Size
3 Attached		
ubuntu-23.10-1-desktop-amd64.iso	4.82 GB	4.82 GB
ubuntu-23.10-desktop-amd64.iso	2.96 GB	2.96 GB

The 'Please choose a virtual optical disk file' dialog box is open, showing a file list. A red '4.' is placed over the file list. The file list contains the following entries:

Name	Size	Type	Date Modified
ubuntu-23.10-1-desktop-amd64.iso	4.82 GB	iso file	13.09.24 11:07
ubuntu-23.10-desktop-amd64.iso	2.96 GB	iso file	13.09.24 20:47

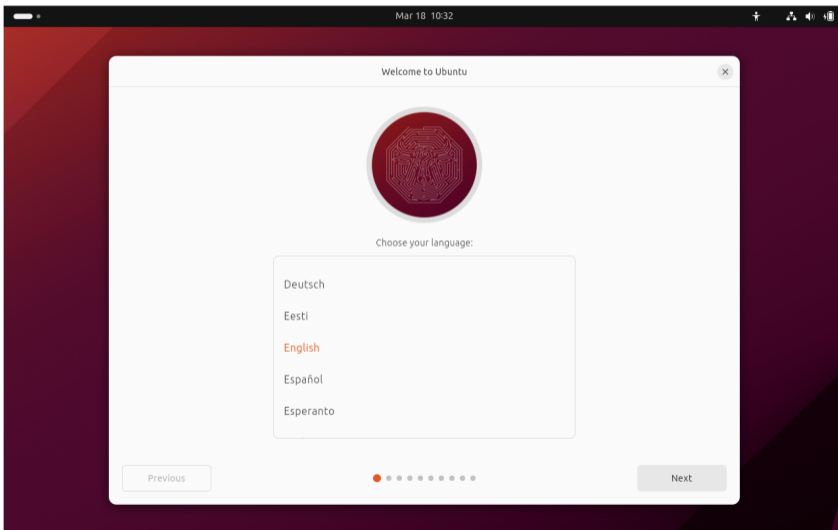
# Linux Desktop - Install

```
GNU GRUB  version 2.12~rc1

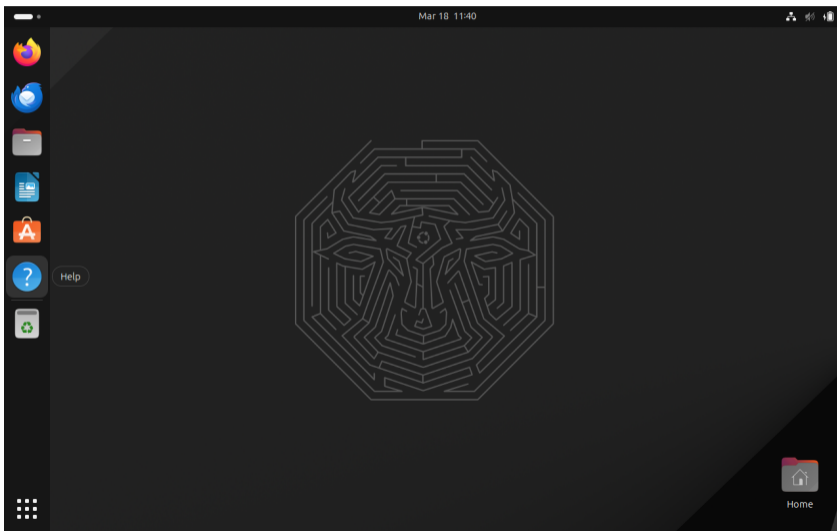
*Try or Install Ubuntu
Ubuntu (safe graphics)
Test memory

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.
```

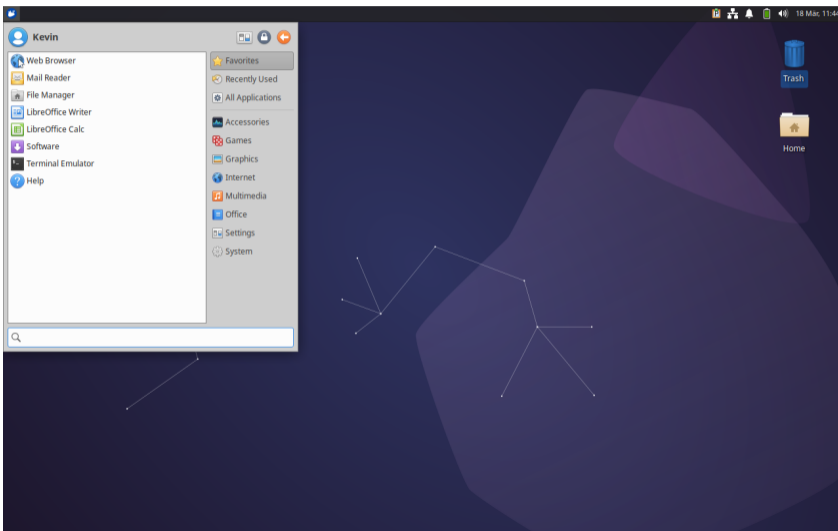
# Linux Desktop - Install



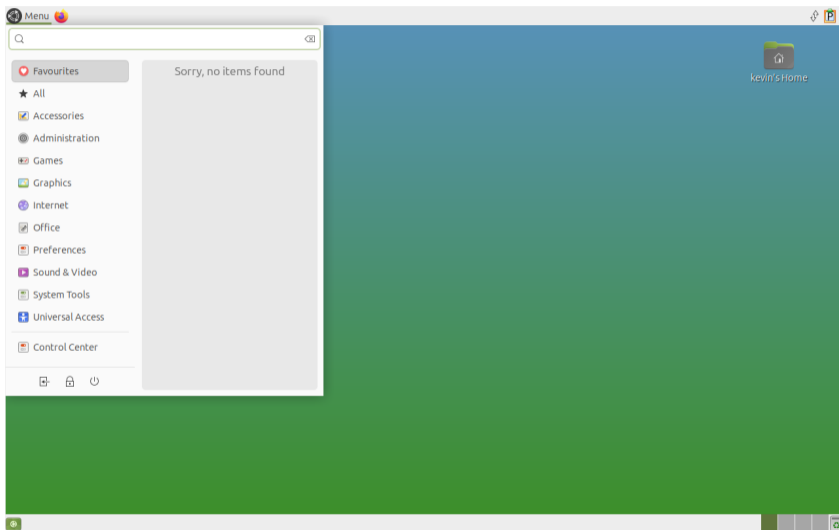
# Linux Desktop - Example desktop: GNOME 3



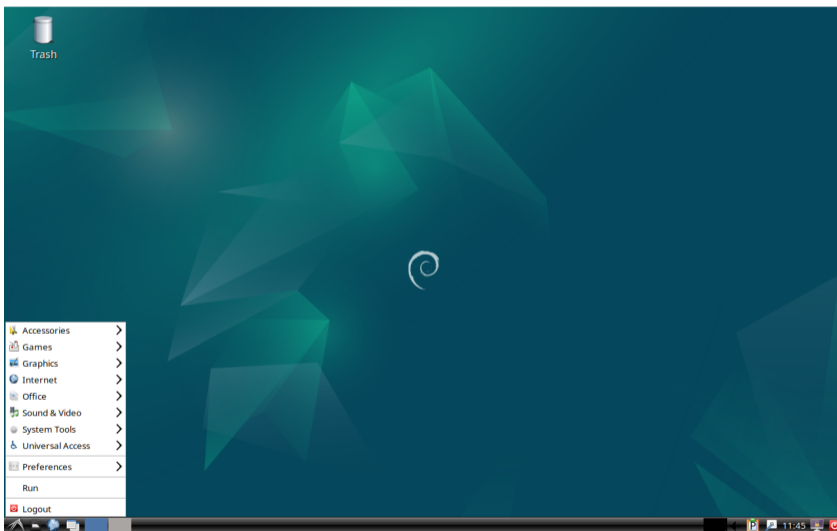
# Linux Desktop - Example desktop: xfce



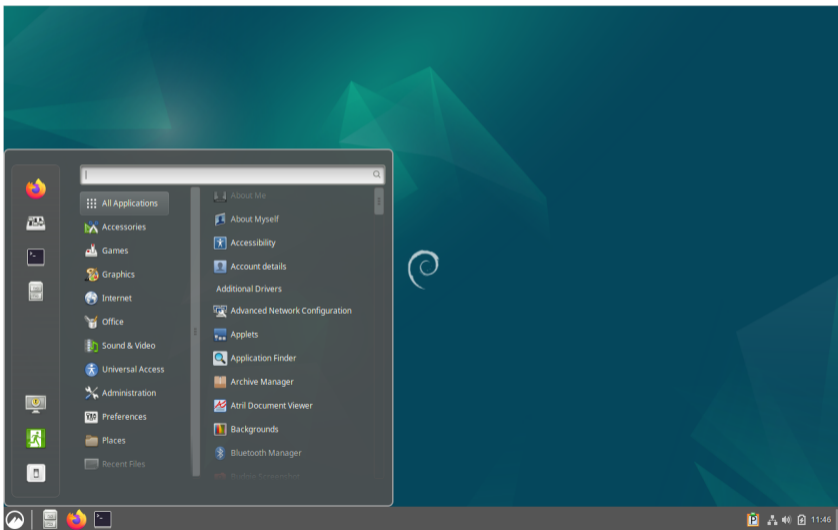
# Linux Desktop - Example desktop: mate



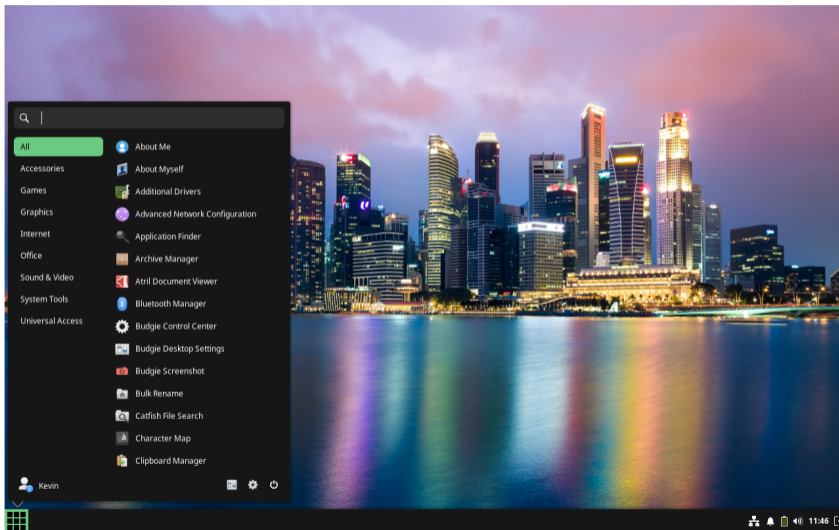
# Linux Desktop - Example desktop: Ixde



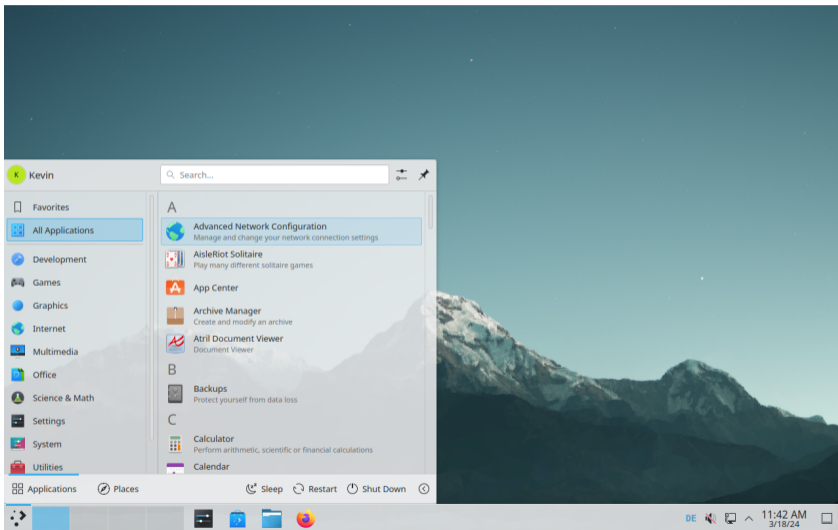
# Linux Desktop - Example desktop: Cinnamon



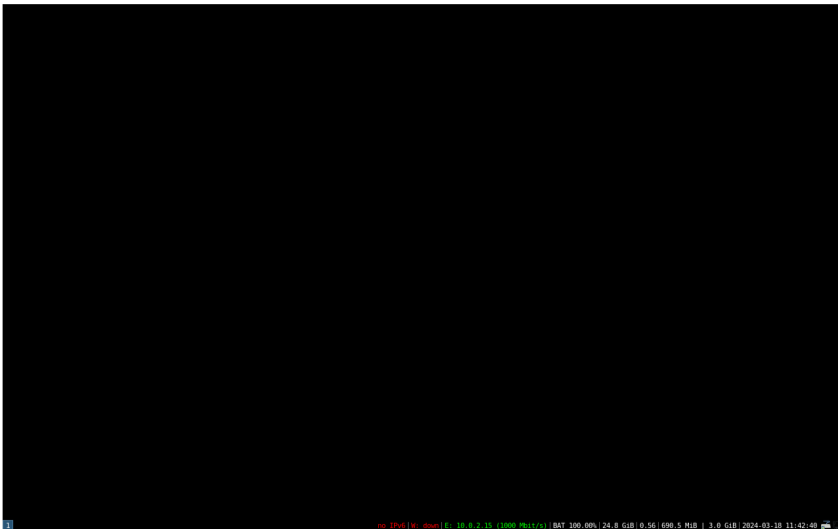
# Linux Desktop - Example desktop: budgi



# 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

The screenshot shows the Linux Desktop App/Software center window. The title bar indicates the date and time as "Mar 18 16:35". A search bar at the top contains the text "Search for apps". On the left side, there is a vertical sidebar with navigation options: "Explore" (selected), "Featured", "Productivity", "Development", "Games", "Manage", and "About". The main content area features a large banner with the text "Jump start your desktop" and a "Discover more" button. Below the banner, there are six application cards, each with an icon, name, developer, description, and user ratings:

- Transmission** by Sameer Sharma: Download and share files over BitTorrent. Very good | 129 votes.
- Cheese** by Ken VanDine: Take photos and videos with your webcam, with fun graphical effects. Good | 66 votes.
- remmina** by Remmina Upstream Developers: Remote Desktop Client. Good | 82 votes.
- GNOME Calendar** by Canonical: Calendar for GNOME. Good | 126 votes.
- GNOME Mahjongg** by Ken VanDine: Match tiles and clear the board. Good | 35 votes.
- GNOME Mines** by Ken VanDine: Clear hidden mines from a minefield. Insufficient votes | 20 votes.



# 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

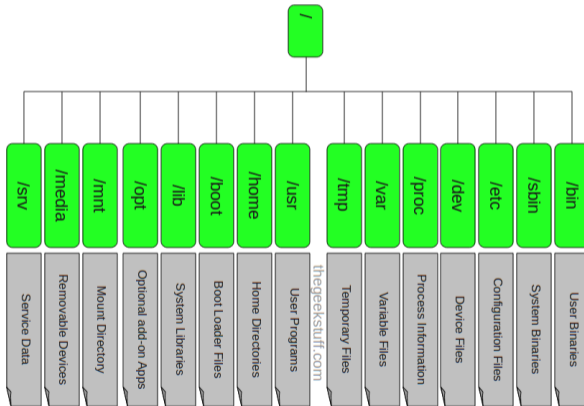


Image source: <https://static.thegeekstuff.com/wp-content/uploads/2010/11/filesystem-structure.png>

# 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